APEC ENERGY OVERVIEW 2024

Disclaimer

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Foreword

The ***APEC Energy Overview*** (the Overview) is an annual publication that highlights the current energy situation in each of the 21 APEC economies. Since its first publication in January 2001, it has been the pioneer publication for APERC, showcasing the latest APEC energy data compiled by the Expert Group on Energy Data and Analysis (EGEDA).

The Overview monitors progress toward meeting the two APEC energy goals, namely:

1. Energy intensity improvement of 45% by 2035 (relative to 2005).
2. Doubling the modern renewable energy share in the APEC energy mix by 2030 (relative to 2010).

In 2021, the APEC-wide energy intensity had improved by 27%, leaving an 18% improvement needed to meet the 2035 goal. The recent *APEC Energy Demand and Supply Outlook 8th edition* forecasts that APEC is expected to meet this goal in both the Reference and Carbon Neutrality scenarios of that report ahead of the schedule. Progress has also been made in doubling the share of modern renewables. Modern renewables in total final energy consumption in 2021 have increased by 3.9 percentage points or 66% of the way to the 2030 goal. Modern renewables in the total primary energy supply have increased, albeit slower, but by more than 50% compared with 2010, while the share of modern renewables for power generation has increased by 62%.

One of the highlights of the 2024 edition of the Overview includes data to 2021 and this begins to shed light on the extent of the continuing impact of COVID-19 and initial economic recovery from the pandemic. Additionally, each economy chapter discusses many other trends, issues, policies, initiatives, and notable developments.

The basis of this report is the EGEDA data that each member economy submits on an annual basis. We thank EGEDA members for their continued support in providing us with these data. We also encourage APEC member economies and other stakeholders to make use of this publicly available resource to continue to develop, implement, refine and analyse energy policy, alongside other energy related analyses.

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The ***APEC Energy Overview 2024*** could not have been accomplished without the contributions of many individuals and organisations in APEC. We would like to thank all those whose efforts made this publication possible.

We would also like to thank in particular those named below who contributed to the successful completion of this publication.

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Economy chapters

Commonly used abbreviations and terms

Abbreviation	Term
2017 USD PPP	2017 USD purchasing power parity
APEC	Asia-Pacific Economic Cooperation
APERC	Asia Pacific Energy Research Centre
ASEAN	Association of Southeast Asian Nations
B/D	barrels per day
Bcf	billion cubic feet
bcm	billion cubic metres
Btu	British thermal units
GW	gigawatt
GWh	gigawatt-hour
kL	kilolitre
km	kilometre
km/L	kilometres per litre
ktoe	kilotonne of oil equivalent
kV	kilovolt
kW	kilowatt
kWh	kilowatt-hour
Mbbl/D	thousand barrels per day
ML	million litres (megalitre)
Mloe	million litres of oil equivalent
MMbbl	million barrels
MMbbl/D	million barrels per day
MMBFOE	million barrels of fuel oil equivalent
MMBtu	million British thermal units
MMcf/D	million cubic feet per day
MMscf/D	million standard cubic feet per day
mpg	miles per gallon
Mt	million tonnes
Mtce	million tonnes of coal equivalent
Mtoe	million tonnes of oil equivalent
MW	megawatt
PJ	petajoules
Tbbl/D	trillion barrels per day
tce	tonnes of coal equivalent
Tcf	trillion cubic feet
toe	tonnes of oil equivalent
tU	tonnes of uranium metal
TWh	terawatt-hours
W	watt
Wh	watt-hours

Currency codes

Code	Currency	Economy
AUD	Australian dollar	Australia
BND	Brunei dollar	Brunei Darussalam
CAD	Canadian dollar	Canada
CLP	Chilean peso	Chile
CNY	yuan renminbi	China
HKD	Hong Kong dollar	Hong Kong, China
IDR	rupiah	Indonesia
JPY	yen	Japan
KRW	won	Korea
MYR	Malaysian ringgit	Malaysia
MXN	Mexican peso	Mexico
NZD	New Zealand dollar	New Zealand
PGK	kina	Papua New Guinea
PEN	nuevo sol	Peru
PHP	Philippine peso	The Philippines
RUB	Russian ruble	Russia
SGD	Singapore dollar	Singapore
TWD	New Taiwan dollar	Chinese Taipei
THB	baht	Thailand
USD	US dollar	United States
VND	dong	Viet Nam

Introduction

This year's *APEC Energy Overview* comprises data up to 2021 and covers analyses on the initial economic recovery or the possible continuing impact of COVID-19 post-pandemic, on energy supply and demand across APEC economies.

In addition to energy supply, transformation, and final consumption data for the period 2000 to 2021, an up-to-date accounting of energy policies and notable energy developments to 2024 is provided in each of the APEC member economy chapters.

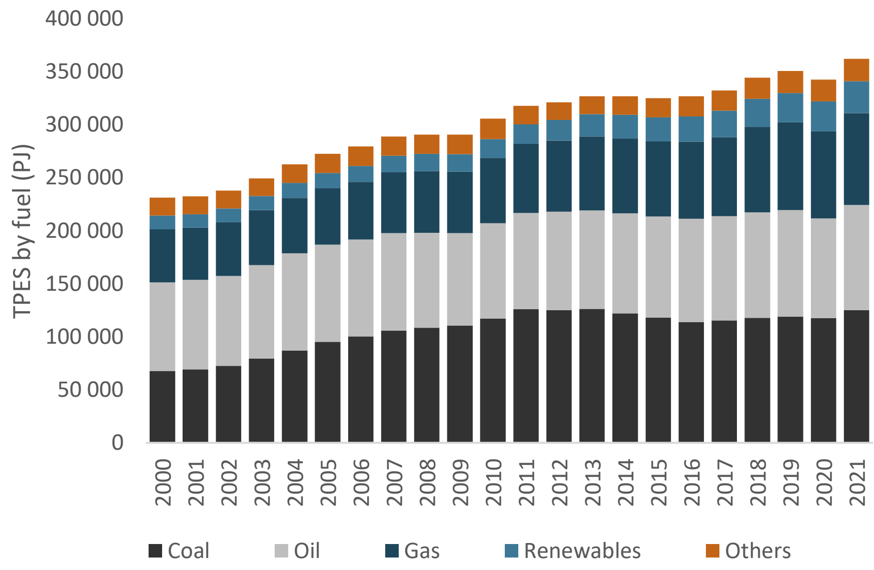
Energy Supply and Consumption

Total primary energy supply

The global economy experienced a growth of 6.2% (PPP constant 2017 USD) in 2021, rebounding from economic slowdown in 2020. The APEC region, which was similarly significantly impacted by COVID-19, recovered with an economic output of around 6.1% (PPP constant 2017 USD) in 2021. The recovery in economic activity resulted in an increase in the APEC energy supply by over 19 exajoules (5.7% annual increase) to finally settle at 362 051 PJ in 2021 (Figure 1). Renewables surged by 7.3%, contributing significantly to the overall rise in energy supply.

All energy products similarly rebounded in 2021. Coal saw a 6.4% increase, gas by 5.4% and oil rose by 5.2%. By composition, in 2021, coal share of TPES reached 34.6%, followed by oil (27.4%), gas (23.9%), renewables (8.3%), and others (5.8%). Despite renewables expanding much faster than all other products, their share in TPES remains lower than fossil fuels.

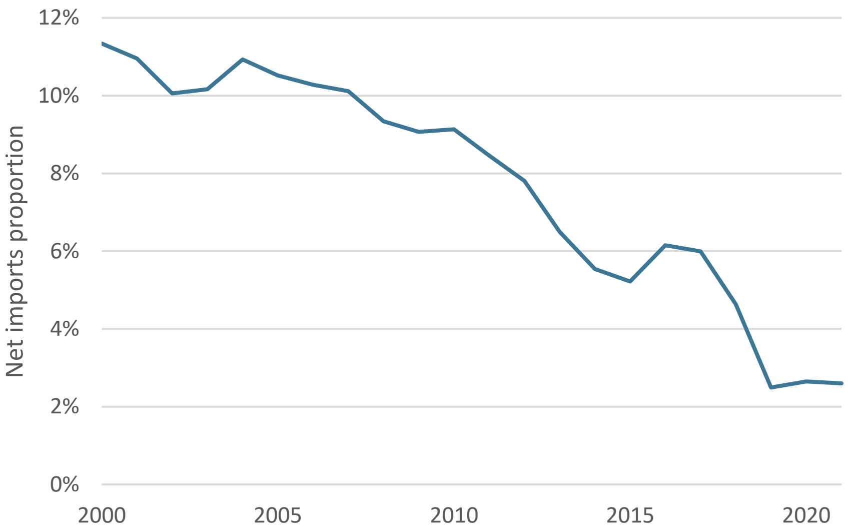
Figure 1: APEC energy supply by fuel (PJ), 2000 to 2021



Source: EGEDA (2023)

APEC continues to be a net energy importer from the rest of the world, but the proportion of net imports to energy supply has been declining rapidly for more than two decades (Figure 2). While net imports experienced a slight increase in 2021, its level was well below the 2018 level. This marks the third consecutive year that net imports have remained at this low since 2019. This three-year trend is attributed to the structural shift in the US and APEC Southeast Asian (SEA) economies. Between 2018 and 2021, the US and APEC SEA economies maintained their positions as net exporters while China continued to be a net importer and net imports expanded, from 28 477 PJ to 33 030 PJ during the same period. Most of the energy reliance on the rest of the world is tied to multiple APEC member economies importing oil from Middle East economies. But this reliance on the Middle East is being offset by the rise in energy production and exports from economies such as Australia; Canada; Indonesia; Russia (until 2021); and the US.

Figure 2: APEC net energy imports as a proportion of supply, 2000 to 2021



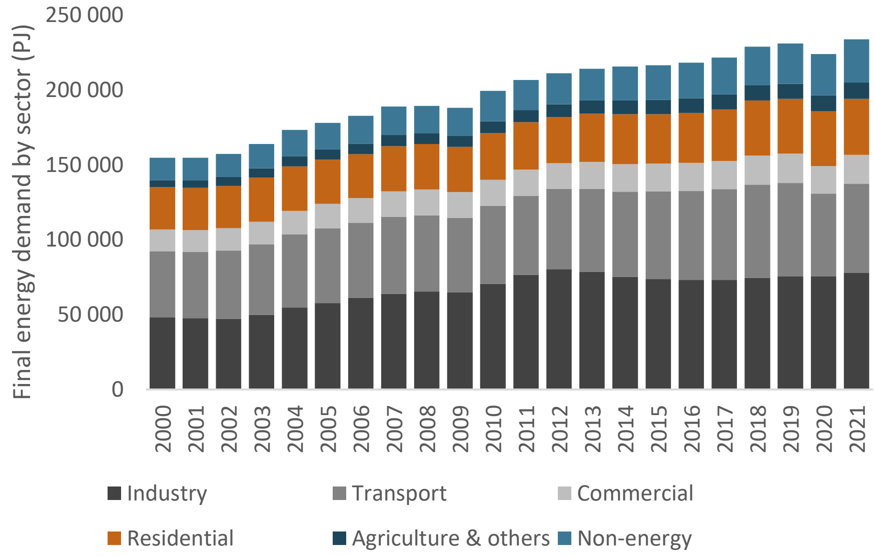
Source: EGEDA (2023)

Total final consumption

Total final consumption (which includes consumption of energy commodities by the non-energy sector) rebounded 4.4% to 233 850 PJ in 2021. Relaxation of pandemic control measures, gradual recovery of transport, and recovery of economic activities were the main reasons for this rebound.

The most significant rebound occurred in the transport sector with a 7.3% increase in 2021, but its level remained significantly lower than the pre-pandemic levels in 2019. The non-energy sector, which drove the growth of final consumption in 2020, remained strong and grew 4.8% in 2021. Rebound was also seen in the final consumption in the services (4%) and industry (3.5%) sectors in 2021. Meanwhile, consumption in the residential sector, which was largely unchanged in 2020 in view of the shift to work-from-home scheme for many workers, saw a rise of 2.2% in 2021. By composition, the industry comprised 33.4% of total final consumption in 2021, followed by transport (25.4%), residential (16%), non-energy (12.4%), commercial (8.2%), and agricultural and other sectors (4.6%).

Figure 3: APEC final consumption by sector (PJ), 2000 to 2021



Source: EGEDA (2023)

In terms of final energy consumption by energy products, electricity saw the fastest increase at 7.2%, leading to a 33.6% share of final energy consumption. Mirroring the increases in most of the energy-consuming sector, oil and gas showed an increasing trend, rising by 6.2% and 3%, respectively. Coal consumption continued its decline and fell 5.4% in 2021. As a result, oil retained the second-largest share of final energy consumption at 32.9%, followed by gas (18%), coal (11.3%), and non-electricity renewables (4.3%).

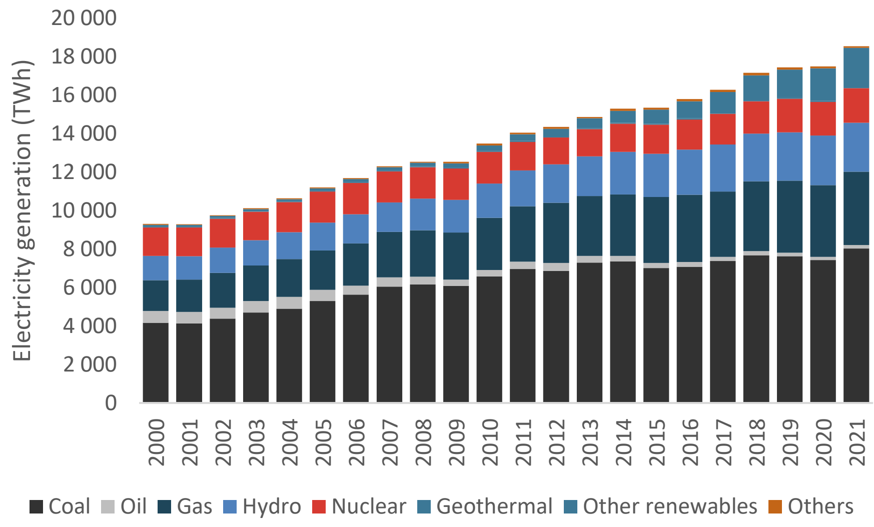
Transformation

Power sector

Power generation in APEC increased significantly (up 6.4%) to exceed 18 600 TWh in 2021. Other renewable generation (which include solar and wind) still maintained the fastest growth at 25% in 2021. Thermal power generation showed a strong recovery (6.1%) after declining in 2020 due to the pandemic; in particular, oil (8.6% increase) and coal (8.1%) remarkably rebounded in 2021. Nuclear electricity generation also recovered, by 3.4%. However, power generation from hydro and geothermal individually remained declining at by 1.3% and 0.3%, respectively in 2021.

APEC's power generation still relies on thermal sources with, 64.5% of power generation. The total share of renewable energy in power generation reached 25.2% in 2021, accounting for a quarter of the total power generation. Nuclear has a 9.7% share in power and has had a stable increase since 2012, except in 2020.

Figure 4: APEC electricity generation by fuel, 2000 to 2021



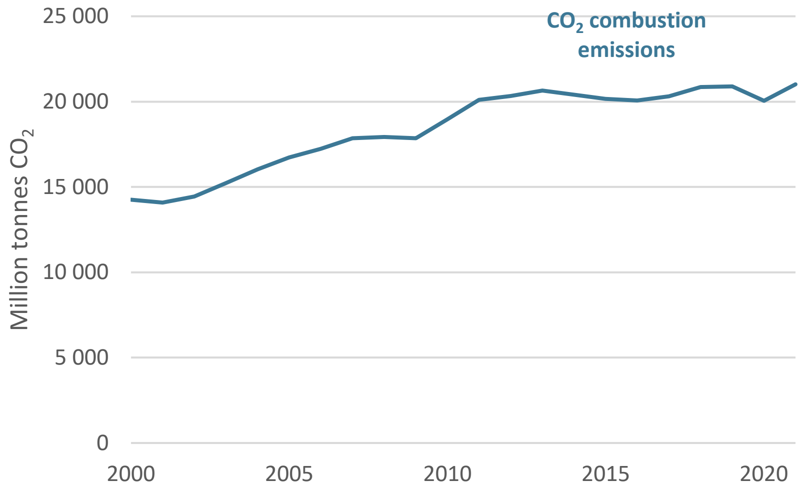
Source: EGEDA (2023)

Energy Transition

Emissions

As energy consumption rebounded alongside economic activities in 2021, CO_2 emissions in the APEC region also experienced a remarkable surge. Although renewable energy increased much faster than fossil fuels, it remains at a relatively low base. As a result, CO_2 emissions from fuel combustion grew 4.8% in 2021, reversing the decline brought by the reduced mobility during COVID-19 pandemic in 2020 (Figure 5).

Figure 5: APEC CO_2 combustion emissions (million tonnes), 2000 to 2021



Source: EGEDA (2023)

APEC Energy Goals

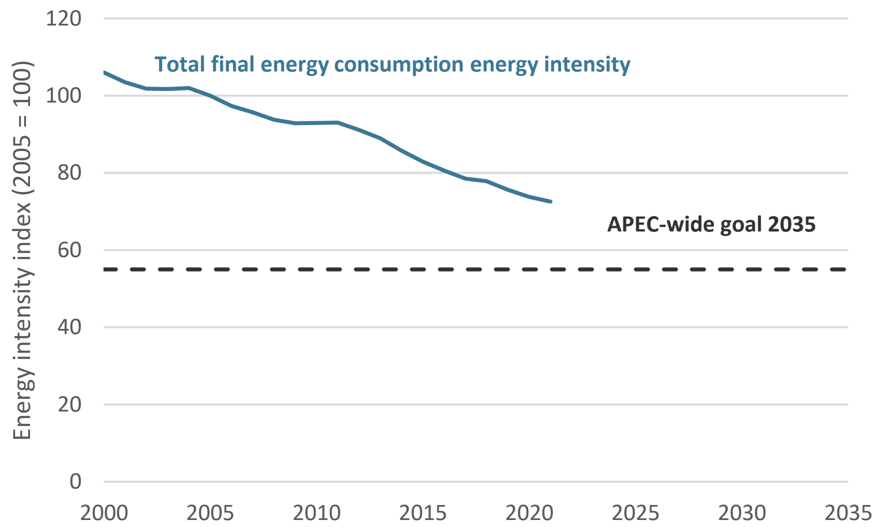
There are two energy-related objectives that APEC member economies have agreed to meet as a collective – to improve energy intensity and double the share of modern renewables.

Energy intensity goal

In 2011, APEC member economies agreed to increase their ambition to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

As of 2021, APEC-wide final energy intensity has improved 27% compared to the 2005 level, leaving an additional 18% improvement needed to meet the 2035 goal (Figure 6). APEC is on track to achieve this energy intensity improvement if current trends continue.

Figure 6: APEC total final energy consumption intensity index, 2000 to 2021 (2005 = 100)



Source: EGEDA (2023)

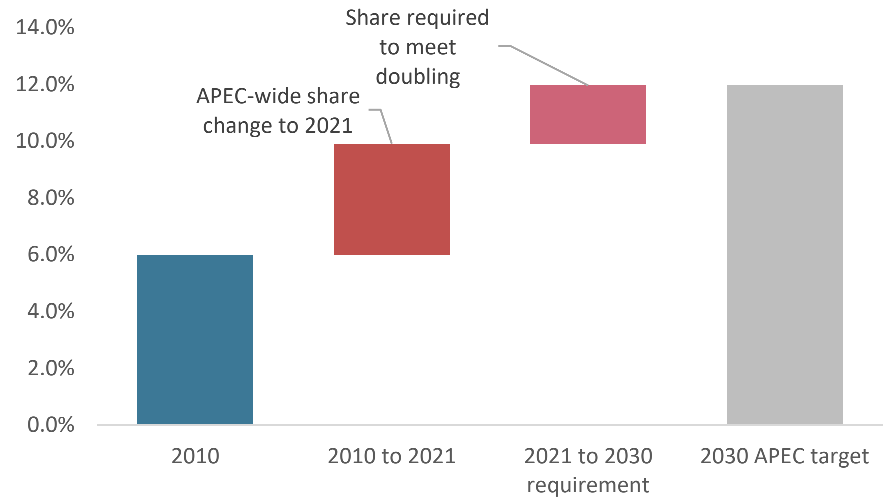
The observed improvement in primary energy supply intensity (not shown here, 25% improvement) is very close to the observed improvement in final energy intensity.

Doubling of renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period 2010 to 2030.

Modern renewables do not include traditional biomass, which is typically relied on in emerging economies for household energy needs and is associated with negative health outcomes. Many APEC economies are enacting policies to reduce traditional biomass consumption, either through upgrading fuel stoves, or via facilitating switching to alternative fuels such as natural gas, liquefied petroleum gas (LPG), or electricity. The modern renewables share of final energy consumption has increased from 6% in 2010 to almost 9.9% in 2021, which is a 66% improvement. This means that APEC is ahead of schedule to double its share of modern renewables by 2030 (Figure 7).

Figure 7: APEC modern renewable energy share in final energy consumption, 2010 through to 2030

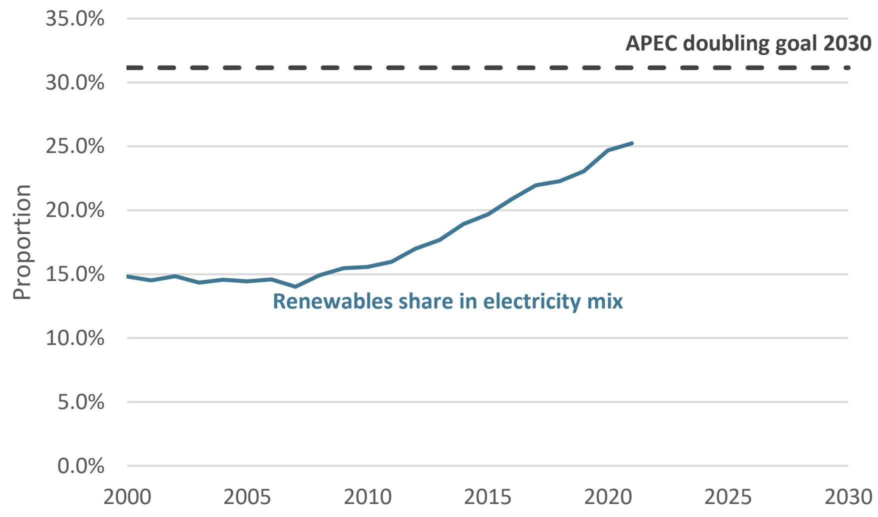


Source: EGEDA (2023)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Progress has also been made in doubling the share of renewables in the electricity mix by 2030 (relative to 2010). Renewable generation accounts for 25% of APEC electricity generation in 2021, up from 15.6% in 2010 (Figure 8).

Figure 8: APEC modern renewable energy share in the electricity mix, 2000 to 2020



Source: EGEDA (2023)

In terms of supply, modern renewables in TPES have increased from 4.8% in 2010 to 7.5% in 2021, which is almost a 53% increase at the halfway mark to the goal year of 2030.

Economy chapters

Australia

Introduction

Australia updated its nationally determined contribution (NDC) in June 2022, committing to reduce greenhouse gas emissions to 43% below 2005 levels by 2030. This is a significant expansion of the prior commitment of a 26 to 28% reduction for the same period. Australia's updated NDC also includes a commitment to achieve net zero emissions by 2050. The updated NDC commitments were legislated via the *Climate Change Act 2022*.

Underpinning the legislated NDC is an Australian Government plan to reach 82% renewable generation by 2030 (Powering Australia, 2024). The share of renewables generation for 2023 in the National Electricity Market (NEM) was 38% (AEMO, 2024). More than doubling the current renewable generation share will rely on a significant buildout of offshore wind, continued growth in rooftop and utility scale solar PV, for Snowy 2.0 (2.2 GW capacity) to become operational, and for regulatory approval, integration, distribution, and transmission challenges, that facilitate a much higher share of renewables, to be met.

Current high population growth—population is anticipated to reach almost 37 million in 2050 (Intergenerational Report, 2023)—and rapid electrification of end-use sectors will be an additional challenge in delivering high levels of renewable generation.

The high prices for energy commodities brought about by the COVID-19 recovery and geopolitical volatility are abating but remain historically high. The largest energy commodity earner for Australia for the past few years, LNG, generated export earnings that surpassed AUD 92 billion in 2022–23, up by almost a third. An easing of geopolitical pressures and expanded LNG supplies from the US and Qatar should see prices and export earnings fall in the coming years.

Australia's thermal coal export revenues also increased by a third, reaching AUD 65 billion in 2022–23 (REQ, 2023). A large coal inventory in China and fewer anticipated global supply disruptions mean that earnings are likely to be lower for 2024, even with resiliency in short-term production volumes.

Metallurgical coal export earnings were AUD 61 billion in 2022–23, but this represented a decline of almost 10% from the previous financial year and the very high prices of 2021. Volumes are likely to increase in the coming year, though earnings are anticipated to continue to fall due to prices returning to much lower levels.

Table 1: Australia macroeconomic data and energy reserves

Key data [a, b]		**Energy reserves** [c, d]	
Area (million km^2)	7.7	Oil (billion barrels)	2.4
Population (million)	27	Gas (trillion cubic feet)	84.4
GDP (2017 USD billion PPP)	1278.6	Coal (million tonnes)	150 227
GDP per capita (2017 USD PPP)	49 774	Uranium (kilotonnes U < USD 130/kgU)	1 239

Source: a ABS (2024); b World Bank (2024); c Energy Institute (2023); d UN (2024)

Note: Reserves are total proved reserves and reasonably assured recoverable resources for uranium.

The high global prices for energy commodities have transmitted through to many Australian consumers. The Australian Government has attempted to shield east coast consumers from these high prices by instituting a domestic wholesale natural gas price cap of AUD 12 per gigajoule. However, LNG exporters controlling 90% of east coast gas supply has meant incentives have not aligned for new gas to be made readily available (ACCC, 2023). Uncertainty over how the gas market will develop over the next few decades has also hampered investment in pipelines that would more readily transport gas domestically.

The market power of LNG exporters has meant the price cap acts like a price floor and is only applicable for the small proportion of gas consumption that has been newly contracted. These high price gas market conditions are also influential for electricity prices due to gas generation regularly being the marginal price setter for wholesale electricity prices in the NEM. Wholesale gas and electricity prices in Western Australia are lower, in part, due to a policy of domestic gas reservation, but delays in new gas supply and rising demand from domestic consumers are also bringing about price rises (S&P Global, 2023).

Australia has the largest uranium reserves in the world, though only accounts for the fourth highest production or uranium behind Kazakhstan, Canada, and Namibia (World Nuclear Association, 2023). Most of Australia's relatively small level of oil production is from the remote North West Shelf. Distance from Australia's refineries and ill-suited grades mean that most of the oil is exported (Geoscience, 2023).

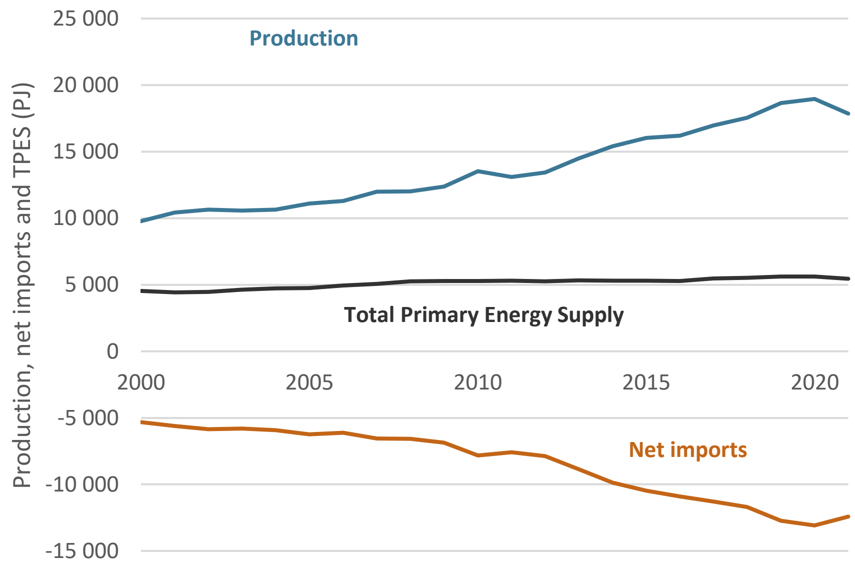
Energy Supply and Consumption

Total primary energy supply

Australia's energy supply—energy that is ultimately consumed domestically—fell by 2.9% in 2021 to just over 5 450 PJ. But this reduction was outshone by a fall in production of over 1 100 PJ. Two years of wet weather and labour force disruptions (from the COVID-19 pandemic and labour shortages) had a large impact on coal production, explaining most of this fall (REQ, 2023).

While the 5.8% fall in energy production was large, the pullback has been a rare blip of the past two decades. Energy production has increased by more than 80% since 2000 with almost all this production destined for export markets, mostly in Asia.

Figure 1: Australia energy supply, production, and net imports (PJ), 2000 to 2021



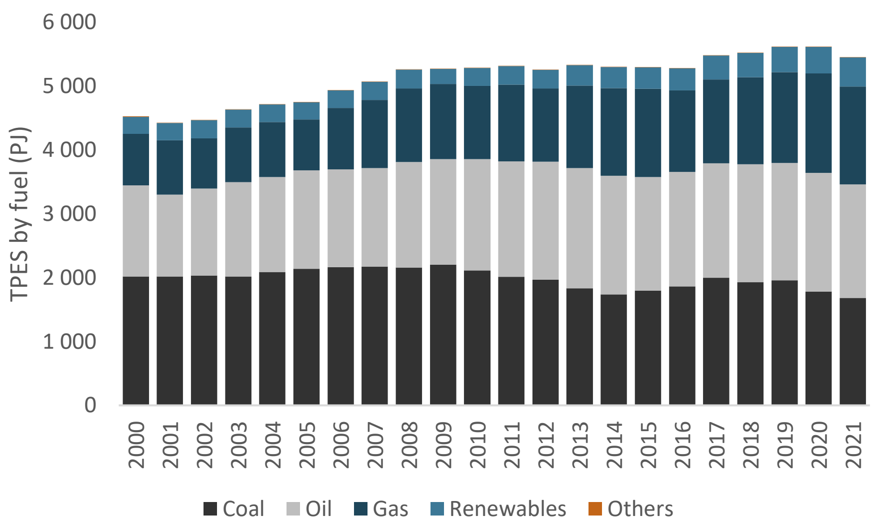
Source: EGEDA (2023)

Australia was the fifth-largest global producer of coal and the seventh-largest global producer of natural gas in 2022 (EI, 2023). Almost 90%

of Australia's coal production is exported to meet demand from coal-fired power plants (thermal coal) and blast furnaces for steel production (metallurgical coal) that are in Asia. Metallurgical coal accounts for less than one-fifth of APEC coal consumption, though it accounts for almost half of Australia's coal exports.

Australia shipped its first LNG cargo from the North West Shelf, Western Australia in 1989. The north-western regions of Australia continued to account for all of Australia's LNG exports until unconventional coal seam gas resources from the Surat and Bowen basins were developed in Queensland. The first east coast LNG cargo was shipped from Gladstone, Queensland in 2015, and has since led Australia to challenge to being the largest global LNG exporter. Australia and Qatar both accounted for a 21% share of global LNG exports in 2022.

Figure 2: Australia energy supply by fuel (PJ), 2000 to 2021

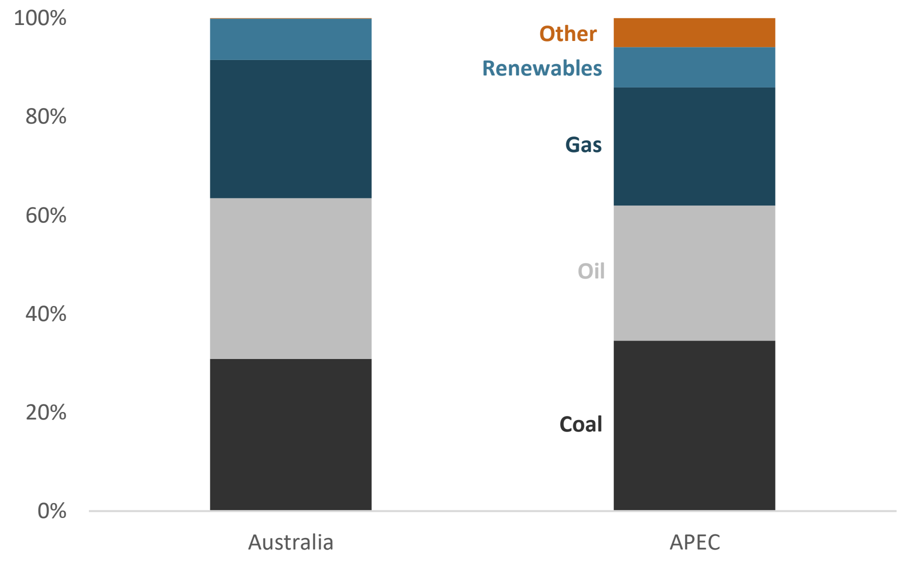


Source: EGEDA (2023)

The US is poised to challenge for the leading LNG title with significant additions to LNG exporting becoming operational in the mid-2020s (EI, 2023). The US and Qatar are also both generally lower down the LNG cost curve than coal seam gas supply from Australia.

Australia's energy supply was slowly increasing until the global financial crisis in 2008. Energy supply has mostly maintained a high plateau since then, even though population has increased by a fifth and economic output has increased by more than a quarter. The accumulation of improvements in energy efficiency partially explains why this plateau is observed (Figure 2). Non-combustible renewables—wind and solar—replacing fossil fuels also constrains growth in energy supply, due to their statistical treatment.

Figure 3: Energy supply mix – Australia and APEC, 2021



Source: EGEDA (2023)

Coal supply fell for the third year in a row, to 31% of Australia's supply mix in 2021. Oil supply (which includes petroleum products imports) also fell in 2021, by 4.3%, but remained the most prominent absolute source of supply for the second year running. Natural gas supply bucked its trend of the last four years by falling 1.7% in 2021. There is a current trend away from using natural gas in many end-use applications, but it is playing an important role in the power sector, via gas-fired peaking turbines to help meet the challenge of variable renewable generation. There is also significant consumption of natural gas associated with the liquefaction process required for LNG exports, though that is unlikely to be a source of growth moving forward. Renewables supply increased by 10.4% in 2021, so that they now account for 8.4% of Australia's energy supply. Australia may have world-beating levels of solar PV (one-in-three households), but other APEC economies have very significant hydro generation that contributes to APEC having a similar share of renewables (8.3%) to Australia.

When compared to APEC, oil is more prominent due to Australia's transport sector. Australia has high levels of car ownership and people and freight move greater distances between population centres than in many other APEC economies. Australian consumer preferences are also for larger sport utility vehicles, which mean that recent energy efficiency gains are being offset by more energy hungry vehicles (energy.gov.au, 2024).

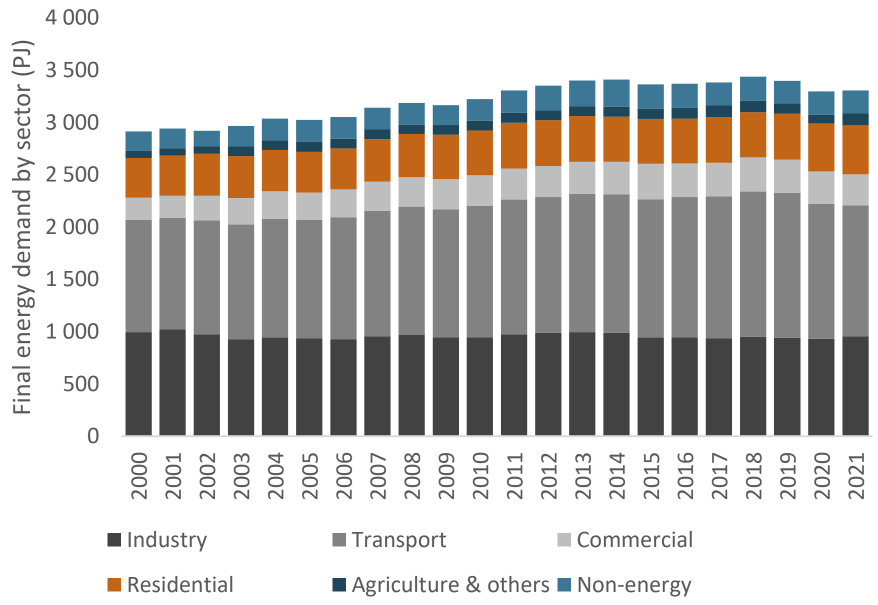
Total final consumption

Australia's energy supply of 5 453 PJ in 2020 flows through to 3 306 PJ of end-use demand. This means that almost two-fifths is consumed in the transformation process, which comprises own use and losses.

Total final consumption, which includes the consumption of energy commodities by the non-energy sector, increased marginally (0.3%) in 2021, and is almost 4% lower than peak consumption in 2018.

Commercial sector energy consumption posted another fall (3.8%) in 2021 due to COVID-19 activity restrictions. But just like in 2020, this was counterweighed by an increase in residential energy consumption, which increased 2.0%. The increase in residential energy consumption is partly explained by COVID-19 and the greater level of economic activity that is now occurring in households.

Figure 4: Australia final consumption by sector (PJ), 2000 to 2021

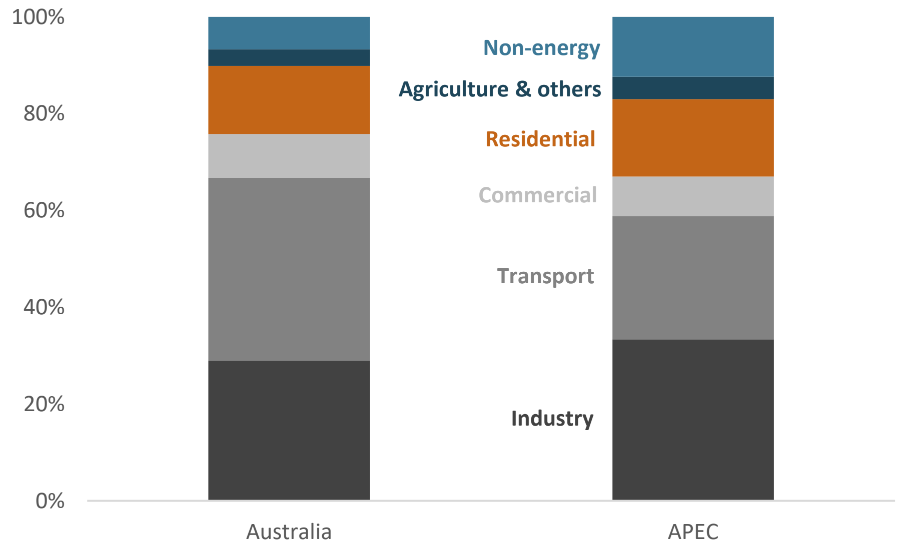


Source: EGEDA (2023)

The transport sector posted another fall (3.2%) in consumption in 2021. Lockdowns and COVID-reduced mobility, including interstate travel restrictions and increased working from home, impacted road and air transport strongly through 2020 and 2021—lockdown and state-border restrictions ended progressively from late 2021 to early 2022. In contrast, APEC transport energy consumption boomed in 2021, increasing by 7.3%, with many APEC economies rapidly reopening, aided by vaccine rollout.

Australia's industrial energy consumption has maintained a similar level for most of the last two decades (Figure 4). The commodity and resources boom of the 2000s and 2010s led to increased minerals mining activity (the energy consumption is captured in the industry sector), but this was not enough to offset the impacts of a strong Australian dollar and the offshoring of many other industrial enterprises. The accelerating rollout of renewables and batteries will require large quantities of minerals such as lithium and rare earth elements, that Australia is well placed to supply.

Figure 5: Final consumption by sector, Australia and APEC, 2021



Source: EGEDA (2023)

The Australian Government has developed a *Critical Minerals Strategy* (2023) that not only prioritises greater mining activity, but also seeks to expand downstream processing that could contribute to an industrial revival in the coming decades.

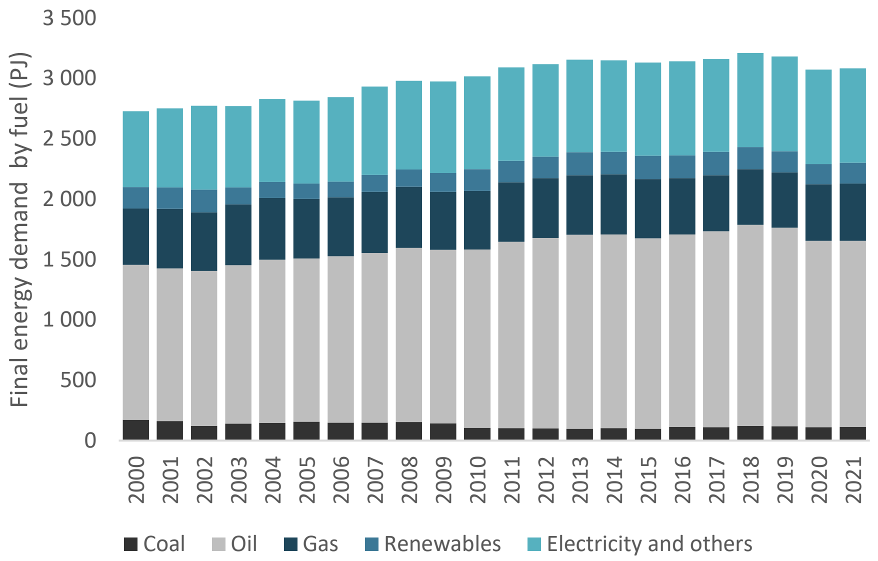
Difficulty for Australian manufacturers to secure reliable long-term gas supply at a competitive price will provide an incentive for the electrification of many industrial pursuits. The rise of renewable powered industry, such as green steel, will be an opportunity for Australia to pursue due to its vast wind and solar renewable potential. But these prospects require significant infrastructure and technological development that are unlikely to be realised until at least the 2030s. In the interim, lack of reliably sourced gas supply will be a disadvantage for Australian manufacturers.

Final energy demand

Final energy demand excludes the consumption of energy products by the non-energy sector and is a subset of final consumption.

Transport energy consumption is still mostly tied to oil (refined products) in all APEC economies. For Australia, almost four-fifths of refined product consumption is by the transport sector. Refined products are also used in all other end-use sectors, such as diesel in minerals mining (industry), LPG in residential buildings, and diesel generators in commercial buildings. These use cases combine to mean that oil accounted for half of Australia's final energy demand in 2021, with this share higher than it was in 2000 (47%).

Figure 6: Australia final energy demand by fuel (PJ), 2000 to 2021



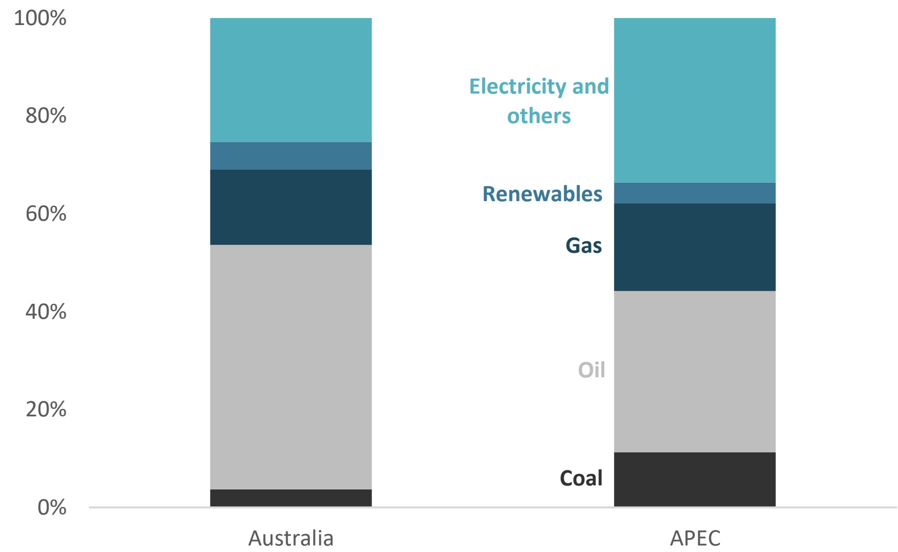
Source: EGEDA (2023)

Note: Does not include non-energy sector consumption of energy products.

Wide-scale electrification of end-use applications has yet to occur and so electricity has yet to rise in prominence, maintaining a share of roughly a quarter for most of the previous two decades. With the rise of electric vehicles, and a move to electrifying other sectors, electricity is anticipated to undergo significant growth in the next few decades. See the 8th edition of the *APEC Energy Demand and Supply Outlook* for an analysis and discussion of these trends.

Australia's relatively small heavy industry sector means that coal consumption in applications such as steel making, cement, and chemicals manufacturing is relatively low. The other end-use sectors use almost no coal in Australia.

Figure 7: Final energy demand fuel share, Australia and APEC, 2021



Source: EGEDA (2022)

Roughly three-quarters of Australia's natural gas production was exported in 2021. A large portion of this production occurs in the north-west and is unavailable to domestic east coast consumers, due to limited domestic pipeline networks and no LNG import terminals. There are currently multiple proposals to build LNG import facilities at locations on the east and south coasts, and one of these projects is nearing completion at Port Kembla in NSW. It is uncertain whether additional import terminals will be built.

Heating and cooking applications within the buildings sectors have been among the most prominent sources of natural gas demand. Multiple manufacturing applications have also relied on the consistent heating properties of natural gas and its ability to generate high heat. But higher prices and difficulty in securing long-term contracts on the east coast had been constraining natural gas demand in the lead up to COVID-19.

In 2021, natural gas consumption increased by 1.6%, which was partly due to lower global demand that freed up supply for domestic consumption. This small increase is likely to be a fluctuation away from the longer-term decline in domestic natural gas consumption. Australia's domestic consumption of gas is likely to stay lower than for the APEC region (Figure 7).

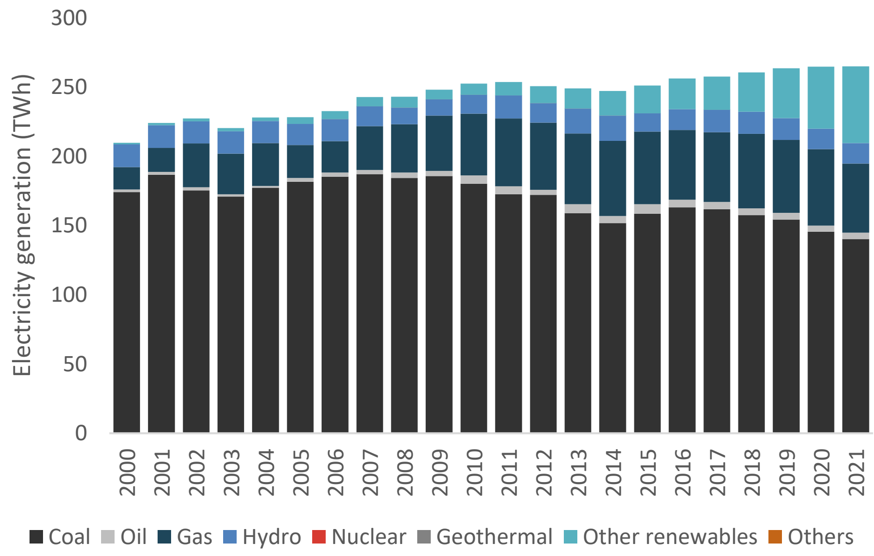
The small size of Australia's heavy industry sector provides a partial explanation for the relatively low consumption of coal by Australian end-use energy consumers. Australia's relatively low consumption of electricity also correlates with the high relative share of the transport sector, which is dependent on refined products (oil). With the rise of EVs, end-use electricity consumption is likely to grow faster in Australia than for other economies that have a less prominent transport sector.

Transformation

Power sector

Coal remains the dominant source of electricity generation for Australia. However, coal's share in the generation mix has fallen from well over 80% at its peak to 53% in 2021. The rapid rise in renewable generation, particularly solar PV, has negatively impacted the economics of coal-fired power. With continued rapid renewables deployment, coal is likely to be phased out in the 2030s, as long as regulatory, integration, distribution, and transmission challenges of integrating a very high share of renewable are met.

Figure 8: Australia electricity generation by fuel, 2000 to 2021

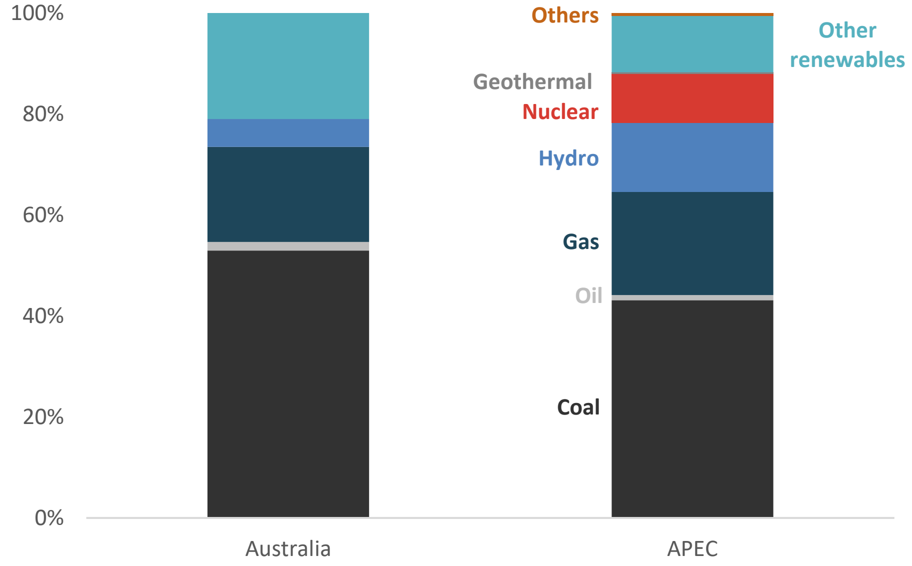


Source: EGEDA (2023)

Natural gas-fired generation had been increasing strongly for a decade but fell by almost 10% in 2021. Much of this fall accommodated the sustained very large increase in renewable generation, which accounted for a 26.5% share in 2021.

The very large increase in renewable generation is supported by Australia's world-leading solar rooftop PV rates of installation. The rise of rooftop solar is partly due to very favourable solar radiation conditions, and partially to do with policy support from state and federal governments. One in three Australian homes have a solar panel system installed. The complementary rise of utility scale solar and wind means that renewable generation is continuing to accelerate (Figure 8).

Figure 9: Electricity generation fuel share, Australia and APEC, 2021



Source: EGEDA (2023)

The 'other renewables' generation category, which includes solar PV, increased by 24% in 2021. This amounted to almost 11 000 GWh, which more than offset the decline in coal-fired power generation. The relative share of the 'other renewables' category for Australia is almost double the size for APEC.

Australia's hydro generation is under two-fifths of the relative share of hydro in the APEC generation mix. The Snowy Hydro 2.0 scheme will provide an additional two gigawatts of pumped hydro capacity but is now delayed until 2029. When this capacity is eventually available, hydro generation is poised to increase, but it will remain significantly lower than hydro-dominant APEC economies like Canada and New Zealand.

Refining

The federal government has announced support measures for Australia's remaining two refineries in Geelong, Victoria and Lytton, Queensland to continue to meet some of Australia's demand for refined products until at least 2030. These remaining two refineries have an output that fulfils just under a quarter of Australia's petroleum product consumption in 2023 (Australian Petroleum Statistics, 2023).

Energy Transition

Since a new federal government was elected in May 2022, commitments that support Australia's legislated net zero 2050 commitment have accelerated. A National Net Zero Authority has been established to ensure the opportunities are shared widely, including with workers and communities that are associated with emissions intensive sectors (Prime Minister of Australia, 2023).

At the end of 2022, Australian federal, and state and territory, energy ministers introduced the Commonwealth Capacity Investment Scheme (CIS). The scheme aims to develop a capacity market for clean dispatchable storage and generation to ensure reliability and security while delivering much lower emissions from Australia's electricity grid.

In November 2023, the Australian Government announced an expansion to the scheme to target a total of 32 GW of new capacity, made up of:

- 23 GW of renewable capacity representing AUD 52 billion in investment
- 9 GW of clean dispatchable capacity representing AUD 15 billion in investment.

The expanded CIS will be rolled out from 2024 to 2027 with regular competitive tenders held approximately every six months, starting in April/May 2024. Some 14 GW of the CIS will be rolled out through a guaranteed tender, with the remaining 18 GW delivered through Renewable Energy Transformation Agreements.

New transmission infrastructure to deliver renewable energy and increased generation is being supported by low-cost finance (Rewiring the Nation, 2022). The locations of these new sources of power will be guided by renewable energy zone analysis by the Australian Energy Market Operator (AEMO), which includes Offshore Wind Zones analysis (AEMO, 2022).

The Australian Government has also announced up to AUD 1 billion funding for the Solar Sunshot program in March 2024. The program aims to support facilities along the supply chain of Australia's solar photovoltaic (PV) manufacturing (ARENA, 2024).

Australia is supporting multiple hydrogen initiatives to capitalise on potential demand. Details of these hydrogen initiatives are available in the energy policy section later in the chapter.

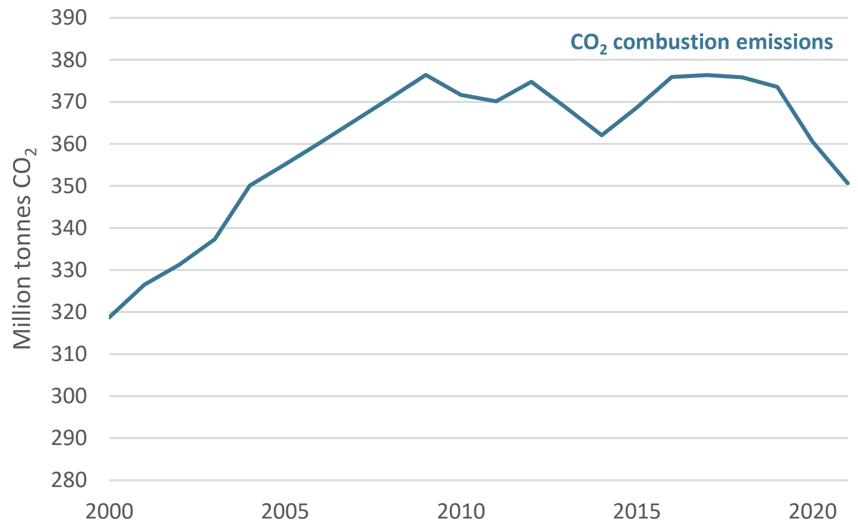
The Department of Climate Change, Energy, the Environment and Water has also ensured that energy policy is more closely aligned with environmental considerations, to support energy transition objectives.

Emissions

The expert group on energy data and analysis (EGEDA) falls under the umbrella of APEC's Energy Working Group (EWG). In addition to energy data compiled by EGEDA, CO_2 emissions from combustion activities in the energy sector are recorded. These emissions are a subset of total greenhouse gas (GHG) emissions that are considered in the context of climate change, such as under the United Nations Framework Convention on Climate Change (UNFCCC).

For Australia, CO_2 combustion emissions have maintained a high plateau for most of the last decade, though they have fallen in 2020 and 2021. This fall was partly due to a decline in economic activity that was brought on by the COVID-19 pandemic and partly due to the rapid rise in renewable generation.

Figure 10: Australia CO_2 combustion emissions (million tonnes), 2000 to 2021



Source: EGEDA (2023)

The EGEDA emissions data presented here only accounts for CO_2 from energy combustion (from transformation and end-use activities), calculated using default Intergovernmental Panel on Climate Change emission factors and energy contents. Due to these reasons, this data does not closely match Australia's emissions reported under UNFCCC guidelines.

Australia joined the Global Methane Pledge in October 2022, with participant economies agreeing to a collective effort to reduce global methane emissions at least 30% from 2020 levels by 2030.

Energy security

Even though Australia produces much more energy than it consumes, energy security has become an increasingly prominent issue in recent years. The difficulty in securing natural gas supply, and the much higher prices for that supply, mean that Australian consumers are in a similar predicament to many European and Asian consumers.

The much higher global price for coal and gas has also impacted Australia's electricity markets and is a prominent reason for the increased levels of inflation that Australia has experienced since 2022.

The unprecedented spikes in energy prices have sparked significant debate in Australia about energy policy settings. Two-thirds of the respondents of a survey of top economists (Economic Society of Australia, 2022) advocated intervention in response to these challenging market conditions. The proposed interventions include a cap on domestic prices, a tax on wartime profits that can then be used to finance subsidies, or domestic reservation.

In December 2022, the Australian Government implemented a wholesale price cap of AUD 12 per gigajoule for natural gas and AUD 125 per tonne of black coal (Energy Price Relief Plan, 2024). The price cap for gas applies to new domestic wholesale gas contracts by east coast producers. However, because 90% of gas supply is controlled by the east coast LNG producer-exporters, east coast consumers have still found it difficult to secure a ready supply (ACCC, 2023). To deliver price relief will require an intervention such as domestic reservation, guaranteeing requisite supply, or an intervention that encourages a more competitive supply landscape. The Future Gas Strategy, released May 2024, attempts to meet these challenges (Department of Industry, Innovation, Science and Resources, 2024).

Australia has been non-compliant with the International Energy Agency (IEA) 90 days of oil stock requirement since 2012. The federal government signed an agreement with the US in 2020 to lease a portion of the US Strategic Petroleum Reserve (SPR) as part of a commitment to return Australia to compliance by 2026. Economy owned oil held in the SPR was released to the market in response to the IEA's March collective action. A collective action is a coordinated release of oil that aims to stabilise the market and put downward pressure on prices.

The closure of two of the remaining four oil refineries in Australia in 2021 means that Australia is now more reliant on sources of refined products supply, and less reliant on sources of crude oil supply.

APEC Energy Goals

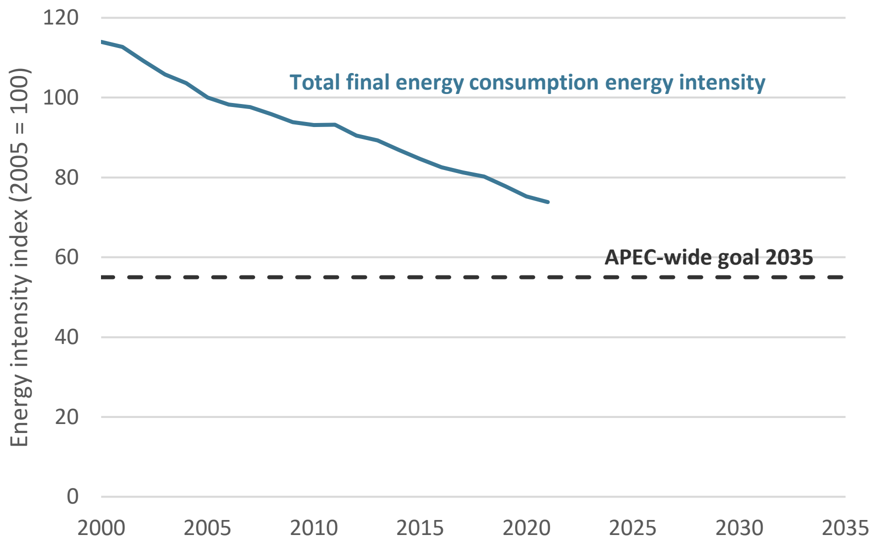
There are two energy-related objectives that APEC member economies have agreed to meet as a collective: to improve energy intensity and double the share of modern renewables.

Energy intensity goal

In 2011, APEC member economies agreed to increase their ambition to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

APEC is on track to achieve this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

Figure 11: Australia total final energy consumption intensity index, 2000 to 2021 (2005 = 100)



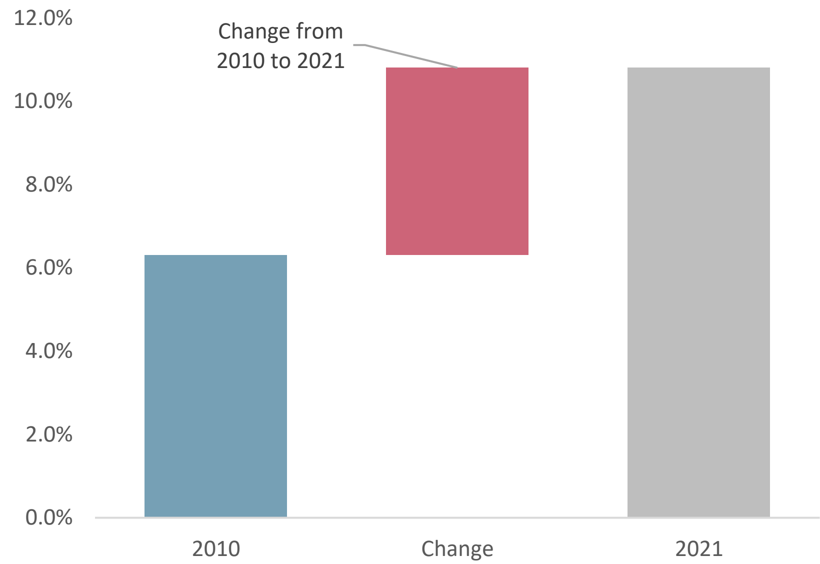
Source: EGEDA (2022)

Australia's final energy demand energy intensity has been consistently improving at a rate of between 1.5 and 2% per annum for the two decades to 2021 (Figure 11). This represents more than a 26% improvement since 2005. Energy supply intensity has improved by just under 23% for the same period, with the discrepancy partly due to the large ramp in LNG operations and associated large own-use and energy losses.

Doubling of renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for 2010 to 2030. There is no economy-level goal for individual member economies, but individual economies will contribute to the doubling goal.

Figure 12: Australia modern renewable energy share, 2010 and 2021

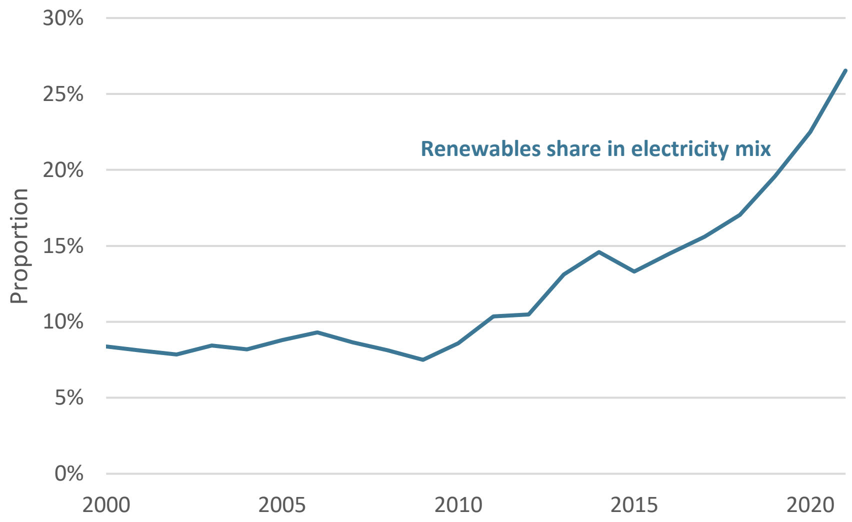


Source: EGEDA (2023)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

The share of modern renewables in Australia's final energy demand mix increased from 6.3% in 2010 to 10.8% in 2021, which was a 72% increase. Australia's large year-on-year increases in renewable generation explain most of this increase.

Figure 13: Australia renewable generation share, 2000 to 2021



Source: EGEDA (2023)

Electricity generation from renewables increased from 22.5% in 2020 to 26.5% in 2021, which was triple the 2005 level of 8.8% (Figure 13). The large pullback in 2015 coincided with the end of Australia's carbon price in 2014 and a collapse in renewables investment.

The short-lived carbon price, from 2012 to 2014, correlated with an increase in renewable generation but it is difficult to determine how large the impact was from the imposition of this short-lived price. The sustained rise of the late 2010s was largely due to the rise of rooftop solar, though the growth of utility scale solar and wind generation capacity is also accelerating.

In 2021, the annual increase in renewable generation was more than 18%, which was large considering that hydro generation was flat. Solar and wind capacity continues to accelerate and is supporting increased climate ambitions such as Australia's updated NDC, released in 2022. However, it remains to be seen whether this pace of increase can deliver on the Australian Government target of 82% renewable generation by 2030. A more recent update shows that renewable generation reached 35% in 2023 (Australian Energy Statistics, 2024).

Energy Policy

Energy policy	Details	Reference
Paris Agreement Nationally Determined Contribution	To reduce greenhouse gas emissions by 43% below 2005 levels by 2030. To achieve net zero emissions by 2050. These are enshrined in law in the *Climate Change Act 2022*. Australia has also set a target to grow the renewable share of the National Electricity Market to 82% by 2030 but this has not been legislated.	Department of Climate Change, Energy, the Environment and Water
Energy price relief plan	The Commonwealth introduced an emergency gas price cap, at AUD 12 per gigajoule on new wholesale gas sales by east coast producers. The Australian Government has worked with the NSW and Queensland governments to set an effective cap for the price of coal used for electricity generation at AUD 125 a tonne.	Department of Climate Change, Energy, the Environment and Water
Powering Australia Plan	The Australian Government's Powering Australia Plan is focused on creating jobs, cutting power bills, and reducing emissions by boosting renewable energy. It includes: • AUD 20 billion investment in transmission. • AUD 102 million for community solar banks. • AUD 224 million for the installation of 400 community batteries. • AUD 1.9 billion for powering the region's fund.	Department of Climate Change, Energy, the Environment and Water
Offshore Wind Strategy	Unlocking the power of offshore wind in Australia will help improve energy security as coal fire power stations retire, as well as improving affordability, and sustainability and bring the economy another steps closer to net zero by 2050.	Department of Climate Change, Energy, the Environment and Water
National Capacity Investment Scheme (CIS)	The scheme will provide an economy framework to encourage new investment in clean dispatchable capacity to support reliability and reduce the risk of price shocks in Australia's rapidly changing energy market. Expansion details provided in notable energy developments section.	energy.gov.au
Critical Minerals Strategy 2023-2030	This updated strategy builds on the first Critical Minerals Strategy, published in 2019. It has a vision to put Australia at the centre of meeting the growing demand for critical minerals. It will underpin the economy's prosperity and security by improving access to reliable, secure and resilient supplies of critical minerals.	Department of Industry, Science and Resources

Energy policy	Details	Reference
Safeguard mechanism	The safeguard complements the ACCU Scheme (previously ERF) by placing a legislated obligation on Australia's largest greenhouse gas emitters to keep net emissions below their emissions limit (or baseline). These baselines will decline on a trajectory consistent with achieving Australia's emission reduction targets of 43% below 2005 levels by 2030 and net zero by 2050. The targets were legislated into Australian law in 2022.	Clean Energy Regulator
ACCU Scheme (previously known as Emissions Reduction Fund)	This legislated scheme allows participants to earn Australian Carbon Credit Units (ACCUs) for every tonne of emissions reduced or sequestered through a project. These credits can be sold to the Australian Government or to other buyers in the market. The Independent Panel, which released its completed review of ACCUs in December 2022, concluded the scheme arrangements are sound, while recommending some changes to strengthen the scheme. The government is working with stakeholders to implement the recommendations from the Review.	Clean Energy Regulator
Australia's National Hydrogen Strategy	Designed to establish Australia's hydrogen industry as a major global player by 2030. Australia is currently reviewing this strategy.	Department of Climate Change, Energy, the Environment and Water
Rewiring the Nation	Rewiring the Nation is AUD 20 billion program to provide low-cost finance to upgrade, expand and modernise Australia's electricity grid and drive down power prices.	Department of Climate Change, Energy, the Environment and Water
Growing Australia's hydrogen industry (Multiple initiatives)	Various hydrogen projects, with the potential to help revitalise manufacturing, support regional economies, create jobs, investment, and trade opportunities, while helping Australia achieve its decarbonisation targets.	Department of Climate Change, Energy, the Environment and Water
The National Greenhouse and Energy Reporting scheme	A single domestic framework for mandatory reporting and dissemination of company information about greenhouse gas emissions, energy production, energy consumption, and other information from the energy, waste, and industrial processes sectors.	Clean Energy Regulator and DCCEEW
Bilateral Renewable Energy Transformation Agreements	On 23 November 2023 the Commonwealth announced a significant expansion of the Capacity Investment Scheme (CIS) with additional capacity to be negotiated with state and territory governments through bilateral Renewable Energy Transformation Agreements (RETAs). Building on successful collaboration to date under the National Energy Transformation Partnership, RETAs are designed to detail how the Commonwealth and respective state and territory governments will work together to achieve shared objectives in the renewable energy transformation.	Department of Climate Change, Energy, the Environment and Water

Energy policy	Details	Reference
Energy and Climate Change Ministerial Council (ECMC)	The ECMC is a forum for the Commonwealth, Australian states and territories, and New Zealand to work together on priority issues of domestic significance and key reforms in the energy and climate change sectors. The Hon Chris Bowen MP, Minister for Climate Change and Energy, chairs the ECMC. This council replaced the former Energy National Cabinet Reform Committee in 2022.	Department of Climate Change, Energy, the Environment and Water
National Energy Customer Framework	Regulates the connection, supply, and sale of energy (electricity and gas) to grid-connected residential and small-business energy customers.	Department of Climate Change, Energy, the Environment and Water
Australia's fuel security package	Various measures to increase domestic storage and hold a sovereign refining capability that meets Australia's needs during an emergency.	Department of Climate Change, Energy, the Environment and Water
Energy emergency management forums	Participation in gas, liquid fuel, and electricity emergency management forums to ensure effective communication and collaboration between governments and industry in energy supply emergencies.	Department of Climate Change, Energy, the Environment and Water
Trusted Information Sharing Network	The Trusted Information Sharing Network for Critical Infrastructure Resilience Energy Sector Group is a forum for sharing information on security issues and practical measures to improve the resilience of energy infrastructure to all hazards.	Cyber and Infrastructure Security Centre
Energy supply policy	The Australian Government is ensuring supply security, reliability, and affordability via clean energy and electricity market reforms, delivering priority transmission projects and pumped hydro, and supporting the Tasmanian energy taskforce.	Department of Climate Change, Energy, the Environment and Water
Subsidies for residential (and commercial) storage and/or PV	State-based government programs providing incentives for solar PV installations.	Solar rebates in Australia
Large-scale Renewable Energy Target	The Large-scale Renewable Energy Target (LRET) incentivises the development of renewable energy power stations in Australia through a Renewable Energy Certificate Market for the creation and sale of certificates called large-scale generation certificates (LGCs).	Clean Energy Regulator
Small-scale Renewable Energy Scheme	Incentivises small-scale renewable energy systems through legislated demand for small-scale technology certificates (STCs). The STCs act as a discount offered to small energy consumers to install RE systems such as solar water heaters and solar PV.	Clean Energy Regulator
Snowy 2.0	Sponsoring and commissioning of a 2GW pumped hydro facility in 2027 by the federal government.	Snowy Hydro
Climate Active	Certification is awarded to Australian businesses that meet the requirements to achieve net zero carbon emissions.	Climate Active

Energy policy	Details	Reference
Liddell Taskforce	Will advise government whether sufficient dispatchable capacity has been built to make up for the closure of the Liddell power plant in 2023.	Department of Climate Change, Energy, the Environment and Water
Retailer Reliability Obligation (RRO)	If gaps are forecast between energy demand and supply, the Australian Energy Market Operator will compel energy retailers to contract additional generation.	Department of Climate Change, Energy, the Environment and Water
Regional Australia Microgrid Pilots Program	An AUD 50 million six-year program that aims to improve the resilience and reliability of power supply for regional and remote communities. Administered by ARENA.	ARENA
GEMS program	The Greenhouse and Energy Minimum Standards Act 2012 (GEMS Act) provides for Greenhouse and Energy Minimum Standards for specific types of products before they can be supplied in Australia.	GEMS Determinations
Commercial Buildings Disclosure	The Commercial Building Disclosure (CBD) program requires energy efficiency information to be provided in most cases when commercial office space of 1000 square metres or more is offered for sale or lease.	Commercial Building Disclosure
National Electric Vehicle Strategy	Launched in April 2023, provides a domestically agreed framework to make Australia a globally competitive market for electric vehicles.	energy.gov.au
Electric Vehicle policies	Australian states and territories have multiple targets for EV sales, EV rebates, support for EV charging infrastructure, and other such policies that aim to support electrification of transport.	Department of Climate Change, Energy, the Environment and Water
National Energy Productivity Plan 2015–2030	Provides a framework and an economy-wide work plan of new and existing measures designed to coordinate efforts and accelerate improvement to deliver a 40% improvement in Australia's energy productivity.	Department of Climate Change, Energy, the Environment and Water

Notable Energy Developments

Notable development	Details	Reference
Climate change and energy transformation	The Australian Government announced a budget of AUD 24.9 billion in October 2022, which includes the Powering Australia Plan.	Energy Minister press release
Community Batteries for Household Solar	The Community Batteries for Household Solar program will install 400 batteries across Australia. This will provide shared storage for up to 100 000 households. The batteries will store excess solar energy for families and households to use during peak times.	Department of Climate Change, Energy, the Environment and Water
National Energy Performance Strategy	Framework to deliver the energy efficiency savings required to meet the government's 2030 and 2050 emissions reduction targets.	Department of Climate Change, Energy, the Environment and Water
National Energy Transformation Partnership	On 12 August 2022, federal, state and territory Energy Ministers agreed to establish a new National Energy Transformation Partnership. The Partnership is a framework for domestic alignment and cooperative action by governments to support the smooth transformation of Australia's energy sector.	energy.gov.au
Gas Code of Conduct	The Australian Government has implemented a mandatory Gas Code of Conduct, as part of the Energy Price Relief Plan announced in December 2022, to ensure that east coast gas users can contract for gas at reasonable prices and on reasonable terms.	energy.gov.au
Expansion of the Capacity Investment Scheme	On 23 November 2023, the Australian Government announced an expansion of the Capacity Investment Scheme to target a total of 32 GW of new capacity, made up of: • 23 GW of renewable capacity representing AUD 52 billion in investment • 9 GW of clean dispatchable capacity representing AUD 15 billion in investment (an additional 7.9 GW to the 1.1 GW already in progress through the first stage of the CIS).	Department of Climate Change, Energy, the Environment and Water
Solar Sunshot	The Australian Government is investing AUD 1 billion in the Solar Sunshot program to supercharge Australia's ambition to become a renewable energy super power at home and abroad. Solar Sunshot will help Australia capture more of the global solar manufacturing supply chain through support, including production subsidies and grants.	Australian Renewable Energy Agency
Hydrogen Headstart	The Australian Government will invest AUD 2.0 billion in the new Hydrogen Headstart program, providing revenue support for large-scale renewable hydrogen projects through competitive hydrogen production contracts. The program will put Australia on course for up to a gigawatt of electrolyser capacity by 2030.	Department of Climate Change, Energy, the Environment and Water

Notable development	Details	Reference
Powering Net Zero Industries	• AUD 2 billion Hydrogen Headstart. • Critical minerals to drive clean energy technologies. • Support growing demand for batteries. • Explore CCUS or CCS. • Reforming Safeguard Mechanism. • Transparency and integrity through Annual Climate Change Statement.	Budget.gov.au
Just energy transition	• Encouraging Australians to consider a career in the clean energy sector. • New Energy Apprenticeships Program. • National Skills Agreement. • Equal by 30 is building gender equity across clean energy sector. • National Net Zero Authority. • Working with and learning from First Nations people to manage climate crisis adaptation.	Powering Australia

Useful Links

Australian Bureau of Statistics – https://www.abs.gov.au/

Australian Competition and Consumer Commission – https://www.accc.gov.au/

Australian Energy Market Commission – https://www.aemc.gov.au/

Australian Energy Market Operator – https://aemo.com.au/

Australian Energy Regulator – https://www.aer.gov.au/

Australian Renewable Energy Agency – https://arena.gov.au/

Clean Energy Finance Corporation – https://www.cefc.com.au/

Clean Energy Regulator – http://www.cleanenergyregulator.gov.au/

Department of Climate Change, Energy, the Environment and Water – https://www.dcceew.gov.au/

Department of Industry, Science and Resources – https://www.industry.gov.au/

Energy.gov.au – https://www.energy.gov.au/

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Brunei Darussalam

Introduction

Brunei Darussalam has been a net energy exporting economy due to an abundance of oil and gas. These commodities accounted for 52% of Brunei Darussalam's total GDP of USD 26.8 billion in 2021 and more than 80% of the overall government revenue in the same year. This has generated a high per capita GDP of USD 60 127, enabling the government to provide a comfortable quality of life for the citizens through subsidised education, healthcare, housing and fuels, among other services. In 2021, most of the crude oil and petroleum products were exported to several APEC economies, notably Australia and Singapore, while LNG volumes were mainly shipped to China; Japan; Korea; Malaysia and others.

Brunei Darussalam aims to achieve a 20% reduction in its greenhouse gas (GHG) emissions from business-as-usual levels in 2030 in their updated Nationally Determined Contributions (NDC). To further enhance Brunei Darussalam's climate ambitions, the economy pledged to achieve net zero emissions in 2050 as per the announcement in COP26 in Glasgow, United Kingdom. The Brunei National Climate Change Policy (BNCCP) serves as the foundation for achieving the economy's NDC target, outlining key strategies to reduce emissions across the energy sector in principle, in addition to strengthening carbon sequestration in the forestry sector and enhancing climate adaptation.

The Brunei Darussalam National Council on Climate Change (BNCCC) launched a directive on the mandatory reporting of GHG emissions in 2023. Through this directive, all emitting facilities, including government departments and private sector companies, are required to report their quarterly and annual emissions, in line with the BNCCP objectives.

Brunei Darussalam is a signatory to the Global Coal to Clean Power Transition Statement, which was announced during COP26. The economy is committed to transition away from unabated coal-fired power generation, through rapid deployment of clean power generation and energy efficiency measures, ceasing issuance of new permits for construction of unabated coal-fired power generation projects.

Table 1: Brunei Darussalam's macroeconomic data and energy reserves

Key data [a, b]		**Energy reserves** [c]	
Area (km^2)	5 765	Oil (billion barrels)	1.1
Population (million)	0.45	Gas (trillion cubic feet)	7.9
GDP (2017 USD billion PPP)	26.8	Coal (million tonnes)	0
GDP per capita (2017 USD PPP)	60 127	Uranium (kilotonnes U < USD 130/kgU)	0

Source: a MOFE (2023); b World Bank (2023); c EI (2023).

Note: Reserves are total proved reserves and reasonably assured recoverable resources for uranium.

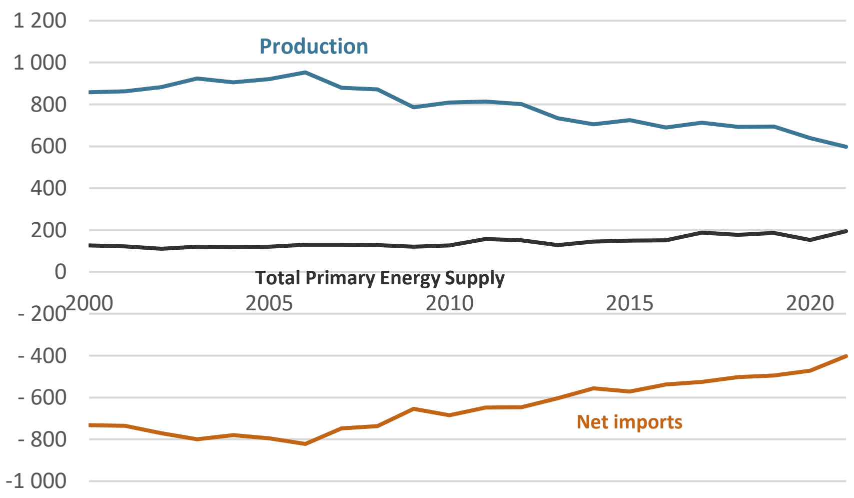
Energy Supply and Consumption

Total primary energy supply

Brunei Darussalam's energy supply in 2021 amounted to almost 195 PJ – a significant increase of 27% from 2020 levels (Figure 1). This is driven primarily by imports of crude oil to meet the domestic refinery requirements. Consequently, the net import grew by almost 15% during the same period. Increased imports of coal from Indonesia were also influential in the growth of the economy's net imports.

Generally, indigenous upstream production has been on the downward trend since 2000. Total production in 2021 stood at almost 598 PJ, down by 6.6% in the previous year, attributed to maturing oil and gas fields in shallow waters.

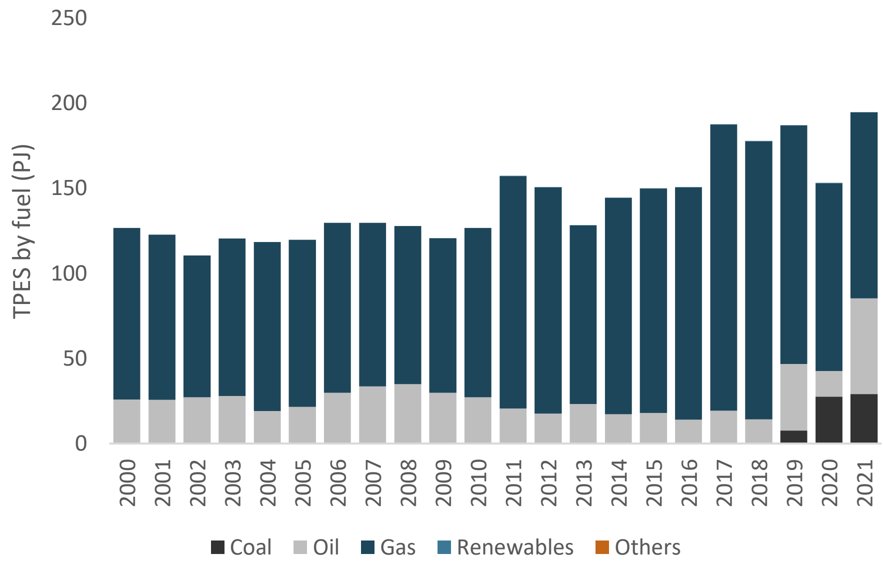
Figure 1: Brunei Darussalam's energy supply, production, and net imports (PJ), 2000 to 2021



Source: EGEDA (2023)

The energy supply in Brunei Darussalam has been gas-centric for more than two decades, serving as fuel and feedstock in the power and non-energy sectors, respectively. In 2021, gas accounted for 56% of Brunei Darussalam's energy supply, while coal and oil made up the remaining 15% and 29% respectively. Renewables supply remained negligible (Figure 2).

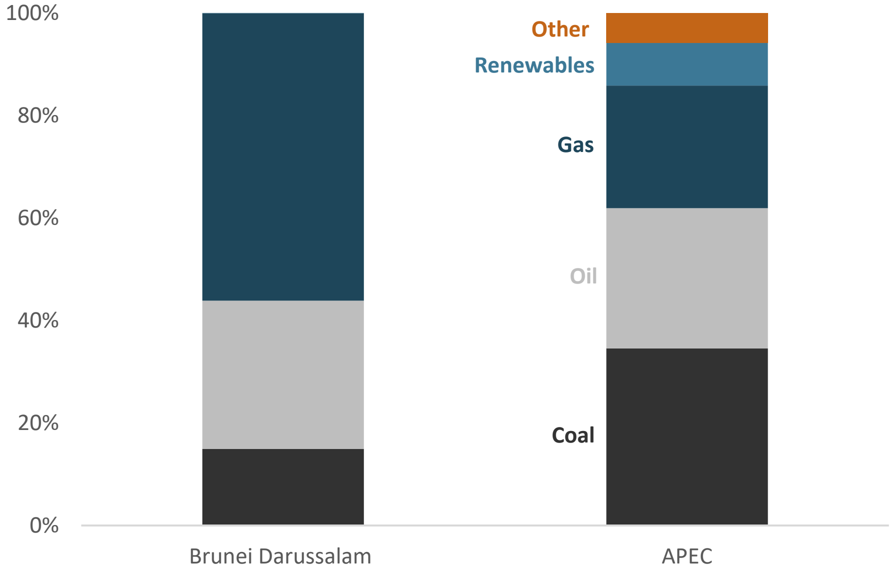
Figure 2: Brunei Darussalam's energy supply by fuel (PJ), 2000 to 2021



Source: EGEDA (2023)

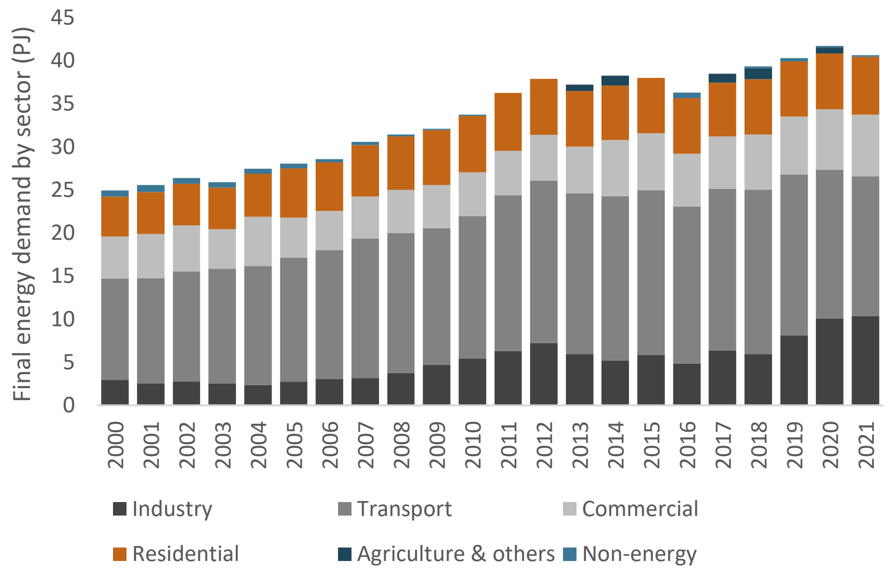
With respect to APEC energy supply mix (Figure 3), Brunei Darussalam remained well above APEC in terms of gas share in 2021, given its monopoly in the economy's power sector. Oil shares were nearly identical to each other, while the coal share was significantly below that of APEC as coal utilisation is only in the domestic refinery.

Figure 3: Energy supply mix – Brunei Darussalam and APEC, 2020



Source: EGEDA (2023)

Figure 4: Brunei Darussalam final consumption by sector (PJ), 2000 to 2021



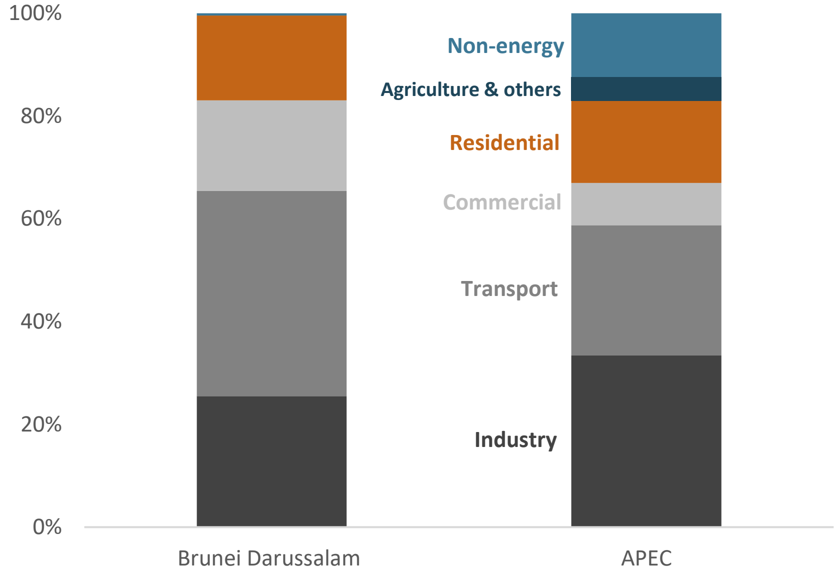
Source: EGEDA (2023)

Total final consumption

Brunei Darussalam recorded a decline of almost 3% in its final consumption in 2021 relative to 2020 levels (Figure 4). Demand growth in the industry, commercial and residential sectors were not enough to offset the declines of more than 6% and 11% in the transport and non-energy sectors, respectively. The Delta variant-driven resurgence of COVID-19 infections forced the government to impose partial lockdowns across the economy, which partially drove the decline in the transport sector. The decline in non-energy consumption was due to a decrease in the consumption of lubricants and bitumen in the industry sector.

Compared to the APEC region (Figure 5), Brunei Darussalam's share of the transport sector was substantially higher than that of APEC, owing to the economy's high private vehicles ownership and limited public transport use. Given the high dependency on oil and gas industry, Brunei Darussalam's share of the industry sector was smaller than that in APEC. The share of the commercial sector in the economy was higher than that in APEC, while the residential sector shares in both Brunei Darussalam and APEC were identical to each other. The shares of both agriculture & others and non-energy sectors in Brunei Darussalam were well below those of APEC, given negligible demands in both sectors.

Figure 5: Final consumption by sector, Brunei Darussalam and APEC, 2021

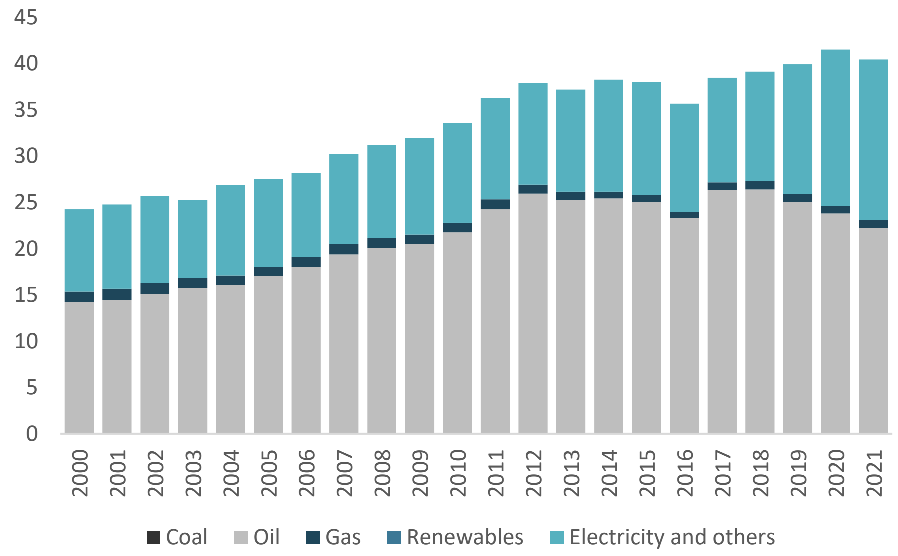


Source: EGEDA (2023)

Final energy demand

There was a modest growth of almost 3% in electricity demand in 2021 from 2020 levels, in line with the sectoral demand growth in industry, residential and commercial sectors. On the other hand, oil demand declined by almost 7% between the same period, attributed largely to a decline in transport sector activity as mentioned earlier. Meanwhile, demand for gas remained stable between 2020 and 2021 (Figure 6).

Figure 6: Brunei Darussalam final energy demand by fuel (PJ), 2000 to 2021

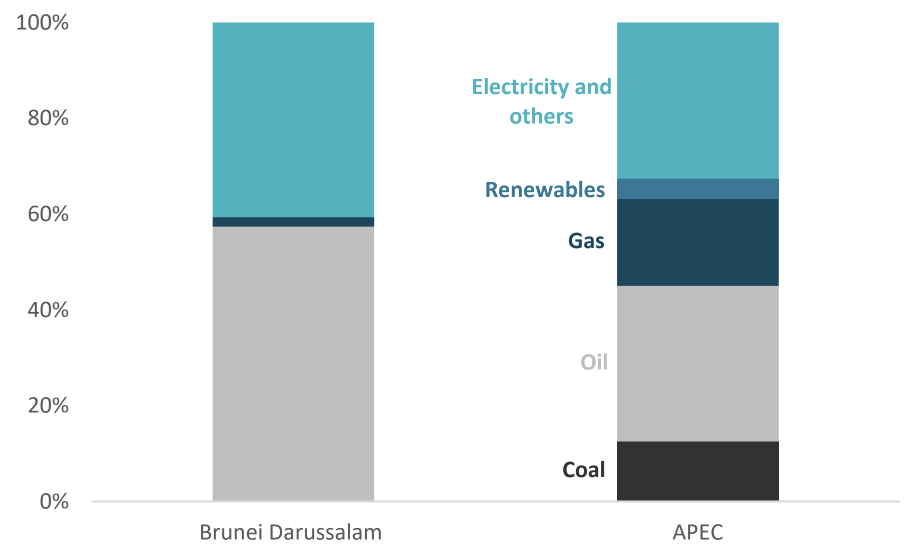


Source: EGEDA (2023)

Note: Does not include non-energy sector consumption of energy products.

Brunei Darussalam's final energy demand mix was largely electricity and oil based in 2021, hence the shares of both fuels were well above those of APEC (Figure 7). The electricity share was high because of the substantial electrification rate in the economy as well as high electricity usage per capita. The oil share was high because of the dominance of gasoline and diesel-powered vehicles usage, in addition to low fuel prices. Direct gas usage in Brunei Darussalam is very small, owing to a limited number of households that are directly connected to the gas supply via pipelines, as most households in the economy are utilising LPG cylinders for cooking purposes.

Figure 7: Final energy demand fuel share, Brunei Darussalam and APEC, 2021



Source: EGEDA (2023)

Transformation

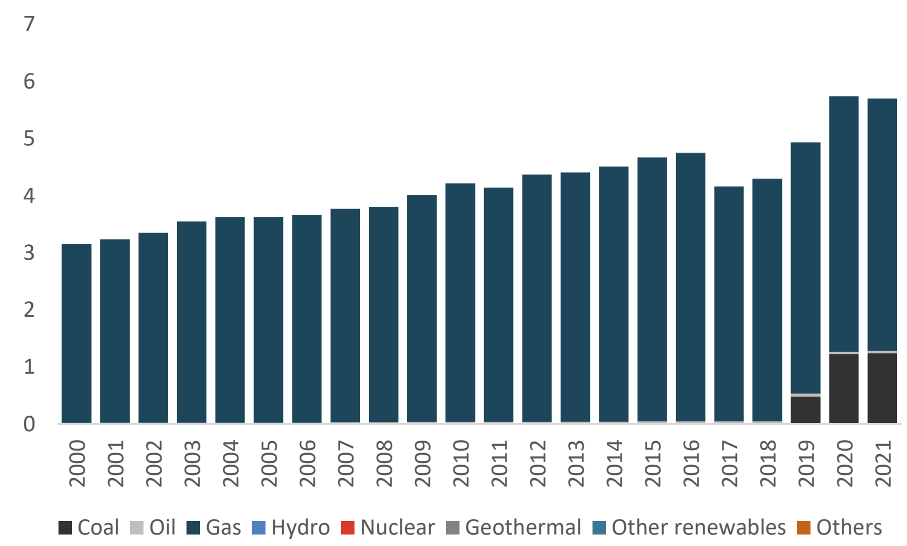
Power sector

Brunei Darussalam produced more than 5.6 TWh (20 PJ) of electricity in 2021, a slight decline of 0.6% from the previous year (Figure 8). Gas remained the main source of fuel for the electricity generation in the economy, accounting for 77% of the total electricity output. On an annual basis, gas input for the electricity generation declined by 1.2% between 2020 and 2021.

Electricity generation from oil (diesel) constituted only 1% of the total, given that it only supplied a small population in the Temburong District. Looking at yearly growth, diesel input for the electricity generation fell by almost 9% from 2020 levels.

Coal-fired electricity generation, which is exclusive for Hengyi Industries' refinery and petrochemical complex, contributed about 22% of the total output in 2021, equivalent to about 1.2 TWh (4 PJ). On an annual basis, coal input grew by 1.3% in 2021 from 2020 levels.

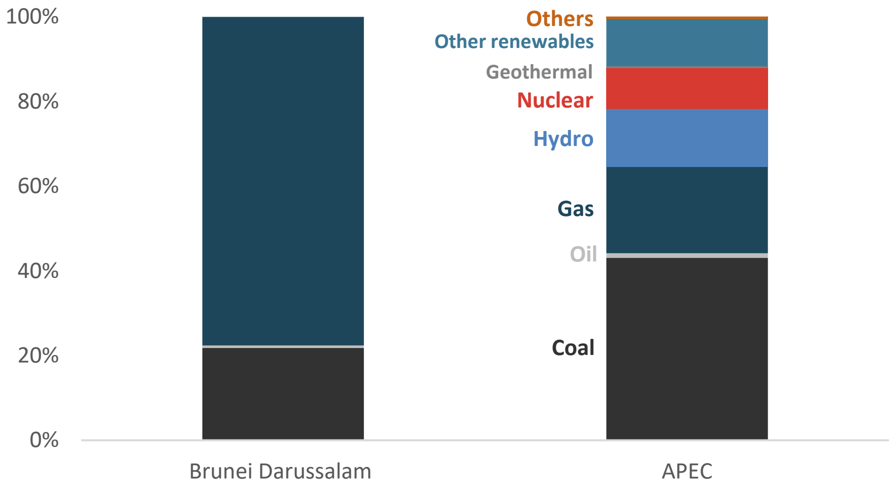
Figure 8: Brunei Darussalam's electricity generation by fuel (TWh), 2000 to 2021



Source: EGEDA (2023)

The dominance of gas in Brunei Darussalam's electricity generation mix in 2021 means that the economy's gas share is placed well above APEC's share. On the other hand, the share of coal-fired electricity generation was significantly lower than APEC's share, given that coal-fired electricity generation is only within the refinery and petrochemical complex, i.e., not connected to the public grid.

Figure 9: Electricity generation fuel share, Brunei Darussalam and APEC, 2021



Source: EGEDA (2023)

Refining

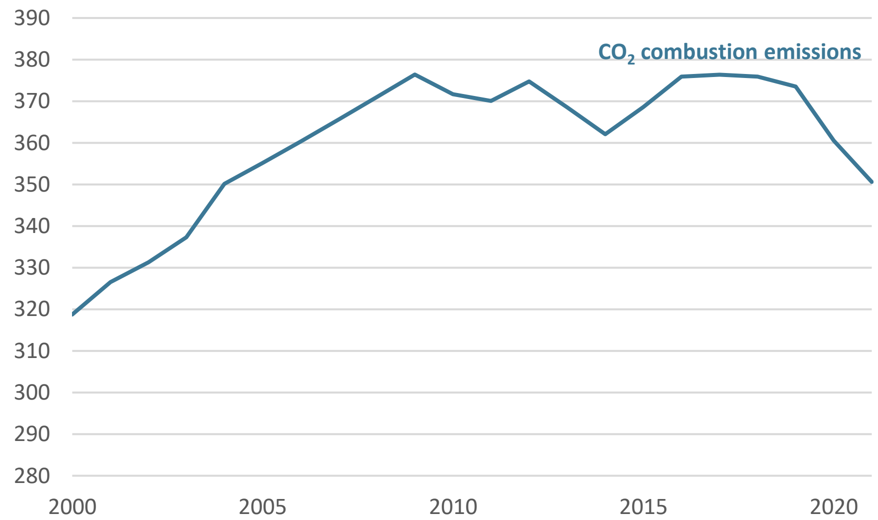
Brunei Darussalam currently houses the first phase of the Hengyi refinery and petrochemical complex, located in Pulau Muara Besar (PMB). The integrated complex is capable of refining about 175 000 barrels of crude oil per day. Given its huge capacity, more than half of the crude oil input to the complex is procured from abroad, with domestic crude accounting for the remainder of the input. As of 2021, crude oil input to the complex stood at almost 370 PJ, up 6% from the previous year. To put that into perspective, the annual oil demand in Brunei was about 20 PJ.

Energy Transition

Emissions

CO_2 emissions in Brunei Darussalam reached more than 12 million tonnes in 2021, an increase of almost 5% from 2020 levels (Figure 10). This is attributed to increased coal input for electricity generation within the refinery and petrochemical complex, despite declines in the gas-fired electricity generation as well as the transport sector between the same period.

Figure 10: Brunei Darussalam CO_2 combustion emissions (million tonnes), 2000 to 2021



Source: EGEDA (2023)

Energy security

Brunei Darussalam is a net energy exporter, given its abundance of oil and gas resources in its disposal. That said, energy self-sufficiency has been on a downward trend for more than two decades, largely due to declining domestic oil and gas production. However, the low domestic energy demand still ensured Brunei Darussalam's supply to be more than sufficient. In 2021, self-sufficiency stood at 307%, well above the threshold of the self-sufficiency indicator.

APEC Energy Goals

There are two energy-related objectives that APEC member economies have agreed to meet as a collective: to improve energy intensity and to double the share of modern renewables.

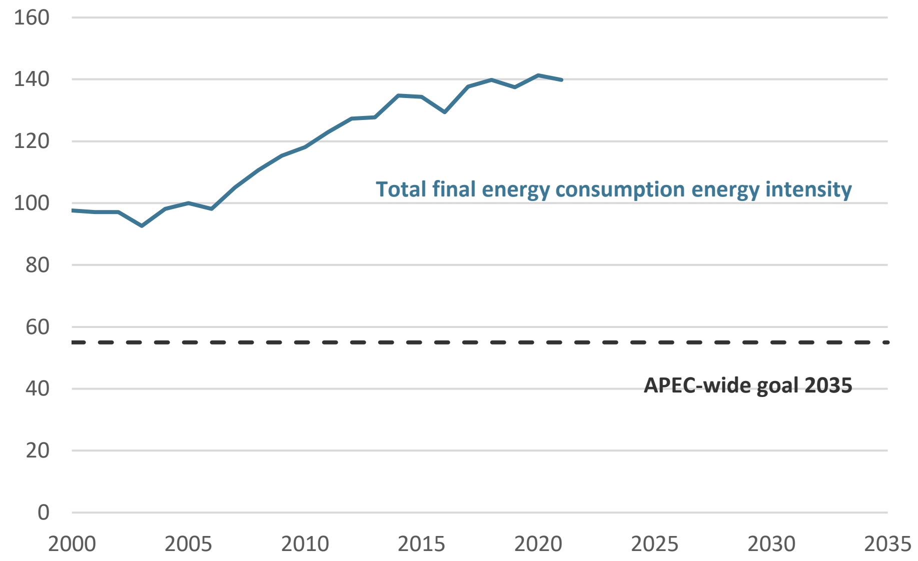
Energy intensity goal

In 2011, APEC member economies agreed to increase their ambition to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

APEC is on track to achieve this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

Brunei Darussalam's energy intensity has seen an increasing trend since 2005, given that the rate of increase of total final energy consumption is greater than the increase rate of the economy's GDP. As of 2021, energy intensity declined by 1% from 2020 levels, given the decline in the economy's energy consumption (Figure 11).

Figure 11: Brunei Darussalam's total final energy consumption intensity index, 2000 to 2021 (2005 = 100)

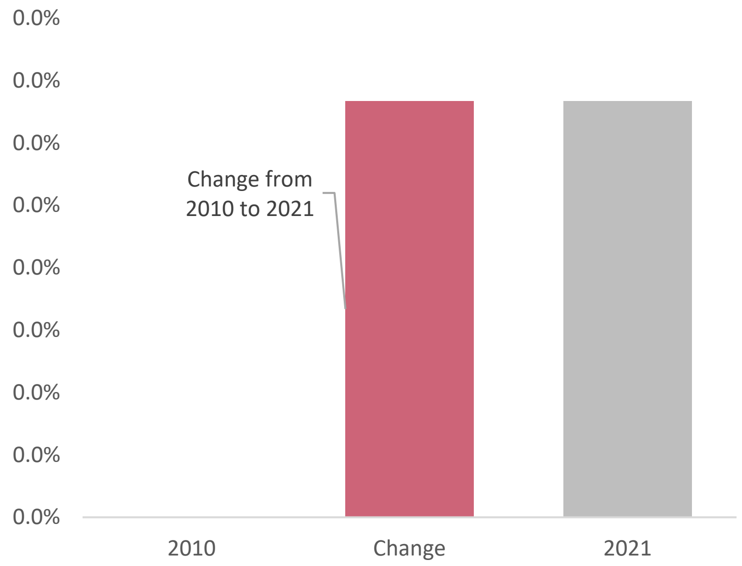


Source: EGEDA (2023)

Doubling of renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period 2010 to 2030. There is no economy-level goal for individual member economies, but improvements by individual economies will contribute to the doubling goal.

Figure 12: Brunei modern renewable energy share, 2010 and 2021

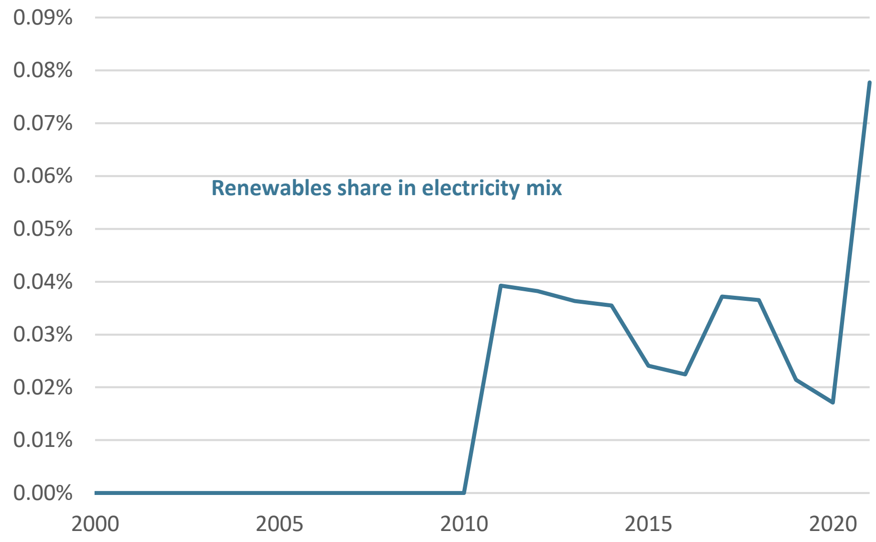


Source: EGEDA (2023)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Given the predominance of natural gas in Brunei's electricity generation mix, the share of modern renewables is still negligible (0.03% in 2021). To reduce the dependence on natural gas in the economy's power sector, Brunei is planning to expand its renewables share by installing 200 MW of large-scale solar photovoltaic (PV) plants in 2025, and further increasing this to 300 MW in 2035. Currently Brunei has about 4.5 MW of solar PV capacity.

Figure 13: Brunei Darussalam's renewable generation share, 2000 to 2021



Source: EGEDA (2023)

Energy Policy

Energy policy	Details	Reference
Nationally Determined Contributions	A 20% reduction of GHG emissions relative to business-as-usual levels by 2030.	UNFCCC (2020)
Brunei Darussalam National Climate Change Policy	The policy was established to pave the way for Brunei's low-carbon and climate-resilient pathways for a sustainable economy, through adoption of 10 key strategies: industrial emissions, forest cover, electric vehicles, renewable energy, power management, carbon pricing, waste management, climate resilience & adaptation, carbon inventory, awareness & education.	BCCS (2020)
Net Zero Emissions	Brunei is moving towards net-zero emissions by 2050, announced at UNFCCC COP26 in Glasgow, Scotland, United Kingdom.	UNFCCC (2021)
Energy Efficiency (Standards and Labelling) Order, 2021	The Department of Energy at the Prime Minister's Office introduced the Order in 2021, in line with its energy efficiency and conservation initiatives. The Order requires manufacturers, suppliers, wholesalers and retailers in Brunei to import and sell appliances that meet the minimum energy performance standards.	Department of Energy, Prime Minister's Office (2022)
Directive on the Mandatory Reporting of Greenhouse Gas	Beginning 2023, all facilities that emit GHG emissions are required to report their GHG emissions on a quarterly and annual basis, in line with the objective of Strategy 9 of the BNCCP (Carbon Inventory).	BCCS (2023)

Notable Energy Developments

Energy development	Details	Reference
Kampung Belimbing Subok Solar PV Project	The 30 MW Solar PV plant in Kampong Belimbing Subok is set to be operational in 2025.	Department of Councils of State (2024)
Hengyi Industries Refinery and Petrochemical Complex Phase 2	Phase 2 of the Hengyi Industries Refinery and Petrochemical Complex is set to commence operation in 2029.	Department of Councils of State (2024)
LPG inventory	Economy-wide minimum stock for LPG will be increased from 7 days to 14 days beginning 2024.	Department of Councils of State (2024)
Bukit Panggal Gas-fired Power Plant Phase 2	Phase 2 of combined-cycle gas power plant in Bukit Panggal is set to be operational in 2027.	Department of Councils of State (2024)

Useful Links

Brunei Climate Change Secretariat – https://climatechange.gov.bn

Brunei Shell Petroleum – https://www.bsp.com.bn/

Brunei LNG – https://www.bruneilng.com/

Department of Economic Planning and Statistics, Ministry of Finance and Economy – https://deps.mofe.gov.bn

Department of Energy, Prime Minister's Office – https://www.energy.gov.bn/

Hengyi Industries – https://www.hengyi-industries.com/

Canada

Introduction

Several climate policies and regulatory updates were released in 2023, steering and tracking Canada's progress to reaching its emissions reduction targets of 40%-45% below 2005 levels by 2030 en route to net zero emissions by 2050. Given that approximately 80% of Canada's greenhouse gas (GHG) emissions stem from energy-related activities, climate policies targeting emissions reductions inherently affect Canada's energy system (CER, 2023a).

Canada is home to a diverse energy landscape, influenced by varied geography, climate, and economic drivers. This diversity necessitates a tailored approach to energy generation among its provinces and territories. In Canada's oil-producing regions, the sector experienced a resilient rebound following COVID-19, marked by an increase in oil production from 2020 to 2021, a trend continuing into 2022 and 2023 (CER, 2023b). Simultaneously, strides were taken to maintain and increase capacity of non-emitting energy sources such as nuclear, solar and wind (CanREA, 2024; CNSC, 2023; NRCan, 2023a; ON Gov, 2023). Across Canada, discussions about clean electricity gained momentum with the publication of draft Clean Electricity Regulations (ECCC, 2023a).

In 2021, Canada released its 2030 Emissions Reduction Plan. This past year, in fulfilment of a legal requirement under the Canadian Net-Zero Emissions Accountability Act, Canada released its 2023 Progress Report on the 2030 Emissions Reduction Plan (ECCC, 2023b; Justice Canada, 2023). The progress report provides an overview of current decarbonisation efforts and outlines additional policies that will help Canada reach its climate goals.

Nonetheless, challenges persist in achieving Canada's decarbonisation targets. Uncertainty surrounding climate policies, specifically in light of the federal decision to temporarily pause the carbon price on deliveries of heating oil, as well as debates regarding timelines, methods and cost-bearing to achieve Canada's emissions reduction goals remain at the forefront.

Table 1: Canada macroeconomic data and energy reserves

Key data [a, b]		Energy reserves [c, d]	
Area (million km^2)	10	Oil (billion barrels)	168
Population (million)	38	Gas (trillion cubic feet)	83
GDP (2017 USD billion PPP)	1 843	Coal (million tonnes)	6 582
GDP per capita (2017 USD PPP)	48 218	Uranium (kilotonnes U < USD 130/kgU)	490

Source: a StatCan (2018); b World Bank (2022); c Energy Institute (2023); d NEA (2023)

Note: Reserves are total proved reserves and reasonably assured recoverable resources for uranium.

Table 1 outlines key data and energy reserves in Canada for 2021. Canada's economic output rebounded following the COVID-19 pandemic. GDP increased 5.0% in 2021 to USD 1 843 billion (2017 USD purchasing power parity [PPP]), and income increased 4.4% to USD 48 218.

Energy Supply and Consumption

Total primary energy supply

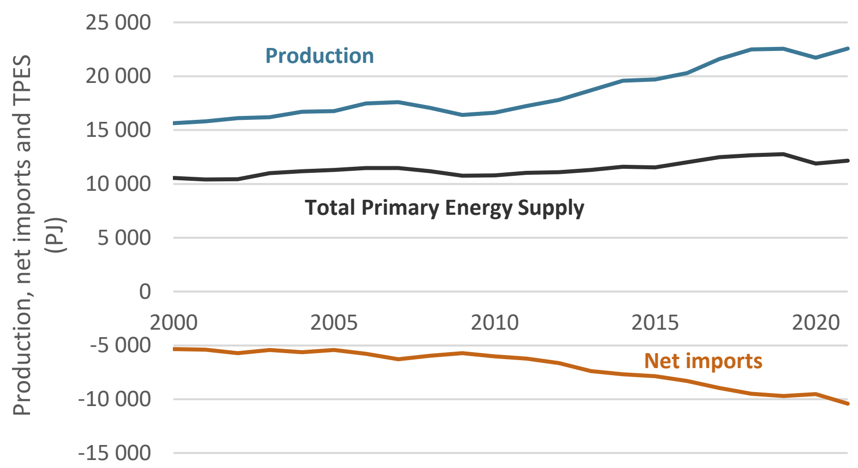
Canada is a self-sufficient and leading producer of energy, with much of its production driven by demand in global markets. Canada is a top-five producer of crude oil, gas, hydro and uranium, and a top-six exporter of crude oil, natural gas, uranium and electricity. As such, the energy sector is an important contributor to Canada's economy, directly and indirectly accounting for 11.8% of GDP. Of that, 7.2% is directly from petroleum and 1.7% directly from electricity (NRCan, 2023b).

With 90% of its energy exports landing in the US, Canada is trying to diversify its export market. The first phase of LNG Canada is to become its first large-scale LNG export facility by mid-decade, and the Trans Mountain expansion, which will increase oil export capacity by 590 000 barrels per day, began commercial operations in May 2024 (LNG Canada, 2023; Trans Mountain, 2024). Both projects will provide a strategic source of energy supply for APEC members.

Although Canada's crude oil sources vary geographically, oil predominantly comes from Western Canada. Almost two-thirds of the total production comes from the oil sands, while conventional, offshore and tight oil production comprise the remainder (CER, 2023b). Over 99% of natural gas production occurs in Western Canada (CER, 2023c). While the output from conventional resources is declining, advances in hydraulic fracturing have enabled the development of tight gas resources in the Montney Formation and the Alberta Deep Basin. Production from these basins is expected to dominate any future production and LNG exports in the coming decades, dictated largely by domestic energy policy, gas prices and global demand.

After decreasing in 2020, energy production increased 3.9% to a record high of 22 572 petajoules (PJ) in 2021 as prices increased following a collapse caused by COVID-19 (EGEDA, 2023). Fossil fuels continue to dominate production with a share over 85% (StatCan, 2022). Oil production is currently setting new highs, at around 5 million barrels per day (NRCan, 2023b). While the production impacts of COVID-19 were swift, Canada's oil production proved resilient compared to other producers.

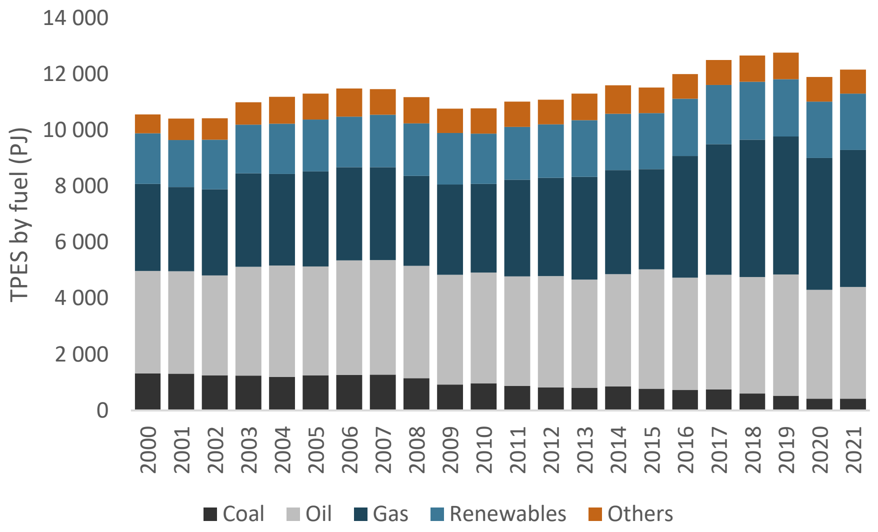
Figure 1: Canada energy supply, production, and net imports (PJ), 2000 to 2021



Source: EGEDA (2023)

Net imports decreased 9.2% from 2020 to 2021, as oil and gas exports increased, following increased production, coupled with a decrease in crude oil imports. Crude oil imports alone decreased by nearly 20% from 2020 to 2021 as interprovincial crude oil shipments from Western Canada to Ontario and Quebec increased, causing Ontario and Quebec to rely less on imports from the US (CER, 2022). Gas imports remained relatively stable.

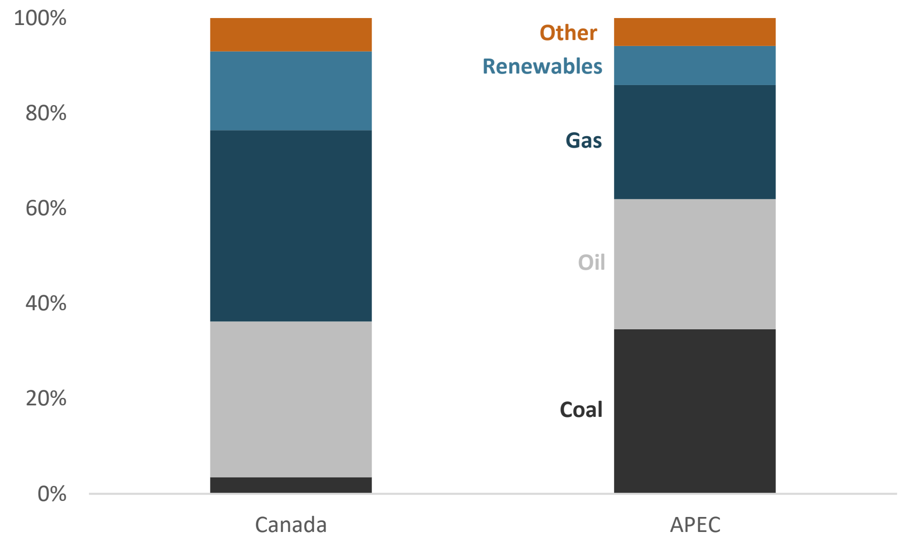
Figure 2: Canada energy supply by fuel (PJ), 2000 to 2021



Source: EGEDA (2023)

Figures 2 and 3 illustrate how dominant fossil fuels continue to be in Canada's energy mix. While coal has been steadily declining over the past two decades, oil and gas persist as predominant fuel sources in Canada's energy mix, making up more than 50% of each provincial or territorial energy supply in all regions except Quebec, where it comprised just under 50% in 2021 (CER, 2023d). Quebec is uniquely positioned to capitalise on hydroelectricity due to its extensive, existing hydropower resources. Canada has significant renewable potential and continues to realise more of its potential with deployment of solar and wind generating capacity leading the way across the economy.

Figure 3: Energy supply mix – Canada and APEC, 2021



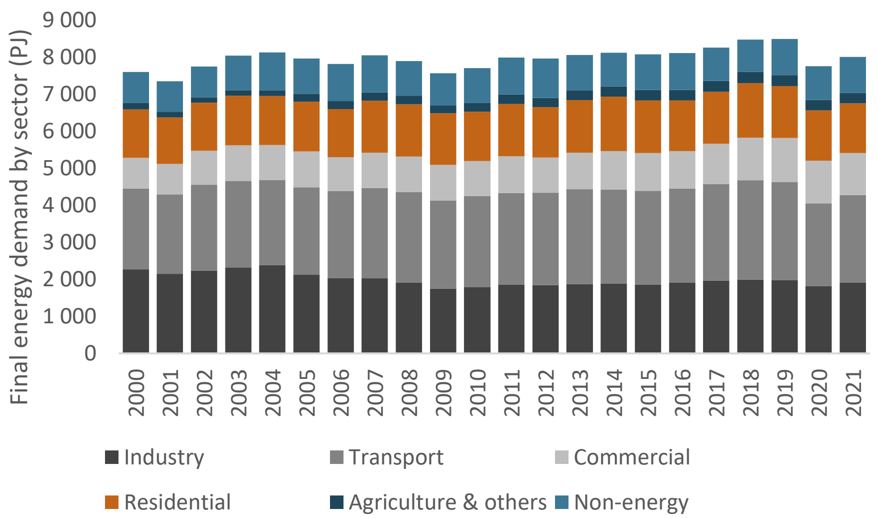
Source: EGEDA (2023)

Hydro is currently the most prominent source of renewable energy in Canada, supplying 60% of Canada's electricity in 2021 from an installed capacity of more than 82 GW (CER, 2023d). Around 14% of Canada's total electricity is provided by nuclear energy, through an installed capacity of more than 13 MW (WNA, 2024). Hydro is also a key fuel source for Canada's electricity exports, making up more than 85% of electricity generation in three of the four provinces with the largest exports of electricity to the USA (CER, 2023e; CER, 2023f). In the remaining province, nuclear is the dominant electricity source at about 55%, while hydro generates approximately one quarter of the total generation. Canada aims to leverage non-emitting electricity capacity to decarbonise its oil, natural gas and LNG operations, driving down own-use emissions to align with its commitment to achieve net zero emissions by 2050. Some oil sands majors have expressed particular interest in the deployment of small modular reactors (SMRs) as a clean electricity source to decarbonise operations through electrification in the coming decade (Pathways Alliance, 2023).

Total final consumption

Canada's total final consumption increased 3.2% from 2020 to reach 8 002 PJ in 2021 (EGEDA, 2023). This positions Canada as the fifth-largest energy consumer in APEC, after China; the USA; Russia; and Japan. Despite an increase in total final consumption from 2020 to 2021, the value for 2021 remains the lowest recorded since 2013, other than 2020.

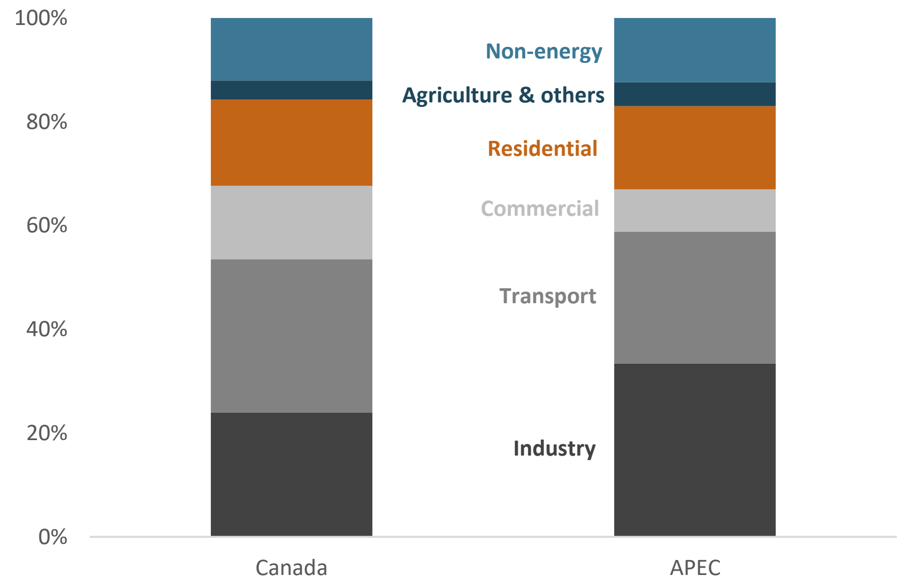
Figure 4: Canada final consumption by sector (PJ), 2000 to 2021



Source: EGEDA (2023)

The transport, industry, non-energy use and agriculture sectors all experienced increases in total final consumption from 2020 to 2021. The transport sector once again accounted for the largest share of final energy consumption (2 360 PJ), followed by the industrial sector (1 918 PJ). Non-energy use comprised 964 PJ and agriculture and non-specified others made up 290 PJ. These increases can likely be attributed to increases in activity following COVID-19 lockdowns that persisted through most of 2020. The residential and commercial sectors underwent decreases in final consumption from 2020 to 2021, with 2021 demand at 1 334 PJ (a 1.9% decrease) and 1 136 PJ (a 1.1% decrease) respectively.

Figure 5: Final consumption by sector, Canada and APEC, 2021

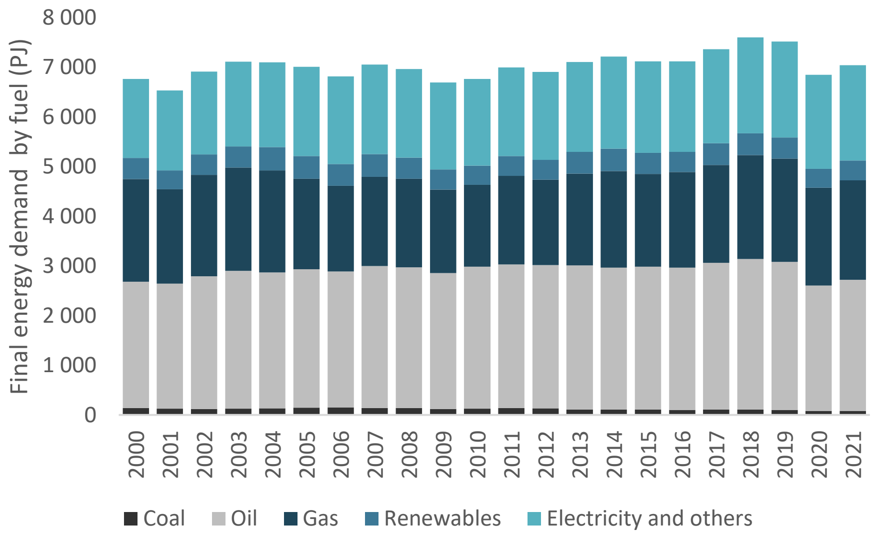


Source: EGEDA (2023)

Final energy demand

Canada's final energy demand paralleled total final consumption, increasing 2.8% to 7 038 PJ in 2021 (EGEDA, 2023). Increased oil demand (4.4%) contributed the most to this increase, which could be attributed to a resurgence in travel post-COVID-19 leading to a rise in the use of oil products. Natural gas saw a modest increase of 1.8%, while renewables experienced the most significant increase with a 4.8% increase in demand, driven by an expansion of installed capacity. Overall, final energy demand remained low compared to pre-COVID-19. This was likely influenced by continued restrictions and shifts in consumer behaviour, including the widespread adoption of remote and hybrid work that persisted into 2021.

Figure 6: Canada final energy demand by fuel (PJ), 2000 to 2021

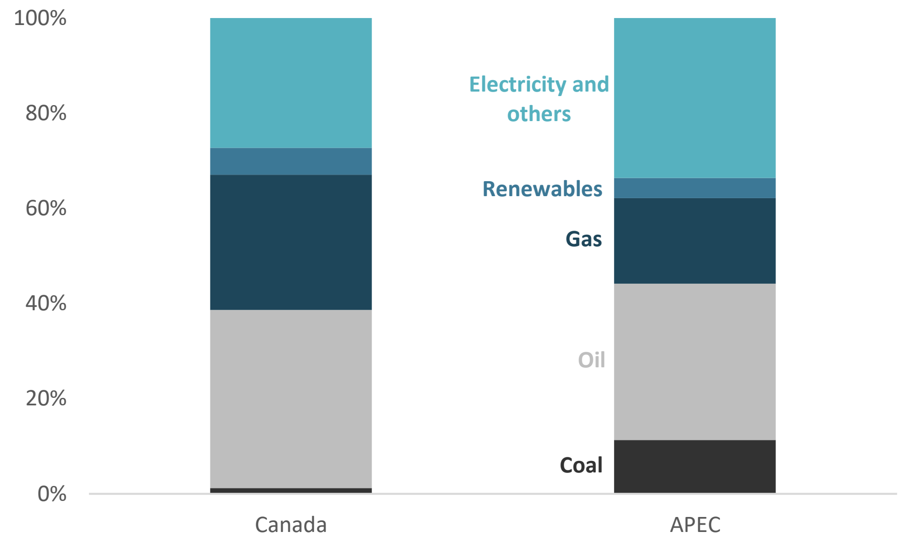


Source: EGEDA (2023)

Note: Does not include non-energy sector consumption of energy products.

In 2021, fossil fuels accounted for two-thirds of final energy demand[1], comprising oil (2 635 PJ, 37%), gas (2 000 PJ, 28%), and coal (85 PJ, 1.2%) (EGEDA, 2023). The remainder was formed by the share of renewables (399 PJ, 5.7%) and electricity and others (1 918 PJ, 27%), of which the share of renewable electricity and others was 1 278 PJ. Although coal makes up less of Canada's fuel mix than the APEC region, Canada relies more on fossil fuels.

Figure 7: Final energy demand fuel share, Canada and APEC, 2021



Source: EGEDA (2023)

Transformation

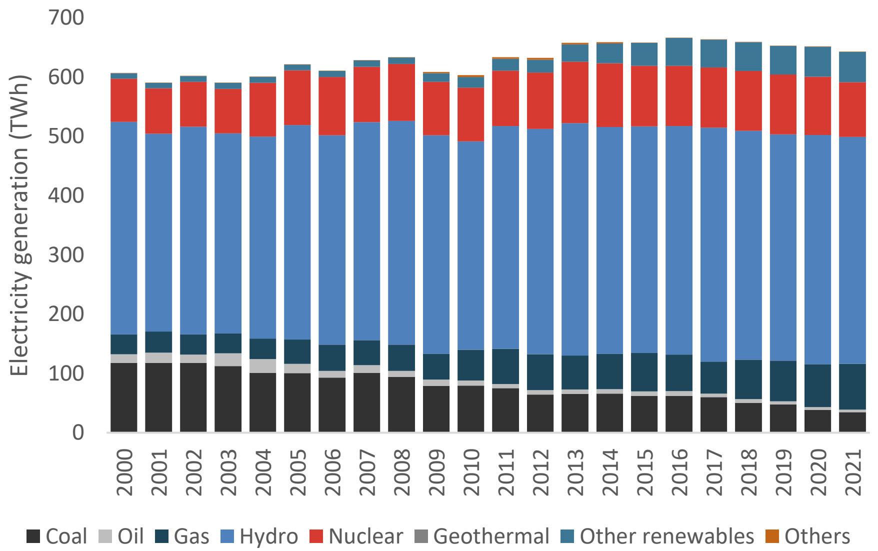
Power sector

Canada generated 643 terawatt-hours (TWh) of electricity in 2021, a decrease of 1.4% from the previous year. Non-emitting electricity

[1] Note that the demands in the EGEDA energy balance differ than those in the Report on Energy Supply and Demand (RESD) energy balances due to differences in energy accounting frameworks (StatCan, 2023a).

generation constituted the largest share of this generation (82%), with hydro as the major contributor at 60% followed by nuclear at 14%. While the contribution from hydro decreased a similar percentage as total electricity generation, nuclear decreased 5% from 2020 to 2021. This decrease in nuclear was likely influenced by a decrease in production in Ontario, which generates approximately 55% of its electricity using nuclear (CER, 2023d; IESO, 2024).

Figure 8: Canada electricity generation by fuel, 2000 to 2021



Source: EGEDA (2023)

Fossil generation accounted for 18% of total power generation. The proportion of power generated from coal continued its downward trajectory, dropping to 5.3% as Canada advances in its efforts to phase out coal-fired power plants. Natural gas-fired generation continued as the primary fossil generation source, reaching 12% of total power generation in 2021.

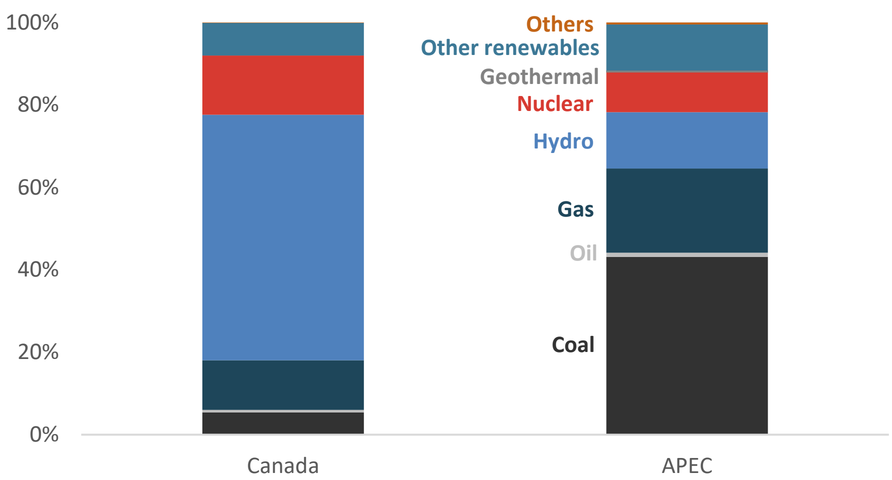
In 2016, the federal government announced its plan to phase out coal-fired electricity generation in Canada by 2030. As of 2023, Alberta, Saskatchewan, New Brunswick, and Nova Scotia maintained some electricity supply through coal-fired generation. Nova Scotia relied most heavily on the source, where coal and coke provided more than 45% of electricity in 2023 (CER, 2023d). Alberta has committed to phase out coal-fired electricity in 2024, and the remaining three provinces have aligned with the federal timeline of 2030.

Ontario is supporting the refurbishment of 14 nuclear reactor units (ON Gov, 2023a; ON Gov 2023b). These refurbishments will add approximately 25-30 years to the operational life of each unit and allow Ontario to maintain a dependable source of clean electricity.

The Government of Alberta enacted a temporary pause on all approvals of renewable energy projects greater than 1 MW from August 2023 to February 2024 (AB Gov, 2023a). The pause was initiated for the Alberta Utilities Commission to conduct an assessment on land use and reclamation. The pause on approvals came at a time of high renewable energy development in the province – Alberta accounted for more than 90% of Canada's overall growth in renewables in 2023 (CanREA, 2024). Following the pause, the Government of Alberta unveiled plans for new rules surrounding renewables development. These include a requirement to demonstrate ability for both crops and/or livestock to coexist with renewable generation on certain classes of agricultural land, and a minimum 35 kilometre buffer zone around protected areas and pristine viewscapes, as designated by the province, where wind projects are prohibited (AB Gov, 2024). The impact of these rules on renewables investment remains uncertain, and its effects may not be fully realised until 2025 or beyond.

Canada's variable renewable capacity continues to grow in general. In 2022, Canada's added more than 1.8 GW of new renewable generation capacity, and despite increasing interest rates, added another 2.3 GW of installed capacity in 2023 (CanREA, 2023). The installed capacity of major grid-connected solar and wind hit 20 GW in 2023 (CanREA, 2023). Policy support stemming from the proposed Clean Electricity Regulations, a 2035 target of 100% net zero power, the Clean Electricity Investment Tax Credit, and higher carbon prices, among other incentives, will likely drive renewable deployment higher this decade.

Figure 9: Electricity generation fuel share, Canada and APEC, 2021



Source: EGEDA (2023)

Canada's water resources enable significant parts of its economy to rely on clean electricity and provide clean electricity export options to several states in the US. The electricity networks of Canada and the US are highly integrated. In 2021, electricity exports to the US decreased to 217 PJ and imports increased to 47 PJ (StatCan, 2023b). The bulk of Canada's electricity trade with the US occurs between the provinces of Quebec, Ontario, Manitoba and British Columbia and their neighbouring American states. While new international power lines could increase electricity trade between the two economies, opposition to the construction of new transmission lines is challenging growth.

Refining

As of May 2023, there were seven existing or planned renewable diesel facilities in Canada, with several having been repurposed from existing petroleum refineries (CER, 2023g). The main driver of these facilities is Canada's Clean Fuel Regulations, for which compliance obligation began in July 2023, that require liquid fuel suppliers to gradually decrease carbon intensity. These renewable diesel facilities would add up to 70 thousand barrels per day by 2027, up from zero in 2020.

Energy Transition

Canada released its 2023 Progress Report on the 2030 Emissions Reduction Plan, which suggests that Canada is on track to reach a 36% reduction in emissions by 2030 (ECCC, 2023b). This narrowly falls short of the targeted 40%-45% reduction.

This projection does not include emissions reductions from policies that are expected but lack sufficient publicly available details, such as any that may be outlined in the forthcoming Canada Green Buildings Strategy and the oil and gas sector emissions cap that is under development. The progress report underscores the importance of collaborative efforts required from both the federal and provincial/territorial governments in Canada. Strengthening existing measures or introducing new ones will be necessary to close the gap between the projected reduction in the progress report and targeted reduction by 2030.

The largest reductions are intended to come from key sectors such as oil and gas, transportation, power generation, and buildings. To that end, in December 2023 the federal government released its framework to cap oil and gas sector emissions (ECCC, 2023c). The framework proposes using a cap-and-trade system with a hard and declining cap on emissions. While certain details are being refined as regulations take shape, it is estimated that the sector will be expected to reduce sectoral emissions approximately 35%-38% below 2019 levels by 2030.

Canada's efforts in this space will be complemented by its commitment to reduce oil and gas sector methane emissions 75% below 2012 levels by 2030. Proposed amendments to existing regulations that will help facilitate this increased reduction were released in December 2023 (ECCC, 2023d). Finalised amendments are expected in 2024. Despite fluctuations in total GHG emissions for the sector, emissions have stabilised since 2010. While emissions intensity varies across subsectors, it has decreased over the decade due to increased efficiencies.

Canada continued investing in zero emission vehicle (ZEV) charging and refuelling infrastructure and incentives to make it easier and more affordable to own and operate ZEVs. Canada has committed to sales mandates that ensure that ZEVs constitute 20% of light-duty vehicles (LDVs) sales by 2026, 60% by 2030 and 100% by 2035 (Canada Gazette, 2023). For medium- and heavy-duty vehicles (MHDVs), the government is targeting 35% of sales by 2030 and, for those applications wherein it is feasible, a 100% target by 2040.

Draft Clean Electricity Regulations were released in August 2023 (ECCC, 2023a). The proposed regulations would establish a performance standard for fossil fuel-generated electricity starting in 2035. Additionally, to help shape Canada's future electricity systems, the Clean Electricity Advisory Council was launched (NRCan, 2023c). The council is a group of experts who will provide the Government of Canada with advice on actions needed to achieve a net zero electricity sector by 2035.

Canada's 2022 Budget allocated CAD 150 million to develop the Canada Green Buildings Strategy and launch the Codes Acceleration Fund. Budget 2024 will invest CAD 903.5M in the Canada Green Buildings Strategy, which will focus on lowering home energy bills and reducing building emissions by supporting energy efficient retrofits, the adoption of better building codes, and promoting home energy labelling. This will include a new Canada Greener Homes Affordability Program and support for ongoing measures to improve energy efficiency tools for building owners and develop government approaches to home energy labelling. The anticipated publication date for the strategy is Spring 2024.

Approximately 80% of Canada's building stock anticipated to exist in 2030 is already constructed (ECCC, 2022). This underscores the critical need to prioritise energy efficiency measures in existing buildings and to expedite future emissions reduction requirements to decrease the risk of carbon lock-in from the sector. Buildings have been a key focus of Canada's energy efficiency actions, with a focus on affordability. Since 2021, Canada has committed to invest over CAD 6 billion to accelerate retrofits in commercial and institutional buildings, homes and community buildings through the Canada Infrastructure Bank, the Canada Greener Homes Initiative, and the Green and Inclusive Community Buildings program.

In Budget 2023, Canada announced new or expanded investment tax credits to spur investment in key sectors across the economy. The value of the tax credits varies by type, but are available for investments in carbon capture, use and storage, clean technologies, clean hydrogen, clean electricity, and clean manufacturing (ECCC, 2023e). Additionally, Budget 2024 announced the intention to introduce a new

10% tax credit on the cost of buildings used in key segments of the EV supply chain (Finance Canada, 2024).

While Canada is working towards policies and regulations targeted at reducing emissions, uncertainty around the future of some policies lingers. This uncertainty was amplified by the federal government's decision to remove the carbon tax on heating oil deliveries in November 2023, a pause that will continue until 1 April 2027 (ECCC, 2023f).

Moreover, disagreements between provincial and federal governments regarding the when and how for emissions reductions introduces additional uncertainty for some projects. Alberta has publicly remarked that it is prepared to take the federal government to court over regulations that the province perceives as a violation of constitutional jurisdiction, such as the proposed oil and gas sector emissions cap (AB Gov, 2023b). Regarding the draft Clean Electricity Regulations, the province invoked its Sovereignty Act by tabling a resolution that instructs governments and provincial entities such as the Alberta Electric System Operator and the Alberta Utilities Commission to ignore the clean electricity regulations to the extent legally permissible (AB Gov, 2023c). Potential legal action could lead to delays in the implementation of policies and regulations, which exacerbates investment uncertainty.

At the federal level, one step taken to alleviate some investment uncertainty was the introduction of the Canada Growth Fund's carbon contracts for difference (Finance Canada, 2023a). These contracts will backstop the future price of carbon and possibly other commodities, such as hydrogen, to provide predictability and help to de-risk investments in projects that reduce emissions. The first carbon contract was signed in December 2023 (Finance Canada, 2023b). Canada is also actively considering a carbon border adjustment mechanism to reduce carbon leakage and maintain competitiveness of domestic industries (Finance Canada, 2023c).

An update to Canada's social cost of carbon (SCC) was effective December 2022 and sets a 2024 SCC value of CAD 266/tonne (2021 CAD), with a trajectory that increases annually (ECCC, 2023g). The 2023 value was CAD 261/tonne (2021 CAD). Canada has committed to update the estimates to reflect the best available science and methodologies.

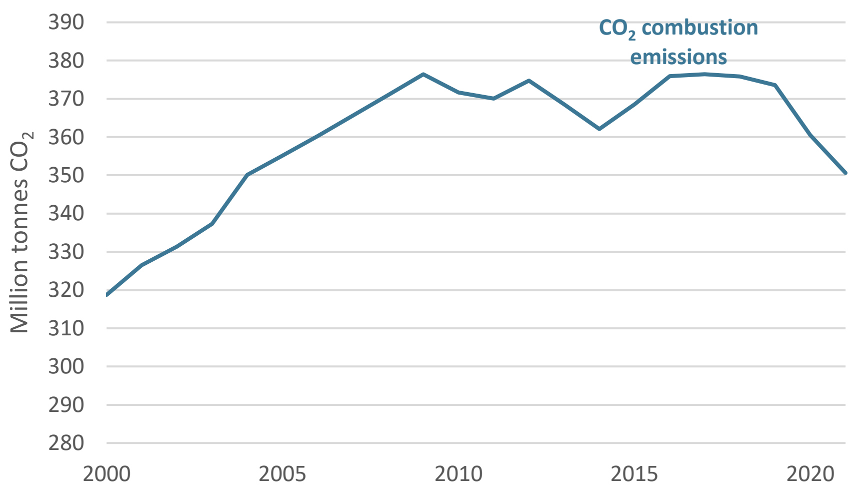
In February 2024, Canada announced the beginning of its engagement process to establish its 2035 emissions reduction target (ECCC, 2023h). This target-setting step is legally mandated under the Canadian Net-Zero Emissions Accountability Act (Justice Canada, 2023).

Emissions

The expert group on energy data and analysis (EGEDA) falls under the umbrella of APEC's Energy Working Group (EWG). In addition to energy data compiled by EGEDA, CO_2 emissions from combustion activities in the energy sector are recorded. These emissions are a subset of total GHG emissions that are considered in the context of climate change, such as under the United Nations Framework Convention on Climate Change (UNFCCC).

Canada's CO_2 combustion emissions have maintained a plateau near record highs over the past 20 years, but lower activity during the onset of COVID-19 led to a 9.0% drop in 2020. Moving into 2021, GDP rebounded 5% from 2020 to 2021, while CO_2 combustion emissions remained low. Moving forward, Canada's climate policies should provide downward pressure on emissions this decade.

Figure 10: Canada CO_2 combustion emissions (million tonnes), 2000 to 2021



Source: EGEDA (2023)

Energy security

Because Canada is a net-energy exporter, it generally considers itself to be a driver of energy security solutions, not a victim of energy security disruptions. However, higher energy prices are challenging the affordability of energy for Canadians. Provinces across the economy are providing relief via tax cuts, subsidies, and retail price caps on the end-user prices for oil products, natural gas and electricity.

Furthermore, Canada's provincial power system operators are working to address the challenges that integrating high amounts of variable renewables could pose for the reliability and affordability of their electricity systems. However, other analysis has suggested that while electricity rates will rise into the future, total energy spending will decrease because of increases in energy efficiency (CCI, 2023). The federal government has provided several programs to support energy affordability, and given that provinces and territories regulate electricity, it is additionally up to those governments to implement the policy solutions that keep prices low for middle- and low-income households.

As electricity demand is expected to increase in the coming decades through increased electrification, questions are being raised about how supply will meet demand. Power system operators are beginning to include reliability assessments in their plans to target a net zero electricity system by 2035 while balancing increasing demand. Increasing or enhancing interprovincial (federally regulated) and intraprovincial (provincially regulated) transmission could provide a more flexible and reliable grid for Canada. However, differences in regulatory and market structure across provinces can hinder the speed and depth of interprovincial infrastructure development.

Several infrastructure developments to connect Canadian oil and natural gas to global markets are inching towards completion. The 14 million tonnes per annum first phase of the LNG Canada plant in Kitimat, BC is more than 85% complete. The construction of its Coastal Gaslink feeder pipeline was mechanically complete at the end of 2023, and start-up testing is set to begin in 2024. Production is expected to begin mid-decade (LNG Canada, 2023). The Trans Mountain pipeline expansion began commercial operations in May 2024 (Trans Mountain, 2024). Upon completion, both projects may provide a strategic source of energy supply for APEC members for the coming decades.

APEC Energy Goals

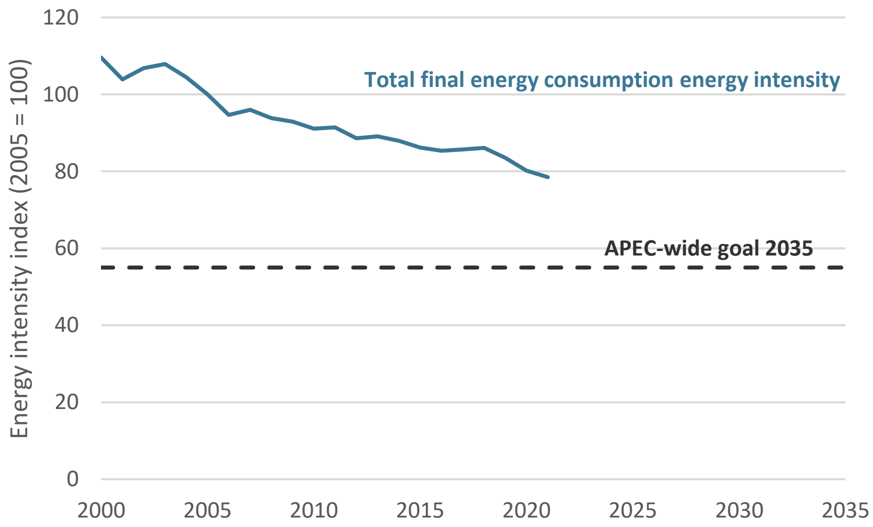
There are two energy-related objectives that APEC member economies have agreed to meet as a collective: to improve energy intensity and double the share of modern renewables.

Energy intensity goal

In 2011, APEC member economies agreed to increase their ambition to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

APEC is on track to achieve this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

Figure 11: Canada total final energy consumption intensity index, 2000 to 2021 (2005 = 100)



Source: EGEDA (2023)

Canada's energy efficiency policies, commitment to reducing GHG emissions, and other targeted regulations have historically reduced energy intensity. Figure 11 illustrates this, showing a 22% reduction in energy intensity since 2005.

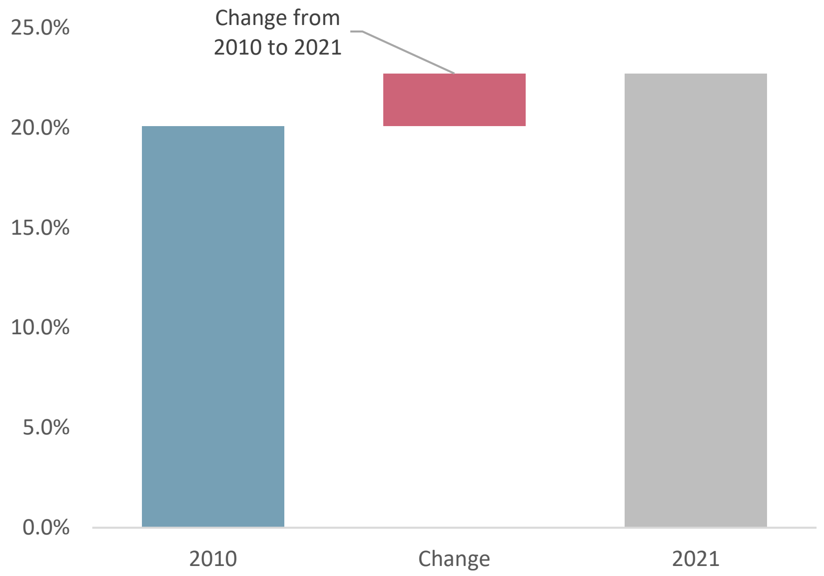
After declining steadily since 2005, energy intensity fell sharply for three consecutive years in 2019, 2020, and 2021. The implementation of economy-wide carbon prices and the adoption of energy-efficient technologies and climate policies (see below) could prompt accelerated efficiency improvements en route to achieving the aspiration target by 2035.

Doubling of renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period 2010 to 2030. There is no economy-level goal for individual member economies, but improvements by individual economies will contribute to the doubling goal.

Canada is hard-pressed to double its share to 40%, particularly with its already high share of renewable electricity, with more than two thirds of generation being from renewable sources (Figure 13). However, Canada can still contribute to APEC achieving its aspirational goals. Several of Canada's climate policy announcements, including draft Clean Electricity Regulations, a 100% net zero power system target by 2035, various investment tax credits, climbing carbon prices, and grants and contributions programs such as the Smart Renewable and Electrification Pathways program, will continue to increase the share of renewables in the Canadian and APEC fuel mix. Canada's renewables share in the electricity mix saw no marked percentage change from 2020 levels.

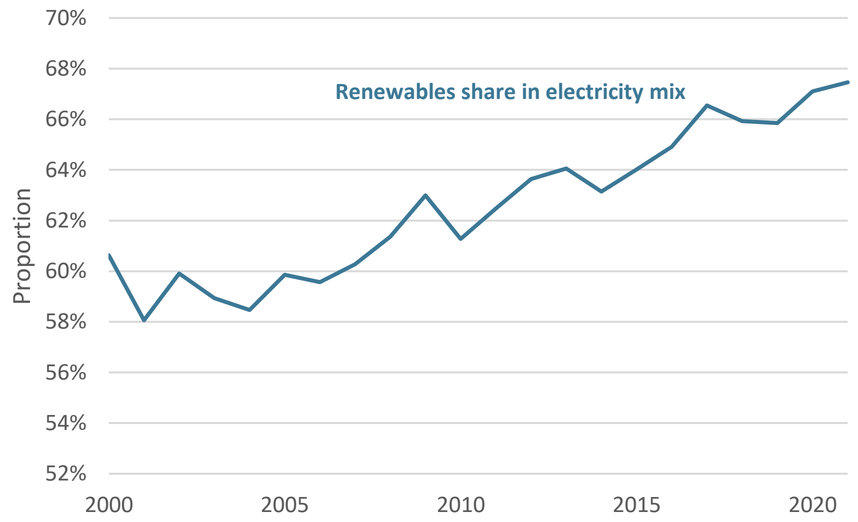
Figure 12: Canada modern renewable energy share, 2010 and 2021



Source: EGEDA (2023)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Figure 13: Canada renewable generation share, 2000 to 2021



Source: EGEDA (2023)

Energy Policy

This table is not an exhaustive list of energy and climate policies in Canada. However, it is a list of policies that are expected to have a substantial impact on Canada's energy system going forward. For the complete list of key federal energy and climate measures, please refer to the following:

- The Pan-Canadian Framework on Clean Growth and Climate Change (ECCC, 2016): This was Canada's first-ever economy-wide climate plan that was developed with its provinces and territories and in consultation with Indigenous peoples. It is an important first step for Canada to achieve its Paris Agreement target. It is structured to cut pollution in a more practical and affordable way than any climate plan in Canadian history.
- Canada's Strengthened Climate Plan: A Healthy Environment and a Healthy Economy (ECCC, 2020): Includes more than 60 new and strengthened federal measures and an initial CAD 15 billion in investments, to make life more affordable for Canadians, make communities more liveable and, at every turn, focus on creating jobs, growing the middle class, and supporting workers in a stronger and cleaner economy.
- 2030 Emissions Reduction Plan: Canada's Next Steps for Clean Air and a Strong Economy (ECCC, 2022): A comprehensive roadmap that reflects levels of ambition to guide emissions reduction efforts in each sector.
    - 2023 Progress Report on the 2030 Emissions Reduction Plan (ECCC, 2023b): The first progress report released shows interested individuals Canada's progress on the path laid out in the Emissions Reduction Plan. Additional progress reports will be produced in 2025 and 2027 in line with requirements under the Canada Net-Zero Emissions Accountability Act. Additional targets and plans will be developed for 2035 through to 2050.
- Budget 2024 (Finance Canada, 2024): Announces new and updated information on the federal toolkit for investing in the clean economy: a set of clear and predictable investment tax credits, low-cost strategic financing, and targeted investments and programming, where necessary, to respond to the unique needs of sectors or projects of economic significance.

Additionally, provincial and territorial climate policies and plans can be referenced for specific information about what each respective province and territory is doing to contribute to their respective climate goals and targets, as well as to Canada's as a whole.

Energy policy	Details	Reference
2023 Progress Report on the 20230 Emissions Reduction Plan	The 2023 Progress Report is the first progress report on the 2030 Emissions Reduction Plan (ERP) and provides an update on progress towards Canada's emissions reduction targets described in the 2030 ERP.	Environment and Climate Change Canada
Canada Green Buildings Strategy	The Government of Canada, through Budget 2024, will invest CAD 903.5M in the Canada Green Buildings Strategy, which will focus on lowering home energy bills and reducing building emissions by supporting energy efficient retrofits, the adoption of better building codes, and promoting home energy labelling. This will include a new Canada Greener Homes Affordability Program and support for ongoing measures to improve energy efficiency tools for building owners and develop government approaches to home energy labelling.	Natural Resources Canada
Canada Greener Affordable Housing	This program provides forgivable and low-interest loans up to CAD 170 000 per unit to residential owners to help finance building retrofit measures and activities needed to meet climate goals. It also supplies contributions for pre-retrofit activities needed to plan, prepare and apply for retrofit funding. Applicants must meet certain affordability criteria.	Canada Mortgage and Housing Corporation (CMHC)
Canada Greener Homes Initiative	Provides grants of up to CAD 5 000 and loans of up to CAD 40 000 to help homeowners undertake home retrofits, and up to CAD 600 toward the costs of pre- and post-retrofit EnerGuide evaluations. The initiative also includes the Oil to Heat Pump Affordability Program.	Natural Resources Canada
Canadian Net-Zero Emissions Accountability Act	Legislates emissions reductions accountability to address climate change, by setting legal requirements on the Government of Canada to plan, report, and course correct on the path to net zero emissions by 2050.	Justice Canada
Canadian Sustainable Jobs Act	The legislation will put workers and communities at the centre of policy and decision-making by establishing a federal framework for accountability, a governance structure and engagement mechanisms. The Act will hold future governments to account with respect to supporting Canada's workers for generations to come.	Natural Resources Canada

Energy policy	Details	Reference
Carbon Capture, Utilisation and Storage Investment Tax Credit	Proposed investment tax credit for capital investments in carbon capture, utilisation, and storage of up to 60% for capture carbon from ambient air, up to 50% for capture other than directly from ambient air, and up to 37.5% for related carbon transportation, use, and storage infrastructure.	Finance Canada
Carbon Management Strategy	The strategy articulates the role of carbon management on the path to net zero and the federal actions that are being taken to accelerate innovation, advance policies, attract investments, scale up projects and build partnerships in developing carbon management solutions.	Natural Resources Canada
Clean Electricity Investment Tax Credit	Proposed investment tax credit of up to 15% for investments in non-emitting electricity generation systems, abated natural gas-fired electricity generation (subject to an emissions intensity threshold), electricity storage, and projects that transmit electricity between provinces and territories.	Finance Canada
Clean Electricity Regulations	Draft regulations were released for consultation in August 2023 with a revised iteration being issued for comment in early 2024. The regulations function as a set of rules for transitioning Canada's electricity grid to net-zero. They are to set a technology-neutral emissions performance standards and include flexibilities so that provinces and utilities are able to maintain reliable and affordable electricity. Finalised regulations are expected in 2024.	Environment and Climate Change Canada
Clean Fuel Regulations	Requires liquid fossil fuel (gasoline and diesel) primary suppliers to gradually reduce the carbon intensity from the fuels they produce and sell for use in Canada over time, leading to a decrease of approximately 15% (below 2016 levels) by 2030.	Environment and Climate Change Canada
Clean Hydrogen Investment Tax Credit	Proposed investment tax credit of 15%-40% of eligible expenses on equipment for hydrogen projects. The rate of the credit depends on the carbon intensity of the hydrogen, calculated using the Government of Canada's Fuel Life Cycle Assessment model.	Finance Canada
Clean Technology Investment Tax Credit	Proposed investment tax credit of up to 30% to encourage investment in adoption and operation of clean technology property. Eligible types of equipment include those related to electricity storage, zero emissions vehicles and clean energy production.	Finance Canada
Clean Technology Manufacturing	Proposed investment tax credit of up to 30% for capital spending related to the manufacturing of	Finance Canada

Energy policy	Details	Reference
Investment Tax Credit	specified clean technologies or the processing of critical minerals.	
Climate Aviation Action Plan	The plan presents a vision of net zero by 2050 for the sector and includes key pathways for the collaboration between the government and industry to improve efficiency and reduce pollution. A key climate signal delivered through the plan is Canada's goal for 10% for the use of sustainable aviation fuel by 2030 and efficiency improvements.	Transport Canada
Contracts for Difference	The Canada Growth Fund will be the principal federal entity issuing carbon contracts for difference. It will allocate, on a priority basis, up to CAD 7 billion of its current CAD 15 billion in capital to issue all forms of contracts for difference and offtake agreements.	2023 Fall Economic Statement
Critical Mineral Exploration Tax Credit	Tax credit of up to 30% for mineral exploration expenditures renounced under eligible flow through agreements entered into after 7 April 2022, and on or before 31 March 2027.	Finance Canada
Electric Vehicle Supply Chain Investment Tax Credit	Canada intends to introduce a new 10% tax credit on the cost of buildings used in key segments of the EV supply chain, for businesses that invest in Canada across three supply chain segments: 1) EV assembly, 2) EV battery production, and 3) cathode active material production.	Finance Canada
Eliminating Inefficient Fossil Fuel Subsidies	Canada released its *Inefficient Fossil Fuel Subsidies Government of Canada Self-Review Assessment Framework* and the *Inefficient Fossil Fuel Subsidies Government of Canada* guidelines as a step to deliver on the commitment to end inefficient fossil fuel subsidies.	Environment and Climate Change Canada
Enabling Small Modular Reactors (SMRs) Program	This program will promote the safe, commercial development of SMRs. The program will provide CAD 29.6 million over four years to develop supply chains and fund research. Eligible applicants could include private companies, utilities, provinces and territories, universities and Indigenous groups.	Natural Resources Canada
Energy Efficiency Regulations	Establishes energy efficiency standards for a wide range of energy-using products, with the objective of eliminating the least energy-efficient products from the Canadian market.	Natural Resources Canada

Energy policy	Details	Reference
Energy Innovation Program	The program advances clean energy technologies that will help Canada meet its climate change targets, while supporting the transition to a low-carbon economy. It funds research, development and demonstration projects, and other related scientific activities.	Natural Resources Canada
Green Industrial Facilities Manufacturing Program	The program provides financial assistance to support the implementation of energy efficiency and energy management solutions designed to maximise energy performance, reduce GHG emissions, and increase competitiveness for industry in Canada.	Natural Resources Canada
Green Shipping Corridor Program	Budget 2023 proposed to create a Green Shipping Corridor Program. This would receive CAD 165.4 million to establish green shipping corridors and help decarbonise the marine sector in shipping areas along the Great Lakes, the St. Lawrence Seaway, and the east and west coasts.	Transport Canada
Greening Government Strategy	Sets a target to reduce absolute Scope 1 and Scope 2 GHG emissions from federal operations by 40% by 2025 and by at least 90% below 2005 levels by 2050.	Treasury Board of Canada Secretariat
Green Industrial and Manufacturing Program (GIFMP)	Offers cost-shared financial support for a comprehensive suite of energy efficiency measures and is delivered through two separate tracks: energy efficiency solutions and industrial facility.	Natural Resources Canada
Low Carbon Economy Fund	Consists of four funding streams to support projects to reduce Canada’s GHG emissions, generate clean growth, build resilient communities, and create good jobs for Canadians.	Environment and Climate Change Canada
Net Zero Accelerator (NZA)	With up to CAD 8 billion in funding to support large-scale investments in key industrial sectors across the economy, the NZA ensures that Canada remains competitive in a net zero economy and reduces GHG emissions.	Innovation, Science and Economic Development Canada
Oil to Heat Pump Affordability Program (OHPA)	Launched in February 2023, and strengthened in October 2023, the Oil to Heat Pump Affordability program provides upfront grants to help low- to median-income households switch from oil heating to heat pumps by providing funding toward the purchase and installation of a new heat pump. The program offers up to CAD 15 000 for eligible homeowners residing in a co-delivery province.	Natural Resources Canada
Output-Based Pricing System (OBPS)	Implements output-based emissions performance standards that set a price for industrial emissions if a facility's emissions intensity exceeds their sectoral benchmark. Applies in provinces	Environment and Climate Change Canada

Energy policy	Details	Reference
	and territories that do not have a system of equivalent stringency implemented.	
Powering Canada Forward: Building a Clean, Affordable, and Reliable Electricity System for Every Region of Canada	This paper outlines the work done to date by the federal government, which complements the progress made by other levels of government to transform the electricity sector, informs how the federal government will accelerate work over the coming months, and lays the groundwork for Canada's first Clean Electricity Strategy to be released in 2024.	Natural Resources Canada
Proposed Regulations Amending the Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector)	Proposed amendments to the 2018 Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector) aimed to further reduce methane emissions from the oil and gas sector 75% below 2012 levels by 2030 were published at the end of 2023. Finalised amendments are expected in 2024.	Environment and Climate Change Canada
Public Transit Fund	The Government of Canada is investing CAD 14.9 billion over the next eight years in reliable, fast, affordable and clean public transit. This funding includes CAD 3 billion per year in permanent, predictable federal public transit funding which will be available to support transit solutions beginning in 2026/27.	Infrastructure Canada
Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations	Phase-out of traditional, unabated coal-fired electricity by 2030, with exceptions for coal power equipped with CCS units.	Justice Canada
Regulations Limiting Carbon Dioxide Emissions from Natural Gas-fired Generation of Electricity	Establishes a regime for limiting CO_2 emissions from the generation of electricity via combustion of natural gas. Prohibits the operation of facilities exceeding the standards. Generally speaking, that is 420 tCO_2e/GWh for natural gas boilers and combustion engines with a capacity over 150 MW; 550 tCO_2e/GWh if combustion engines have a capacity under 150 MW.	Justice Canada

Energy policy	Details	Reference
Regulatory Framework for an Oil and Gas Sector Greenhouse Gas Emissions Cap	A regulatory framework outlining plans to implement an emission cap-and-trades system for the oil and gas sector was published in December 2023. It is designed to achieve an emissions reduction of 35% to 38% by 2030 with respect to 2019 levels and net zero by 2050. Upstream oil and gas facilities, including offshore facilities and LNG facilities, fall under the scope of the cap.	Environment and Climate Change Canada
Smart Renewables and Electrification Pathways Program	The program provides approximately CAD 4.5 billion until 2035 for smart renewable energy and electrical grid modernisation projects.	Natural Resources Canada
Sustainable Jobs Plan	An interim plan for 2023-2025 that describes support for Canadians and their communities in realising the net zero economy of the future by equipping Canadians and their communities with the skills and training they need to continue to thrive.	Natural Resources Canada
Regulations Amending the Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations	Legislated Canada's Electric Vehicle Availability Standard, which sets regulated light-duty ZEV sales targets (20% by 2026, 60% by 2030, 100% by 2035).	Canada Gazette II
Update to the Pan-Canadian Approach to Carbon Pollution Pricing 2023-2030	The federal government laid out the economy minimum stringency standards for carbon pricing for the period of 2023-2030. Any province or territory can design its own pricing system tailored to local needs or can choose the federal pricing system. A provincial or territorial system must meet the federal minimum stringency standards, which started at CAD 65/tonne GHG emissions in 2023 and increases by CAD 15 each year to 2030, or the federal system will be implemented.	Environment and Climate Change Canada
Wah-ila-toos: Clean Energy Initiatives in Indigenous, Rural and Remote Communities	Wah-ila-toos' mission is to provide funding for renewable energy and capacity-building projects and related energy efficiency measures in Indigenous, rural and remote communities across Canada. Wah-ila-toos operates under five funding streams.	Natural Resources Canada

Notable Energy Developments

Energy development	Details	Reference
Canada Electricity Advisory Council	The council is an independent, electricity-sector focused, expert advisory body that provides advice to the Minister of Energy and Natural Resources to accelerate investment, and promote sustainable, affordable and reliable electricity systems.	Natural Resources Canada
Canada Growth Fund	A CAD 15 billion arm's length public investment vehicle that will help attract private capital to build Canada's clean economy by using investment instruments that absorb certain risks in order to encourage private investment in low carbon projects, technologies, businesses and supply chains.	Canada Growth Fund
Canada Infrastructure Bank Funding	Budget 2023 announced that the Canada Infrastructure Bank would invest at least CAD 10 billion through its Clean Power priority area, and at least CAD 10 billion through its Green Infrastructure priority area.	Budget 2023
Canada Infrastructure Bank to fund SMR	The Canada Infrastructure Bank (CIB) has finalised an agreement with Ontario Power Generation and committed CAD 970 million towards Canada's first small modular reactor (SMR 300 MW).	Clean Infrastructure Bank
Deep Retrofit Accelerator Initiative	Investment of CAD 200 million during 2023 to 2027 to create the Deep Retrofit Accelerator Initiative. The initiative will provide support for building owners to advance deep retrofits in commercial, institutional, and mid- or high-rise multi-unit residential buildings in Canada, and to drive market transformation in a given region or market segment.	Natural Resources Canada
LNG Canada Phase 1	At the end of 2023, construction on the first 14 million tonnes per annum facility was 85% completed and scheduled to be commissioned mid-decade; a possible final investment decision on a second phase would increase this to 28 million tonnes per annum.	LNG Canada
Methane Centre of Excellence	Spurred by an initial investment of CAD 30 million, work associated with the Methane Centre of Excellence will aim to improve the accuracy, understanding, reporting and mitigation of methane emissions by focusing on key data, measurement techniques and technology development.	Environment and Climate Change Canada

Energy development	Details	Reference
Modified Atlantic Loop	Originally proposed transmission line expansion that would connect Atlantic provinces with Quebec, the project was modified and is now moving forward with the reliability inter-tie between New Brunswick and Nova Scotia. The project has a target in-service date of 2029 and is being pursued in the context of transitioning Atlantic provinces away from coal and decarbonising the electricity system.	Natural Resources Canada
New Social Cost of Greenhouse Gases	An update to the social cost of carbon (SCC) was effective December 2022 and estimates a 2024 SCC of 2021 CAD 266/tonne, which is to increase over time. The 2023 value was 2021 CAD 261/tonne. A 2016 update had previously raised the SCC to CAD 54/tonne for 2020. Canada has committed to update the estimates to reflect the best available science and methodologies.	Environment and Climate Change Canada
Pathways Alliance Carbon Capture and Storage Hub in Alberta	Phase 1 of the planned project focuses on building a proposed CAD 16.5-billion CCS network in north-eastern Alberta that could capture 10 to 12 million tonnes of CO_2 each year, or roughly 5% of oil and gas sector emissions in 2021 in Canada. Proposed start-up for injection and storage of CO_2 is 2026.	Pathways Alliance
Pausing Fuel Charge on Deliveries of Heating Oil	Effective November 2023, the federal government paused the federal fuel charge on deliveries of heating oil in all provinces and territories where it currently applies, until the end of 2026-27.	Environment and Climate Change Canada
Public Engagement on the 2035 GHG Emissions Reduction Target	A public engagement process to hear the opinions of Canadians and Indigenous peoples to inform Canada's 2035 greenhouse gas emissions target commenced. This step is mandated under the Canadian Net-Zero Emissions Accountability Act.	Environment and Climate Change Canada
Regional Energy and Resource Tables	The Regional Tables are joint partnerships between the federal government and individual provinces and territories in collaboration with Indigenous partners - and with input from key stakeholders - to identify and accelerate shared economic priorities for a low-carbon future in the energy and resource sectors. Ten provinces and territories have launched a Regional Table.	Natural Resources Canada

Energy development	Details	Reference
Alberta-Canada Bilateral Working Group	A working group established between the federal government and Alberta provincial government to discuss and develop a shared information base to understand and provide certainty regarding actions and timeframes to achieve these governments' shared goals of economic prosperity and a carbon-neutral economy by 2050.	Prime Minister of Canada
Repealing the Renewable Fuels Regulations (RFR)	The final compliance year under the RFR was 2022, with the final reporting period occurring in 2023. The RFR are officially repealed in September 2024 per s.175 and s.172(2) of the Clean Fuel Regulations. Suppliers regulated under the RFR will continue to be required to meet volumetric requirements for renewable fuel, but will be regulated under the CFR, and be subject to associated declining carbon intensity requirements.	Environment and Climate Change Canada
Sales Targets for Medium- and Heavy-Duty Zero Emission Vehicles	Aim to reach 35% of total new medium- and heavy-duty vehicle sales being ZEV by 2030. In addition, goal to develop a medium- and heavy-duty ZEV regulation to require 100% of new medium- and heavy-duty vehicle sales to be ZEVs by 2040 for a subset of vehicle types based on feasibility, with interim 2030 regulated sales requirements that would vary for different vehicle categories based on feasibility and explore interim targets for the mid-2020s.	Transport Canada
Trans Mountain Pipeline Expansion	Canada's Trans Mountain pipeline expansion began commercial operations in May 2024.	Trans Mountain

Useful Links

Atomic Energy of Canada Ltd – www.aecl.ca

Canada Gazette – http://www.gazette.gc.ca/

Canadian Centre for Energy Information – https://energy-information.canada.ca/en

Canada Energy Regulator – https://www.cer-rec.gc.ca/index-eng.html

Canadian Nuclear Laboratories – www.cnl.ca

Canadian Nuclear Safety Commission – http://nuclearsafety.gc.ca

Environment and Climate Change Canada – www.ec.gc.ca

Innovation, Science and Economic Development Canada – https://ised-isde.canada.ca/site/ised/en

Natural Resources Canada – https://natural-resources.canada.ca/home

Statistics Canada – www.statcan.ca

Transport Canada – www.tc.gc.ca

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Chile

Introduction

The world faced several risks in 2023, including widespread rising inflation, and global energy and food supply crises following the events of previous years. During 2023, Chile introduced several measures to control domestic inflation and reactivate its economy. Despite these measures, Chilean GDP growth is estimated to be close to 0%, although higher growth, closer to 2.5%, is expected for 2024.

In April 2023, the Ministry of Energy launched the Initial Agenda for a Second Time of the Energy Transition, with the aim of taking actions for an accelerated decarbonisation of the electricity sector. The agenda considers the deployment of the first 10 measures in four areas of action: storage promotion; mitigation of risks to suppliers; operational flexibility; and political, regulatory actions and urgent works.

Some initiatives to promote the energy storage that were carried out during 2023 included a proposal for the modification of the Supreme Decree N62/2006 that regulates power transfer between electricity generators to include energy storage systems within the National Electric System.

In December 2023, the Ministry of Energy released the draft of the Green Hydrogen Action plan 2023-2030 for public consultation. The action plan consists of 111 measures that range from pilot projects to the implementation of regulatory changes required for the development of the hydrogen industry in this economy.

Also, in December 2023, the Energy Transition Bill, presented in July 2023, was approved in principle by the Chilean Senate. Some articles of the Bill require further discussion during early 2024 before final approval. This Bill is considered an enabling condition to develop utility scale energy storage projects in Atacama.

Table 1: Chile's macroeconomic data and energy reserves

Key data [a]		Energy reserves [b, c]	
Area (million km^2)	0.8	Oil (billion barrels)	000
Population (million)	20	Gas (trillion cubic feet)	000
GDP (2017 USD billion PPP)	495	Coal (million tonnes)	000
GDP per capita (2017 USD PPP)	25 174	Uranium (kilotonnes U < USD 260/kgU)	561

Source: a World Bank (2023); b Energy Institute (2023); c Nuclear Energy Agency (2023)

Note: Reserves are total proved reserves and reasonably assured recoverable resources for uranium.

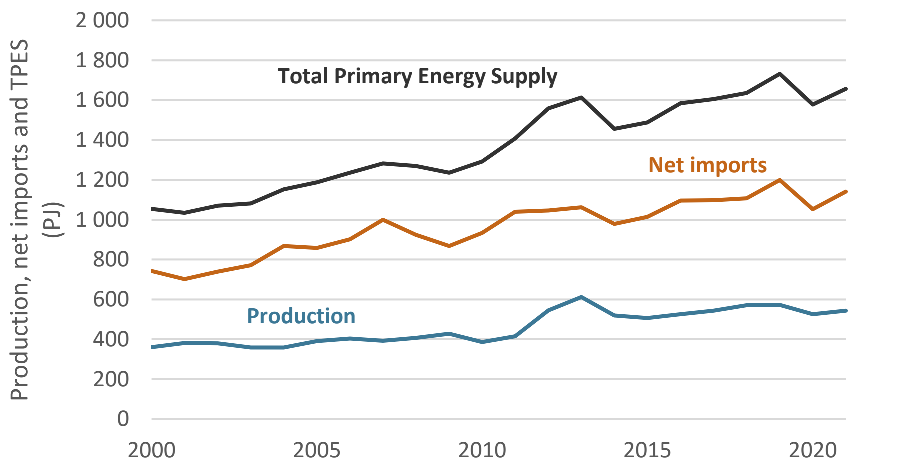
Despite the lack of fossil fuel resources, Chile has an enormous potential for renewable energy (Chile has 2.3 TW of renewable energy reserve from the 30 GW installed by 2023) that it is trying to develop in accordance with its energy policy. In that direction, the Chilean National Energy Commission awarded 777 GWh/year of renewable energy to supply electricity to the economy's electricity system, starting in 2027.

Energy Supply and Consumption

Energy supply

The recovery of the Chilean economy from the impact of the COVID-19 pandemic drove an increase in energy demand during 2021. Chile's total energy supply was 1 656 PJ in 2021 representing a 4.9% increase from the previous year. Most of the energy supply, 68.9%, was met through fuel imports, while the remainder was sourced from domestic energy production. As consequence, Chile is reliant on importing most of fuels, mainly fossil fuels, to meet its energy needs.

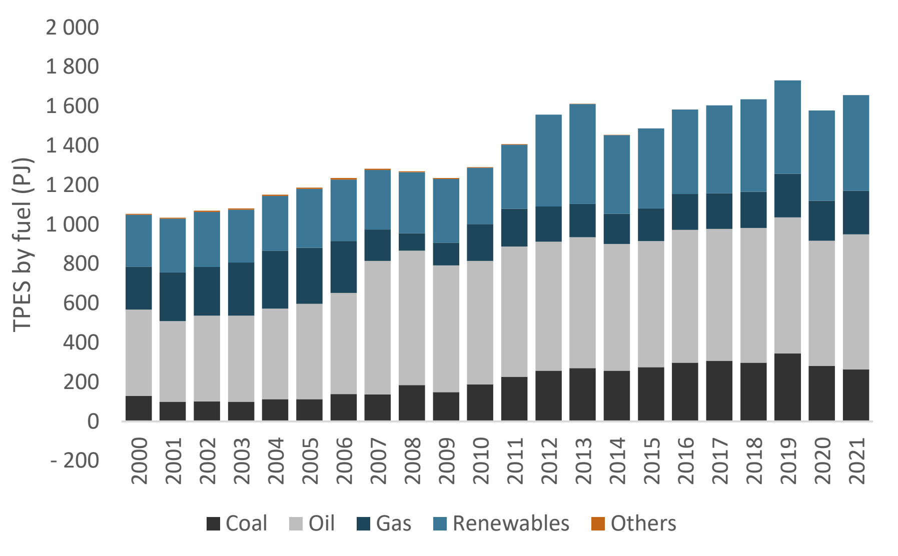
Figure 1: Chile's energy supply, production, and net imports (PJ), 2000 to 2021



Source: EGEDA (2023)

In 2021, total primary energy production was 543 PJ, 3.5% higher than the 2020 level, mostly due to an increase of renewable energy production. Net imports saw an 8.3% increase from the previous year reaching 1 140 PJ, mostly driven by an increase in oil and gas imports.

Figure 2: Chile's energy supply by fuel (PJ), 2000 to 2021

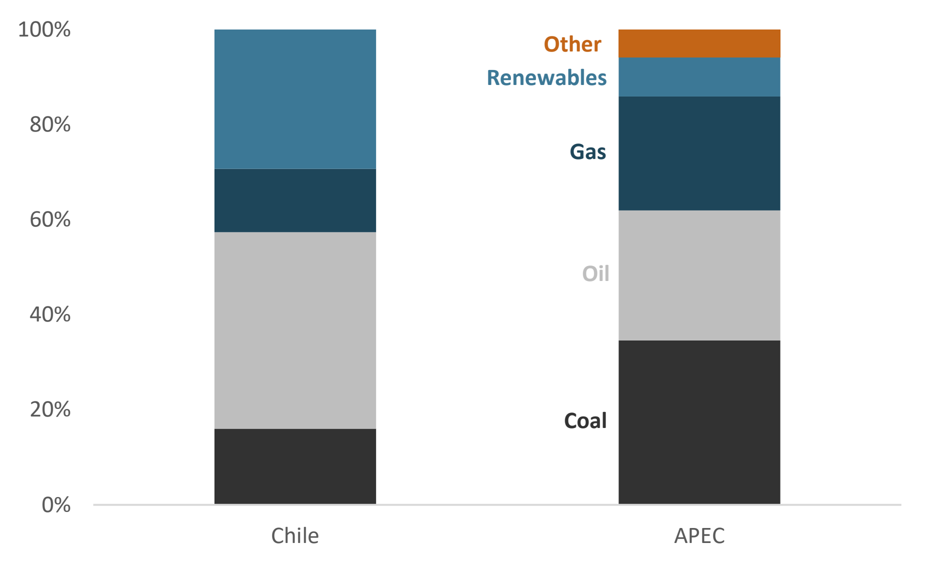


Source: EGEDA (2023)

When analysed by fuel type, total energy supply of coal decreased by 6%, reaching 265 PJ in 2021. This reduction follows the declining trend that began in 2019, aligning with the Coal Phase-Out Plan aimed at closing all of Chile's coal-fired power plants by 2040.

Additionally, oil supply was 685 PJ, a 7.7% increase from the 2020 level, and gas supply reached 221 PJ, a 9.4% increase. Given the limited production of oil and gas in Chile, it can be considered that these increases are met through imports. On the other hand, renewable energy supply has increased by 5.8%, reaching 485 PJ in 2021.

Figure 3: Energy supply mix – Chile and APEC, 2021



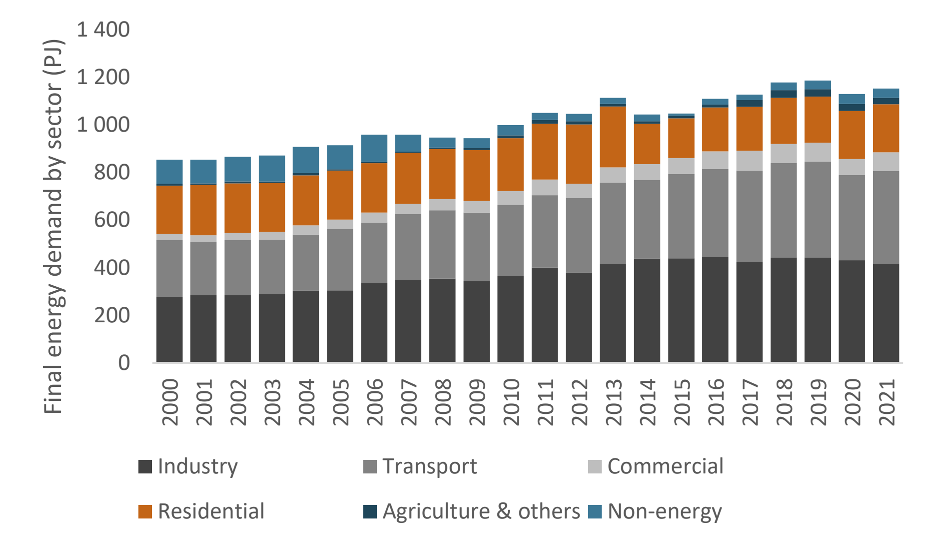
Source: EGEDA (2023)

The share of renewable energy in the total energy supply in Chile was much higher (29.3%) than in APEC (4.3%) during 2021. Oil share is also higher in Chile (41.4%) than in APEC (27.3%). Another important difference is observed in coal. Coal represented 16.0% of the energy supply in Chile while representing 34.6% in APEC.

Total final consumption

Due to the recovery of the economy post pandemic, an increase of total energy consumption was expected for 2021. Transport experienced energy consumption growth at 9.3%, reaching up to 390 PJ in 2021 from 357 PJ in the previous year. Commercial and public sector had a growth of 15.7%, rising from 68 PJ in 2020 to 78 PJ 2021. In contrast, industry energy consumption fell 3.7%, a consequence of the impact of the global economic crisis that affected Chilean products, mainly from mining.

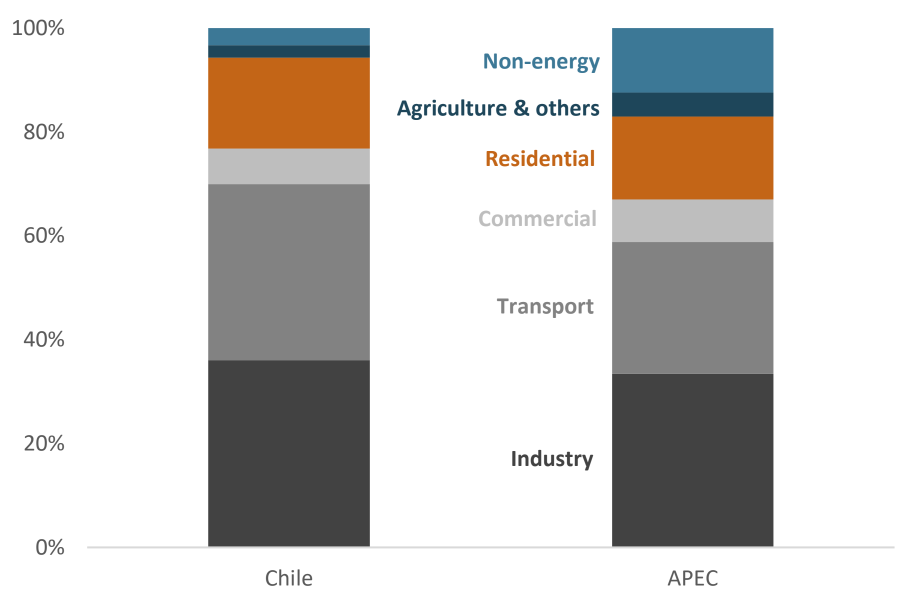
Figure 4: Chile's final consumption by sector (PJ), 2000 to 2021



Source: EGEDA (2023)

Due to diverse rates of growth in energy fuel consumptions across different sectors, there has been a shift of shares of each sector, especially industry and commercial, in 2021 in comparison to 2020. Industry was the biggest fuel consumer at 36.1%, followed by transportation at 33.9%, and residential consumption at 17.5%. When compared to Chile's energy fuel consumption mix, APEC's transport sector showed a lower share at 25.4%. Other relevant difference was in the share of non-energy sector that includes the use of energy products as raw materials for the manufacture of products. This sector represented 3.3% in Chile and 12.4% in APEC in 2020.

Figure 5: Final consumption by sector, Chile and APEC, 2021



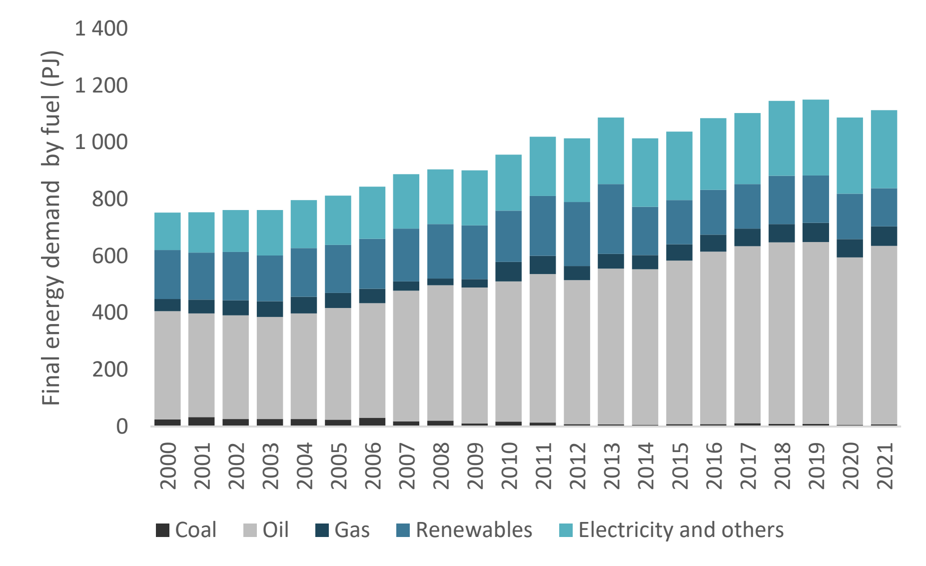
Source: EGEDA (2023)

Final energy demand

Final energy demand grew 2.4%, reaching 1 114 PJ in 2021, although it did not reach the levels of demand observed in 2019 at 1 150 PJ. The biggest demand growths were observed in coal at 15.6% going from 6 PJ in 2020 to 7 PJ, in 2021 gas at 7.2% going from 64 PJ to 68 PJ, and oil and oil products at 6.7% going from 589 PJ to 628 PJ. Renewable energy demand decreased 15.7% going from 160 PJ to 135 PJ.

It is notable that the decreasing trend of coal supply, due to the decreasing use of coal in commercial power generation in energy transformation, is opposite to the increasing trend of final coal energy demand. On the other hand, the opposite case is observed in the trends of renewable energy. In this case, the decrease of final renewable energy demand was due to a reduction of solid biomass in most of the sectors including industry as well as the reduction of hydropower.

Figure 6: Chile's final energy demand by fuel (PJ), 2000 to 2021



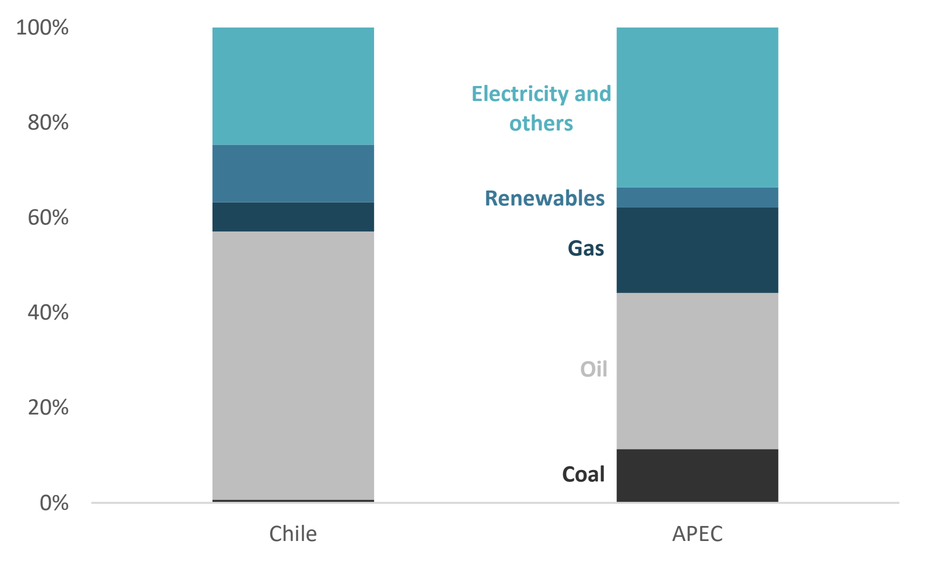
Source: EGEDA (2023)

Note: Does not include non-energy sector consumption of energy products.

Chile's final energy demand fuel share did not change drastically if compared with 2020; more than half of the final energy demand, 56.5%, is satisfied by oil and oil products. Coal satisfied 0.6% of final energy demand; renewables 12.1%; and natural gas 6.1%.

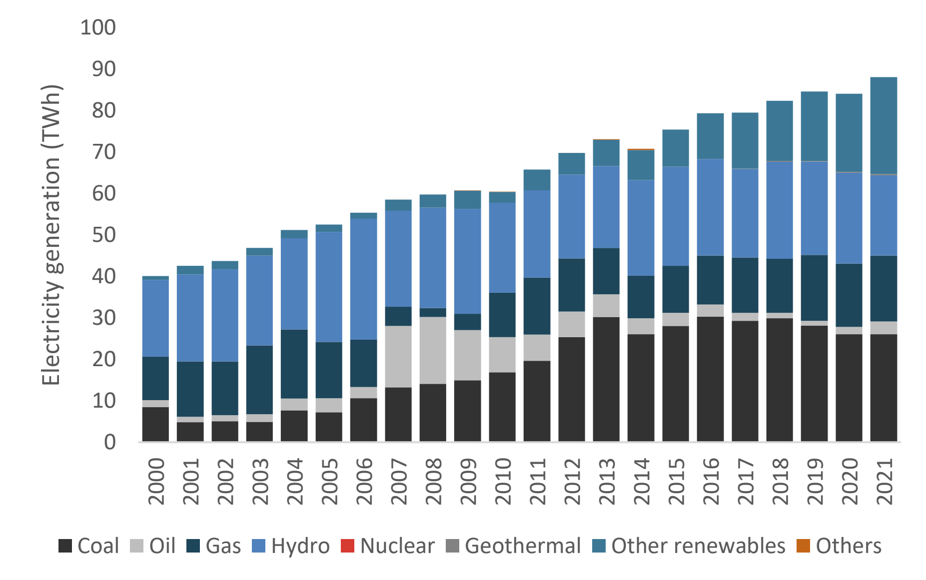
Additionally, electricity represented 24.7% of the final energy demand, slightly below the 33.6% of final energy demand observed in APEC.

Figure 7: Final energy demand fuel share, Chile and APEC, 2021



Source: EGEDA (2023)

Figure 8: Chile's electricity generation by fuel, 2000 to 2021



Source: EGEDA (2023)

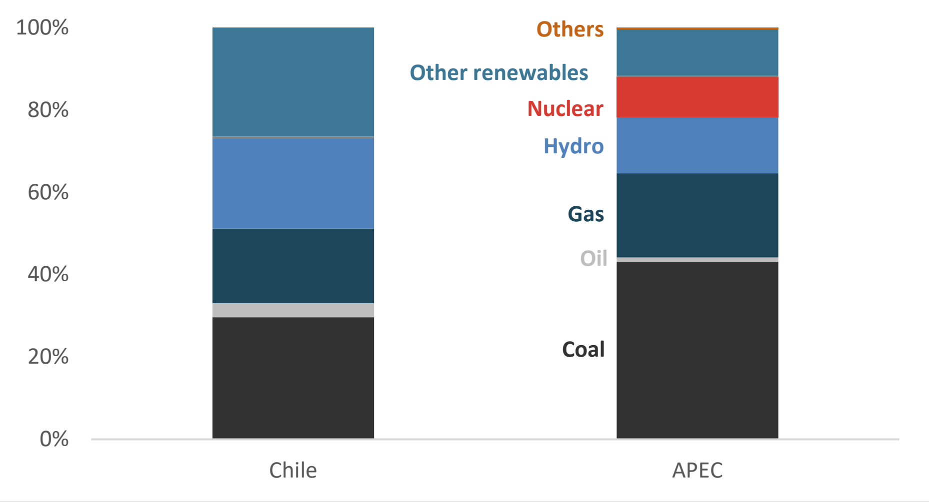
Transformation

Power sector

Chile has an ambitious goal of achieving 70% of renewable energy in the electricity fuel mix by 2030. In 2021, electricity generation fuel mix comprised coal at 29.6%, gas at 18.1%, oil at 3.5%, hydro at 22.0%, geothermal at 0.4%, and other renewables at 26.5%.

Following the calendar of the Coal Phase-Out Plan, eleven coal-fuelled units of electric generation power plants were retired between 2019 and April 2024. Additionally, four units are expected to close, and another five are expected to switch fuels by 2025. To achieve the plan's objectives, the remaining ten units will be closed by 2040. However, following these objectives will be challenging over the coming years because the retirement of coal-fuelled units must not compromise grid stability and must adhere to operational grid requirements.

Figure 9: Electricity generation fuel share, Chile and APEC, 2021



Source: EGEDA (2023)

Electricity generation, that includes power generation from main electricity producers and auto producers, grew by 4.8%, reaching 88 TWh in 2021 from 84 TWh in 2020. However, hydropower plant generation was reduced by 11.5% due to severe droughts that Chile suffered in 2021, going from 21.9 TWh in 2020 to 19.3 TWh. To compensate for the decline in hydro generation, other types of power plants increased production. Oil-fuelled power generation rose by 76.8%, going from 1.7 TWh in 2020 to 3.1 TWh in 2021. Geothermal power generation rose by 50%, increasing from 0.2 TWh in 2020 to 0.3 TWh in 2021. Other renewable energy power plant generation, which includes biomass, solar, wind and others renewable, increased by 24%, going from 19 TWh in 2020 to 23 TWh in 2021. Gas-based power generation increased by 4%, going from 15 TWh in 2020 to almost 16 TWh in 2021. Finally, coal-fuelled power generation was nearly maintained at the level observed in 2020 at 26 TWh.

The combined share of hydro and other renewables represented 49% of the Chilean electricity generation fuel share in 2021, where 26.5% represented just the share of geothermal, biomass, wind, and solar energy. In that regard, Chile's electricity generation has a lower carbon intensity than APEC does because in APEC all renewables represent 25.2% of electricity generation.

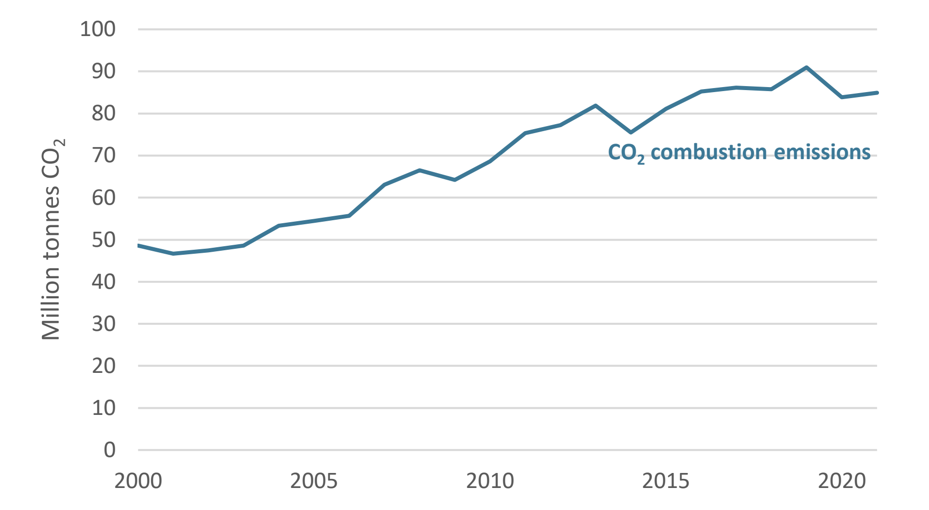
Energy Transition

In addition to the policies mentioned above and the efforts to have the Energy Transition Bill approved, the Ministry of Energy and the Ministry of Environment have initiated the development of a Chilean decarbonisation roadmap with the objective of accelerating decarbonisation and making Chile carbon neutral by 2050 or earlier.

Emissions

Emissions increased 1.3%, reaching 84 941 kt-CO_2 in 2021. This can be explained by the increase of energy consumption due to economic recovery after the pandemic. However, it is noteworthy that emissions have not reached the level observed between 2016 and 2019.

Figure 10: Chile's CO_2 combustion emissions (million tonnes), 2000 to 2021



Source: EGEDA (2023)

Energy security

To contribute to energy security, Chile and Argentina signed an agreement on energy collaboration that includes Argentina supplying 300 000 m^3/day of gas to Chile from June 2022 to September 2023. It is expected that this supply might increase to 4 000 000 m^3/day in the future.

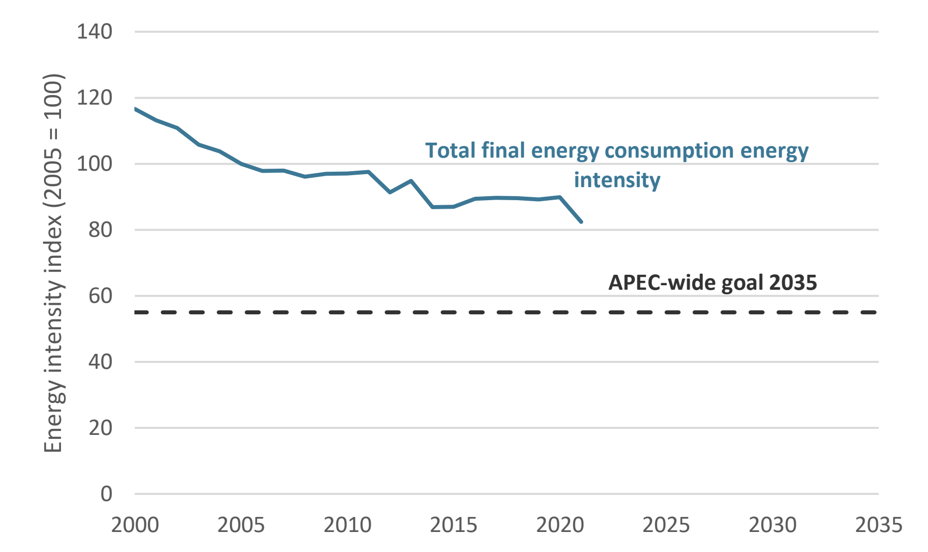
APEC Energy Goals

There are two energy-related objectives that APEC member economies have agreed to meet as a collective: to improve energy intensity and to double the share of modern renewables.

Energy intensity goal

In 2011, APEC member economies agreed to increase their target to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

Figure 11: Chile's total final energy consumption intensity index, 2000 to 2021 (2005 = 100)



Source: EGEDA (2023)

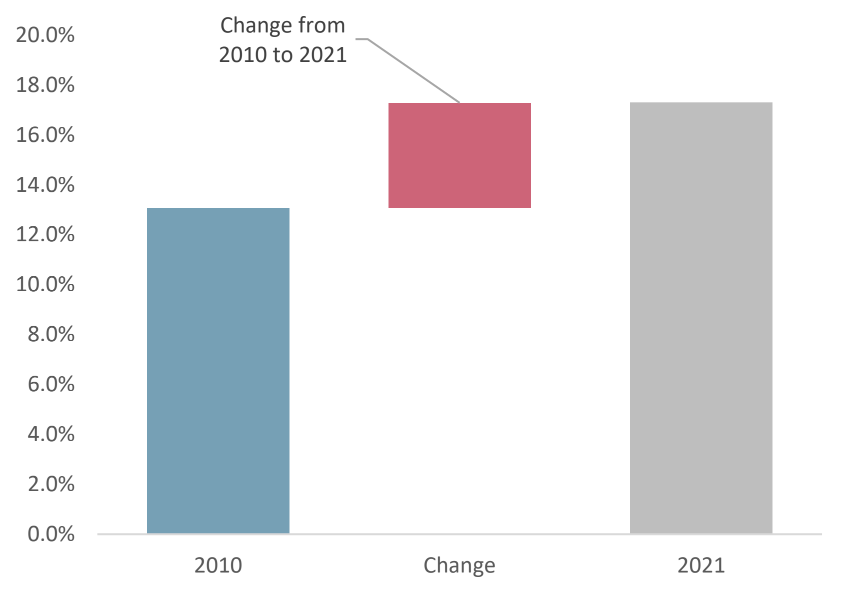
APEC is on track to achieve this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

Chilean energy intensity decreased 8% in 2021, the lowest recorded since this indicator has been monitored. Given that energy intensity is calculated as the ratio of total energy consumption over GDP, this decline was mainly driven by the GDP growth observed in 2021, a growth that was the result of economy reactivation measures.

Doubling of renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period 2010 to 2030. There is no economy-level goal for individual member economies, but improvements by individual economies will contribute to the doubling goal.

Figure 12: Chile's modern renewable energy share, 2010 and 2021

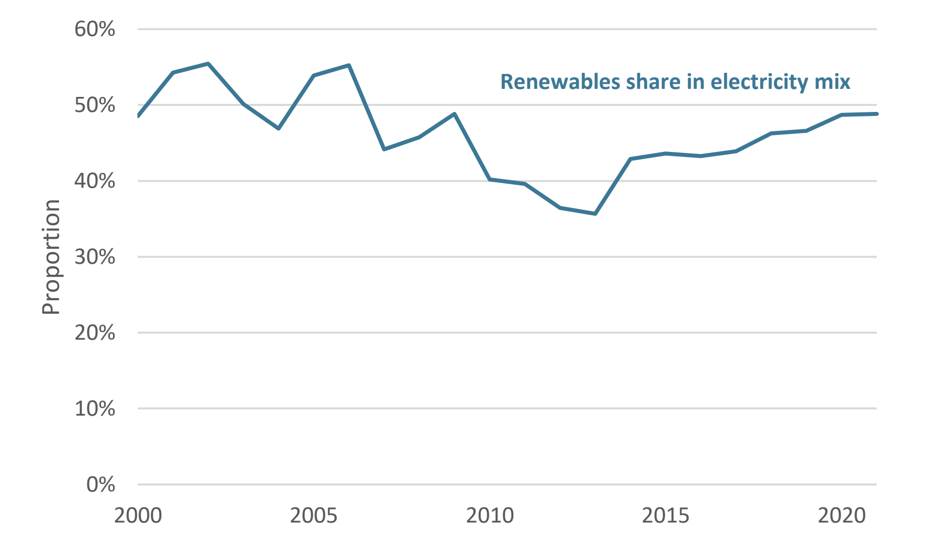


Source: EGEDA (2023)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources in distributed generation.

Chile has increased its share of modern renewables in total final energy consumption it does not include traditional biomass, in total final energy consumption, which went from 13.1% in 2010 to 17.3% in 2021.

Figure 13: Chile's renewable generation share, 2000 to 2021



Source: EGEDA (2022)

Chile maintained its renewable generation share in 2021 at 49%. The production of auto producers was considered in the estimation of this indicator.The goals established in the updated National Energy Policy 2050 suggest that Chile will see a rapid increase in its renewable generation share.

Energy Policy

Energy policy	Details	Reference
Hydrogen Strategy for Chile	The design and implementation of a development policy for hydrogen would allow the displacement of fossil fuels on a large scale in the power generation, transport, and industry sectors.	Ministry of Energy
Energy Efficiency Law	The law 21.305 outlines a long-term energy efficiency plan, to be updated every five years. The new law regulates the management of energy by large consumers and delivers information to homebuyers regarding housing energy requirements.	Ministry of Energy
Framework Law on Climate Change	In June 2022, the Chilean Government published the Law 21.455, the Framework Law on Climate Change, which establishes the goal of reaching carbon neutrality by 2050.	Ministry of Environment
Coal-fired power plant shutdown	A total of 3.63 GW of coal-fired power plants will shut down before 2025, which is equivalent to 65% of the total coal electricity capacity. Operation of coal power plants will cease by 2040 at the latest.	Ministry of Energy
National electromobility strategy	This strategy outlines actions to be taken in the short and medium terms to meet the government's goal of having 40% of private vehicles and 100% of public transport fleets powered by electricity by 2040. By the end of 2050, 58% of privately owned vehicles will be powered by electricity.	Ministry of Energy
Long-term National Energy Planning (2023-2027)	The Ministry of Energy release the preliminary result on 2021, and it´s expected to close in July 2024. The main objectives of this work are to present scenarios to estimate the future energy demand, to be used as input information for the electric transmission planning and to function as a tool that helps policymakers develop energy policies. The last report that updated the background information for the long-term economy energy planning was released in 2023.	Ministry of Energy
Energy Agenda 2022-2026	The new government of Chile launched this energy roadmap. The document emphasises equitable access to quality energy and the development of a clean, secure and resilient energy system.	Ministry of Energy
Updated National Energy Policy 2050	This update increased the goal of renewable energy in electricity generation to 80% by 2030 and aims to achieve 100% zero-emission energy by 2050. Additionally, there is a goal of 100% access to electricity by 2030, established goals for hydrogen and electromobility, and the role of Chile as a green hydrogen and derivates exporter by 2030.	Ministry of Energy

Energy policy	Details	Reference
Law 21.499 that regulates production and trade of solid fuels	This law declares wood fuel, pellets, briquettes, charcoal and agricultural waste as fuels and establishes requirements and standards for commercialisation. This law is intended to improve air quality and protect the health and safety of people who live in areas where these fuels are used.	Ministry of Energy
Law 21.505 to promote electricity storage and electromobility	This Law will expand renewables in the electricity mix by promoting storage technologies, provide greater security to the grid, and help the process of decarbonisation. The law also promotes electric mobility through economic incentives.	Ministry of Energy
Initial Agenda for a Second Time of the Energy Transition	In April 2023, the Ministry of Energy launched the Initial Agenda for a Second Time of the Energy Transition, with the aim of taking actions for an accelerated decarbonisation of the electricity sector	Ministry of Energy
Decarbonization Plan 2030	This plan aims to facilitate the decarbonization of the electricity grid by 2030	Chile lanzó un nuevo Plan de Descarbonización con miras al 2030 - Energía Estratégica (energiaestrategica.com)
Energy Transition Bill for approval at the Senate	The Bill is considered key to promoting investment in energy storage projects that will strengthen the transmission network and allow the integration of variable renewable energy.	Senado aprobó en lo general el proyecto de ley de Transición Energética de Chile - Energía Estratégica (energiaestrategica.com)

Notable Energy Developments

Energy development	Details	Reference
Launch of roadmap for electromobility	This document presents concrete measures to expand the utilisation of electromobility in the short and medium term.	Ministry de Energy
Launch of Initial Agenda for a Second Time of the Energy Transition,	This agenda presents 10 measures in four areas to accelerate the decarbonisation of the power sector: promotion of energy storage, mitigation of suppliers’ risks, operational flexibility, policy and regulatory actions.	Ministry de Energy
HIF Global initiated commercial exports of synthetic fuels to Europe	Haru Oni demonstration exported 24 600 litres of synthetic gasoline to the United Kingdom. The synthetic gasoline is manufactured with domestically produced green hydrogen.	Ministry de Energy
Draft of Green Hydrogen Action Plan	The draft of the Green Hydrogen Action Plan was presented for public consultation. Revision will finalised by the first trimester of 2024.	Ministry de Energy

Useful Links

Government Institutions

Chilean National Energy Commission (CNE) – www.cne.cl

Renewable Energy National Register(RENOVA) – https://www.coordinador.cl/renova/

Energía Abierta Beta – www.energiaabierta.cl

Fuel Prices in Refuelling Stations Information System – http://www.bencinaenlinea.cl/web2/

Chilean Energy Sustainability Agency (ASE) – www.agenciaSE.org

National Electric Coordinator – www.coordinador.cl

Government of Chile – www.gobiernodechile.cl

Ministry of Economy, Development and Reconstruction – www.economia.cl

Ministry of Energy – www.energia.gob.cl

Ministry of the Environment – www.mma.gob.cl

Nuclear Energy Chilean Commission (CCHEN) – www.cchen.cl

National Institute of Statistics (INE) – www.ine.cl

National Oil Company (ENAP) – www.enap.cl Superintendence of Electricity and Fuel (SEC) – www.sec.cl

Energy Associations

Chilean Association of Power Generators – www.generadoras.cl

Chilean Association for Renewable Energies and Storage ACERA AG – www.acera.cl

Chilean Association of Electric Companies – www.electricas.cl

Chilean Association of Solar Energy – www.acesol.cl

Chilean Association for Small and Mid-hydro Power Plants (APEMEC) – www.apemec.cl

Chilean Geothermal Energy Association A.G. (ACHEGEO A.G.) - www.achegeo.cl

Chilean Hydrogen Association (H2 Chile) - https://h2chile.cl/

Association of Producers of Green Hydrogen and its Derivatives in Magallanes - www.h2vmagallanes.cl/

Association of Chilean Transmitters - https://transmisoras.cl/

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Ministerio de Energía (2023) *Plan de Accion del Hidrógeno Verde 2023-2030.* https://energia.gob.cl/consultas-publicas/plan-de-accion-de-hidrogeno-verde-2023-2030

Claudia Saravia (2021*) Déficit de hasta 80% de lluvias pone a 2021 como el cuarto año más seco de la historia de Chile*. Diario Financiero. https://www.df.cl/empresas/industria/deficit-de-hasta-80-de-lluvias-pone-a-2021-como-el-cuarto-ano-mas-seco

China

Introduction

China is relatively rich in energy resources, particularly coal. According to the 2023 BP statistics, China's proven coal reserves were more than 143 billion tonnes, proven oil reserves were 3.5 billion tonnes, and proven natural gas reserves were 8.4 trillion cubic metres. In addition, China has a hydropower capacity ranging between 400-700 GW, more than the other economies within APEC (International Hydropower Association, 2022).

In 2023, according to a National Bureau of Statistics of China update, China's crude coal production (from industrial enterprises above designated scale) achieved 4.66 billion tonnes, 2.9% more than the previous year. In addition, crude oil annual production reached 208 million tonnes, and gas annual production rose to 230 billion cubic metres, 5.8% more than the previous year, thereby maintaining a stable growth rate of around 10 billion cubic metres annually for seven consecutive years. Also, the first round of large wind and photovoltaic bases in the desert, Gobi and barren areas (45 GW) were completed and connected in 2023, followed by second and third rounds (more than 50 GW). All renewable power capacities amount to more than 1 450 GW, more than 50% of overall power capacity, surpassing thermal power for the first time.

Table 1: China's macroeconomic data and energy reserves in 2020

Key data [a, b]		**Energy reserves** [c, d]	
Area (million km^2)	9.6	Oil (billion tonnes)	3.5
Population (million)	1 412	Gas (trillion cubic meters)	8.4
GDP (2017 USD billion PPP)	24939	Coal (billion tonnes)	143
GDP per capita (2017 USD PPP)	17658	Uranium (kilotonnes U < USD 130/kgU)	119

Source: a UN (2023); b World Bank (2023); c BP (2023); d UN (2023)

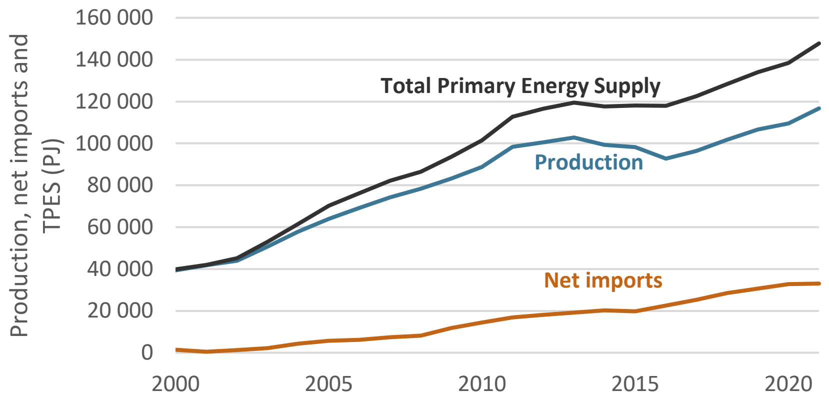
Energy Supply and Consumption

China has maintained relatively steady GDP growth and has become the world's largest energy producer and consumer, forming an energy supply system through the comprehensive development of coal, electricity, oil, natural gas and renewable energy.

Total primary energy supply

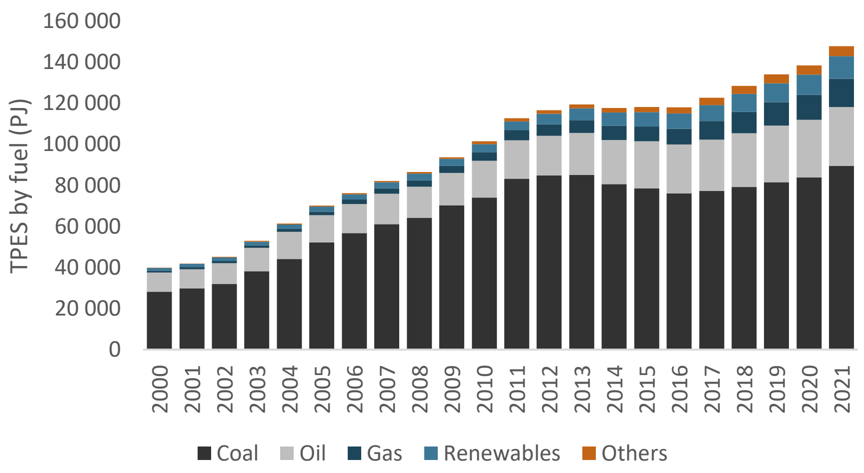
In 2021, China's total primary energy supply increased by 6.8%, reaching 147 771 PJ. Energy production increased by 6.6%, while net imports increased by 0.8%. The net imports share of energy supply decreased from 23.7% in 2019 to 22.4% in 2021 (Figure 1).

Figure 1: China's energy supply, production, and net imports (PJ), 2000 to 2021



Source: EGEDA (2023)

Figure 2: China's energy supply by fuel (PJ), 2000 to 2021



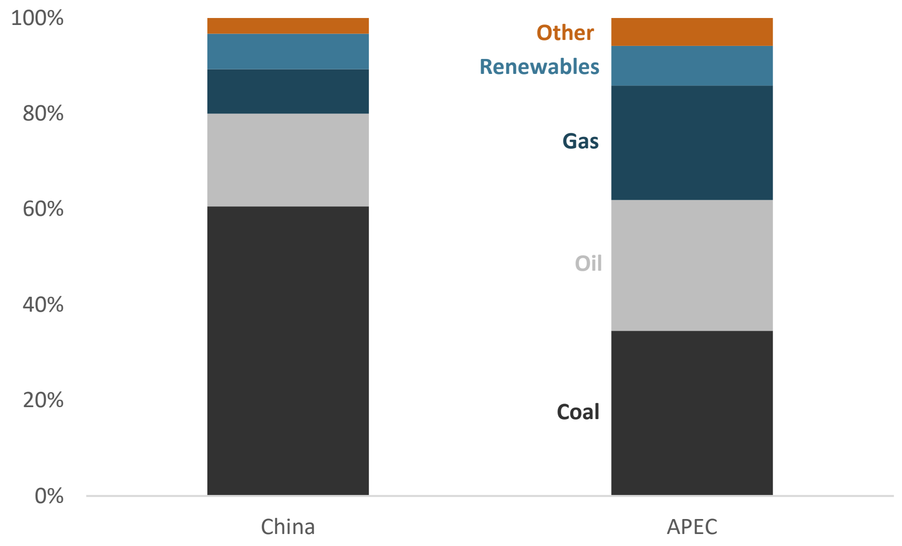
Source: EGEDA (2023)

From the macro view, coal and oil's share in energy supply have maintained their decreasing trend and declined to 60.6% and 19.4% in 2021. In contrast, the share of gas and renewables has increased from 8.8% and 7.1% to 9.3% and 7.4%, respectively. Overall, the structure of China's energy mix is moving away from the most carbon-intensive fossil fuels and on to cleaner fuel types (Figure 2).

Since 2000, the total consumption has gone through three different stages. The period 2000-2011 was the high-speed stage, in which the average annual consumption growth rate remained at around 10%. The period 2012-2016 was the plateau stage, where the average annual consumption growth rate was around 1%. Simultaneously, in 2012, China entered a "New Era" by shifting its policy to "high-quality development", focusing more on environmental protection and commitment to building a community with a shared future for humankind. The period from 2017 to the present has been the low-speed stage, where the total primary energy supply (TPES) grew at a low rate of around 4%. However, with GDP growing at a higher speed of 8.1% in 2021, the fastest since 2011, the annual increase rate in TPES reached 6.8% (Figure 1, 2).

China's large coal reserves, price sensitivity from the demand side, and uncertainties about the oil and gas supply chain contributed to the fact that the share of coal in China's energy supply is much higher than that of other APEC members. However, this share has decreased as gas and renewables begin to account for a more substantial share. China's rapid development of renewable energy in recent years has ensured that China's share of renewables was comparable to the APEC region in 2021 (Figure 3).

Figure 3: Energy supply mix – China and APEC, 2021



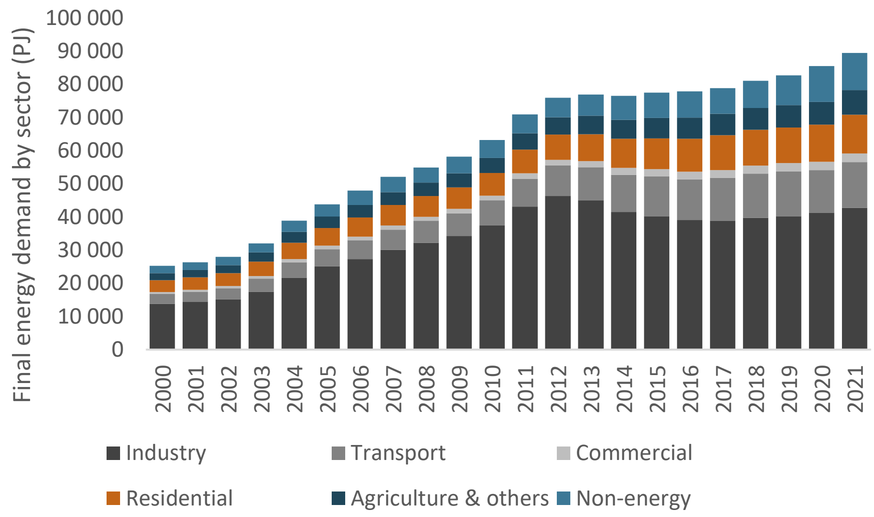
Source: EGEDA (2023)

Total final consumption

China's final consumption increased by 4.7% in 2021, with industry accounting for 48% of the total, followed by transport (15%) and residential (13%). China's industrial sector is the largest in the world and currently produces large volumes of steel, cement, aluminium and many manufactured products. Industrial energy consumption more than doubled from 2000 to 2021. Likely due to China's COVID-19 pandemic control, China's annual foreign trade in 2021 hit a new high, exceeding USD 6 trillion for the first time, which may be one of the reasons for its robust total final consumption increase.

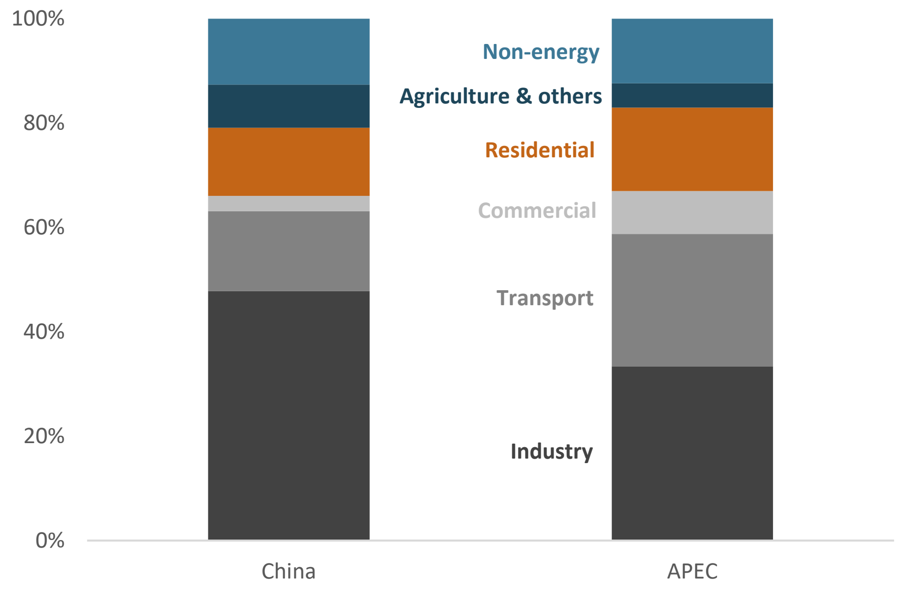
China's transport sector has the second-largest share and kept growing from 2000 to 2019. After experiencing an unprecedented fall caused by the COVID-19 pandemic in 2020, the transport sector showed a vigorous recovery increase of 6.8% in the next year. The consumption of the residential sector continuously grew, partially elevated by the implementation of the Clean Winter Heating Plan in Northern China (2017-2021), which helped tens of millions of families shift from scattered coal or biomass stove heating to gas or electricity heating.

Figure 4: China's final consumption by sector (PJ), 2000 to 2021



Source: EGEDA (2023)

Figure 5: Final consumption by sector, China and APEC, 2021



Source: EGEDA (2023)

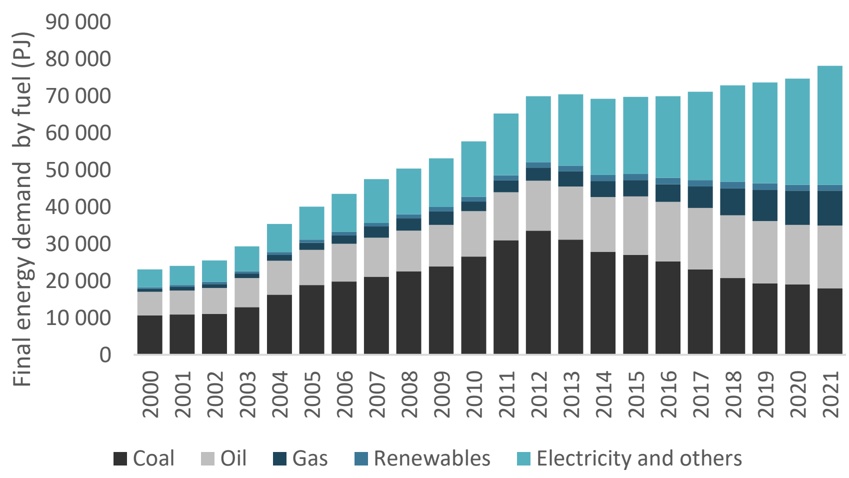
China's industrial energy consumption accounts for 18% of the final consumption for the entire APEC region. A continued transition to a more service-based economy will be important for China to reduce the industry's final energy consumption. However, it is important to recognise that China remains an important source of industrial products for almost all global economies due to its large scale and cheap prices. A dramatic decline in China's industrial sector may initiate an increase in industrial activity in other economies as well as a rise in price of some industrial products.

Final energy demand

From 2000 to 2021, the fuel composition of the final energy demand changed significantly. The most prominent change is that of coal, which increased from just above 10 000 PJ in 2000 to a peak of about 33 554 PJ in 2012. After 2012, coal consumption declined by more than 45% until 2021, and its share in final energy demand was 23% in 2021, down from 48% when it peaked in 2012. In contrast, the share of electricity and others had increased by 2021, reaching 41%, while the share of renewables remained almost stable at 2%.

According to the updated Nationally Determined Commitment (NDC) submitted in 2022 and the 14th Five-Year Plan (FYP), China will strictly limit the increase in coal consumption and phase it down in the decades ahead. The 14th FYP set the targets for 2025: the share of non-fossil fuels in final energy consumption will increase to 20%, CO_2 emissions intensity will decrease by 18%, domestic oil production will keep at 200 million tonnes and natural gas will produce more than 230 billion cubic metres.

Figure 6: China's final energy demand by fuel (PJ), 2000 to 2021

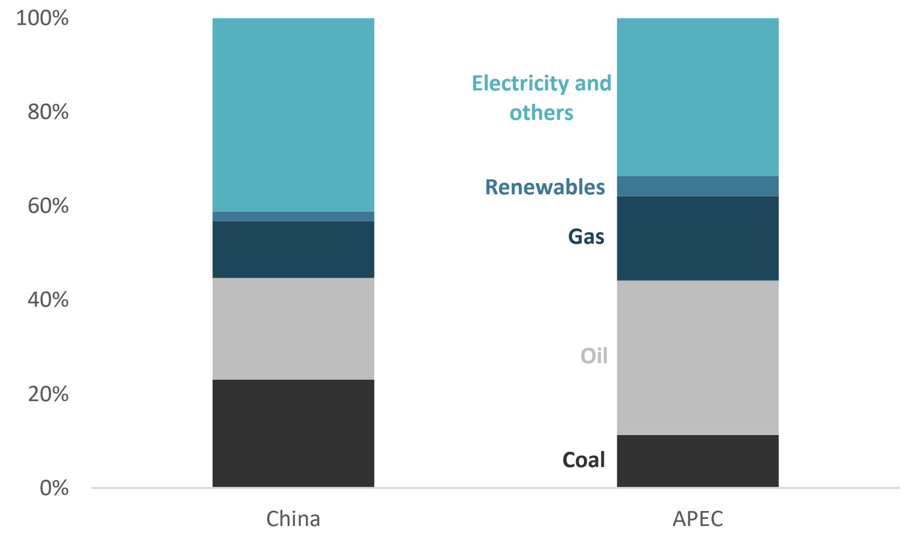


Source: EGEDA (2023)

Note: Does not include non-energy sector consumption of energy products.

Although demand for coal and its share has decreased from the record high in 2012, China's share of coal in 2021 (23%) was still relatively high (Figure 7). For the entire APEC region, coal's share of final energy consumption was 11%.

Figure 7: Final energy consumption fuel share, China and APEC, 2021



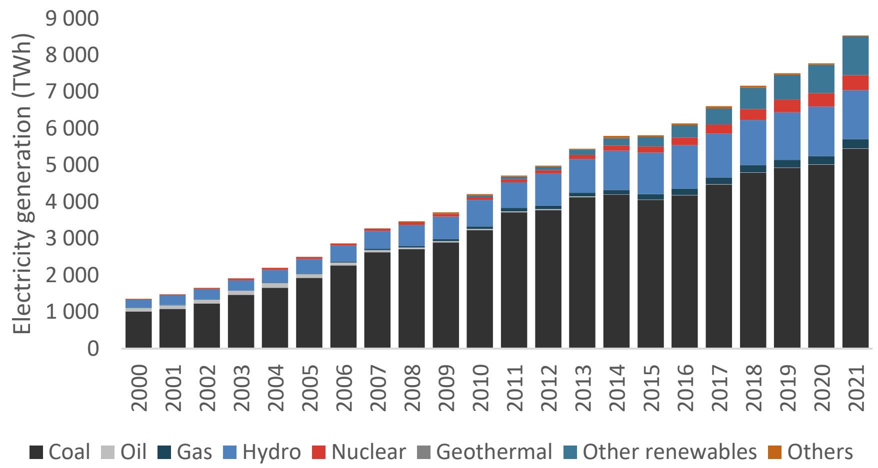
Source: EGEDA (2023)

Transformation

Power sector

Power generation has been an important component fuelling China's economic growth and has increased more than five-fold since 2000. China's power sector remains heavily reliant on coal, with 64% of China's electricity generated from coal-fired power plants in 2021. However, this share represents a decline from 75% in 2000 (EGEDA, 2023). From 2000 until 2021, the proportion of non-fossil energy in electricity increased from 18% to 33%. Within this increase, the share of nuclear generation had increased three times (Figure 8).

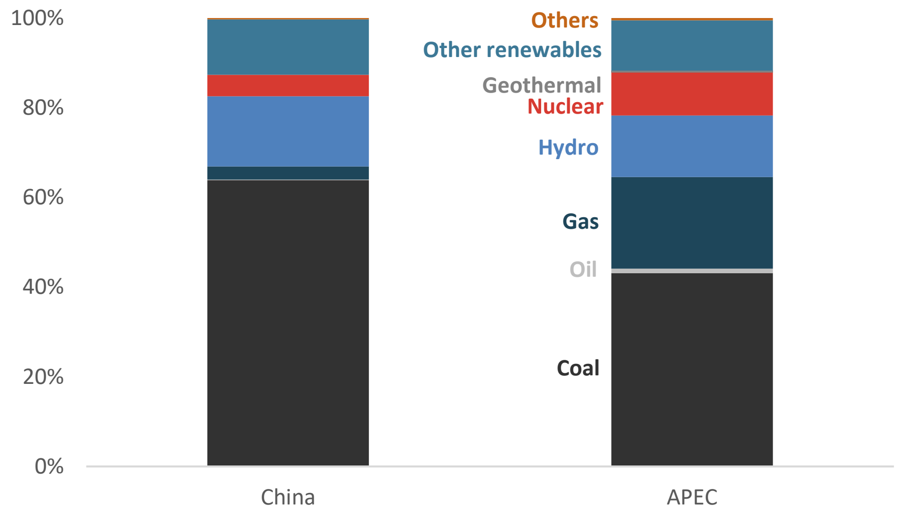
Figure 8: China's electricity generation by fuel, 2000 to 2021



Source: EGEDA (2023)

China is stringently curbing coal-powered projects and has committed to no longer pursuing new coal-fired power projects abroad. At the same time, China has committed to establishing a new power system with new energy sources as the main body. The construction of large wind and photovoltaic bases in the desert, Gobi, and barren areas has been initiated and accelerated. Hydropower and pumped storage power stations will also be developed, depending on regional feasibility. As for nuclear power, China plans to make advances in an orderly and safe manner.

Figure 9: Electricity generation fuel share, China and APEC, 2021



Source: EGEDA (2023)

Secure supply combined with favourable prices has meant that the proportion of coal-fired power in China is higher than that of APEC, while the share of gas generation is less than that of APEC (Figure 9).

In 2021, China's power generation reached 8 534 TWh. Thermal power and hydropower reached 5 707 TWh and 1 339 TWh, respectively (EGEDA, 2023), each ranking as first in the world. Nuclear power generation reached 408 TWh, ranking second behind the United States. (EGEDA, 2023; BP, 2023).

Energy Transition

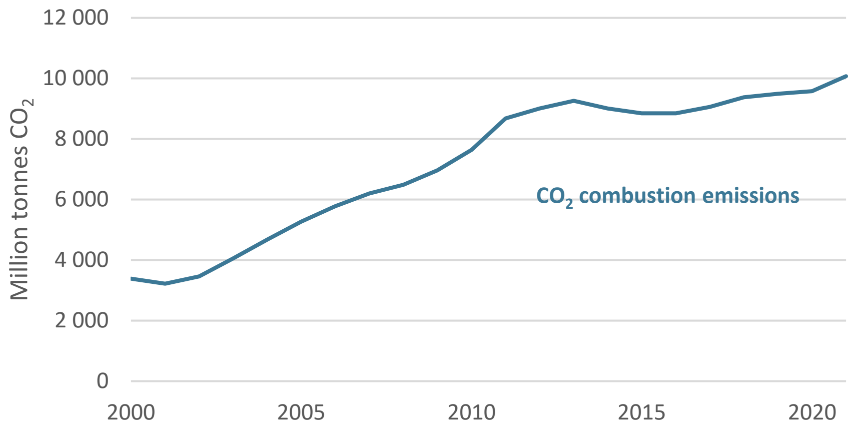
Emissions

For carbon dioxide peaking and carbon neutrality, China has put in place a "1+N" policy framework. "1" means the guiding idea and the top-level design for the above goals, consisting of the two documents issued in 2021: *Working Guidance for Carbon Dioxide Peaking and Carbon Neutrality in Full and Faithful Implementation of the New Development Philosophy* and *The Action Plan for Carbon Dioxide Peaking before 2030*, which clearly articulate the schedules, road maps and working procedures, whereas the "N" is the implementation schemes in key areas and sectors, such as energy, industry, transport, agriculture and rural areas, etc. Meanwhile, all provinces have also implemented their own schemes within their respective jurisdictions.

As the largest industrial economy, China continues to deepen its supply-side structural reforms, aiming to transform the prevailing development model characterised by excessive reliance on increased resource consumption, extensive expansion based on scale, and dependence on high-energy and high-emission industries. Policies such as capacity replacement are implemented in industries with high resource consumption and significant carbon emissions, such as steel, cement, and electrolytic aluminium. During the period of the 13th FYP (2016-2020), cumulative exits from excess steel capacity exceeded 150 million tonnes, and excess cement capacity exceeded 300 million tonnes. Illegitimate strip steel production was entirely eliminated, and outdated capacities in industries such as electrolytic aluminium and cement were largely eradicated.

To optimise the structure of transportation, China has accelerated the construction of special railway lines, promoted the shift of freight transport from road to railways and waterways, and encouraged multi-modal transport. In 2021, the railway and waterway freight volume accounted for 25% of the total in China, an increase of 3.9% over 2012. At the same time, China has vigorously promoted the use of new-energy vehicles in public transport, taxi services, environmental sanitation, logistics, distribution, civil aviation, airports, and Party and government institutions. By the end of 2021, the number of China's registered new-energy vehicles had reached 7.8 million, accounting for about half of the global aggregate (China's Economy Council Information Office).

Figure 10: China CO_2 combustion emissions (million tonnes), 2000 to 2021



Source: EGEDA (2023)

APEC Energy Goals

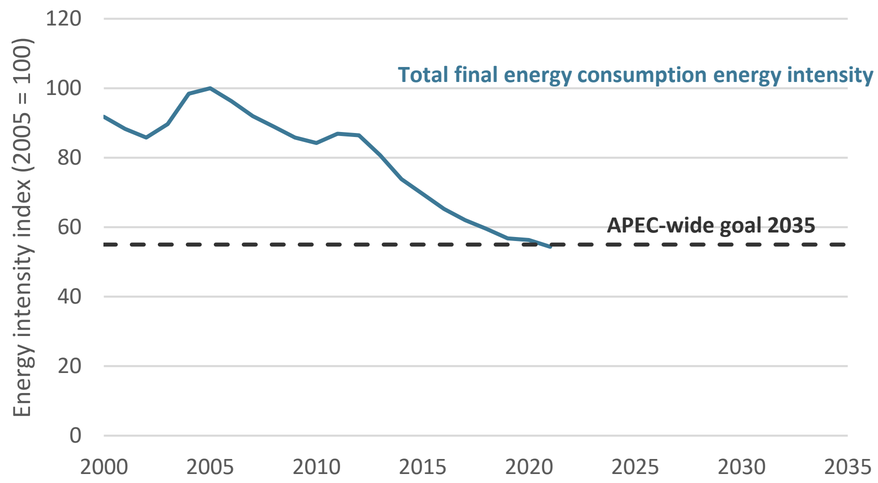
There are two energy-related objectives that APEC member economies have agreed to meet as a collective: to improve energy intensity and to double the share of modern renewables.

Energy intensity goal

Energy intensity in the APEC region has been continuously improving. China is contributing to APEC's aspirational goal of a 45% energy intensity reduction from the 2005 level by 2035. Since 2012, the growth rate of China's energy consumption has slowed significantly, and the 'dual control' of energy intensity and total energy consumption has been included in China's 14th FYP, in which China aims to achieve a 13% reduction in energy consumption per unit of GDP below 2020 levels by 2025.

In 2021, China's total final energy consumption (excluding non-energy sources) energy intensity declined by 46% relative to 2005, already reaching the set target (Figure 11).

Figure 11: China's total final energy consumption intensity index, 2000 to 2021 (2005 = 100)

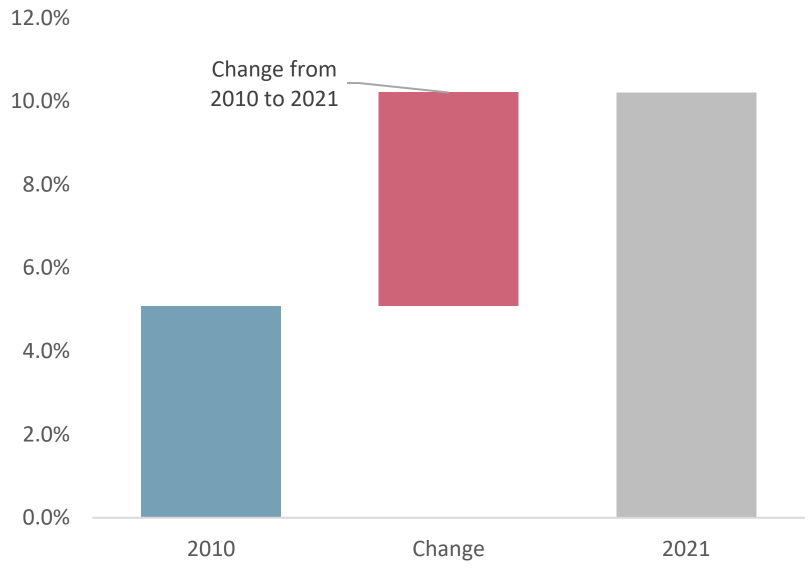


Source: EGEDA (2023)

Doubling of renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix between 2010 and 2030. Modern renewables do not include traditional biomass, and the share is relative to final energy consumption.

Figure 12: China's modern renewable energy share, 2010 and 2021



Source: EGEDA (2023)

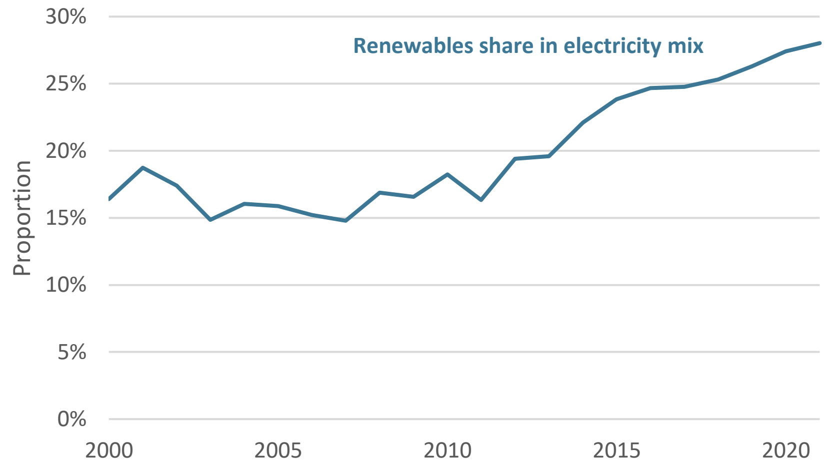
Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

There is no economy-level goal for individual member economies. However, it is possible to calculate the relative improvement of individual economies to get a better sense of whether the goal will be achieved.

Since the implementation of the Renewable Energy Law in 2006, China has entered a period of rapid renewable energy development. The modern renewables' share of final energy consumption in 2010 was 5.1%. In 2021, this proportional share was 10.2%, double what it was in 2010, showing that the set target was achieved (Figure 12). China has set multiple renewable energy targets in the 14th FYP, and as a result, even though it has already attained the renewable energy policy doubling target, China will not slow down its efforts in promoting renewable energy.

The share of renewable energy in China's electricity mix increased from 16% in 2000 to 28% in 2021 (Figure 13). This increase was mainly driven by wind and solar of which total installed capacity is expected to grow to more than 1 200 GW by 2030 (UNFCCC, 2021).

Figure 13: China's renewable generation share, 2000 to 2021



Source: EGEDA (2023)

Energy Policy

Energy policy	Details	Reference
Working Guidance for Carbon Dioxide Peaking and Carbon Neutrality in Full and Faithful Implementation of the New Development Philosophy	The working Guidance provides guiding principles, guidelines, main objectives and measures to realise the carbon dioxide peaking and neutrality.	The Economy Council of the People's Republic of China
Action Plan for Carbon Dioxide Peaking Before 2030	Outline measures for gradually slowing the emission of carbon, transitioning to renewable energy and reducing waste. Offers an overview of China’s overall plan for reaching 2030 goal.	Policy link
14th Five-Year Plan for a Modern Energy System	Clarifies the key tasks for the development of China’s energy sector from 2021 to 2025.	NEA of China
14th Five-Year Plan on Renewable Energy Development (2021-2025)	Clarifies the key tasks for the development of China’s renewable energy sector from 2021 to 2025.	NDRC
Comprehensive Work Plan for Energy Conservation and Emission Reduction in the 14th Five-Year Plan	Improves and implements the dual control system for energy consumption intensity and total volume and total discharge of major pollutants; organises the implementation of key projects for energy conservation and emissions reduction	Government link

Notable Energy Developments

Energy development	Details	Reference
China's Green Development in the New Era	Presents a full picture of China's ideas, actions and achievements in green development in the New Era, and shares with the world its experience in this regard.	https://www.gov.cn/zhengce/2023-01/19/content_5737923.htm
National Electric Power Industry Statistics in 2022	The installed capacity of wind power is about 370 million kW, an increase of 11% year-on-year; the installed capacity of solar power is about 390 million kW, an increase of 28% year-on-year.	NEA of China
Top Ten Landmark Achievements of National Oil and Gas Exploration and Development in 2022	Top Ten Landmark Achievements of National Oil and Gas Exploration and Development in 2022 appraised by the National Energy Administration.	NEA of China
Energy Development Achievements in the Past Ten Years in the New Era	Energy Development Achievements in the Past Ten Years in the New Era released by the National Energy Administration.	NEA of China
Energy Statistics	The production data of coal, electricity, crude oil and natural gas are released by the National Bureau of Statistics.	https://www.stats.gov.cn/
China’s Policies and Actions for Addressing Climate Change (2022)	This report is released to summarise China’s progress in responding to climate change since 2021 and share its experience and approaches with international community.	https://english.mee.gov.cn/Resources/Reports/reports/202211/P020221110605466439270.pdf

Useful Links

National Development and Reform Commission – https://www.ndrc.gov.cn/

National Energy Administration – http://www.nea.gov.cn/

National Bureau of Statistics of China – http://www.stats.gov.cn/english/

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EGEDA (Expert Group on Energy Data Analysis, APEC Energy Working Group) (2021), *APEC Energy Database.*

https://www.egeda.ewg.apec.org/egeda/database_info/index.html

Review of China’s Foreign Trade in 2021, 14 January 2022. http://english.customs.gov.cn/Statics/63ef2d4b-d9f8-411e-8424-34a08b11e3fd.html

Hong Kong, China

Introduction

Hong Kong, China (HKC) announced its goal to achieve carbon neutrality before 2050 in its Climate Action Plan 2050 (CAP2050), released in October 2021. The CAP2050 is one of HKC's major environmental policy plans. It comprises long-term decarbonising targets and action plans, covering energy supply and demand aspects, and including the roadmap towards carbon neutrality. It sets a carbon neutrality target following the issue of the Climate Action Plan 2030+ (CAP2030+) released in 2017. The CAP2050 brings together the overall strategies, plans, targets, and actions for HKC to achieve carbon neutrality before 2050.

HKC is implementing the action plan to progress towards achieving its carbon-neutral goal. Net-zero electricity generation is one of the four major decarbonization strategies that HKC is striving to increase the share of renewable energy in the fuel mix for electricity generation to 7.5%-10% by 2035 and further increase the share to 15% subsequently through facilitating local renewable energy projects. The Government introduced the Feed-in Tariff (FiT) Scheme with the power companies in 2018, in which the power companies purchase renewable energy generated by the private sector at a rate higher than the electricity tariff. The Government has taken the lead in developing renewable energy, and a number of waste-to-energy projects have been launched progressively or are under planning. As of 2022, pilot projects with total design capacity of 300 kW floating solar systems have been installed at three reservoirs for electricity generation in HKC. The Government will further be expanding the scale of floating solar system with generating capacity up to 5 MW at the reservoirs. New waste-to-energy facility at Shek Kwu Chau (I•PARK1), with a treatment capacity of 3 000 tonnes of municipal solid waste, is targeted for commissioning in 2025. HKC continues to promote and enhance energy conservation and improve energy efficiency in buildings through the uplifting of the key measures, the Mandatory Energy Efficiency Labelling Scheme (MEELS), and the Buildings Energy Efficiency Ordinance (BEEO).

For green transport, vehicle electrification is a critical initiative to decarbonise the transport sector. The Government announced the Hong Kong Roadmap on Popularisation of Electric Vehicles (the EV Roadmap) in March 2021, setting the target to cease new registration of fuel-propelled and hybrid private cars (PCs) in 2035 or earlier. In mid-2023, HKC's electric double-decker buses started service in public transport. Apart from promoting the adoption of EVs, HKC is exploring and promoting the adoption of hydrogen in the fields of power generation, energy storage and transport, particularly to decarbonise commercial and heavy goods vehicles. The first hydrogen-powered bus was launched in 2024.

Table 1: Hong Kong, China’s macroeconomic data and energy reserves

Key data [a]		Energy reserves	
Area (km²)	1114.4	Oil (billion barrels)	-
Population (million)	7.5	Gas (trillion cubic feet)	-
GDP (2017 USD billion PPP)	430	Coal (million tonnes)	-
GDP per capita (2017 USD PPP)	58 479	Uranium (kilotonnes U < USD 130/kgU)	-

Source: World Bank (2023); Government HKC (2023)

Energy Supply and Consumption

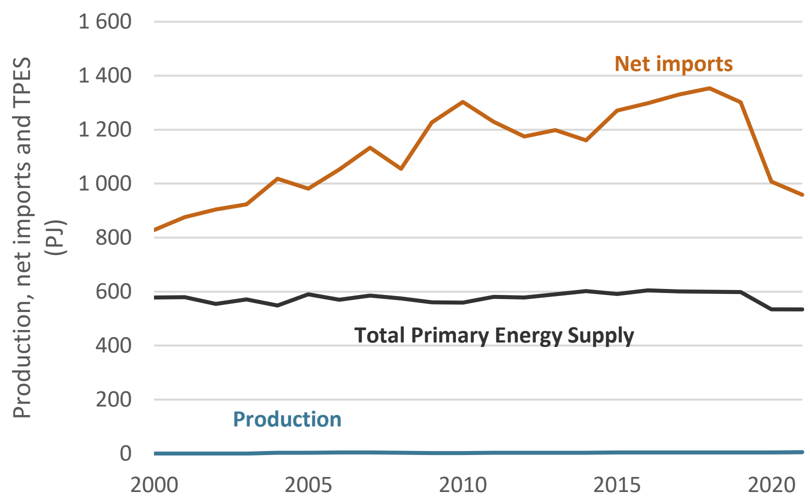
Total primary energy supply

Due to its limited terrain, HKC relies almost entirely on imported energy such as oil, gas, and coal products, or transformed secondary energy such as electricity, to meet its demands. However, due to its limited terrain, HKC produces renewable energy domestically mainly through waste-to-energy projects and government-funded and non-funded solar photovoltaic (PV) projects.

HKC's total primary energy supply remained stable at about 600 Petajoules (PJ) since 2000 before it dropped to 535 PJ in 2020 and 534 PJ in 2021. The faster decline in net imports compared with the total primary energy supply may indicate the dramatically decreasing demand from international shipping and trade caused by COVID-19 (Figure 1).

Apart from low energy demand from the bunkers’ usage, the significant drop in net imports in 2020 and 2021 was also partially due to the gradual reduction of coal consumption in electricity generation. Renewable sources, as part of the total primary energy production, have remained stable at about 5 PJ since 2016.

Figure 1: Hong Kong, China’s energy supply, production, and net imports (PJ), 2000 to 2021

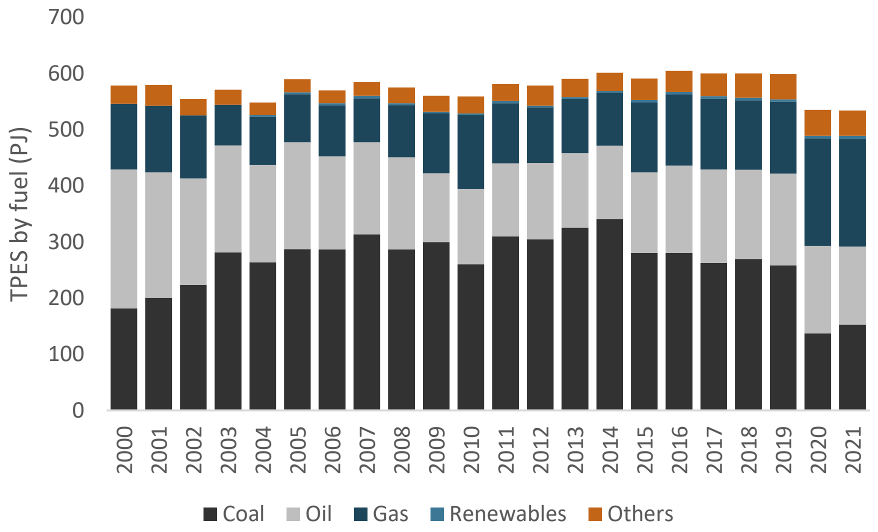


Source: EGEDA (2023)

Fossil fuels have dominated HKC's total primary energy supply for the past two decades, with changes in structure over the period (Figure 2). Coal's share rose from 31% in 2000 to 57% at the peak in 2014 and gradually declined to 29% in 2021. Meanwhile, gas's share increased from 16% in 2014 to 36% in 2021 to replace coal in electricity generation. Over the same period, oil's share showed a similar trend as gas, but at a slower rate, from 22% to 26%.

Renewables and others grew from 5.6% in 2000 to 9.5% in 2021, as the geographical constraint limited the large-scale renewable sources in HKC.

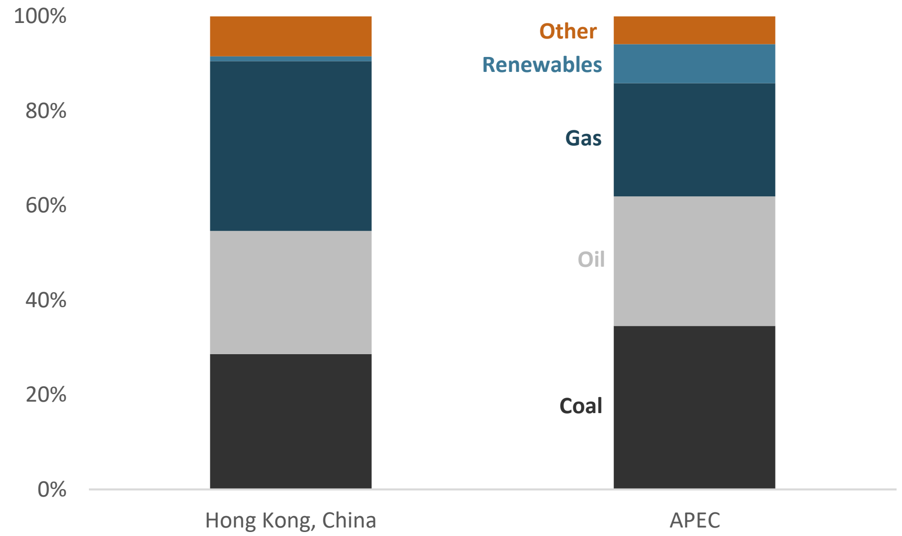
Figure 2: Hong Kong, China’s energy supply by fuel (PJ), 2000 to 2021



Source: EGEDA (2023)

HKC's total primary energy supply structure showed a reliance on fossil fuels about 5% higher than the entire APEC region in 2021 (Figure 3). The coal share was 6% lower; the oil share was almost the same, and the gas share was 12% higher. The share of renewables was significantly lower than the APEC region.

Figure 3: Energy supply mix – Hong Kong, China and APEC, 2021



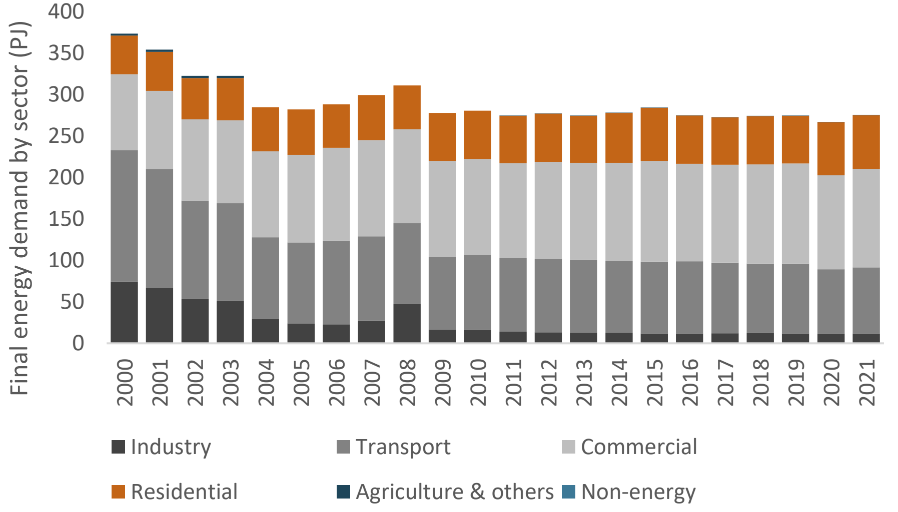
Source: EGEDA (2023)

Total final consumption

HKC's total final consumption declined by about a quarter from 374 PJ in 2000 to 282 PJ in 2005, driven by falling demand from the industry sector (Figure 4). Economic growth in HKC had led to a steady growth of final consumption before being impacted by the financial crisis in 2008. Since then, the final consumption in HKC has stabilised at an average of 276 PJ.

The commercial and transport sectors were the main end-use sectors for the past 21 years, accounting for 43% and 29% respectively of all end-use energy consumption in 2021. The commercial sector has experienced steady energy growth since 2000, while the transport sector has slowly declined in energy consumption. In 2004, the former surpassed the latter for the first time, becoming the largest consumption sector, and rising gradually since then. Limited economic activities due to the COVID-19 lockdown in 2020 caused a drop in energy consumption across most sectors except residential. However, in 2021, the final energy consumption was restored to a similar level as in 2019.

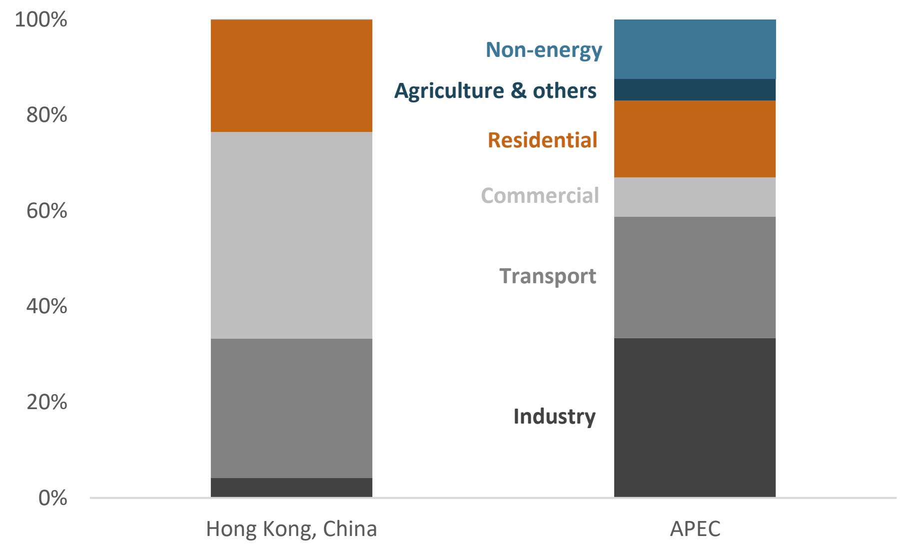
Figure 4: Hong Kong, China’s final consumption by sector (PJ), 2000 to 2021



Source: EGEDA (2023)

HKC's commercial energy consumption share was five times larger than the APEC region in 2021 (Figure 5), as service activities contributed the largest share of economic output since the early 2000s. The transport sector's share was slightly higher than the APEC region, while industry, agriculture & other sectors' shares were much smaller.

Figure 5: Final consumption by sector, Hong Kong, China and APEC, 2021



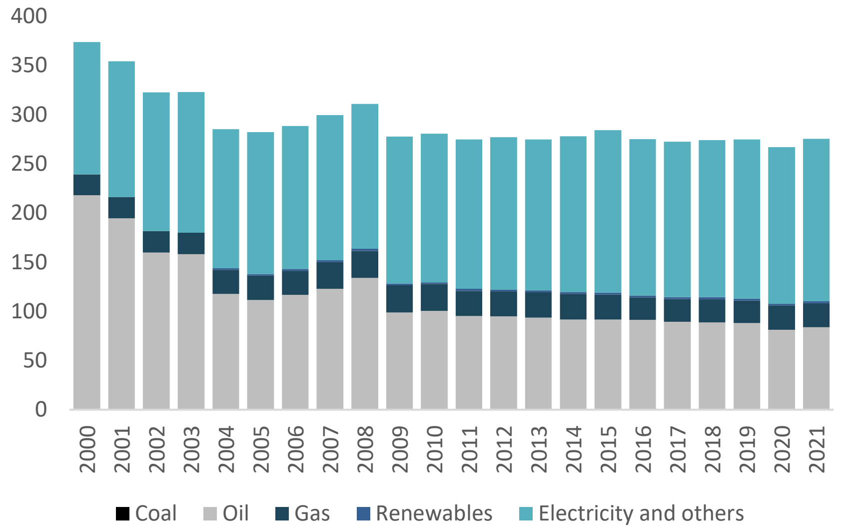
Source: EGEDA (2023)

Final energy demand

HKC's final energy demand was stable at around 280 PJ from 2010 to 2021, except for the pandemic-related drop in 2020 (Figure 6). The final energy demand has been dominated by the electricity and others category since 2004. The share of electricity and others rose from 50% in 2004 to 60% in 2021.

Demand for oil, gas, renewables, electricity and others recovered in 2021 to the previous level, reflecting that mobility and economic activities post COVID-19 lockdown were resuming gradually.

Figure 6: Hong Kong, China's final energy demand by fuel (PJ), 2000 to 2021

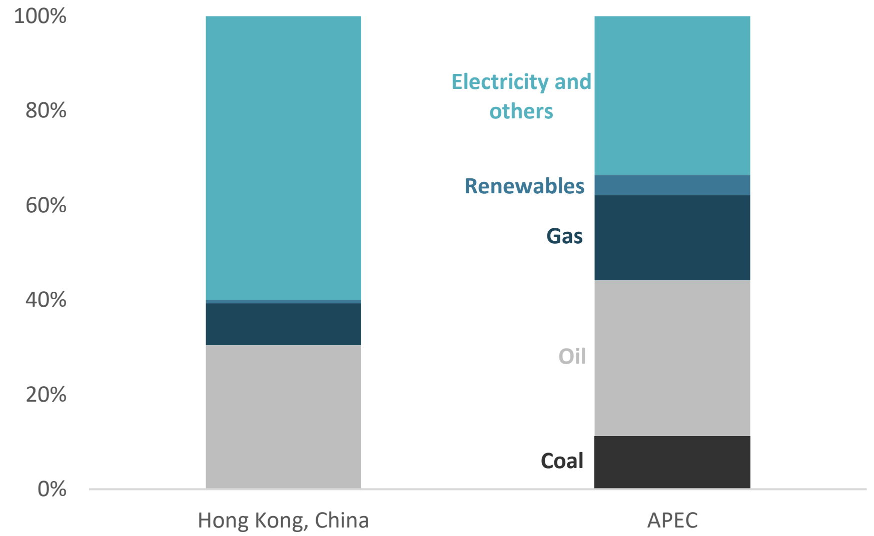


Source: EGEDA (2023)

Note: Does not include non-energy sector consumption of energy products.

As a services-based and high-electrification economy, HKC's electricity and others' share was almost double that of the APEC region in 2021 (Figure 7), with the energy mostly consumed by the commercial and residential sectors. The shares of oil, gas, and renewables were smaller than those in the APEC region, and end-users in HKC did not consume coal in 2021.

Figure 7: Final energy demand fuel share, Hong Kong, China and APEC, 2021



Source: EGEDA (2023)

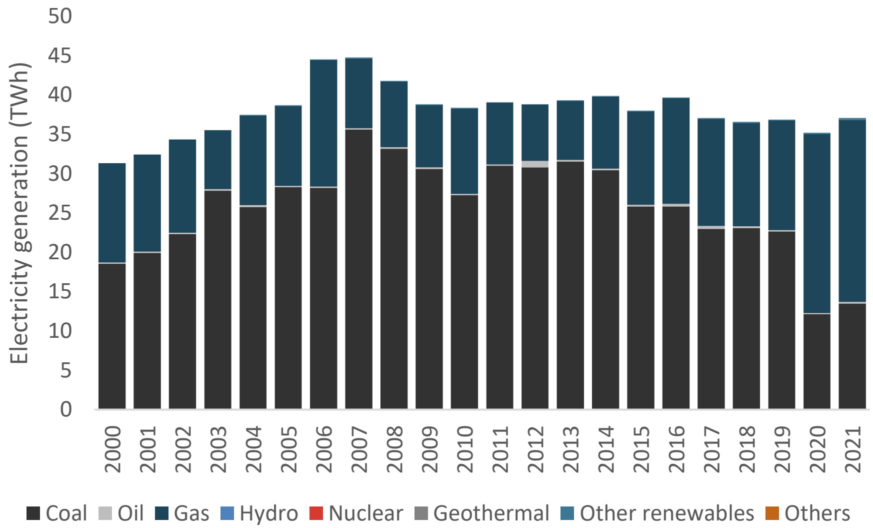
Transformation

Power sector

In the total primary energy supply, HKC's electricity generation relies heavily on fossil fuels, specifically coal and gas. However, the structure has gradually changed between both fuels for the past decade, following the HKC decarbonisation plan in the power sector. On top of its commitment to the Paris Agreement, HKC released the CAP2050 in 2021, which comprises targets and mitigation plans to reduce carbon emissions by 50% (compared with 2005 level) before 2035 and reach carbon neutrality in 2050. One of the mitigation plans is to phase out coal consumption gradually in electricity generation by 2035.

As a result of HKC's decarbonisation commitment, the coal share in electricity generation declined by more than half, from 80% in 2013 to 36% in 2021 (Figure 8), while the share of electricity generation from gas increased from 19% in 2013 to 62% in 2021, reflecting the shift from coal to gas in HKC's power sector. All other fuels aside from coal and gas accounted for less than 1% of the fuel mix in 2021. Other renewables and others increased by about 56% in a year, increasing from 0.17 TWh in 2020 to 0.26 TWh in 2021.

Figure 8: Hong Kong, China's electricity generation by fuel, 2000 to 2021

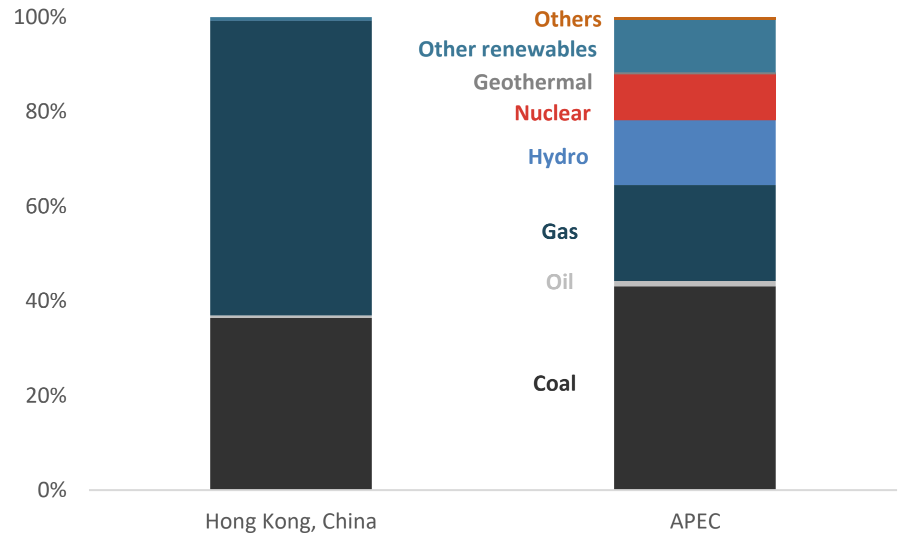


Source: EGEDA (2023)

HKC will gradually cease using coal for daily electricity generation and replace it with low- to zero-carbon energy, as stated in the CAP2050. Gas will be the primary substitute fuel for coal, supported by other renewables. Other renewables' share will be increased to 7.5%- 10% of the fuel mix in electricity generation by 2035 and further increased to 15% by 2050. At the same time, HKC will explore regional cooperation on zero-carbon energy and identify sources of zero-carbon energy in neighbouring areas.

HKC relies heavily on imported fossil fuels to generate electricity and meet demands. Most of the imported coal and gas in 2021 was transformed into electricity for final consumption. The dominance of both fuels in the power sector is apparent compared to the APEC region's generation mix in 2021 (Figure 9).

Figure 9: Electricity generation fuel share, Hong Kong, China and APEC, 2021



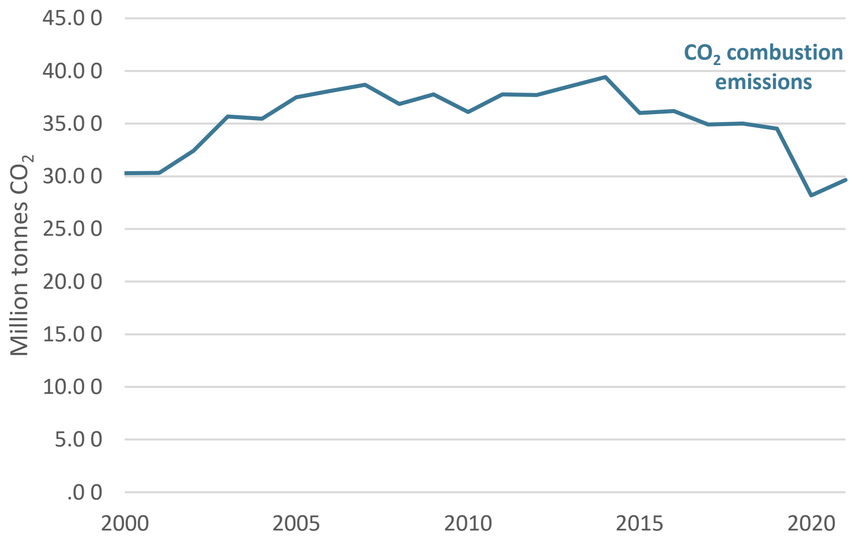
Source: EGEDA (2023)

Energy Transition

Emissions

HKC CO_2 emissions increased by about a third in the period 2000 to 2014, peaking at 40 million tonnes in 2014. Since then, CO_2 emissions have declined to 30 million tonnes in 2021, which is even less than in 2000. Various decarbonisation measures from both the supply and demand sides have supported the reduction of CO_2 emissions in HKC, including promoting electric vehicles and energy-saving measures, introducing innovative waste-to-energy and waste-to-resources facilities, and reducing coal use in electricity generation.

Figure 10: Hong Kong, China's CO_2 combustion emissions (million tonnes), 2000 to 2021



Source: EGEDA (2023)

Energy security

HKC started diversifying its gas sources by importing LNG through the operation of its first offshore LNG receiving terminal in mid-2023. Its maximum regasification is to meet the growing gas demand, mainly from the power sector. HKC also imports zero-carbon energy from the nuclear power station located in Guangdong, China via an electrical grid interconnection of the China Southern Power Grid.

APEC Energy Goals

There are two energy-related objectives that APEC member economies have agreed to meet as a collective: to improve energy intensity and to double the share of modern renewables.

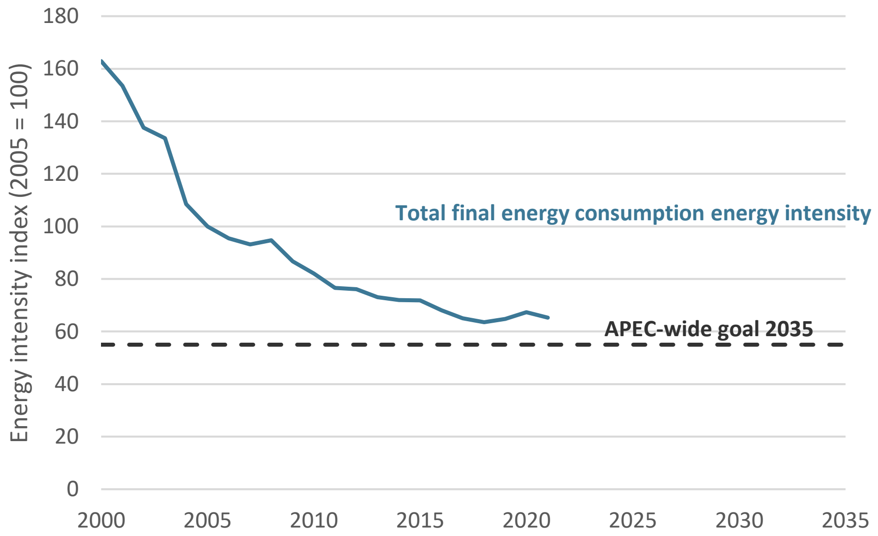
Energy intensity goal

In 2011, APEC member economies agreed to increase their target to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

APEC is on track to achieve this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

Relative to a 2005 baseline, HKC's final energy consumption intensity declined by 35% from 2005 to 2021, about a 2.2% annually reduction. The energy intensity reduction in HKC has also contributed to the positive progress towards achieving APEC's energy intensity goal.

Figure 11: Hong Kong, China's total final energy consumption intensity index, 2000 to 2035 (2005 = 100)



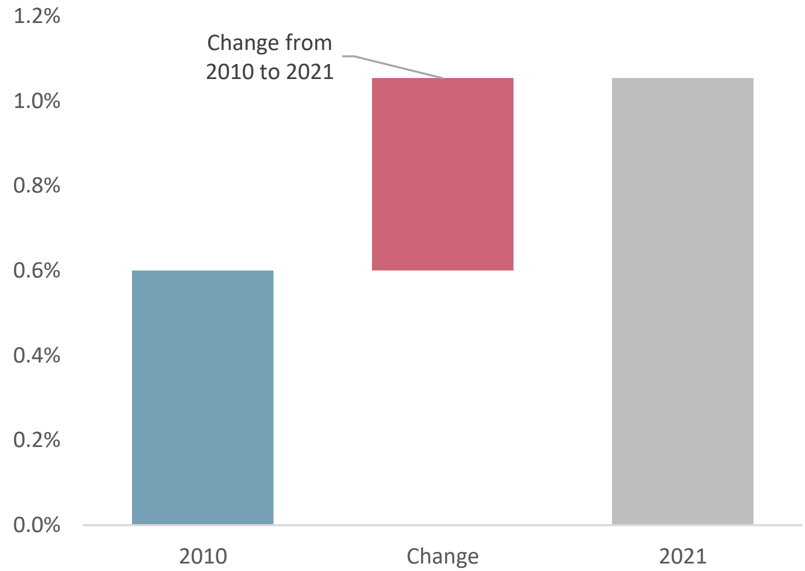
Source: EGEDA (2023)

Doubling of renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period 2010 to 2030. There is no economy-level goal for individual member economies, but improvements by individual economies will contribute to the doubling goal.

HKC's share of modern renewables in final energy consumption reached 1.1% in 2021, increasing by about 87% in 11 years (Figure 12). The renewables share in electricity generation is relatively low. Despite this, there was a rise from 0.11% to 0.71% over the same period (Figure 13).

Figure 12: Hong Kong, China's modern renewable energy share, 2010 and 2021

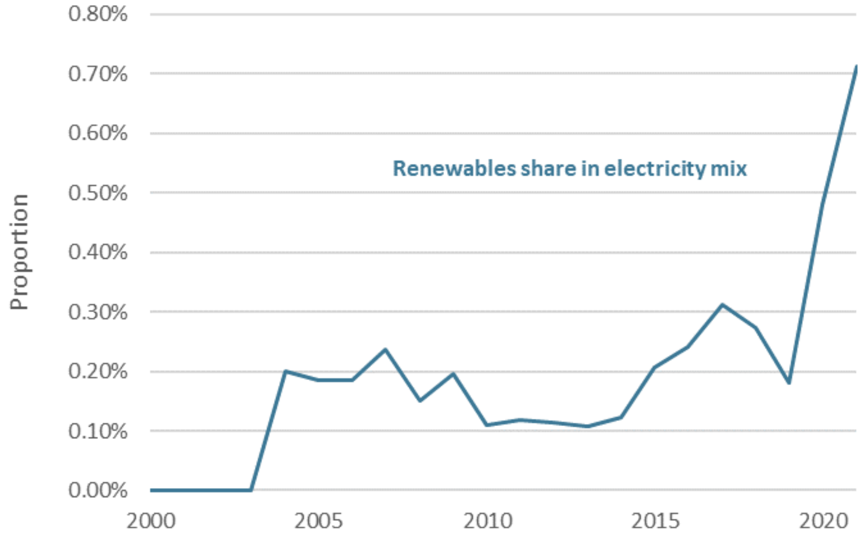


Source: EGEDA (2023)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

HKC committed to increasing the share of renewables in the fuel mix for electricity generation to 7.5%-10% by 2035 and 15% by 2050 through developing more advanced waste-to-energy facilities and Feed-in Tariff (FiT) Scheme to encourage the community to develop distributed renewables, specifically solar energy.

Figure 13: Hong Kong, China’s renewable generation share, 2000 to 2021



Source: EGEDA (2023)

Energy Policy

Energy policy	Details	Reference
Green Tech Fund (GTF)	HKD 400 million has been allocated for setting up the GTF to provide better and more focused funding support for environmental protection.	GTF
Energy Efficiency Initiatives	Mandatory Energy Efficiency Labelling Scheme (MEELS), Voluntary Energy Efficiency Labelling Scheme (VEELS), Building Energy Efficiency Ordinance (BEEO), District Cooling System (DCS), Retro-Commissioning.	MEELS, VEELS, BEEO, DCS, RCx
Renewable Energy Initiatives	Feed-in tariff and Renewable Energy Certificate, Installing renewable energy system in various government schools and welfare non-government organisations, Waste-to-energy infrastructures.	GOVHK, HKRENet
Scheme of Control Agreements (SCAs)	Promotes the development of quality service by power companies and improves energy efficiency and energy conservation.	Environment and Ecology Bureau
A Memorandum of Understanding Between the National Energy Administration (NEA) and HKC	China provides HKC with a stable supply of natural gas and nuclear electricity.	Environment and Ecology Bureau
Energy-Saving Plan for Hong Kong's Built Environment 2015-2025+	Comprises of an energy-saving policy and strategies to achieve energy intensity reduction by 40% from the 2005 level by 2025.	Environment and Ecology Bureau
Climate Action Plan 2030+ Report	Plans and measures across sectors to reduce carbon intensity by 65% to 70% from the 2005 level by 2030, equivalent to a 26% to 36% absolute reduction and a reduction to 3.3-3.8 tonnes on a per capita basis.	CLIMATEREADY
Climate Action Plan 2050	Comprehensive plans and measures across sectors to achieve carbon neutrality before 2050.	Environment and Ecology Bureau
Hong Kong Roadmap on Popularisation of Electrical Vehicles	Measures related to electric vehicles to achieve zero vehicular emissions before 2050.	Environment and Ecology Bureau

Energy policy	Details	Reference
Clean Air Plan for Hong Kong 2035	Comprehensive policies, measures, and long-term decarbonisation strategies to improve the air quality.	Environment and Ecology Bureau
Environmental Protection and Ecological Conservation	Striving to achieve carbon neutrality before 2050 and reduce carbon emissions by 50% before 2035 as compared to the 2005 level.	Policy Address 2023

Notable Energy Developments

Energy development	Details	Reference
Green Tech Fund (GTF)	GTF Assessment Committee in the third round approved 8 projects from 80 applications with a total grant of around HKD 30 million. The fourth round of GTF applications closed on 20 March 2024.	Green Tech Fund
Tax Incentives Scheme for Environment-friendly Commercial Vehicles	HKC released a Qualifying Standard for Environment-friendly Commercial Vehicles, which took effect from 1 April 2024 to 31 March 2025.	Environmental Protection Department
LNG Receiving Terminal	The first HKC LNG receiving terminal was in operation in mid-2023. The floating storage and regasification unit (FSRU) vessel has a storage capacity of 263 000 cubic metres, a regasification capacity of 800 million standard cubic feet per day.	CLP HKE

Useful links

The HKC Government – www.gov.hk/en

Electrical and Mechanical Services Department – www.emsd.gov.hk

Environment and Ecology Bureau – https://www.eeb.gov.hk

Environmental Protection Department – www.epd.gov.hk

Council for Sustainable Development – https://www.eeb.gov.hk/en/susdev/council/pastreports.htm

Climate Ready – https://cnsd.gov.hk/en/climate-ready/

Information on Renewable Energy (RE) Technologies – https://re.emsd.gov.hk/

Low Carbon Living Calculator – https://www.carboncalculator.gov.hk

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Indonesia

Introduction

Indonesia is the world's largest archipelagic economy, located to the south-east of mainland Southeast Asia, between the Pacific Ocean and the Indian Ocean. The economy's total land area, approximately 1.9 million km^2, is 25% of its territory and the largest in Southeast Asia. The population, around 276 million in 2022 (BPS, 2023), was fourth globally. Indonesia had a gross domestic product (GDP) of US dollar (USD) 3 247 billion and a GDP per capita of USD 11 859 in 2021 (2017 USD purchasing power parity [PPP]), recording an annual increase of 3.7% and 3% since 2020, respectively (World Bank, 2023). Indonesia's economy continues to recover from the COVID-19 pandemic in 2020. In 2022, Indonesia's economy grew at a rate of 5.3%, which is higher than the growth before the pandemic (BPS, 2023).

Indonesia updated its Nationally Determined Contribution (NDC) in September 2022. The revised NDC reflects a more substantial commitment to reducing emissions by 31.89% unconditionally and 43.20% conditionally by 2030, compared to the initial NDC and its updated version. This enhanced NDC, along with the Long-Term Low Carbon and Climate Resilience Strategy (LTS-LCCR) 2050, outlines Indonesia's vision to attain net zero emissions by 2060 or earlier (UNFCCC, 2022).

In 2022, Indonesia, in collaboration with the International Partners Group (IPG), initiated the Just Energy Transition Partnership (JETP) to expedite the economy's transition to cleaner energy in the power sector. This long-term partnership seeks to secure an initial funding of USD 20 billion, sourced from both public and private financing, over a span of three to five years. The primary objectives include achieving a power sector emission target of no more than 290 MT CO_2 by 2030, with an immediate trajectory toward net zero emission in the power sector by 2050. Additionally, JETP aims to hasten the adoption of renewable energy, with a goal for renewables to constitute at least 34% of total power generation by 2030. In 2023, JETP took a significant step by unveiling the Comprehensive Investment Policy Plan, which provides detailed recommendations concerning the energy transition in the power sector. This plan encompasses insights into policy reforms, financing requirements, and strategies to propel the shift toward a more sustainable energy landscape (JETP, 2023). Looking forward, the economy expects to see an enormous growth in population by 0.5%-1% from 2020-2050. As such, the economy needs to combine its efforts to decarbonise with the critical goal of maintaining secure and affordable energy for the economy.

Table 1: Indonesia macroeconomic data and energy reserves

Key data [a, b]		Energy reserves [c, d]	
Area (million km^2)	1.9	Oil (billion barrels)	2.4
Population (million)	276	Gas (trillion cubic feet)	44
GDP (2017 USD billion PPP)	3 247	Coal (million tonnes)	34 869
GDP per capita (2017 USD PPP)	11 859	Uranium (kilotonnes U < USD 130/kgU)	7 391

Source: a World Bank (2023) b Energy Institute (2023); c NEA (2023)

Note: Reserves are total proved reserves and reasonably assured recoverable resources for uranium.

Indonesia has substantial and diverse energy resources of oil, natural gas, coal, and renewables. In 2021, there were 14 634 PJ of proven oil reserves and over 44 852 PJ of proven natural gas reserves. Indonesia's coal reserves were estimated at almost 526 316 PJ (Table 1), with more than 60% of the reserve in Kalimantan and the rest mainly in Sumatra (MEMR, 2022b).

In 2022, renewable energy potential included 23 gigawatts (GW) of geothermal, 95 GW of hydropower, 3294 GW of solar, 57 GW of bioenergy, 155 GW of wind power, and 63 GW of ocean energy (DEN, 2023).

Energy Supply and Consumption

Total primary energy supply

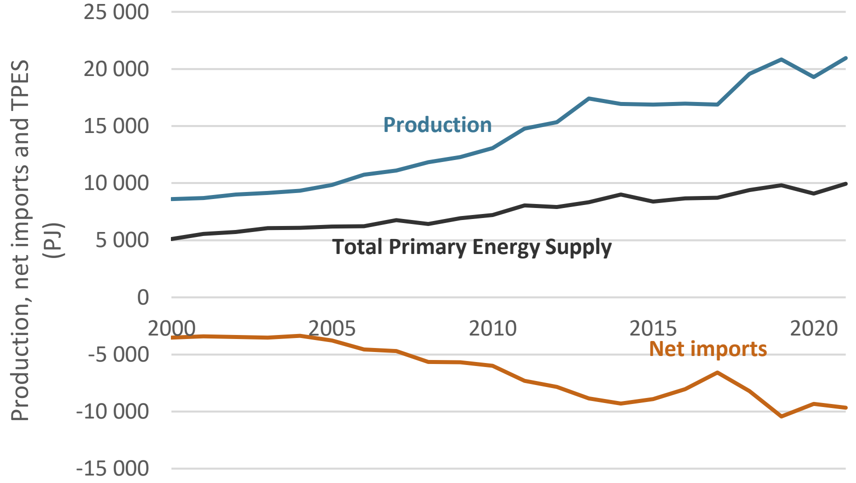
In 2021, Indonesia's energy production increased by 8.7% to 20 951 PJ, mainly due to the increase in coal, gas, and biodiesel production. Energy exports, which mainly were coal and crude oil, increased by 7.4% from 2020. Indonesia's energy imports, mainly high-calorie coal and petroleum products, raised in 2020 by 28%. In total, Indonesia's total primary energy supply (TPES), compared to 2020, increased by 9.4% to become 9 943 PJ.

Coal production in 2021 increased by 0.9% more than in 2020 as international coal demand began to recover from the COVID-19 pandemic. However, coal production in 2021 was still 3.9% below the production level in 2019. Indonesia was one of the world's biggest thermal coal exporters, with export capacity amounting to 435 million tonnes in 2021, equivalent to 70% of its production. China, India, and the Philippines remained as Indonesia's top three coal export destinations.

Indonesia's natural gas production in 2021 was 1 718 PJ, or 21% higher than in 2020 and 5.5% higher than in 2019. Indonesia has continued to prioritise gas utilisation for domestic demand, and therefore limiting the share of gas exports. Even so, gas was still Indonesia's second-largest energy export in 2021, amounting to 280 PJ exported via pipeline and 485 PJ via LNG cargo (MEMR, 2022c).

Indonesia still had to import aviation fuel, diesel oil, and LPG due to the capacity limitations of its refinery units. Indonesia has been trying to reduce LPG imports by promoting induction and electric cookers, resulting in a 0.95% reduction in LPG imports in 2021 compared to 2020.

Figure 1: Indonesia energy supply, production, and net imports (PJ), 2000 to 2021

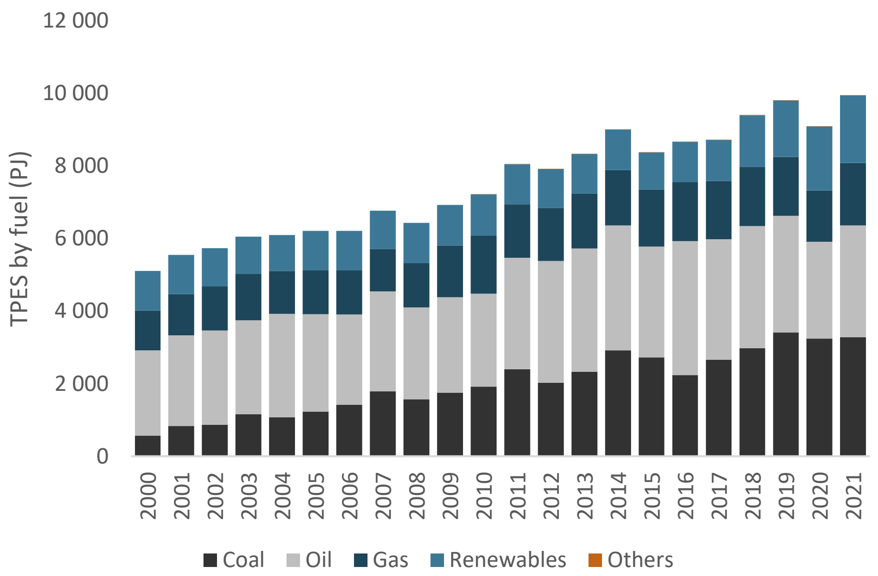


Source: EGEDA (2023)

In 2021, Indonesia's energy supply was predominantly sourced from fossil fuels. The supply of oil increased by 15% compared to 2020, driven by the surge in transportation activity, while gas witnessed a notable 21%

increase from the previous year. In contrast, energy supply from renewables only saw a modest 6% increase from 2020. The boost in renewable energy mainly came from solar, biogas, and biodiesel, showing a rise of about 10%. Hydro and biomass experienced a more modest increase of around 5%, whereas wind and municipal waste saw a decline since 2020.

Figure 2: Indonesia energy supply by fuel (PJ), 2000 to 2021



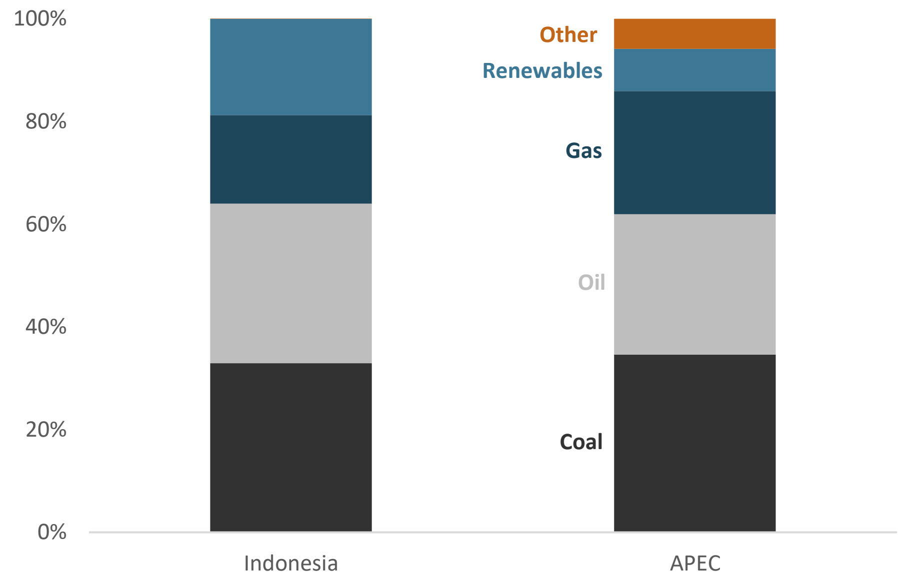
Source: EGEDA (2023)

Fossil fuels in 2021 accounted for more than 80% of Indonesia's energy supply (Figure 3). However, compared to 2020, while the supply of coal remained the same, it accounted for a slightly lower share of the fuel mix than in APEC. Following a slight decrease in supply, gas also accounted for a lower share than in APEC, at 17.3% in Indonesia and 24% in APEC.

Transport is the primary source of oil demand, and so a nearly 10% increase in transport activity in 2021 was the leading cause of the rise in the proportion of oil to 31%, compared with 27% in the APEC regions.

Renewable energy in Indonesia (19%) was more than twice as high as that of APEC (8%). This disparity is attributed to the abundant renewable resources in Indonesia, including geothermal, biofuel, and solar energy. Additionally, the success of renewable utilisation programmes, such as the biodiesel B30 implementation programme, has contributed to this significant increase in renewable energy adoption.

Figure 3: Energy supply mix – Indonesia and APEC, 2021



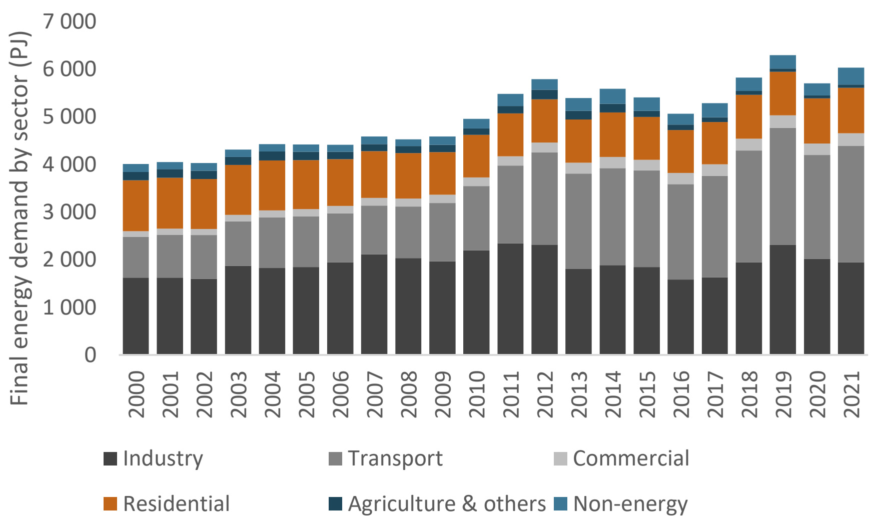
Source: EGEDA (2023)

Total final consumption

Indonesia's final energy demand reached 6 031 PJ, marking a 5.7%

increase from 2020 and showcasing a recovery from the 11% decline observed in 2019-2020 (Figure 4). The transport sector dominated consumption, contributing the highest increase with a 13% uptick from 2020, though not yet reaching 2019 levels. The industry sector continued to grapple with the impact of the COVID-19 pandemic, experiencing a 3.8% decrease in energy demand from 2020. In the residential sector, energy demand increased by only 0.8%, maintaining a constant demand for decades. Despite a growing population and increased residential structures, this stability is attributed partly to using more efficient household appliances, including LED lighting and efficient air conditioning. The agriculture sector showed a remarkable recovery, with a 12% increase in energy demand in 2021, rebounding from a 17% drop in 2020.

Figure 4: Indonesia final consumption by sector (PJ), 2000 to 2021

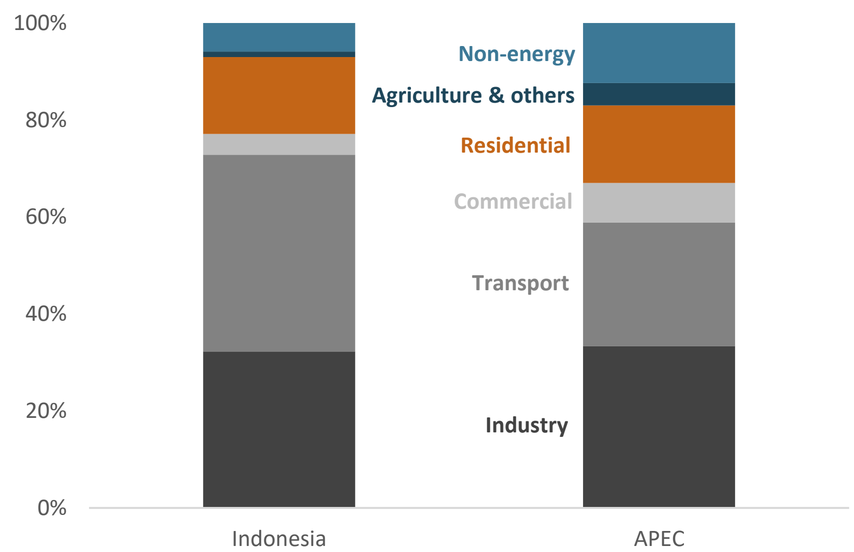


Source: EGEDA (2023)

In contrast to the broader APEC economy (Figure 5), Indonesia diverges in its energy demand distribution. The transport sector commands the largest share at 40%, unlike the APEC region, where the industry sector takes the lead at 33%.

Noteworthy distinctions extend to the shares of agriculture and non-energy use, which are relatively small in Indonesia, accounting for 1.1% and 5.9%, respectively. In comparison, APEC registers higher figures at 4.6% and 12% for agriculture and non-energy use, respectively. These differences underscore Indonesia's unique energy profile, portraying it as a high-energy consumer with a significant emphasis on mobilisation. In contrast, other APEC economies, on average, exhibit greater industrialisation.

Figure 5: Final consumption by sector, Indonesia and APEC, 2021



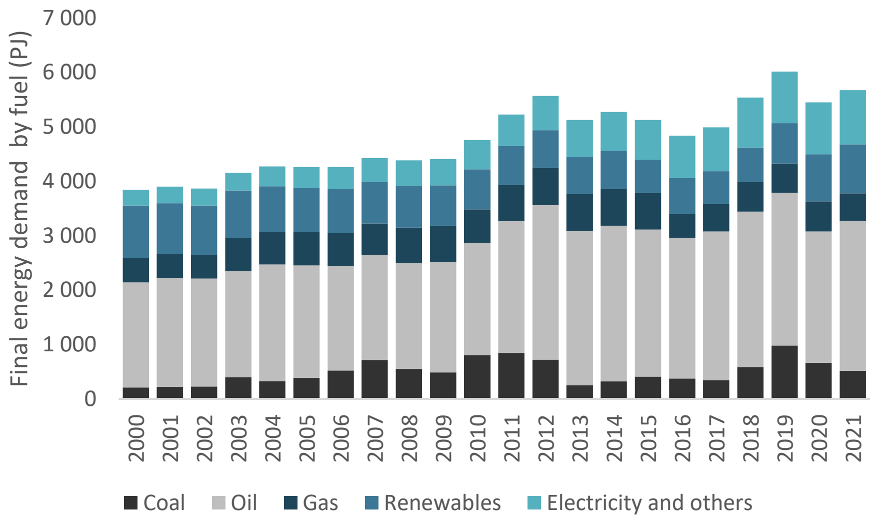
Source: EGEDA (2023)

Final energy demand

As Indonesia's largest energy consumer, the transportation sector relies heavily on oil fuel, making it the primary contributor to the economy's final energy consumption (Figure 6). Beyond powering land transportation, oil is crucial in fuelling marine transit, especially in an economy with an extensive archipelago like Indonesia. Additionally, oil is utilised for power generation in remote and small islands that are not connected to the grid.

Considering Indonesia's status as a net oil importer and the limited longevity of its current oil reserves, regulations have been implemented to ensure efficient oil use. Measures such as promoting biodiesel usage, limiting oil subsidies, and encouraging the adoption of Low-Cost Green Cars (LCGC) have been enacted. These initiatives have contributed to a decrease in the final energy demand for oil in 2021 compared to 2014.

Figure 6: Indonesia final energy demand by fuel (PJ), 2000 to 2021

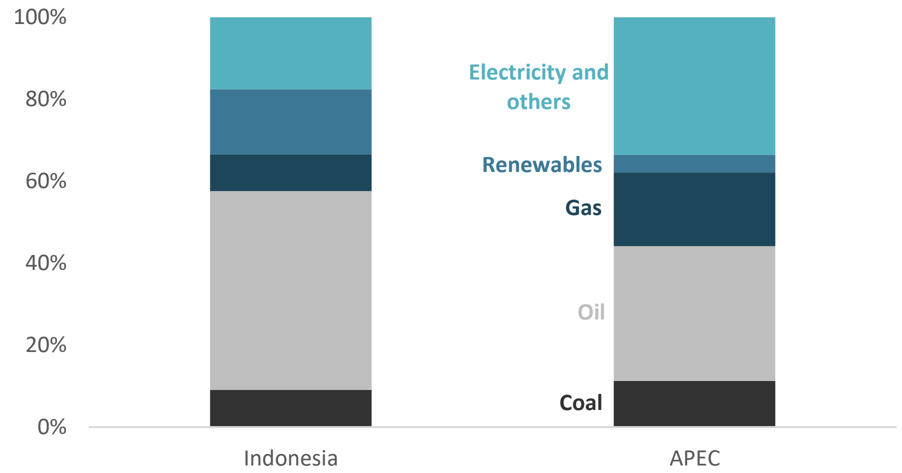


Source: EGEDA (2023)

Note: does not include non-energy sector consumption of energy products.

Meanwhile, the demand for electricity has been consistently rising over the years, driven by government programmes aimed at enhancing energy efficiency and promoting electrification. Industries and commercial enterprises, previously reliant on fossil fuels, are encouraged to transition to power from the utility grid. This shift towards grid-based power consumption is evident even in major companies like Pertamina, which are gradually transitioning from using their own oil production to relying on grid power to energise some of their oil and gas production and refinery platforms.

Figure 7: Final energy demand fuel share, Indonesia and APEC, 2021



Source: EGEDA (2023)

In 2021, Indonesia's final energy demand was as much as 5 675 PJ, representing only 2.8% of the total APEC energy demand. Within APEC, electricity emerged as the dominant source, constituting 34%, followed by oil at 32%, gas at 18%, and renewables at 4.3% of APEC's total energy demand.

In contrast, Indonesia presented a different energy profile. The economy's primary reliance was on oil, accounting for 49%, then electricity at 18%, coal at 9.1%, and lesser contribution from gas at 8.9%. Notably, Indonesia boasted significantly more contribution from renewables at 16%, a figure surpassing the corresponding percentage within APEC.

Transformation

Power sector

In 2021, the total electricity generated was 309 terawatt-hours (TWh), 6.5% higher than that of 2020 and 5.3% higher than that of 2019 (Figure 8). This shows that even though COVID-19 affected demand in all sectors, the electrification rate was high enough that it still increased. The prominent increase was in the industry sector, which saw a 14% increase in demand, followed by the transportation and commercial sectors, which saw 8.5% and 4.9% increases, respectively.

The electricity was produced by facilities with a combined on-grid and off-grid capacity of 74.5 GW. This capacity grew by 2 GW compared to the previous year, driven mainly by the addition of Coal, Combined Cycle, and Hydro Power Plants (MEMR, 2021a). The total 74.5 GW capacity comprised Steam Power Plants (fuelled with coal, gas, oil, or co-firing) at 37 GW, Combined Cycle Gas Turbines at 12.5 GW, Hydro at 6 GW, and Diesel at 5 GW.

Despite a diverse capacity, Indonesia's power sector continued its reliance on coal (Figure 8), contributing 61% of the total electricity generation in 2021. Coal has evolved into the backbone of electricity generation, with its share steadily increasing from 37% in 2000 to 61% in 2021 (EGEDA, 2023). This shift is attributed to its low cost and favourable Levelised Cost Of Electricity (LCOE) compared to other fuel.

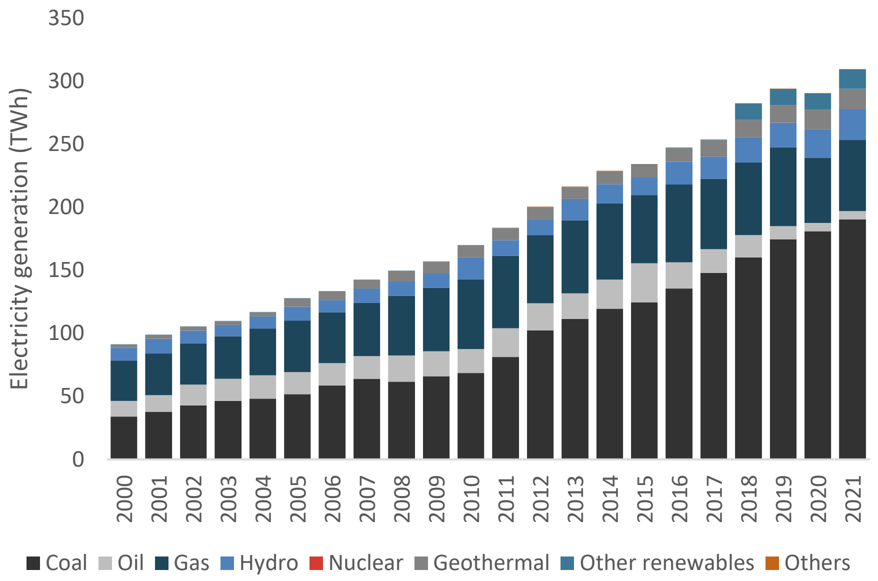
Following coal, gas emerged as the second-largest contributor to electricity generation share. It primarily functioned as a load peaker and follower, ensuring the stability of the power system and meeting peak demand in the evening.

Electricity generated from hydro sources increased by 7.9% from the previous year. Hydroelectricity is commonly employed as a load peaker due to frequent seasonal variations that can suddenly reduce water levels, affecting power production capacity. Encouragingly, electricity generated from renewables saw a significant 9.2% increase from 2020. This surge was mainly attributed to hydro (mini and micro), alongside other renewables such as biomass, biogas, solar, and wind.

Notably, while coal played a crucial role in expanding electricity generation capacity in 2021 compared to 2020, the increase did not originate from coal power plants owned by the domestic utility. Instead, Independent Power Producers (IPP) and Private Power Utilities were the driving forces. Domestic utility-owned coal power plants produced 113 763 TWh in 2021, a marginal 0.4% increase from previous years. Domestic utility-owned coal power plants produced 113 763 TWh in 2021, a marginal 0.4% increase from previous years. Conversely, electricity generated by coal power plants owned by IPP and PPU surged by 25% in 2021, reaching 76 196 TWh.

Lastly, while electricity generated from oil remained consistent in 2021 compared to 2020, a notable trend has emerged since 2000, indicating a continuous decline in the oil share within the electricity energy mix. This decline aligns with the government's persistent push for the de-dieselisation programme, aimed at substituting the use of oil fuel in internal combustion engines (ICE) with a combination of gas fuel and renewables.

Figure 8: Indonesia electricity generation by fuel, 2000 to 2021

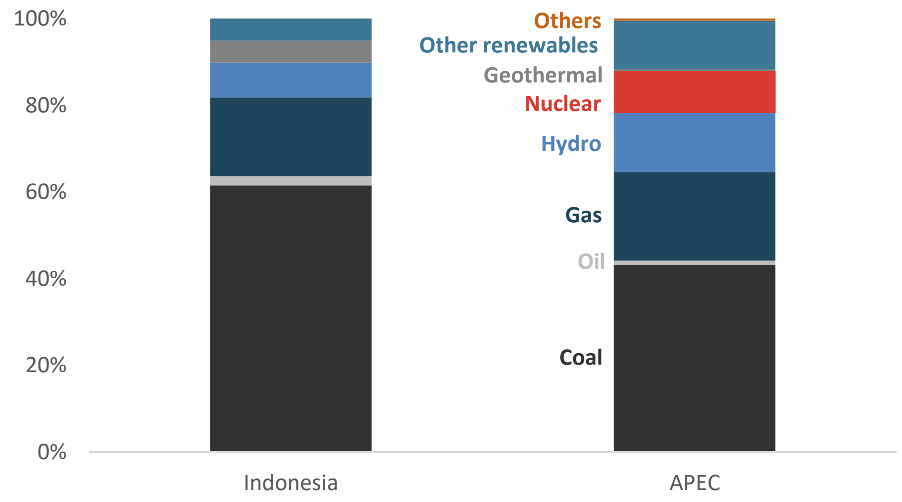


Source: EGEDA (2023)

Compared to the APEC Energy Mix in 2021, Indonesia exhibited a heightened dependence on coal for electricity generation (Figure 9). Coal constituted 62% of Indonesia's electricity mix, a significant disparity from APEC's 43%. The share of gas in Indonesia's energy mix stood at 18%, closely trailing APEC's 20%. This similarity underscores the vital role of gas in maintaining system frequency and stability for both Indonesia and APEC as a whole.

Regarding renewable energy, Indonesia held an 18% share of electricity from renewable sources, while APEC had already achieved 25%. Notably, Indonesia's renewable energy is primarily derived from hydro (8%) and geothermal (5%), whereas APEC predominantly sourced renewables from hydro (14%). Despite Indonesia's substantial solar potential, solar energy comprised a minimal 0.06% share in 2021, remaining unchanged from 2020.

Figure 9: Electricity generation fuel share, Indonesia and APEC, 2021



Source: EGEDA (2023)

Refining

In 2022, Indonesia operated eight oil refineries, collectively possessing a processing capacity of 1 151 thousand barrels of oil equivalent or 7 PJ of energy per day. The most substantial among them is the Cilacap refinery, boasting a daily capacity of 2.1 PJ. Throughout the year, these refineries processed 322 million barrels of crude oil obtained from both imports and domestic sources. The diverse range of refined products includes gasoline, diesel oil, fuel oil, kerosene, aviation turbine fuel, and aviation gas, as well as other non-fuel items such as LPG, lubricants, and naphtha. In 2022, the overall output of oil fuel from refineries reached approximately 1 597 PJ, while non-fuel production accounted for around 312 PJ. Presently, Indonesia is actively expanding its refinery capacity through the Refinery Development Master Program (RDMP), which encompasses the expansion of existing facilities and the establishment of new refineries.

Energy Transition

In 2021, Indonesia declared its commitment to achieving net zero emissions by 2060 with the issuance of its Long-Term Strategy on Low Carbon and Climate Resilient Development (LTS-LCCR) 2050 documents. In 2022, Indonesia updated its nationally determined contribution (NDC), elevating its 2030 emission reduction target. Notably, the Ministry of Energy and Mineral Resources (MEMR) and the International Energy Agency (IEA) collaboratively introduced Indonesia's Net Zero Emission (NZE) roadmap in September 2022 (MEMR, 2022a). This strategic plan outlines various mitigation measures, such as:

- A significant emphasis on the development of renewable sources specifically solar, hydro, and geothermal energy a considerable focus on the development of renewable sources – specifically solar, hydro, and geothermal energy.
- Gradual phasing out of coal power plants.
- Enhancement of transmission connectivity, and
- Implementation of Carbon Capture and Storage/Utilisation (CCS/CCUS).
- Increasing electric vehicle uptake.
- Improved energy efficiency, and
- The development of nuclear, hydrogen, and ammonia in the energy sector (MEMR, 2022a).

The Just Energy Transition Partnership (JETP), established in November 2022 by the Government of Indonesia, together with the International Partners Group (IPG), has planned to organize USD 20 billion in funding to finance the energy transition. This initiative gains significance as the NDC emission reduction target for 2030, initially set at 41%, has been revised to a more ambitious 43%, with dependence on international funding.

In November 2023, the JETP Comprehensive Investment and Policy Plan (JETP-CIPP) was introduced, outlining the formation of multiple working groups within JETP. These groups include key partners such as the International Energy Agency, Danish Energy Agency, Asian Development Bank, GFANZ, JICA, World Bank, USAID, and various other institutes. The primary purpose of these working groups is to oversee programmes and funding initiatives aimed at achieving the deliverables of the energy transition.

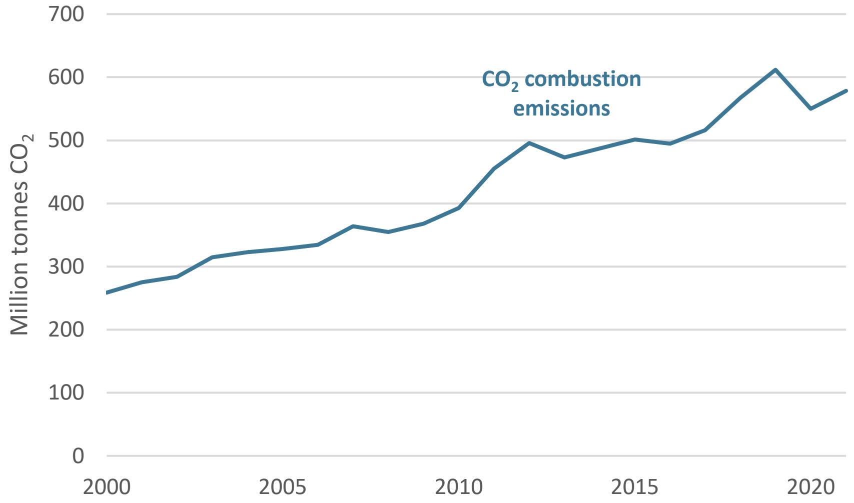
The initial funding injection from the International Partners Group (IPG) is anticipated to act as a catalyst for additional funding, totalling USD 97 billion between 2023 and 2030. This funding is crucial to support various energy transition projects, including (JETP, 2023):

- The deployment of transmission lines and grids.
- The retirement and managed phase-out of early coal-fired power plants (CFPP).
- The acceleration of dispatchable renewable energy (16 GW built out by 2030), and
- The acceleration of variable renewable energy (40 GW built out by 2030).

Emissions

Indonesia's CO_2 combustion emissions have maintained an increasing trend for the past two decades (Figure 10). On average, the CO_2 combustion emissions increased by 4.1% CAGR from 2000, though we can see that in 2020, the emissions decreased by about 6% compared to 2019 due to the COVID-19 pandemic.

Figure 10: Indonesia CO_2 combustion emissions (million tonnes), 2000 to 2021



Source: EGEDA (2023)

Energy security

Coal, oil, and gas have historically dominated Indonesia's energy supply, comprising 81% of the total primary energy supply (TPES) in 2021, with coal holding the largest share at 33% (EGEDA, 2023). While the majority of fossil fuel production occurs domestically, making Indonesia a net energy exporter, the economy has shifted from being a net oil exporter to an importer, thereby exposing its oil supply security to global market fluctuations (EGEDA, 2023). Despite this shift, Indonesia maintained a high self-sufficiency rate, reaching 211% in 2021 (EGEDA, 2023).

To ensure the affordability of energy demand, Indonesia has implemented energy price regulations for domestic consumption. In 2022, the economy continued the domestic market obligation policy for coal, mandating coal miners to allocate 25% of their production for domestic use. Additionally, coal prices were capped at USD 70/tonne for electricity (MEMR, 2022b) and USD 90/tonne for the industry (MEMR, 2022d). Similar regulations were imposed on gas, with fixed prices set for gas used in electricity and specific industries from 2021 to 2024. These measures are essential for managing the energy market and ensuring stability in the face of evolving global energy dynamics (MEMR, 2021b).

APEC Energy Goals

There are two energy-related objectives that APEC member economies have agreed to meet as a collective – to improve energy intensity and double the share of modern renewables.

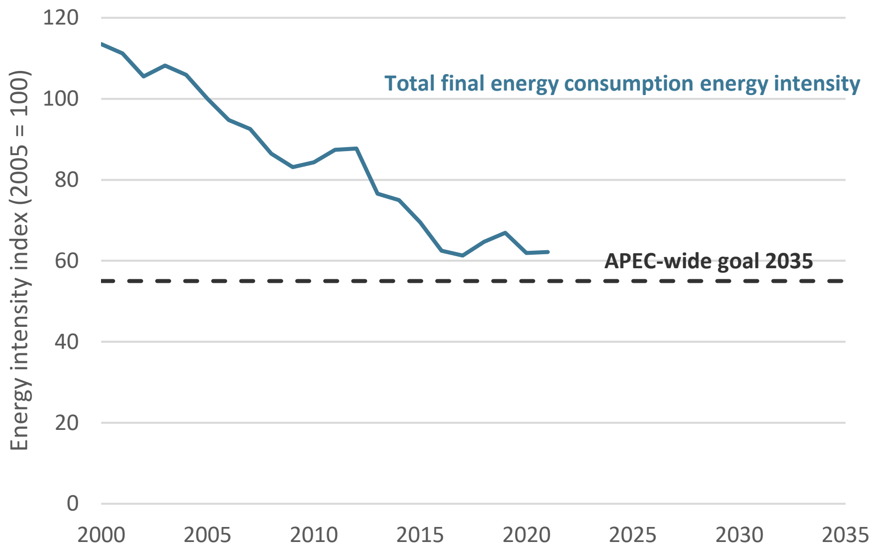
Energy intensity goal

In 2011, APEC member economies agreed to increase their ambition to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

APEC is on track to achieve this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

In 2021, Indonesia's total final energy consumption intensity (not including non-energy) improved by around 33% relative to 2005. This has contributed to APEC's overall commitment to improve energy intensity by 45% by 2035, as shown in Figure 11.

Figure 11: Indonesia total final energy consumption intensity index, 2000 to 2021 (2005 = 100)

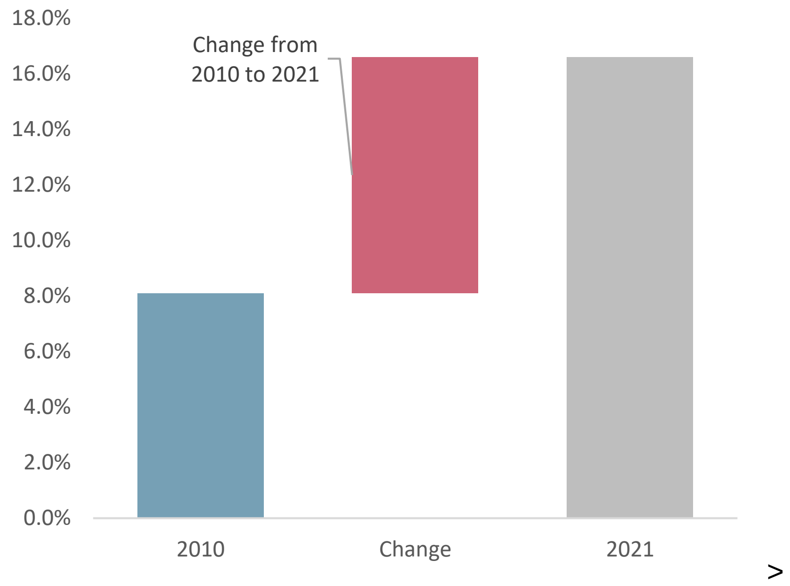


Source: EGEDA (2022)

Doubling of renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period 2010 to 2030. There is no economy-level goal for individual member economies, but improvements by individual economies will contribute to the doubling goal.

Figure 12: Indonesia modern renewable energy share, 2010 and 2021

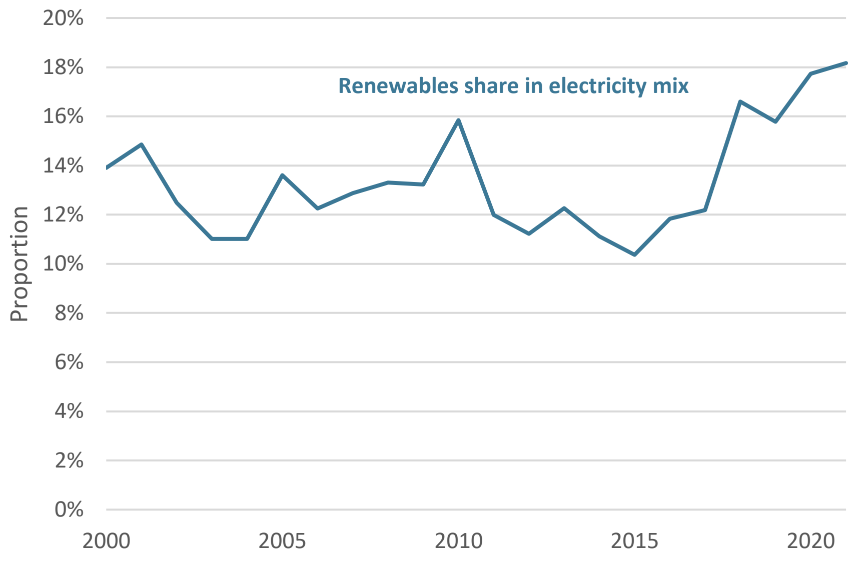


Source: EGEDA (2023)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Indonesia's utilisation of modern renewables in 2010 accounted for 8.1% of its final energy consumption. But in 2021, this proportion had notably increased to 17% (Figure 12). Over the past decade, there has been a surge in the consumption of fossil fuels, particularly coal and oil, in response to the rapidly expanding energy needs within Indonesia (EGEDA, 2023). Remarkably, the share of modern renewables in the 2020s has surpassed that of 2019. This shift is attributed to a decline in fossil fuel demand, particularly in oil for final energy consumption, and a concurrent rise in renewables for electricity generation. As Indonesia advances its policies aimed at achieving net zero emissions by 2060, or possibly even sooner, it is anticipated that the contribution of renewables to the overall energy mix will further escalate, signalling a pivotal step toward a more sustainable energy future.

Figure 13: Indonesia's renewable generation share, 2000 to 2021



Source: EGEDA (2023)

Energy Policy

Energy policy	Details	Reference
General Plan of National Energy	Indonesia has renewable energy targets in the energy mix of 23% in 2025 and 31% in 2050.	Ministry of Energy and Mineral Resources
General Plan of National Electricity	Electricity generation targets are 23% renewables, 22% natural gas, 55% coal, and 0.4% oil by 2025. For 2038, targets are 28% renewables, 25% natural gas, 47% coal, and 0.1% oil.	Ministry of Energy and Mineral Resources
Enhanced Nationally Determined Contribution of Indonesia	A reduction target of 31.89% and conditional reduction target of up to 43.2% of the business-as-usual scenario by 2030, with reduction of the energy sector targeted at 12.5% and conditionally 15.5%.	UNFCC
Coal-gasification programme	Indonesia is prioritising coal gasification as a key energy security programme. The first pilot programme is delivering the coal-to-dimethyl ether project in Sumatra. The constructed plant can produce 1.4 tonnes of DME per year starting in 2027.	Ministry of Energy and Mineral Resources
One million barrels of oil production	Programme to increase domestic oil production through investment in new oil fields and the use of enhanced oil recovery. Through this approach, oil production is expected to grow from 705 000 bpd to 1 million barrels per day and gas production of 12 BSCFD by 2030.	Ministry of Energy and Mineral Resources
The Refinery Development Master Plan	The refinery development master plan improves Indonesian energy security by mandating domestic processing of oil products. It is targeted to increase to 1.3 million bpd by 2025.	Pertamina
Green Refinery Project	The state oil company produces 100% diesel from palm oil by converting the existing Cilacap refinery, producing 6 000 bpd in 2021.	Pertamina
New Simplified Gross Split production share contract	Indonesia plant to introduce new production share contract, simplified gross split, for oil and gas development in Indonesia.	Directorate General of Oil and Gas
Gas pricing policy for the industry	The gas price for the industrial sector lowered to or close to USD 6/MMBTU for 2020-2024.	Ministry of Energy and Mineral Resources
Gas pricing policy for electricity generation	The gas price for electricity generation lowered to or close to USD 6/MMBTU for 2020-2024.	Ministry of Energy and Mineral Resources
Fuel conversion to LPG for small fishery boat	Indonesia continues its programme to convert oil fuel to LPG for small fishery boats as an effort to reduce emissions.	Directorate General of Oil and Gas
City gas expansion programme	Increases the share of gas supply to buildings, mostly in residential buildings. City gas network expansion will increase from up to 662.431 by 2021.	Directorate General of Oil and Gas
Biodiesel blending rate programme increased from 30% to 35%	Mandatory biodiesel blending program starting from a 10% blend rate in 2016 to a 20% rate in 2019 to 30% rate in 2020, and 35% rate from February 2023 onward.	Ministry of Energy and Mineral Resources

Energy policy	Details	Reference
Coal Domestic Market Obligation	Implementation of Coal Domestic Market Obligation rate at 25% of each coal mining company's production with a selling price of USD 70 per tonne for power production in 2022.	Ministry of Energy and Mineral Resources
EV Development Programme	The target for light duty EVs is to reach 2 million units, and electric motorcycles will reach 13 million units by 2030.	Directorate General New and Renewable Energy and Energy Conservation
The 2-wheeler ICE motorcycle conversion programme	Currently, 121 million units of ICE two-wheeler motorcycles are in operation in Indonesia. To accelerate the electrification in transport sector, Indonesia plans to launch the ICE to EV conversion programme for two-wheeler motorcycle.	Ministry of Energy and Mineral Resources
Mandatory Energy Efficiency	Mandatory Energy Efficiency standards for home appliances (LED, lighting, air circulating and air conditioning).	Ministry of Energy and Mineral Resources
Energy Efficiency Improvement Programme	The Indonesian government aimed to improve energy efficiency by 17% of energy saving in 2025 and by 39% in 2050 against business-as-usual energy consumption.	Ministry of Energy and Mineral Resources
Indonesia NZE Roadmap	Indonesia, in cooperation with IEA, launched its NZE roadmap for the energy sector of 2060.	Ministry of Energy and Mineral Resources
Accelerating renewable energy development	Indonesia has issued new Presidential regulation to accelerate the development of renewable energy and phasing out its coal power generations.	Ministry of Energy and Mineral Resources
Indonesia aims to increase mineral-added value by developing downstream industries.	Indonesia aims to increase mineral-added value by developing downstream industries (not only providing/exporting raw materials) and the battery industry to support electrification, especially in the transport sector (EV).	Ministry of Energy and Mineral Resources

Notable Energy Developments

Energy development	Details	Reference
Abadi LNG Project	Indonesia may form a consortium to take over Shell after Shell (35%) pulled out from Masela Block (Abadi LNG Project). In this project, INPEX controls 65% and hopes to make a final investment in Masela in the latter half of this decade.	REUTERS
Pertamina begins the year 2023 with thousands of barrels of oil reserves discovered	Pertamina found potential oil deposits and produced thousands of barrels of new oil reserves in the Rokan Working Area. There are four mainstay wells that are currently the focus because they have sizable oil reserves, namely in the Minas, Petani, Benar, and Bekasap fields, which produce between 1 000 and 1 400 barrels per day.	Pertamina
Bio-CNG from palm plantation	Indonesia started to produce Bio-CNG from palm plantations. For the first phase, 25 installations began to be constructed to make 387 000 M3 Bio-CNG.	Ministry of Energy and Mineral Resources
Extension of Operation 2055: BP LNG Tangguh Terminal	The operation contract of LNG Tangguh Terminal operated by BP is extended from 2035 up to 2055 with an expected new investment of USD 4.6 billion.	Ministry of Energy and Mineral Resources
Coal-to-Dimethyl Ether (DME) Conversion Programme	The coal-to-DME conversion programme is a strategy to reduce LPG imports relied on by the buildings sector. DME production is expected in 2027 at 1.4 million tonnes per year, with a total investment value of around USD 2.1 billion	Ministry of Energy and Mineral Resources
Just Energy Transition Partnership Commitment with Indonesia	EU and the International Partners Group (IPG) launched JETP with Indonesia. This extended partnership aims to mobilise an initial USD 20 billion over three to five years to achieve the future ambitious climate and energy targets.	JETP
Asia Zero Emission Community (AZEC)	Japan and Indonesia initiated the Asia Zero Emission Community (AZEC). With this initiative, Indonesia is prioritised to receive USD 500 million in funding to implement the energy transition.	Ministry of Energy and Mineral Resources
CCGT 275 MW in Sumatera	CCGT Riau, with a total capacity of 275 MW, started its operation in 2022.	Directorate General of Electricity
Refinery Development Master Program (RDMP) Balongan	Balongan Oil Refinery Unit Extension Program, as one of the refinery that undergo the Refinery Development Program, has been completed	Pertamina

Useful Links

BPH Migas, Downstream Oil and Gas Regulatory Agency – www.bphmigas.go.id

Ministry of Energy and Mineral Resources (KESDM) – www.esdm.go.id

Directorate General of Electricity – www.djk.esdm.go.id

Directorate General of Oil and Gas – www.migas.esdm.go.id

Directorate General of New Renewable Energy and Energy Conservation – www.ebtke.esdm.go.id

Directorate General of Mineral and Coal – www.minerba.esdm.go.id

National Energy Council – www.den.go.id

SKKMIGAS, Special Task Force for Upstream Oil and Gas – www.skkmigas-esdm.go.id

Ministry of Transportation – www.dephub.go.id

Ministry of Industry – www.kemenperin.go.id

PT Pertamina – www.pertamina.com

PT Pertamina Gas – www.pertagas.pertamina.com

PT PGN (Persero) – www.pgn.co.id

PT PLN (Persero) – www.pln.co.id

Statistics Indonesia (BPS) – www.bps.go.id

UNDP Indonesia – www.id.undp.org

World Bank – www.worldbank.org

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Japan

Introduction

Japan is an archipelago comprising of several thousand islands, with the largest being Honshu, Hokkaido, Kyushu and Shikoku. Its terrain is largely mountainous and densely forested. Japan boasts the world's third-largest economy after the United States and China.

In 2021, Japan's real gross domestic product (GDP) was approximately USD 5 157 billion (2017 USD purchasing power parity [PPP]) (World Bank, 2023). With a population of 126 million, the economy enjoyed a per capita income of more than USD 41 000, a 2.6% increase from 2020, indicating a strong recovery momentum that has brought Japan's GDP close to its pre-pandemic levels. Despite its economic prowess, Japan has modest energy resources, relying on imports for most of its fossil fuel needs. The economy's proven reserves include approximately 44 million barrels of oil, 738 billion cubic feet (bcf) of natural gas, and 350 million tonnes (Mt) of coal.

The Japanese Government periodically devises a Strategic Energy Plan to steer Japan's energy policy. The latest, the 6th Strategic Energy Plan, promulgated in 2021, underscores a commitment to carbon neutrality by 2050 and a reduction in greenhouse gas (GHG) emissions. Furthermore, it introduces initiatives to ensure a stable energy supply and lower energy costs while enhancing safety and fulfilling Japan's energy demands amidst the ongoing battle against climate change. This plan has already led to significant outcomes, such as the increased adoption of renewable energy sources, improvements in energy efficiency across various sectors, and the stimulation of technological innovation in energy storage and conservation.

Table 1: Japan's macroeconomic data and energy reserves

Key data [a, b]		Energy reserves [c, d, e]	
Area (million km²) [a]	378	Oil (million barrels) [c]	44
Population (million) [b]	126	Gas (billion cubic feet) [c]	738
GDP (2017 USD billion PPP) [b]	5 157	Coal (million tonnes) [d]	350
GDP per capita (2017 USD PPP) [b]	41 035	Uranium (kilotonnes U < USD 130/kgU) [e]	6.6

Source: [a] GIS (2022); [b] World Bank (2023); [c] Xu & Bell-Hammer (2023); [d] EI (2023); [e] NEA & IAEA (2023)

Note: Reserves are total proved reserves and reasonably assured recoverable resources for uranium.

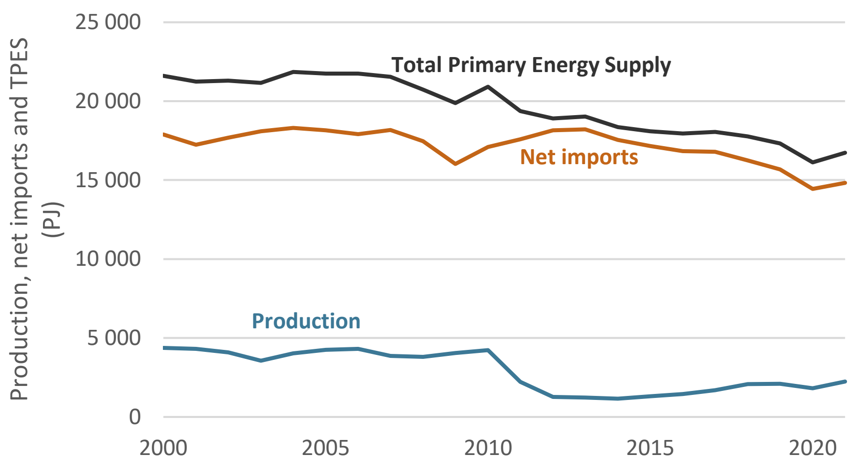
A key legislative advancement, the amendment to the Act on Rationalizing Energy Use effective from April 2023, broadens the policy's remit to encompass non-fossil energies, signalling a strategic pivot towards more sustainable energy consumption patterns. This legislative change reflects Japan's resolve to harmonise economic vitality with environmental conservation, even as it navigates the lingering economic repercussions of the COVID-19 pandemic.

Energy Supply and Consumption

Total primary energy supply

In 2021, Japan's total primary energy supply (TPES) reached 16 731 petajoules (PJ), marking a 3.8% increase from the previous year (Expert Group on Energy Data Analysis [EGEDA], 2023) (Figure 1). Following the Great East Japan Earthquake, Japan took all its nuclear reactors offline, leaving its energy mix dominated by fossil fuels. Although coal and oil consumption saw a resurgence in 2021 following the pandemic's downturn, natural gas usage continued a steady decline because of a significant increase in natural gas prices, attributed to supply constraints and heightened global demand.

Figure 1: Japan's energy supply, production, and net imports (PJ), 2000 to 2021

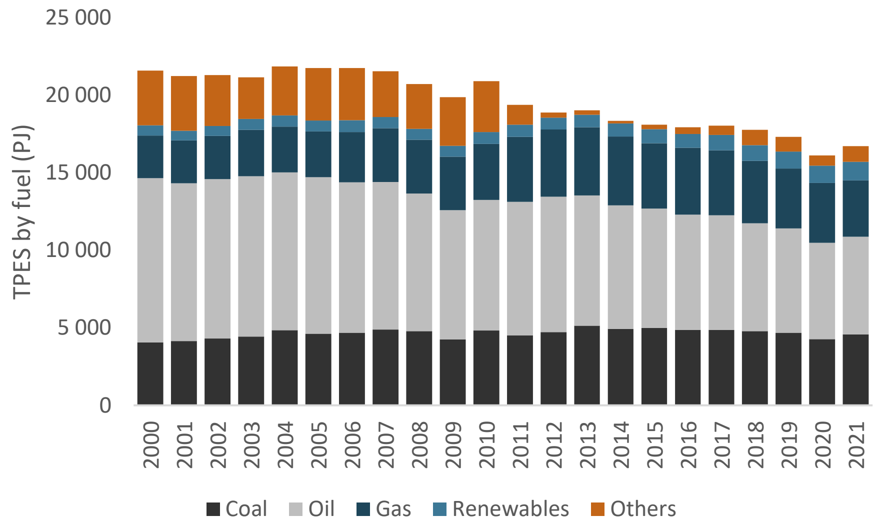


Source: EGEDA (2023)

Oil remained the dominant energy source, accounting for 38% of Japan's TPES in 2021, with coal at 27% and natural gas at 22% (EGEDA, 2023). The economy's reliance on energy imports is significant, as they constituted 89% of the TPES (EGEDA, 2023).

In 2021, Japan maintained its position as the world's sixth-largest oil consumer and the fourth within APEC economies. Japan's oil consumption heavily depends on imports, mostly from the Middle East. During the 2010s, Japan diversified its oil sources, partially due to increased imports from Russia via the Eastern Siberia Pacific Ocean pipeline. By 2021, Saudi Arabia and the United Arab Emirates emerged as the predominant suppliers, providing 37% and 36% of Japan's oil, respectively (METI, 2023a).

Figure 2: Japan's energy supply by fuel (PJ), 2000 to 2021



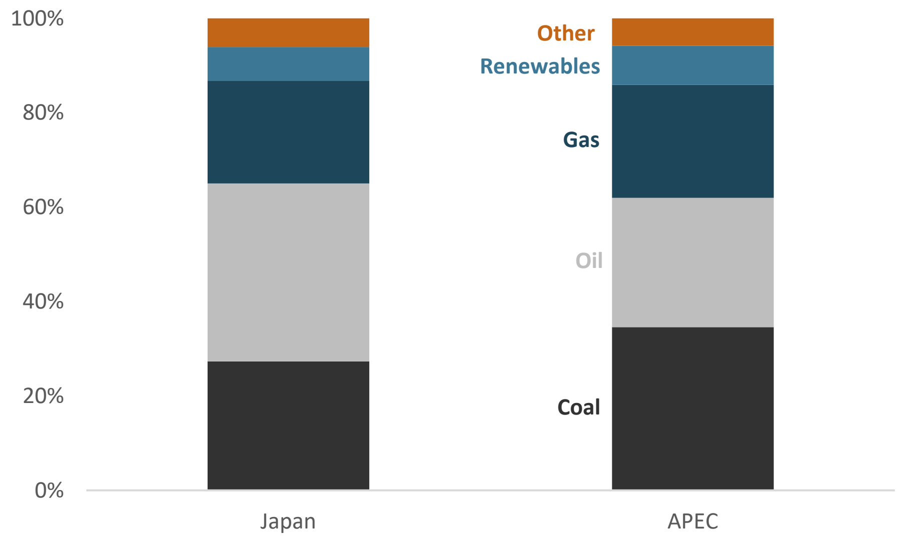
Source: EGEDA (2023)

Japan's energy supply profile in 2021 showed oil leading at 6 308 PJ, a slight increase of 1.6% from the previous year (EGEDA, 2023) (Figure 2). Coal, with the primary supply at 4 659 PJ, saw a more substantial increase of 7%, affirming Japan's status as one of the world's largest coal importers (EGEDA, 2023). The economy's coal demand, driven by power generation, steel production, and the cement industry, was largely met by imports from Australia (72%), as of 2021 (METI, 2023a). Australia was also the top supplier of coking coal at 55% in 2021

(METI, 2023a).

Natural gas, another critical component of Japan's energy mix, is scarce domestically. In 2021, its domestic production stood at 2.3 billion cubic metres (bcm), with notable production in Niigata, Chiba, and Hokkaido prefectures, accounting for 2.2% of domestic demand (METI, 2023a). Japan's LNG imports, essential for electricity generation and city gas, accounted for a significant 20% of the global trade in 2021 and are mainly sourced from Australia (38%), Malaysia (14%), Qatar (9.9%) and Russia (9.5%) (METI, 2023a). The primary natural gas supply was 3 631 PJ, reflecting a decrease of 5.9% from the previous year.

Figure 3: Energy supply mix – Japan and APEC, 2021



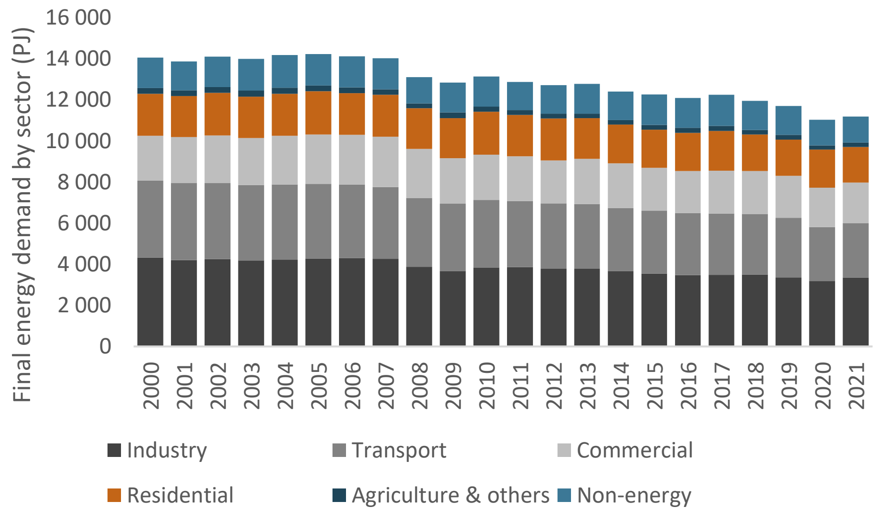
Source: EGEDA (2023)

In contrast to APEC's overall energy mix, Japan has a notably higher reliance on oil (+10%) and less on coal (-7.3%). The share of gas and renewables is almost on par with the APEC region (EGEDA, 2023) (Figure 3).

Total final consumption

In 2021, Japan saw a marginal increase in its final energy consumption, excluding non-energy uses, rising 1.3% to 9 918 PJ from the previous year (EGEDA, 2023). Including non-energy usage, the total climbed to 11 189 PJ (EGEDA, 2023).

Figure 4: Japan's final consumption by sector (PJ), 2000 to 2021

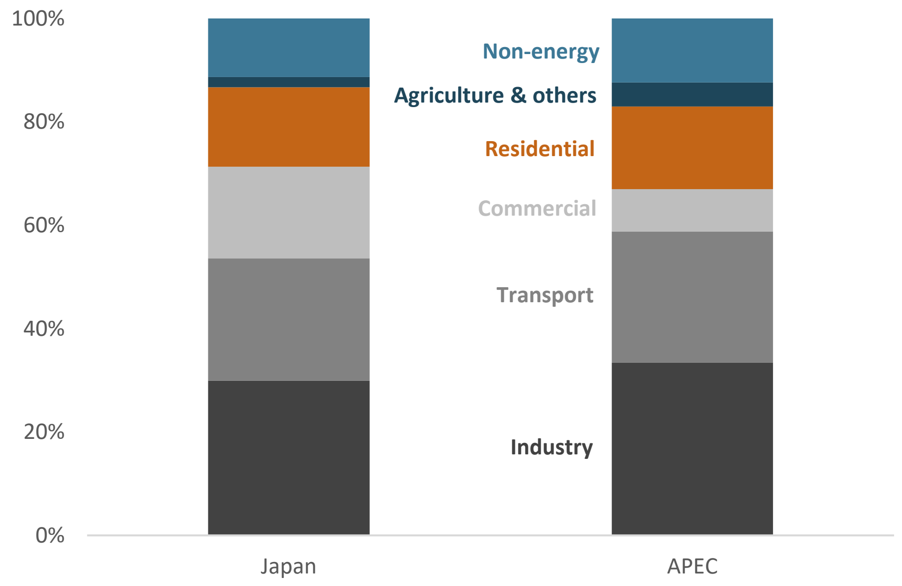


Source: EGEDA (2023)

Despite a long-term downward trend since a 2005 peak, Japan experienced a slight uptick in energy demand in 2021, attributed to the economic rebound following the first year of the pandemic. With the exemption of the residential sector, other sectors saw increases, nudging the economy's overall final consumption up by approximately 150 PJ from 2020 (EGEDA, 2023) (Figure 4).

The industrial sector was responsible for 30% of Japan's final energy consumption, followed by the transport sector at 24%, the commercial sector at 18%, and residential sector at 15% (EGEDA, 2023). Notably, the commercial sector's energy use is more than twice that of the APEC region's 8.2% (EGEDA, 2023) (Figure 5).

Figure 5: Final consumption by sector, Japan and APEC, 2021



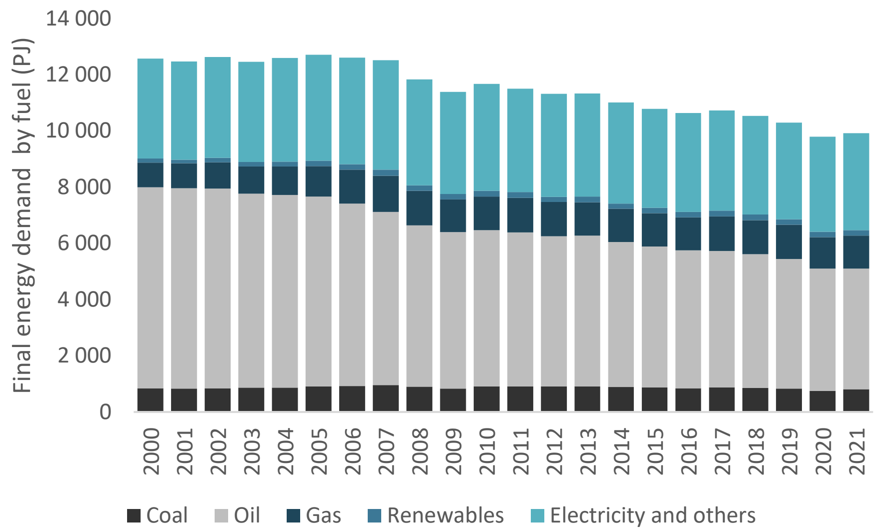
Source: EGEDA (2023)

In 2021, industry demand surged by 5.1% compared to 2020, signalling a recovery from the pandemic's economic impact (EGEDA, 2023). Although passenger transport saw a decline, a rise in freight activities led to an overall 1% increase in the transport sector's energy use to 2 649 PJ (EGEDA, 2023). Meanwhile, the residential sector's consumption fell by 6.6%, reflecting lifestyle changes as the economy reopened (EGEDA, 2023).

Final energy demand

In 2021, oil remained the preeminent component of Japan's final energy demand at 43%, amounting to 4 284 PJ, which represents a slight decrease of 1.4% compared to the previous year (EGEDA, 2023) (Figure 6). Electricity and other energy sources constituted 35%, gas 12%, and coal 8.2% (EGEDA, 2023). The contribution of renewables to Japan's energy demand was relatively low at 2% (EGEDA, 2023). In the APEC context, Japan's dependency on oil was higher by 10 percentage points, while its use of coal was lower by 6.2 percentage points, with negligible differences in the consumption of other fuels (EGEDA, 2023) (Figure 7).

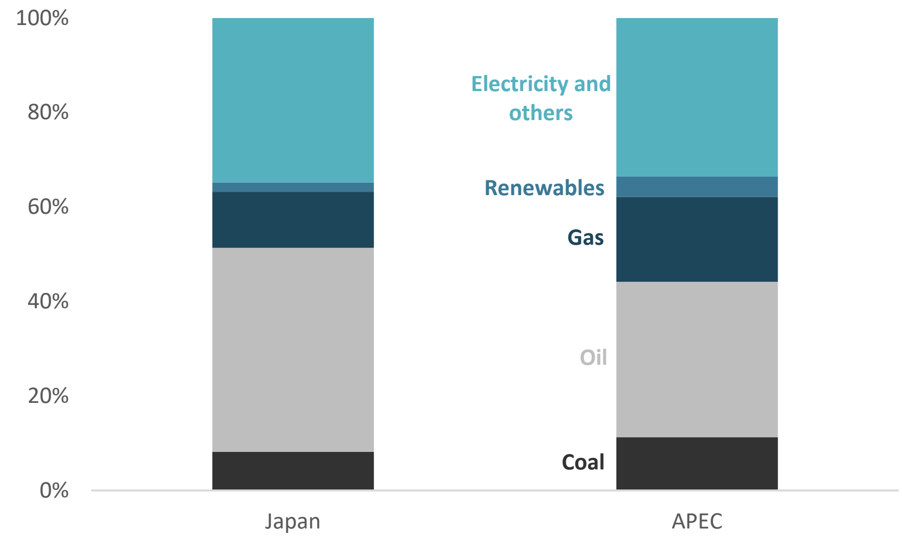
Figure 6: Japan's final energy demand by fuel (PJ), 2000 to 2021



Source: EGEDA (2023)

Note: Does not include non-energy sector consumption of energy products.

Figure 7: Final energy demand fuel share, Japan and APEC, 2021



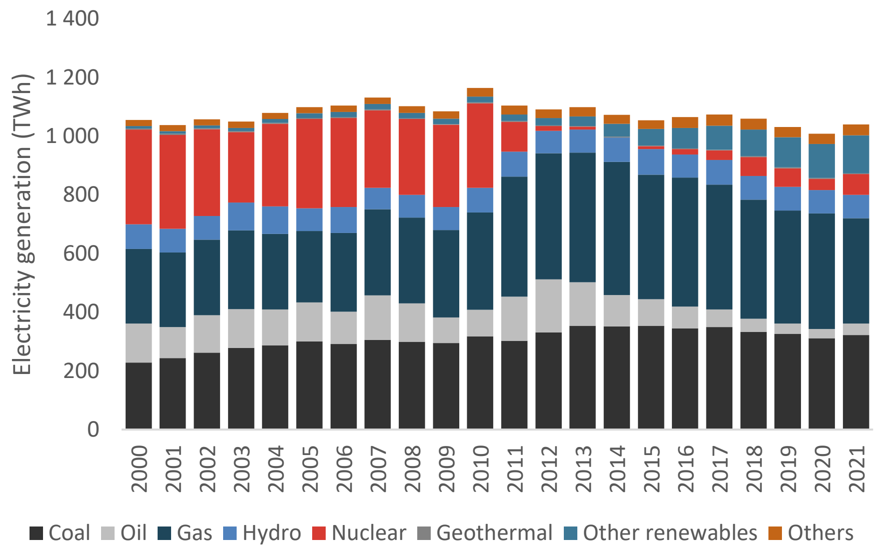
Source: EGEDA (2022)

Transformation

Power sector

As of October 2023, Japan's installed generating capacity stood at 266 gigawatts (GW) (METI, 2024b). It generated 1 040 terawatt-hours (TWh) of electricity in 2021 (EGEDA, 2023) (Figure 8). The majority, 69% of this electricity, was derived from fossil fuels, while a significant 20% came from renewable sources such as hydro, solar, wind and geothermal (EGEDA, 2023). Nuclear energy contributed 6.8% to the mix after a period of stagnation following the 2011 Fukushima Daiichi nuclear accident (EGEDA, 2023). By January 2024, Japan had successfully restarted 12 commercial nuclear reactors, with Takahama Unit 1 and Unit 2 among the latest to be restarted in 2023, further bolstering its nuclear energy capacity (METI, 2024c).

Figure 8: Japan's electricity generation by fuel, 2000 to 2021

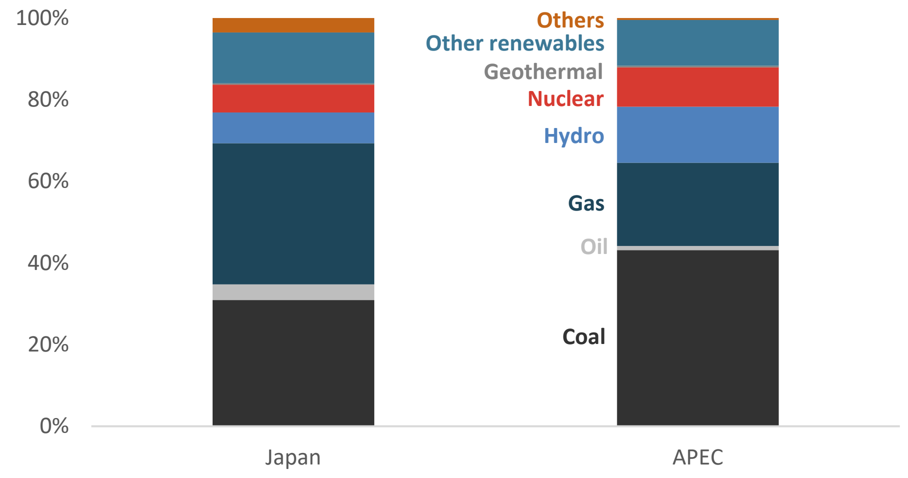


Source: EGEDA (2023)

Japan's energy profile contrasts with that of the broader APEC region; it relies more heavily on fossil fuels by an additional 4.8 percentage points and less on renewables by 4.9 percentage points (EGEDA, 2023) (Figure 9). Notably, it uses 14 percentage points more gas and 12 percentage points less coal, along with 6.1 percentage points less hydropower (EGEDA, 2023).

Since 1995, the Japanese electricity market has been undergoing a process of liberalisation to ensure fair competition and transparency. Liberalisation diminishes monopoly power by facilitating competition in the electricity market, where practical. Japan's partial liberalisation enabled businesses other than major electricity companies to sell electricity. Independent power producers were introduced in 1995, along with a system of power producers and suppliers (PPSs). Additionally, partial retail competition (for purchases over 2 000 kW) was established in 2000. The scope of the retail competition was expanded to include contracts larger than 500 kW in 2004 and larger than 50 kW in 2005 (METI, 2011).

Figure 9: Electricity generation fuel share, Japan and APEC, 2021



Source: EGEDA (2023)

As a result of the earthquake and nuclear power accident in March 2011, and due to the limitations in the capacity of the east-west frequency conversion facilities and inter-regional interconnection lines, it was not possible to sufficiently operate the wide-area grid and supply electricity. Afterwards, Japan's electricity sector faced mounting pressure to deregulate further to create a more competitive and transparent system. Finally, in 2016, the retail electricity market was fully liberalised. As of December 2021, the sales share of PPS reached around 22% (METI, 2022).

This overview underscores Japan's evolving energy landscape, balancing traditional energy sources with renewables and navigating through regulatory reforms to create a resilient and competitive electricity market.

Energy transition

Ensuring a stable energy supply while addressing the urgent need for emissions reductions is a critical balancing act for Japan, given its scarcity of natural energy resources.

Emissions

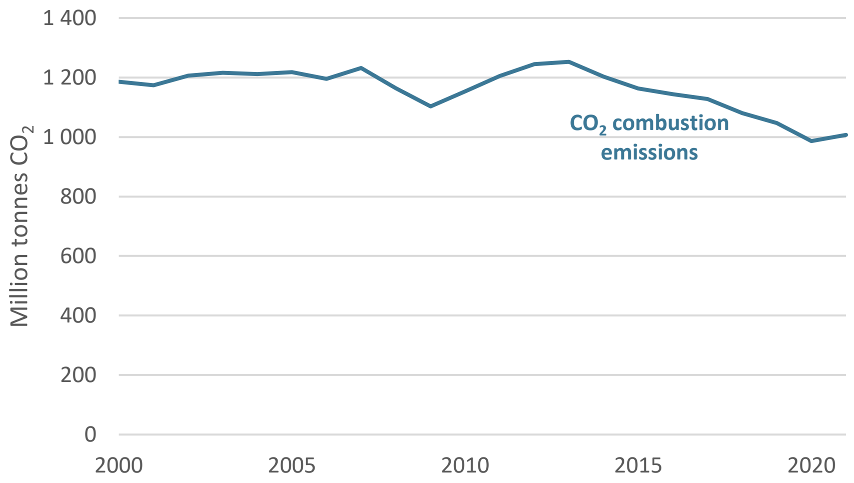
Japan has legally enshrined the goal of carbon neutrality by 2050, underscoring its commitment to environmental sustainability. Alongside this, Japan has set a bold target to reduce greenhouse gas (GHG) emissions by 46% by 2030 from 2013 levels, with an aspirational push for a 50% reduction, as submitted in its Nationally Determined Contribution (NDC) to the United Nations Framework Convention on Climate Change (UNFCCC) (MoE, 2022).

Remarkably, Japan has made noteworthy progress in reducing CO_2 combustion emissions, achieving a 20% reduction by 2021 from 2013, reflecting the success of its energy policies and commitment to global climate change goals (EGEDA, 2023) (Figure 10).

The economy also recognises the importance of improving energy efficiency in developing economies such as Indonesia and Thailand, where energy consumption is expected to surge. Japan is poised to play a supportive role, leveraging its technological advancements and experience to assist these economies in reducing the carbon emissions associated with increased fossil fuel use.

As Japan continues to advance its energy transition, relevant issues such as the integration of renewable energy, enhancement of energy storage solutions, and the development of smart grids will remain at the forefront of policy and innovation. This comprehensive approach to energy transition not only aims to secure Japan's energy future but also contributes significantly to global efforts in combating climate change.

Figure 10: Japan's CO_2 combustion emissions (million tonnes), 2000 to 2021



Source: EGEDA (2023)

Energy security

Japan is actively strengthening its energy security by diversifying its energy mix and building cooperative agreements with other economies. Efforts to accelerate the domestic production of renewable energy are underway, and Japan is also working on bringing more nuclear plants back online. In addition, Japan is developing thermal power plants that aim for lower emissions through techniques such as ammonia co-combustion in boilers.

One of the key strategies in Japan's energy policy is the utilisation of ammonia as a potential clean energy source. Large-scale pilot trials have shown the feasibility of burning a coal-ammonia mix, with the largest power plant operator, JERA, investing in projects to test the feasibility of 50% ammonia mix (Hughes & Beck, 2022). The success of these projects could pave the way for significant reductions in CO_2 emissions from thermal power generation. However, the environmental benefits of using ammonia are contingent on how it is produced. Ammonia production currently relies heavily on processes that emit CO_2, but there is a potential for 'green' ammonia production using renewable energy, which would result in near-zero emissions (Hughes and Beck, 2022).

In terms of nuclear energy, Japan is considering bringing online existing nuclear power plants that were mothballed after the Fukushima triple disaster, as well as investing in the development of advanced next-generation reactors for overseas use. However, the economy still grapples with the aftermath of the Fukushima Daiichi incident, including issues related to nuclear waste, decommissioning of old reactors, and public trust in nuclear energy.

Moreover, carbon capture and utilisation (CCU) and carbon capture, utilisation and storage (CCUS) projects have been implemented to ensure energy security alongside achieving carbon neutrality (METI, 2022).

APEC Energy Goals

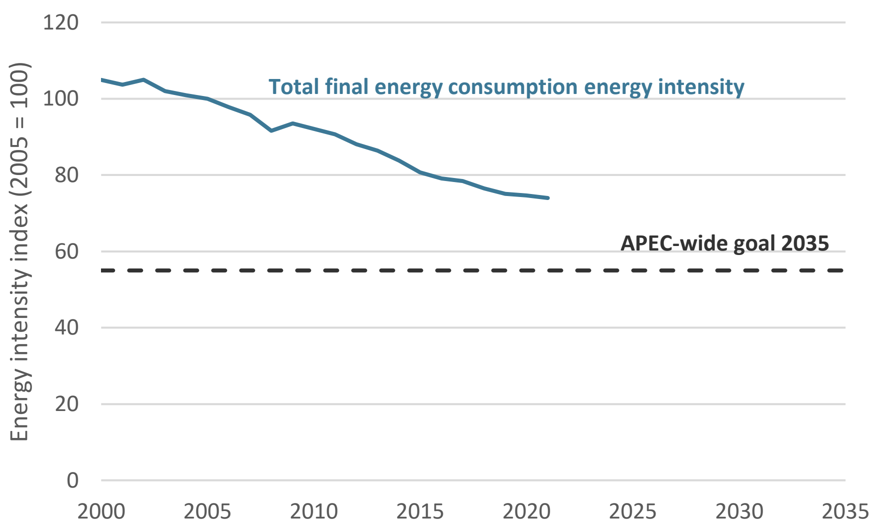
There are two energy-related objectives that APEC member economies have agreed to meet as a collective: to improve energy intensity and double the share of modern renewables.

Energy intensity goal

In 2011, APEC member economies agreed to increase their ambition to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

APEC is on track to achieve this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

Figure 11: Japan's total final energy consumption intensity index, 2000 to 2021 (2005 = 100)



Source: EGEDA (2022)

Japan has made significant strides in enhancing energy efficiency with the establishment of the Energy Conservation Law in 1979, following the oil crisis. This law serves as the cornerstone of Japan's energy conservation efforts (METI, 2019). This legislation targets key sectors such as industry, buildings (both commercial and residential), and transport, mandating improvements in energy efficiency. The law's long-term impact is evident, as Japan realised a notable 26% improvement in energy intensity from 2005 to 2021, a testament to the effectiveness of its energy policies (EGEDA, 2023) (Figure 11). Furthermore, the year-on-year improvement from 2020 to 2021 alone was 0.8%, reflecting ongoing advancements in energy conservation and efficiency practices across the economy (EGEDA, 2023).

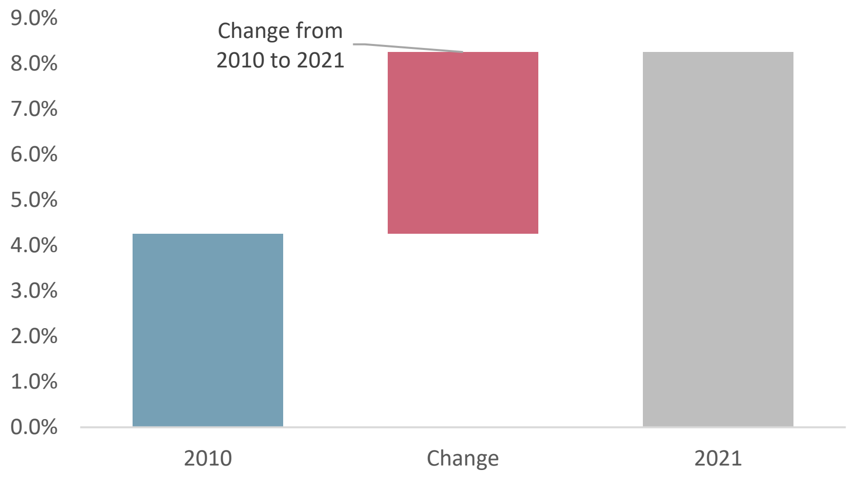
Doubling of renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period 2010 to 2030. There is no economy-level goal for individual member economies, but improvements by individual economies will contribute to the doubling goal.

Japan has made significant strides in renewable energy over the past decade, witnessing a remarkable 93% increase in the renewable share of final energy consumption, reaching 8.3% in 2021 (EGEDA, 2023) (Figure 12).

The introduction of the feed-in tariff (FIT) system in July 2012 played a pivotal role in this growth, particularly in solar energy, where Japan's solar capacity per square kilometre is among the highest of major economies. The FIT system guaranteed a fixed purchase price for electricity from renewable sources, spurring rapid deployment, especially in the solar sector. This also led Japan's renewable generation share in the electricity mix to double in a decade from 10% to 20% between 2011 and 2021 (EGEDA, 2023) (Figure 13).

Figure 12: Japan's modern renewable energy share, 2010 and 2021

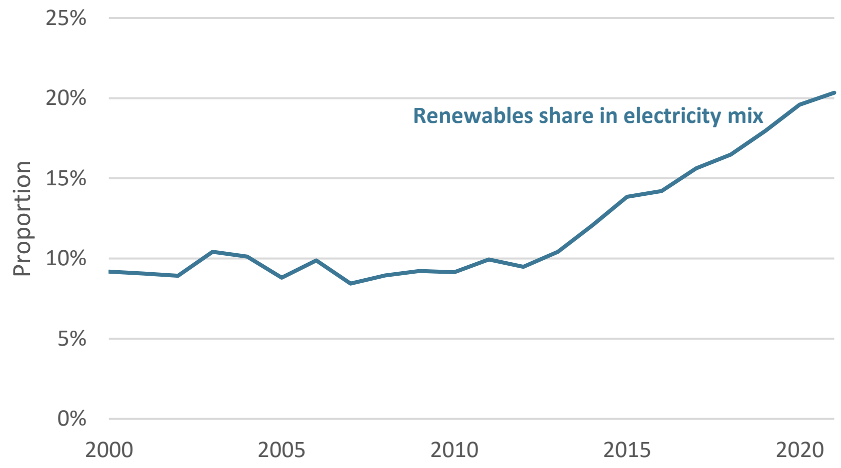


Source: EGEDA (2023)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

The 6th Strategic Energy Plan, released in October 2021, reaffirms Japan's commitment to renewable energy as a cornerstone of its future generation. This plan envisions renewables accounting for 36-38% of Japan's electricity generation by 2030. The strategy emphasises the need for innovation and recognises the potential role of hydrogen, expecting it to play a central role in Japan's clean energy transition. Japan aims to establish a comprehensive hydrogen supply chain and is exploring large-scale power generation based on hydrogen, which could offer insights to the global energy community on making hydrogen a viable clean energy source.

Figure 13: Japan's renewable generation share, 2000 to 2021



Source: EGEDA (2023)

Japan faces challenges due to its geographical constraints, which can lead to high grid connection costs. This, along with a gradual decrease in FIT prices, has slowed down investment in solar power. To address these issues, Japan is transitioning towards a feed-in premium (FIP) scheme, which aligns the revenue for generators with market prices, providing incentives for supply adjustments based on demand, unlike the FIT scheme.

To continue reducing the cost of renewable generation and make it competitive with conventional power sources, Japan is focusing on technological innovation and market-based instruments to foster low-carbon technologies. Discussions are underway about introducing economic mechanisms such as carbon tax and carbon border adjustments to enhance low-carbon technology adoption and further increase energy efficiency.

The journey towards a sustainable and resilient energy system in

Japan is characterised by a combination of policy measures, technological advancements, and international cooperation, all aimed at harmonising the economy's energy security with its environmental commitments.

Energy Policy

Energy policy	Details	Reference
The 6th Strategic Energy Plan	The Plan reflects Japan's approach to balancing energy security and environmental sustainability. Sets diverse energy mix targets for 2030, emphasising a balanced approach between renewables (36-38%), nuclear (20-22%), LNG (20%), coal, oil (2%), and hydrogen/ammonia (1%).	METI
Japan's Nationally Determined Contribution (NDC)	A 46% GHG emission reduction target by 2030 from 2013 levels, showcasing Japan's commitment to international climate goals.	MOE
The Plan for Global Warming Countermeasures	Outlines actionable measures for various stakeholders to achieve a 46% GHG emission reduction by 2050.	MOE
The Long-Term Strategy under the Paris Agreement	Japan’s strategy for low GHG emission development in line with the Paris Agreement provisions.	MOE
Clean Energy Strategy to Achieve Carbon Neutrality by 2050	Focuses on energy security and accelerated decarbonisation in response to global energy shifts, especially due to geopolitical events.	Cabinet Public Affairs Office, Cabinet Secretariat
Green Growth Strategy	Action plans for 14 industries to support sustainable development and green technology through various incentives and international cooperation.	METI
Basic Policy for the Realisation of GX	A policy decided in February 2023 to enhance industrial competitiveness and decarbonisation, promoting energy efficiency and the shift to decarbonised power sources.	METI
Sector-specific Investment Strategies for GX	Promotes investment in prioritised sectors as part of the GX initiative, accelerating Japan's sustainable energy policies.	METI
Top Runner Programme	Sets efficiency benchmarks for household appliances to promote energy conservation.	METI

Energy policy	Details	Reference
Electricity System Reform	Expand Economy-wide Coordination of Transmission Operators, achieve full liberalisation of electricity retail business and generation and secure neutrality of power transmission and distribution sectors.	METI
Establishing Resilient and Sustainable Electricity Supply Systems	Implements measures for sustainable electricity supply, including disaster response collaboration and renewable energy support.	METI
Baseload Market	Aims to ensure equal access to cheap power supplies for new power retail companies, fostering market competition.	METI (Japanese only)
Long-term Decarbonised Power Source Auction	Encourages investment in non-carbon-emitting power sources, aiming for long-term financial stability for renewable energy, nuclear power, and battery storage, reflecting a strategic approach to energy transition.	METI (Japanese only)
Feed-in Tariff (FIT) Law	Enhances economy-wide coordination of transmission operators and achieves full liberalisation of the electricity retail business.	METI (Japanese only)
Feed-in Premium (FIP)	Introduced in April 2022, the FIP system complements the FIT by aligning renewable energy prices with market rates.	METI (Japanese only)
J-Credit Scheme	Certifies CO_2 reduction or absorption volumes as credits, facilitating carbon offset initiatives.	METI
Roadmap for Carbon Recycling Technologies	Focuses on recycling CO_2 into useful products, reducing atmospheric CO_2 emissions.	METI
Basic Plan for the Promotion of Biomass Utilisation	Utilise biomass for energy, contributing to rural revitalisation and a recycling-oriented society.	MAFF
JOGMEC's Financial Assistance to Japanese Companies	Provide financial support to Japanese companies for energy projects.	JOGMEC
Japan Bank for International Cooperation (JBIC) Support	Provide export loans, overseas investment loans, import loans, united loans, equity participation and guarantees.	JBIC

Notable Energy Developments

Energy development	Details	Reference
Asia Zero Emission Community (AZEC)	In the Asia Zero Emission Community (AZEC) Leaders Meeting in December 2023, Prime Minister Kishida affirmed the importance of achieving a common goal of "net-zero emissions through various pathways" and of a triple breakthrough of simultaneously achieving "decarbonization, economic growth, and energy security". And the meeting emphasised net-zero emissions in Asia, with Japan promoting next-generation technologies and collaboration, indicating Japan's leadership role in regional decarbonisation efforts.	METI
The Revised Act on Rationalizing Energy Use	Expands energy rationalisation to non-fossil fuels, targeting large-scale businesses to adopt environmentally friendly equipment and processes.	METI
GX Promotion Act	Supports Japan's transition to a decarbonised, growth-oriented economy with measures including carbon pricing mechanisms and the establishment of a GX Promotion Organization.	METI
Updated Basic Hydrogen Strategy	Focuses on establishing a hydrogen supply chain based on carbon intensity and aims to position Japan as a leader in hydrogen and ammonia technology in Asia and the Indo-Pacific.	METI
New Nuclear Law	Extends the operational limit of nuclear power plants beyond 60 years under strict safety regulations, reflecting the role of nuclear energy in Japan's energy mix.	AEC
Tokyo GX Week 2023	A METI-led initiative focused on Green Transformation (GX), aiming to align clean energy transitions with decarbonisation and economic development, reflecting Japan's leadership in global green transformation dialogues.	METI
LNG Producer-Consumer Conference 2023	An annual forum initiated by METI since 2012 for stakeholders in the LNG market to foster dialogue and cooperation, demonstrating Japan's pivotal role in the global LNG sector.	LNG PCC
Sixth Hydrogen Energy Ministerial Meeting	Discussions focused on accelerating hydrogen demand with goals for substantial increases by 2030, highlighting hydrogen's role in sustainable growth and job creation, aligning with global sustainable energy objectives.	METI

Energy development	Details	Reference
Launch of Nuclear Supply Chain Platform Website	The platform supports Japan's nuclear energy initiatives, serving as a collaborative hub for stakeholders, ensuring alignment with Japan's energy goals and safety standards.	METI
Comprehensive Evaluation of Seafloor Hydrothermal Deposits	METI and JOGMEC's evaluation of these deposits for domestic mineral supply, aligning with Japan's ocean policy and marine resource development plans, indicating exploration of alternative resources.	METI

Useful Links

Agency for Natural Resources and Energy – https://www.enecho.meti.go.jp/en/

Ministry of Economy, Trade and Industry – https://www.meti.go.jp/english/index.html

Ministry of the Environment – http://www.env.go.jp/en/index.html

Ministry of Land, Infrastructure, Transport and Tourism – https://www.mlit.go.jp/en/index.html

Institute of Energy Economics, Japan – https://eneken.ieej.or.jp/en/

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Republic of Korea

Introduction

The Republic of Korea (Korea) is located in Northeast Asia, positioned between China and Japan. It has an area of 100 413 square kilometres (km^2) and in 2022 had a population of approximately 52 million. Korea has an extremely high population density, with an average of around 516 people per km^2. Seoul, Korea's largest city and capital, is home to around 20% of the total population and has a population density of 15 550 people per km^2. The economy's terrain consists of hills and mountains with extensive coastal plains in the west and south. The climate is relatively temperate, with four distinct seasons. Korea's energy consumption is influenced by weather conditions, which means that air conditioning is essential during the hot summers and heating during the frigid winters.

Korea has emerged as one of Asia's most dynamic and rapidly expanding economies in recent decades. In 2022, the GDP reached USD 2 352 billion (2017 USD purchasing power parity [PPP]). The GDP per capita in 2022 stood at USD 45 560(2017 USD PPP), reflecting a threefold increase from 1990.

Korea's primary industries include semiconductors, shipbuilding, cars, petrochemicals, digital electronics, steel, and machinery parts and materials. In 2022, manufacturing accounted for approximately 28% of GDP, with an export-oriented manufacturing sector driving economic growth. For instance, Korea's semiconductor and electric vehicle (EV) battery production sectors are enhancing their capacities in line with increasing demand.

Before and since President Yoon assumed office in May 2022, the Korean government has faced global energy supply volatility due to the rebalancing of the world energy markets provoked by geopolitical volatility post-COVID conditions. As it becomes increasingly important to strike a balance between carbon neutrality and energy security, the new government continues to monitor the direction of changes in the global energy supply chain to develop a feasible and reasonable energy mix, having released their new energy policy goals and directions in July 2022.

Korea has limited domestic energy resources. With no oil resources except for a small amount of condensate, only 326 million tonnes of recoverable coal reserves, and 0.3 trillion cubic feet of natural gas, Korea relies on energy imports to sustain its strong economic growth.

Table 1: Korea's macroeconomic data and energy reserves

Key data [a, b]		Energy reserves [c]	
Area (km^2) [a]	100 413	Oil (billion barrels)	-
Population (million) [a]	51.8	Gas (trillion cubic feet)	0.3
GDP (2017 USD billion PPP) [b]	2 352	Coal (million tonnes)	326
GDP per capita (2017 USD PPP) [b]	45 560	Uranium (kilotonnes U < USD 130/kgU)	-

Source: a KOSIS (2022); b World Bank (2023); c Energy Institute (2023)

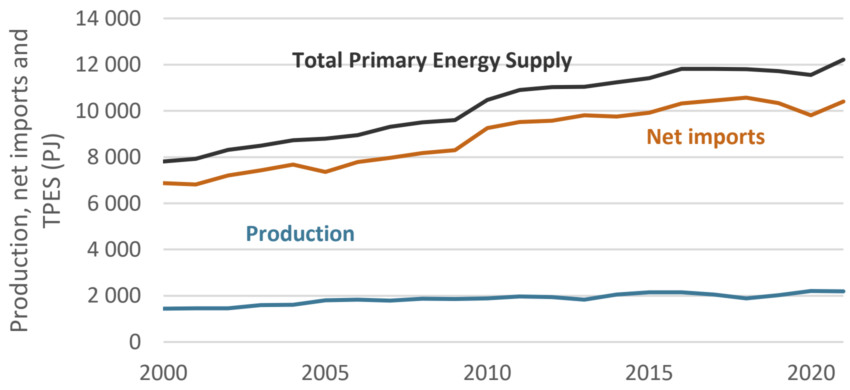
Note: Reserves are total proved reserves and reasonably assured recoverable resources for uranium.

Energy Supply and Consumption

Total primary energy supply

From 1990 to 2021, Korea's total primary energy supply (TPES) experienced a nearly threefold increase, rising from 3 890 PJ to 12 216 PJ. TPES demonstrated a robust growth trajectory, with an annual average rate of 7.3% from 1990 to 2000, outpacing the 7.1% annual growth rate of the economy during the same period. Following 2000, TPES experienced a notable increase of 56%, rising from 7 811 PJ to 12 216 PJ. However, a decrease of 2.08% was observed in the three-year span from 2018 to 2020 largely attributable to the COVID-19 pandemic (Figure 1). In particular, reductions in energy supply in 2020 were primarily derived from coal and oil compared to 2019 levels. After four consecutive years of decline, Korea witnessed a substantial 5.7% surge in its TPES in 2021, primarily driven by oil and gas (EGEDA, 2023).

Figure 1: Korea's energy supply, production, and net imports (PJ), 2000 to 2021

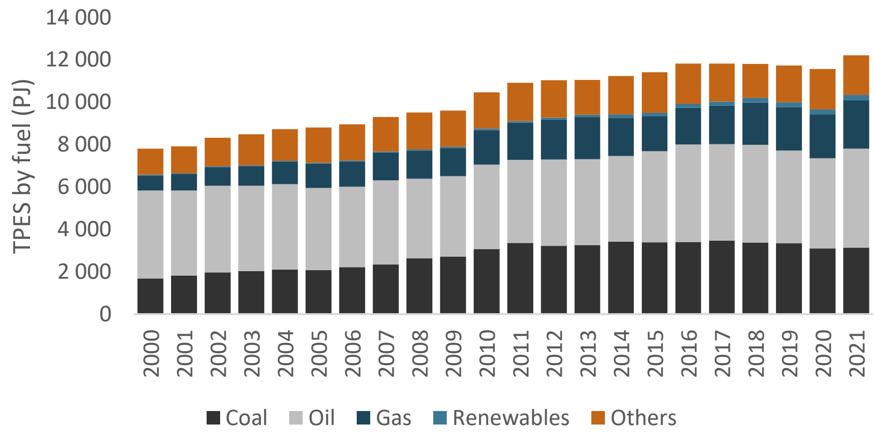


Source: EGEDA (2023)

Due to its limited domestic energy resources, a significant portion of Korea's TPES is imported. In 2021, approximately 85.2% of Korea's TPES was reported as net imports. During that year, Korea ranked as the world's fourth-largest importer of crude oil, sixth-largest importer of natural gas, and fourth-largest importer of coal (IEA, 2023).

From 2000 to 2021, Korea's TPES fuel mix reflected the economy's desire to have a stable energy supply (Figure 2). During this period, renewable energy experienced substantial growth, rising from 34 PJ to 254 PJ, marking a modest increase in its proportional share from 0.4% to 2.1%. Notably, the share of natural gas saw a rapid surge, from 9% in 2000 to 18.6% in 2021. The volume of natural gas consistently increased from 1 647 PJ in 2015 to 2 278 PJ in 2021. In contrast, coal reached its peak in 2017, and oil reached its highest point in 2018, followed by a subsequent decline until 2020. Despite these fluctuations, coal, oil, natural gas and renewable energy sources collectively contributed to an overall increase in TPES in 2021 (EGEDA, 2023).

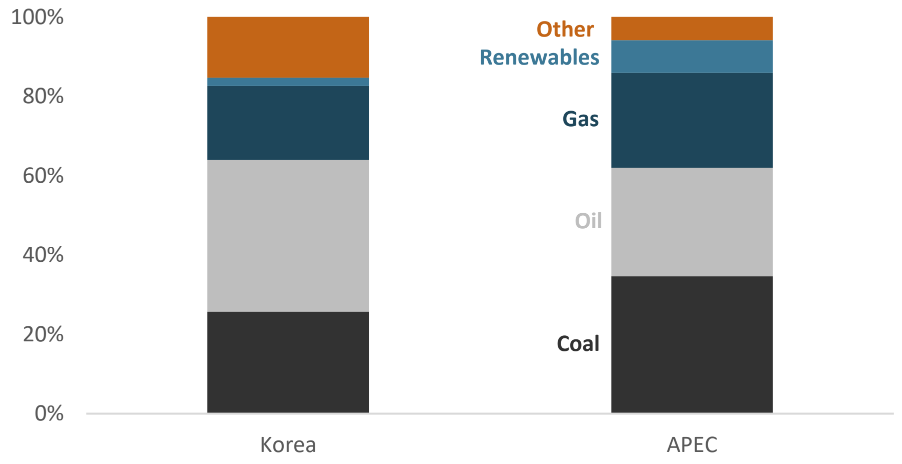
Figure 2: Korea's energy supply by fuel (PJ), 2000 to 2021



Source: EGEDA (2023)

As of 2021, the composition of coal, oil and gas in Korea's energy mix accounted for more than 80% of TPES, which is similar to APEC (Figure 3). However, Korea's TPES fuel mix displayed differences in the distribution of energy sources when compared to the overall APEC region. Notably, the proportion of oil and other in Korea's TPES was higher than APEC, although coal, gas, and renewables were comparatively lower. Korea's oil share in the TPES was 38%. Coal and gas were followed by 26% and 19% respectively, which was lower than the APEC estimates. Meanwhile, APEC's renewable energy share was four times that of Korea's. Renewable energy accounts for 8.2% of the energy supply in APEC, compared to 2.1% in Korea.

Figure 3: Energy supply mix – Korea and APEC, 2021



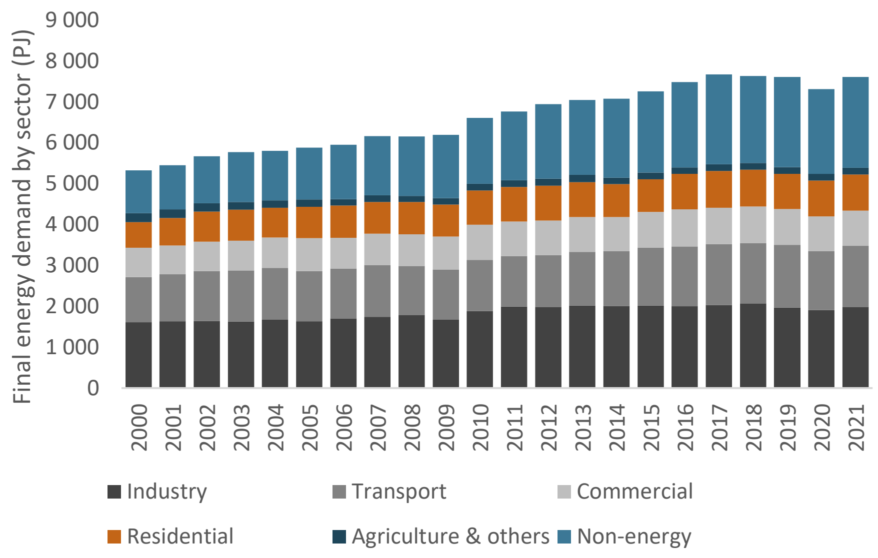
Source: EGEDA (2023)

Total final consumption

Total final consumption represents end-use energy, which includes non-energy uses of energy products. Korea's total final consumption (including non-energy) in 2021 was 7 608 PJ, indicating a 4% rise from the previous year. After three consecutive years of declining energy consumption, which included a significant 3.4% decrease in 2020 due to the impact of the COVID-19 pandemic, 2021 marked a rebound in energy consumption.

Korea's final consumption was primarily dominated by the non-energy and industrial sectors, which accounted for the largest shares at 29% and 26%, respectively. The transport sector, on the other hand, accounted for approximately 20%. The remaining 25% consists of the commercial, residential, and agriculture sectors. Since the late 1990s, the agricultural sector has seen an overall decrease in consumption, hitting its lowest point at 158 PJ in 2021. Except for agriculture and commercial sectors, all other sectors experienced growth in consumption in 2021.

Figure 4: Korea's final consumption by sector (PJ), 2000 to 2021

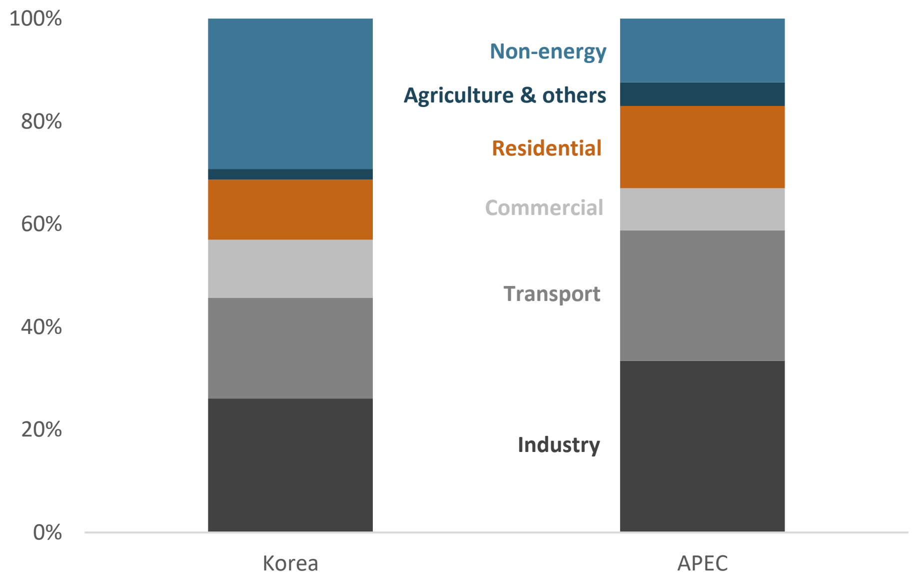


Source: EGEDA (2023)

In comparison to APEC, Korea's industry and transport sectors account for a smaller share of final consumption, with the non-energy sector holding a larger portion (Figure 5). In 2021, APEC's final consumption share in the industry and transport sectors was 33% and 25%, respectively, compared to Korea's consumption of 26% and 20%.

The non-energy sector generally refers to energy products that are used as raw materials rather than being consumed as fuel or transformed. These are often oil products used in the chemical and petrochemical industries to produce plastics or lubricants. In 2021, Korea's non-energy sector represented 29% of final consumption, more than doubling the APEC proportion of 12%.

Figure 5: Final consumption by sector, Korea and APEC, 2021

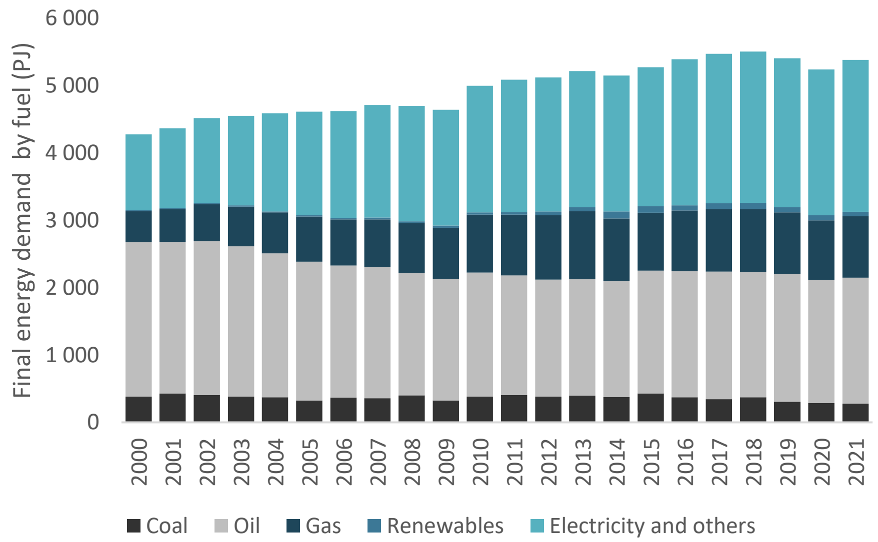


Source: EGEDA (2023)

Final energy demand

Korea's final energy demand displayed a steady upward trend from 2009 to 2018. However, a decline in the final energy demand was observed from 2019 to 2020 because of the COVID-19 pandemic (Figure 6). Korea's final energy demand, on the other hand, rebounded to 5 382 PJ in 2021, which is comparable to levels observed prior to the COVID-19 pandemic. An analysis of fuel demand over the past two decades indicates that the proportion of coal and oil in the total demand has declined, according to data from 2001 to 2021. In particular, the combined share of the two fuel sources decreased from 61% to 41% between 2001 and 2021. However, the share of other sectors, including gas, renewables, electricity, and others, has consistently increased.

Figure 6: Korea final energy demand by fuel (PJ), 2000 to 2021

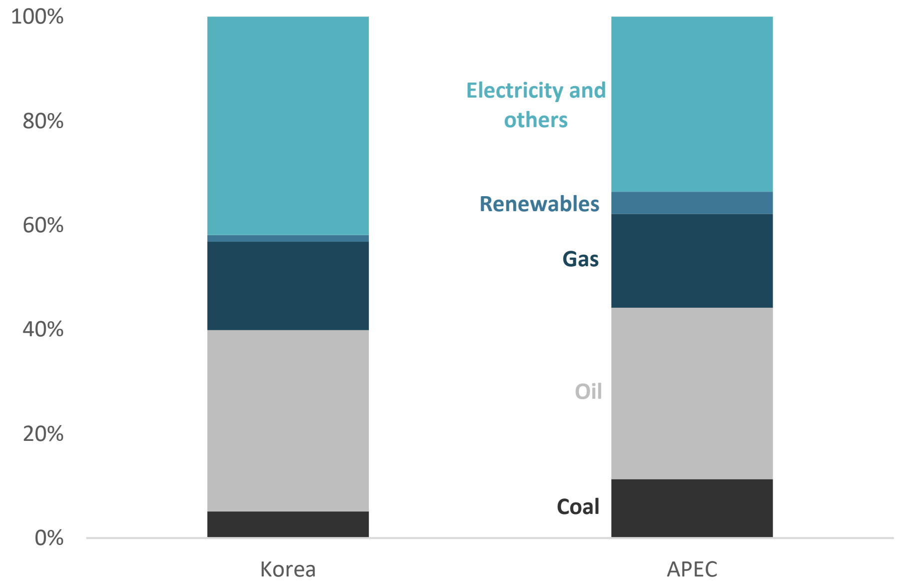


Source: EGEDA (2023)

Note: Does not include non-energy sector consumption of energy products.

In comparison to APEC, Korea's electricity demand is relatively high. Korea's final energy demand in 'electricity and others' accounts for 42%, while APEC accounts for 34% (Figure 7). Korea's economic growth has led to a huge increase in electricity demand during the last few decades. Power-based equipment has also continuously increased, which has contributed to electricity's growing share of total final energy demand. According to the 10th Basic Plan for Long-term Electricity Demand and Supply (2022-36) announced by the Ministry of Trade, Industry and Energy (MOTIE), it is projected that electricity consumption will increase by 1.7% annually from 2022 to 2036. Notably, as of 2021, Korea's coal consumption remains considerably lower than that of APEC.

Figure 7: Final energy demand fuel share, Korea and APEC, 2021



Source: EGEDA (2023)

Transformation

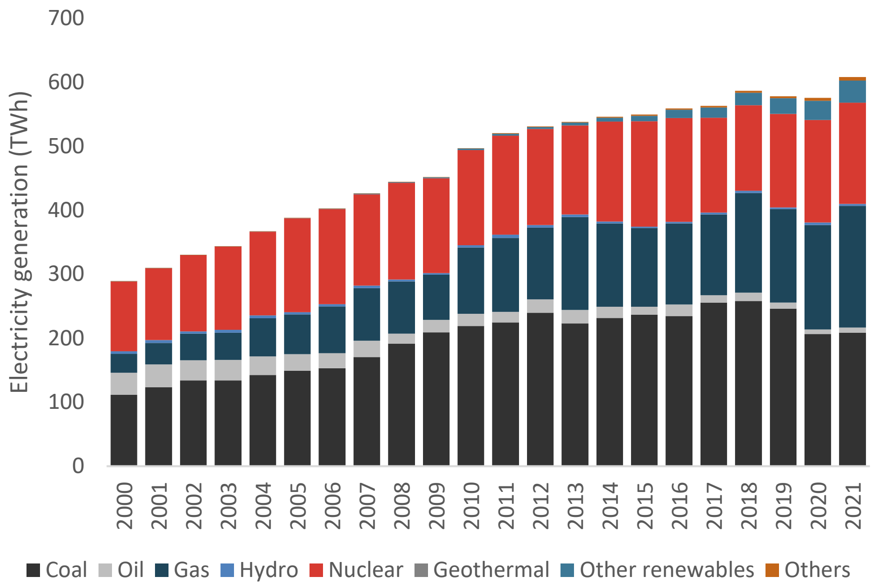
Power sector

The energy consumption in Korea's transformation sectors has experienced significant growth since 2000, primarily driven by a steady expansion of electricity generation capacities. Between 2000 and 2021, the overall power generation more than doubled, from 289 TWh in 2000 to 608 TWh in 2021 (Figure 8). In 2011, a power outage led to restrictions on electricity supply in certain areas. A stable electricity supply was therefore one of the foremost energy policies of Korea.

Analysing each source of fuel generation, coal contributed to 34% of Korea's electricity in 2021, compared to its share of 42% in 2019. With an increased emphasis on carbon neutrality ambitions, coal power generation is expected to fall considerably in the long run. In contrast, gas and renewable energy increased their proportion of the generation mix in 2021 compared to the previous year.

In January 2023, the Korean government released the 10th Basic Plan for Long-term Electricity Demand and Supply, a 15-year outlook that is updated every two years. According to the plan, nuclear power, LNG, and renewable energy facilities are expected to expand, while coal power plants would be steadily phased out. Specifically, the Plan involves the replacement of aging coal plants with LNG. Additionally, there will be continued investments in nuclear power and renewables, which will be assessed for safety and feasibility. Given the potential for high volatility in long-term power generation, a cautious estimate suggests that nuclear power and renewables will each account for more than 30% of total electricity generation by 2036.

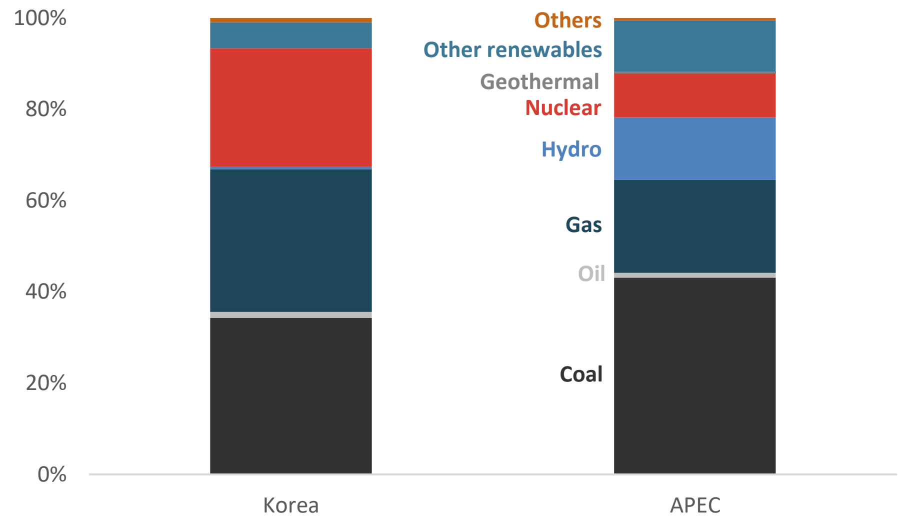
Figure 8: Korea's electricity generation by fuel, 2000 to 2021



Source: EGEDA (2023)

In Korea's electricity generation mix, the proportions of oil were comparable to the generation mix observed for APEC in 2021 (Figure 9). Meanwhile, there were some differences between Korea and APEC in terms of power generation fuels. In 2021, Korea had a smaller percentage of coal power generation than APEC, with 34% in Korea and 43% in APEC, whereas Korea and APEC had similar shares of coal power generation in 2019. Gas constituted 31% of the power sector in Korea, an amount that surpassed that of APEC (20%). The share of nuclear power in Korea was 26%, more than double that of APEC's part of roughly 10%. In contrast to gas and nuclear, APEC had a larger ratio of renewables than Korea. In addition, hydro accounts for 0.5% in Korea and 14% in APEC.

Figure 9: Electricity generation fuel share, Korea and APEC, 2021



Source: EGEDA (2023)

Refining

Korea has steadily promoted investments in large-scale refineries and facility enhancements to improve the quality of its products. As a result, as of 2022, Korea's oil refining capacity reached 3 363 thousand barrels per day, ranking 5th in the world (Energy Institute, 2023). More precisely, Korea's global share stood at 3.3%, followed by the US (18%), China (17%), Russia (7%) and India (5%).

Following the end of the COVID-19 pandemic, Korean oil refining businesses reported increased exports of major oil products such as diesel, gasoline, and jet fuel, reaching 46 672 billion barrels in 2023. Despite this short-term export performance, Korean oil refineries are facing challenges in reducing long-term oil demand and achieving carbon neutrality to diversify their business portfolio.

Energy Transition

Given that climate change transcends environmental concerns, and the Paris Agreement signifies a global pledge, the Korean Government maintains its dedication to the clean energy transition. In October 2021, the government announced an updated nationally determined contribution (NDC) towards achieving carbon neutrality by 2050. This updated target sets a more ambitious goal of a 40% reduction in Korea's GHG emissions by 2030, compared to 2018 levels, representing a significant increase from the original target of 26%. To oversee and coordinate domestic carbon-neutral policies, the 2050 Carbon Neutrality Committee was established in May 2021 as a presidential body, and later renamed the Presidential Commission on Carbon Neutrality and Green Growth in March 2022. However, it is noteworthy that the pursuit of energy security, especially in the context of global energy supply instability, is emerging as a crucial consideration within the energy transition policies.

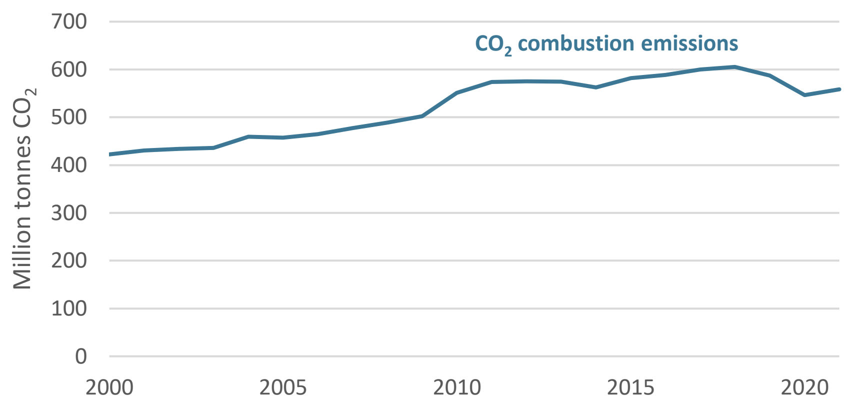
Emissions

EGEDA data reveals that, although Korea's CO_2 emissions per GDP have shown a decline over the past three years, there has been a general increase in emissions since 2000, reaching a peak in 2018 (Figure 10). This implies that efforts from stakeholders to reduce CO_2 emissions in each sector should be complemented by effective policy implementation.

After President Yoon took office in May 2022, the Presidential Commission on Carbon Neutrality and Green Growth released vision and promotion strategies for carbon neutrality and green growth in October 2022. Subsequently, in April 2023, the commission unveiled its 1st Basic Plan for Carbon Neutrality and Green Growth. The Basic Plan aims to provide policy directions and strategies for achieving carbon neutrality by 2050 through the following strategies: (1) implementing specific and efficient measures to reduce GHG emissions, including the utilisation of carbon-free energy sources; (2) promoting carbon neutrality led by private sectors through technology innovation and facilitating investments; (3) improving the efficiency of domestic energy consumption and establishing a cooperative system between the central and municipal government, and (4) strengthening international cooperation.

Furthermore, the Korean Government proposed to push forward the Carbon-Free Energy (CFE) Initiative to the international community. The CFE Initiative emphasises the widespread use of nuclear energy, hydrogen, and CCUS (carbon capture, utilisation, and storage), which would serve as a feasible and sustainable ways to achieve both energy security and carbon neutrality goals. Korea intends to develop detailed measures for CFE initiative such as carbon-free certification requirements that other economies may agree on and pursue together.

Figure 10: Korea's CO_2 combustion emissions (million tonnes), 2000 to 2021



Source: EGEDA (2023)

Energy security

Since Korea is one of the world's largest importers of oil and gas, energy security has long been a priority for ensuring the stable supply of energy. The recent geopolitical volatility has raised greater emphasis on energy security, particularly during the ongoing energy transition to cleaner sources. In response to recent environmental changes, the Korean Government announced new energy policy goals and directions in July 2022, aiming to respond to global energy supply chain risks and carbon neutrality.

The energy policy directions aim for a practical and balanced energy mix, implying a resumption of the construction of the Shin-Hanul No. 3 and No. 4 nuclear reactors. The objective is to increase the nuclear energy ratio to at least 30% by the year 2030. The energy mix adjustment involves the construction of power grid to accommodate the change in power supply mix, along with the implementation of a power system stability plan.

Furthermore, several internal and external efforts are underway to strengthen the supply. In January 2024, Korea's National Assembly passed the Special Act on National Resource Security Act, which aims to develop a comprehensive framework for energy security through the implementation of essential policy measures. There is also a continued effort to diversify imports through bilateral and multilateral collaborations. For instance, participation in a Mineral Security Partnership (MSP) is aimed at ensuring a secure supply chain for critical minerals in coordination with other economies. In addition, to alleviate the financial burden on individuals vulnerable to energy poverty, energy vouchers and support for energy efficiency measures have been expanded.

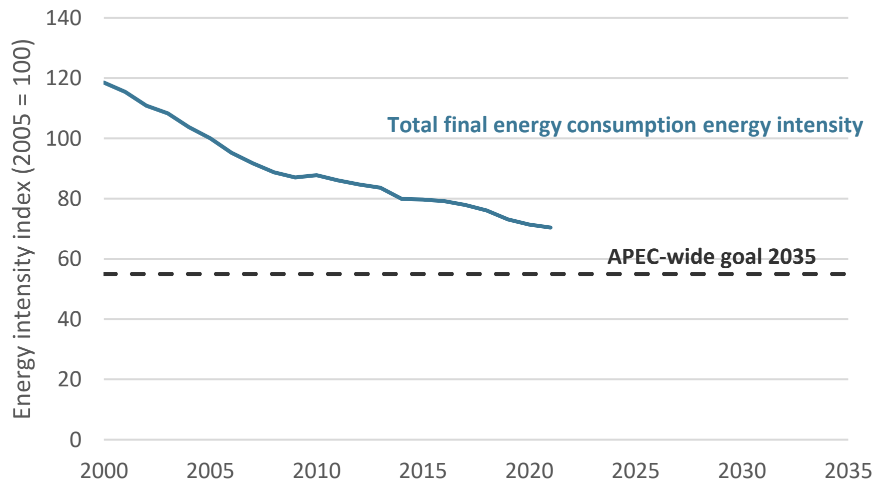
APEC Energy Goals

There are two energy-related objectives that APEC member economies have agreed to meet as a collective: to improve energy intensity and double the share of modern renewables.

Energy intensity goal

In 2011, APEC member economies agreed to increase their target to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline. APEC is on track to achieve this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

Figure 11: Korea's total final energy consumption intensity index, 2000 to 2021 (2005 = 100)



Source: EGEDA (2022)

Korea’s total final energy consumption intensity, excluding non-energy sectors, has shown improvement since 2005, with only a slight setback in 2010 (Figure 11). In 2020, the improvement was 30% compared to the 2005 baseline, representing 1% improvement from the previous year and 8% during the last five years (2017-2021).

The economic situations of APEC economies, especially energy usage, may change as technology advances and industries develop. It is therefore necessary to closely monitor whether the energy intensity in Korea continues to improve in the next years.

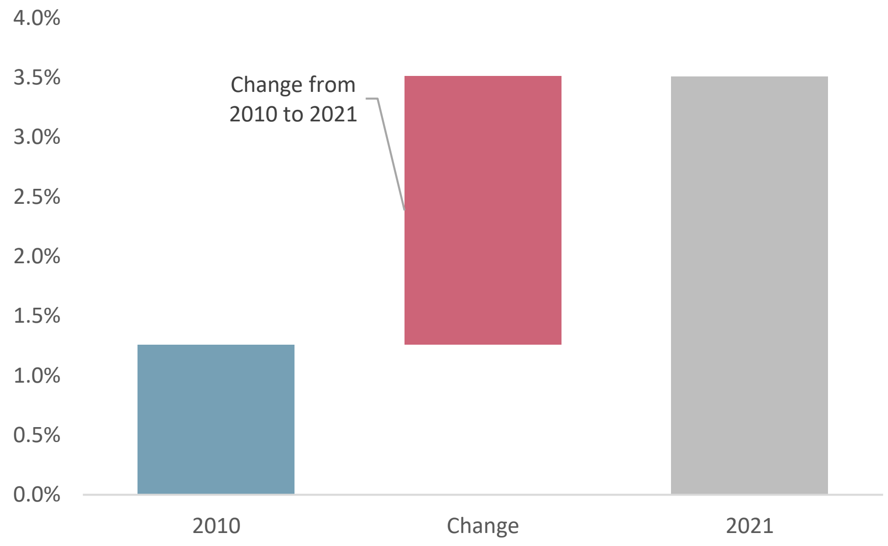
Doubling of renewables

The second energy goal involves doubling the proportion of modern renewables in the APEC energy mix from 2010 to 2030. While there is no specific economy-level goal for each member economies, progress made by individual economies will contribute to achieving the doubling goal.

Korea has continuously promoted policies to increase renewable energy in response to climate change and for sustainable long-term growth. While APEC increased from 6.0% to 9.9% in 2021 compared to 2010, Korea increased at a faster rate, surging from 1.3% to 3.5%.

Between 2000 and 2021, Korea's renewable energy witnessed a rapid increase, particularly notable from around 2015 (Figure 13). The 10th Basic Plan for Long-term Electricity Demand and Supply (2022-36) announced that it would promote phased renewable supply along with renewable energy back-up facilities. According to this plan, renewables will account for around 30% of total generation mix by 2036.

Figure 12: Korea’s modern renewable energy share, 2010 and 2021

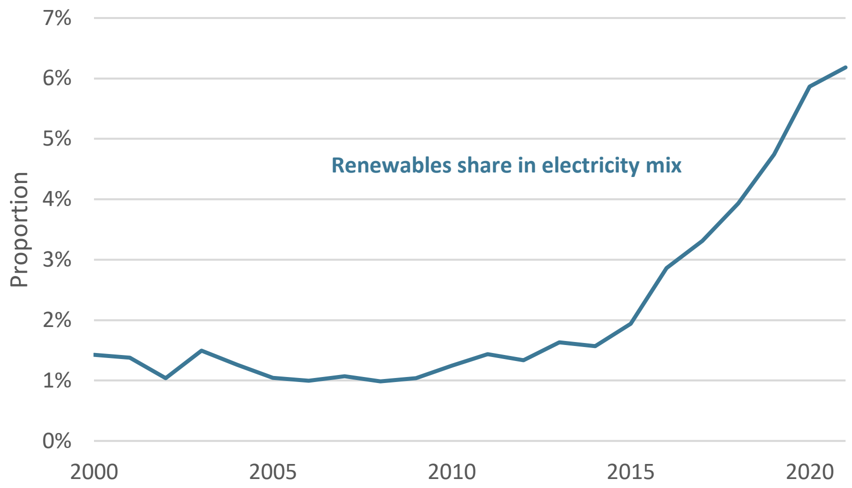


Source: EGEDA (2023)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Korea has also implemented measures to ensure a stable supply of renewables, such as the Renewable Portfolio Standards (RPS) established in 2012. The RPS requires power generation businesses to produce a certain amount of annual electricity production as renewable energy. While the RPS system has served its role in fostering the development of a more mature renewable energy market, MOTIE announced in January 2024 that it considers changing the current RPS system to gradually introducing an auction system to effectively adapt to changing market conditions.

Figure 13: Korea's renewable generation share, 2000 to 2021



Source: EGEDA (2023)

Energy Policy

Energy policy	Details	Reference
10th Basic Plan for Electricity Demand and Supply	In accordance with the Electricity Business Act, it is required for the Ministry of Trade, Industry and Energy (MOTIE) to establish the biennial Basic Plan for Electricity Demand and Supply. The 10th Basic Plan, which was released in January 2023, presented mid- to long-term projections for power demand and proposes a pragmatic and rational energy mix from 2022 to 2036. MOTIE plans to develop the 11th Basic Plan in 2024 for the period 2024-2038.	Ministry of Trade, Industry and Energy
15th Long-term Natural Gas Demand and Supply Plan	The Gas Business Act requires MOTIE to develop a biennial long-term plan for natural gas supply and demand. The 15th Plan, published in April 2023, underlined the importance of gas supply and demand stability, and provided a natural gas demand forecast for the years 2023 - 2036.	Ministry of Trade, Industry and Energy
New Energy Policy Goals and Directions	In July 2022, MOTIE announced the New Government Energy Policy Direction. This announcement provided re-establishing the energy mix by raising the share of nuclear energy to a minimum of 30% by 2030. Furthermore, ensuring energy security, emphasising energy demand efficiency, and improving the structure of electricity market were outlined in the New Energy Policy.	Ministry of Trade, Industry and Energy
3rd Energy Master Plan	The Energy Master Plan serves as an all-encompassing strategy that covers macro-scale plans across various energy sectors. This comprehensive plan outlines mid- to long-term energy policy frameworks and targets across the economy. In June 2019, the 3rd plan was unveiled, covering the period from 2019 to 2040.	Ministry of Trade, Industry and Energy
New Hydrogen Economy Policy Directions	Announced during the 5th meeting of the Hydrogen Economy Commission in November 2022. This new plan strives to cultivate the clean hydrogen ecosystem, establish a legal framework for hydrogen infrastructure, and drive technical innovation, etc.	Ministry of Trade, Industry and Energy
5th Basic Plan for Renewable Energy	The 5th Plan, released in December 2020, is designed to establish an ecosystem that facilitates the utilisation of renewable energy for a low-carbon economy. This plan outlines key strategies for renewable energy industry and demand projections.	Ministry of Trade, Industry and Energy
2030 NDC (Nationally Determined Contribution)	The 2030 NDC are intermediate goals for achieving carbon neutrality by 2050. Korea has established an updated target of reducing 40% of its GHG emissions by 2030 from 2018 levels.	Presidential Commission on Carbon Neutrality and Green Growth
1st Basic Plan for Carbon Neutrality and Green Growth	In accordance with the Framework Act on Carbon Neutrality, Korea unveiled its 1st Basic Plan in April 2023. This plan will be updated every five years for the next 20 years, spanning from 2023 to 2042. The 1st Plan includes provisions for adjusting reduction targets for each sector, developing core green technologies, and facilitating support for policy and private financing.	Presidential Commission on Carbon Neutrality and Green Growth

Energy policy	Details	Reference
Strategy for Securing Reliable Critical Minerals Supply	In February 2023, MOTIE unveiled a strategy that outlined various measures to secure the supply chain of critical minerals. These measures include identifying specific strategic critical minerals, enhancing international cooperation, mitigating supply risks, and promoting financial assistance and investment.	Ministry of Trade, Industry and Energy
Basic Plan for Resources Development	In May 2020, MOTIE announced a plan to enhance the government's financial support for resource exploration projects undertaken by private sector enterprises, aiming at ensuring resources security.	Ministry of Trade, Industry and Energy
6th Basic Plan for Energy Use Rationalization	In accordance with the Energy Use Rationalization Act, MOTIE has formulated a demand-side strategy for the mid- to long-term every five years since 1993. The 6th plan, unveiled in August 2020, aims to strengthen demand management, enhance energy use efficiency, and promote institutional development.	Ministry of Trade, Industry and Energy

Notable Energy Developments

Energy development	Details	Reference
Carbon-Free Energy (CFE) Initiative	The Korean Government proposed the concept of the CFE Initiative during the 2023 UN General Assembly and COP 28, highlighting the importance of utilising various carbon-free energy sources such as nuclear power, hydrogen, and renewable energy. This initiative aims to provide more sustainable and rational carbon-free energy alternatives, especially to highly industrialised economies like Korea.	Ministry of Trade, Industry and Energy
Special Act on National Resource Security	In January 2024, the Special Act on National Resource Security Act was passed in Korea's National Assembly. This Act seeks to establish a comprehensive framework for energy security through the implementation of the key policy measures. These measures include the identification of critical resources, such as oil, natural gas, uranium, and critical minerals. The Act also provides a legal basis for storage requirements and the establishment of an early warning system for emergency situations.	Ministry of Trade, Industry and Energy
Act on Carbon Capture, Utilization and Storage (CCUS)	In January 2024, Korea's National Assembly passed the new CCUS Act bill, which aims to provide a comprehensive framework to promote the CCUS business within the economy. This legislation enables the establishment of a CCUS Basic Plan every five years and outlines promoting the CCUS industry, infrastructure, project management, and technology development.	Ministry of Trade, Industry and Energy

Energy development	Details	Reference
6th Hydrogen Economy Committee Meeting	In continuation of the New Hydrogen Economy Policy Directions, released during the 5th Hydrogen Economy Committee, the 6th meeting held in December 2023 focused on outlining specific strategies to promote the hydrogen industry. These strategies include the establishment of certification criteria, technology development, and the growth of hydrogen car and charging infrastructure.	Ministry of Trade, Industry and Energy

Useful Links

Korea Energy Statistical Information System – https://www.kesis.net/main/main.jsp

Korea Electric Power Corporation – https://home.kepco.co.kr/kepco/main.do

Korea Energy Economics Institute – http://www.keei.re.kr/main.nsf/index.html

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Malaysia

Introduction

Malaysia has always emphasised the importance of the energy sector's critical role in the economy. In pursuing a net zero future, Malaysia has released the Twelfth Malaysia Plan, spanning 2021 to 2025, and the National Energy Policy 2022-2040 has laid the groundwork for transitioning to this target. Malaysia has developed the National Energy Transition Roadmap (NETR) 2023 to accelerate this energy transition effort. This roadmap is vital for steering Malaysia's shift from a traditional fossil fuel-based economy to a high-value green economy. The NETR approach is based on the fundamental energy trilemma of security, affordability and sustainability.

The NETR establishes the pathway for improving the domestic energy mix, GHG emission reduction, and energy transition initiatives. Within NETR there are ten flagship catalyst projects covering six energy transition levers, namely, energy efficiency (EE), renewable energy (RE), hydrogen, bioenergy, green mobility, and carbon capture, utilisation, and storage (CCUS).

In addition, Malaysia has launched multiple documents spearheading the economy's vision to reach the status of a carbon-neutral economy by 2050, i.e., the Hydrogen Economy and Technology Roadmap (HETR) and New Industrial Masterplan (NIMP).

These plans reinforce Malaysia's commitment to net zero emissions as early as 2050. By 2050, NETR initiatives are expected to deliver a 32% reduction in GHG emissions for the energy sector compared to the 2019 baseline, reaching 4.3 $MtCO_2eq$ emissions per capita. This aligns with Malaysia's Nationally Determined Contribution (NDC) under the Paris Agreement. Malaysia intends to reduce its greenhouse gas (GHG) emissions intensity against GDP by 45% by 2030, relative to its 2005 levels, on an unconditional basis. Malaysia has announced a new target for installed renewable energy (RE) capacity in July 2023, aiming for 70% by 2050. As of December 2023, Malaysia's installed RE capacity stood at 25%.

Table 1: Malaysia macroeconomic data and energy reserves

Key data [a, b]		Energy reserves [c]	
Area (million km^2)	330 441	Oil (billion barrels)	4.43
Population (million)	33.4	Gas (trillion cubic feet)	76.032
GDP (2017 USD billion PPP)	884.1	Coal (million tonnes)	1 938.4
GDP per capita (2017 USD PPP)	26 332.2	Uranium (kilotonnes U < USD 130/kgU)	0 000

Source: a DOSM, EPU (2023); b World Bank (2022); c EC (2023).

Note: Reserves are total proved reserves and reasonably assured recoverable resources for uranium.

On October 2023, the Malaysian Parliament passed the Energy Efficiency and Conservation Bill 2023 (EECA). This legislation represents a key component of the National Energy Transition Roadmap and aims to promote demand-side energy management by overseeing conservation and efficient energy consumption. The act will require significant domestic energy consumers to implement energy-saving measures covering electrical and thermal energy. The EECA will regulate the heavy industrial and commercial users that consume 21 600 GJ per annum, equivalent to MYR 2.4 million (USD 500 thousand) in annual electricity bills or MYR 1 million (USD 200 thousand) in natural gas bills, covering 1 500 out of 2 700 industrial users, representing 70%-80% of industrial consumption and 500 out of 1.7 million commercial consumers.

Malaysia's GDP growth was confirmed at 3.3% year-on-year in Q3 of 2023 from a near two-year low of 2.9% in the previous period.

Malaysia's energy sector has historically been dominated by fossil fuels, i.e., coal, oil and natural gas, with the economy being a significant producer and exporter of oil and gas. Malaysia's crude oil reserve stood at 4.43 billion barrels, while total natural gas reserves stood at 76.032 Tscf in 2023. Malaysia has significant coal reserves at 276.04 million tonnes, The economy uses 90% of the reserve for domestic use.

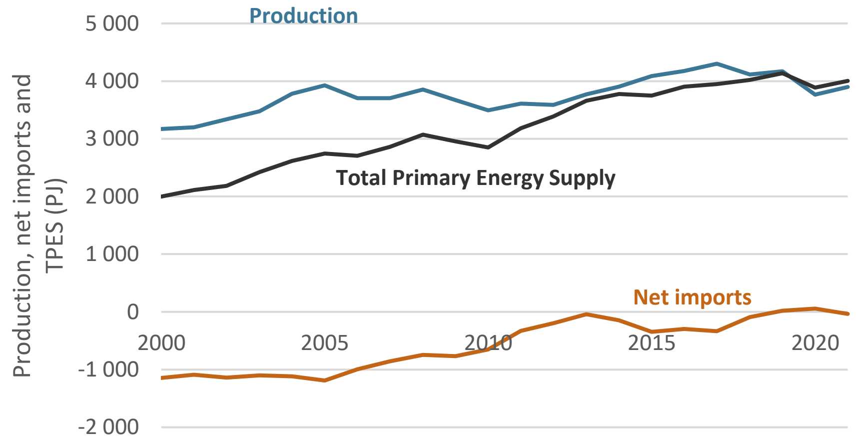
Energy Supply and Consumption

Total primary energy supply

Malaysia's total energy supply has grown since 2000 at an annual average of 3.4%, reaching 4 006 PJ in 2021 (Figure 1). In 2020, there was low energy demand due to the outbreak of COVID-19, and in 2021, a slight increment in energy supply was observed as a result of economic recovery, although the recovery has been relatively slow, given that 2019 levels of supply have not been surpassed.

Total primary energy supply (TPES) increased by 2.9% compared to 2020, but is still down 3.1% in 2019. Both gas and renewable fuel types increased. However, coal and oil recorded a slight reduction. Natural gas is the leading fuel used in TPES with its share of 44.5%, followed by crude oil at 27.7%, coal and coke at 23.8%, and renewable energy (RE) at 4.1%.

Figure 1: Malaysia energy supply, production, and net imports (PJ), 2000 to 2021

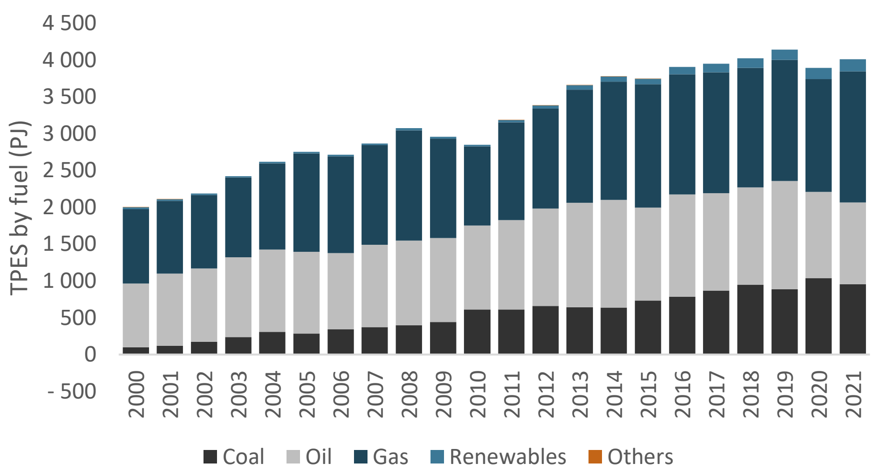


Source: EGEDA (2023)

Gas is the main energy source in Malaysia for 2021 due to its reliability and affordability compared to other fossil fuels. Malaysia has significant natural gas reserves, making it a readily available and domestically sourced energy option. Decades-long gas price control by the government, fostering demand and inefficient energy use, burdening Petronas investment capacity and discouraging the development of more expensive domestic production. Investments in gas infrastructure and technologies have enhanced its accessibility and efficiency, further solidifying its position as the main energy supply in the economy.

It is forecast that in the coming three years, more than 25 oil and gas wells are to be drilled each year, focusing on shallow water plays within Peninsular Malaysia and Sarawak and deepwater wells in Sabah. This is expected to sustain and grow Malaysia's oil and gas production of two million barrels of oil equivalent per day by 2025. Malaysia's renewable energy comes from solar and hydro sources and is mostly used in power generation.

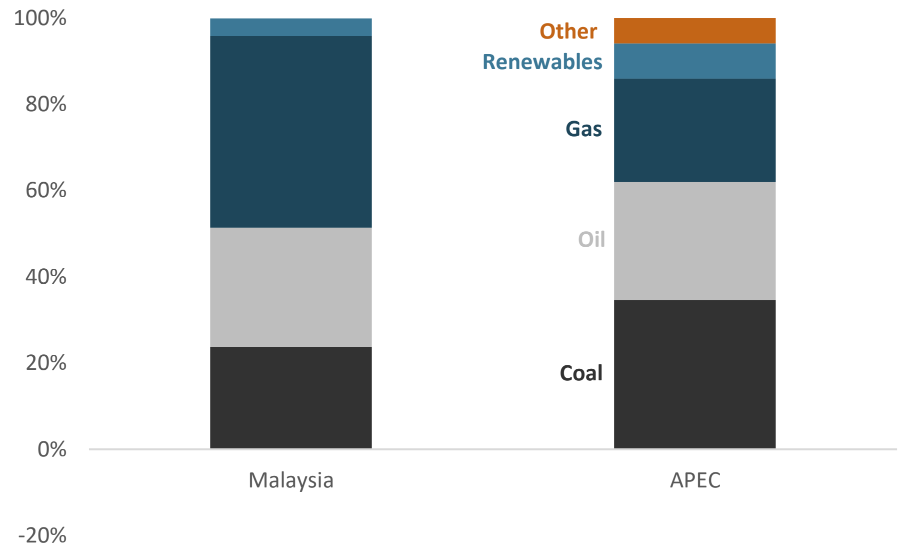
Figure 2: Malaysia energy supply by fuel (PJ), 2000 to 2021



Source: EGEDA (2023)

The availability of indigenous oil and gas resources in Malaysia and the low global fossil fuel prices in 2021 continued to be contributing factors to higher reliance on fossil fuels than the APEC region (Figure 3). Oil and gas shares were about 20% higher than in the APEC region. Coal was lower as Malaysia imported about 90% of its coal supply and shifted away to cleaner resources. Renewables and other shares were also below that in the APEC region.

Figure 3: Energy supply mix – Malaysia and APEC, 2021

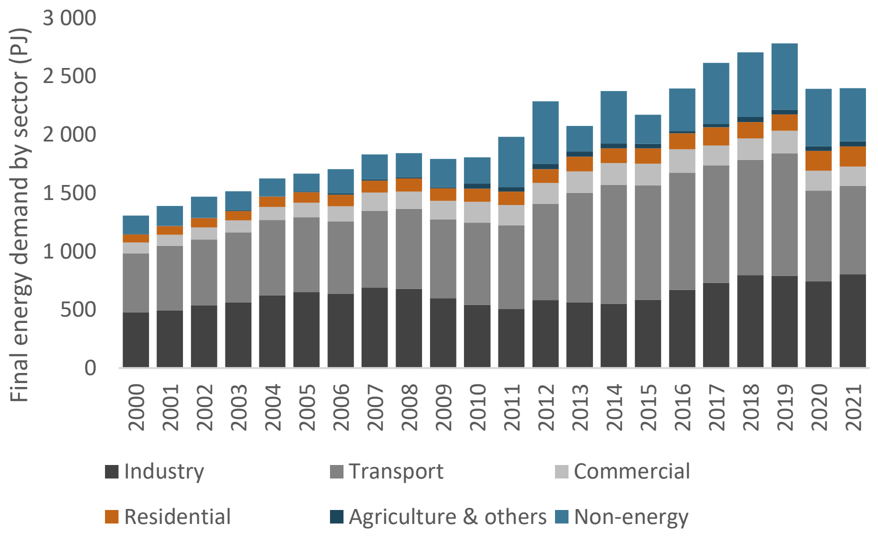


Source: EGEDA (2023)

Total final consumption

In terms of final consumption, the industry sector has the largest share, with 33.5% in 2021. The transport sector followed with 31.6%, non-energy with 19.0%, and the 'others' sector with 15.9%. As shown in Figure 5, in 2021 the total final energy consumption experienced an upward trend of 0.2% from 2020. This was due to increasing energy consumption in the industry sector in particular. In contrast, the transport sector is still facing a downward trend as the government and private organisations are encouraged to work from home (WFH).

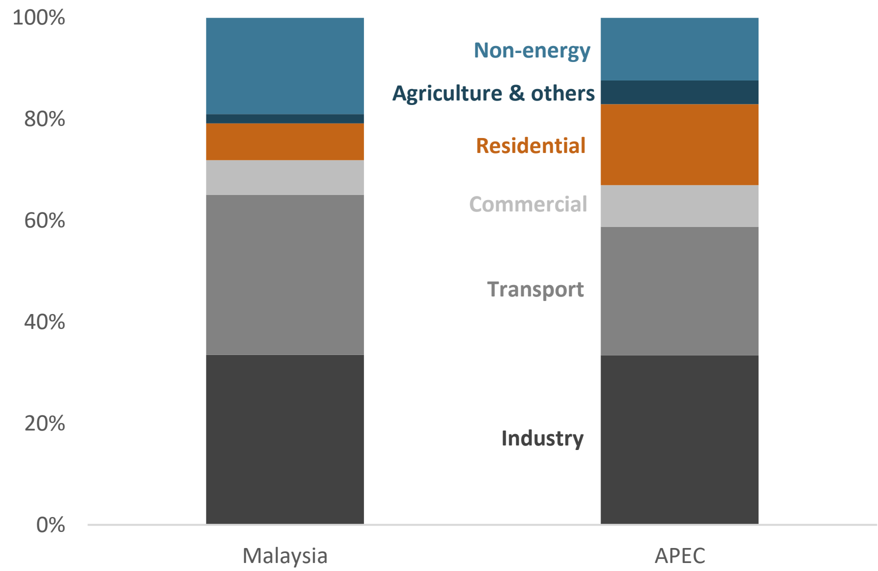
Figure 4: Malaysia final consumption by sector (PJ), 2000 to 2021



Source: EGEDA (2023)

Like the APEC region, the transport and industry sectors represented the most significant portion of Malaysia's final consumption, more than 60% in 2021 (Figure 5). The non-energy consumption share was larger in Malaysia than in the APEC region in 2021. Malaysia has many petrochemical plants, including fertiliser plants in Peninsular Malaysia, Sabah and Sarawak, which use oil and gas as feedstock. The non-energy sector's energy consumption growth was mainly driven by feedstock availability and price. The industry sector was expected to grow steadily, supported by one of the main clusters of the Twelfth Malaysian Plan on propelling the growth of strategic hub and high-impact industries as well as micro, small and medium-enterprises.

Figure 5: Final consumption by sector, Malaysia and APEC, 2021



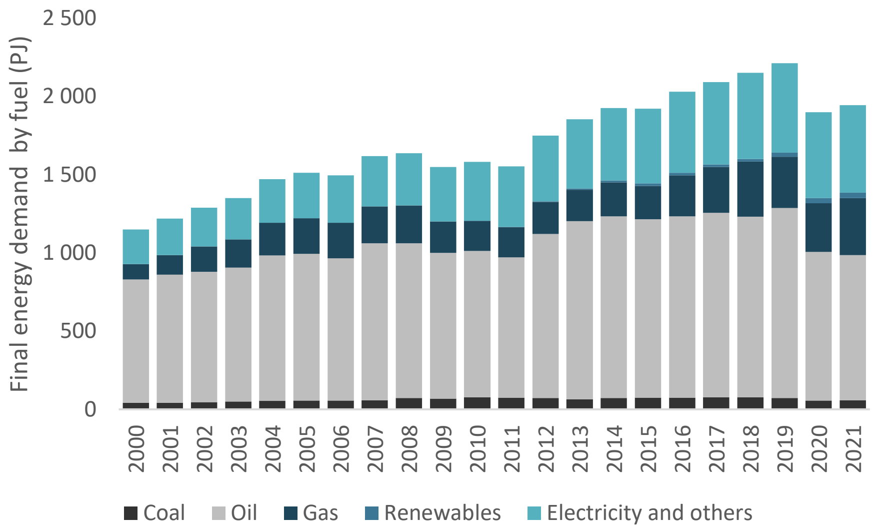
Source: EGEDA (2023)

Final energy demand

Malaysia experienced a 4% annual growth in final energy demand, rising from 1 149 PJ in 2000 to 1 944 PJ in 2021. Fossil fuels constituted nearly 70% of the fuel share utilised by end-users in 2021, marking a 0.04% increase from the previous year. Petroleum products, primarily oil, comprised over half of the end-user fuel share in 2021. Within this, the transport sector accounted for 76% of the total oil demand, while the industry sector utilised 19.7%, the non-energy sector 4%, and other sectors 0.3%.

Electricity emerged as the second most prominent fuel, remaining unchanged from 29% of the end-user fuel share in 2020 to 29% in 2021. Post-COVID-19 pandemic, electricity demand in 2021 experienced a minor increase in volume due to a notable increase from the residential sector, offset by a substantial reduction from other sectors. The government had introduced reliefs and initiatives to mitigate household electric bill increases.

Figure 6: Malaysia final energy demand by fuel (PJ), 2000 to 2021



Source: EGEDA (2023)

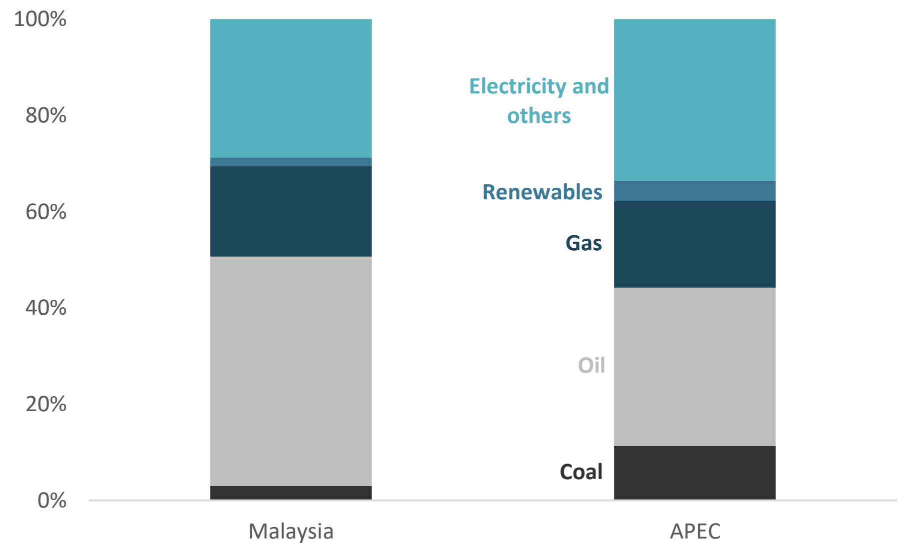
Note: Does not include non-energy sector consumption of energy products.

In 2021, gas and coal collectively represented 21.8% of the fuel share utilised by end-users, with a slight increase in demand from the industry sector attributed to lower gas prices compared to 2019 and a slight recovery from the impact of COVID-19 in 2020.

Gas demand has followed an upward trend since recovering from the global financial crisis in 2008. In contrast, coal has remained stable at an average of 74 PJ before experiencing declines in 2019 and 2020 and rebounding slower in 2021.

The significant consumption of petroleum products in the transport sector contributed to a larger portion of oil in Malaysia's final energy demand than the APEC region in 2021 (Figure 7), despite a decrease in its share from 50% in 2020 to 47.7% in 2021. Conversely, the shares of other fuels were below those of APEC, except oil and coal.

Figure 7: Final energy demand fuel share, Malaysia and APEC, 2021



Source: EGEDA (2022)

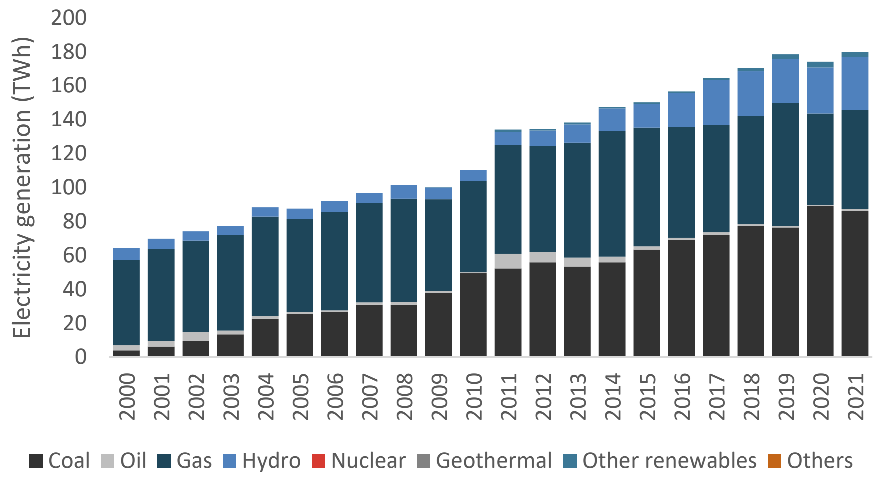
Transformation

Power sector

Since 2000, Malaysia's electricity generation predominantly relied on coal and gas, which held a combined share of 85% and then steadily increased to a peak of 93% in 2010 before gradually declining to 80% in 2021 (Figure 8). This decrease reflects Malaysia's efforts to achieve a 31% renewable energy capacity mix by 2025, i.e., 91% contributed by hydro. This helps Malaysia achieve the target outlined in the Malaysia Renewable Energy Roadmap (MYRER). Malaysia has set an unconditional target of a 45% reduction in economy-wide carbon intensity against GDP compared to 2005 levels, to be achieved in 2030 (revised in 2021). As a result of these renewable energy targets and climate change commitments, including the newly announced decision not to develop any new coal-fired power plants for electricity generation (while existing coal-fired power plants will retire according to the Power Purchase Agreement (PPA) date), the contribution of renewables to electricity generation more than tripled from 6% in 2010 to 20% in 2021, while the share of oil remained consistently low over the past two decades.

In 2020, there was an annual drop in electricity generation, a significant decline of 24% in gas-based electricity generation. However, in 2021, a slight increase was observed due to the commissioning of two new gas-fired power plants (SPG Block 1 and SPG Block 2), partially offset by a 19% increase in coal-based generation.

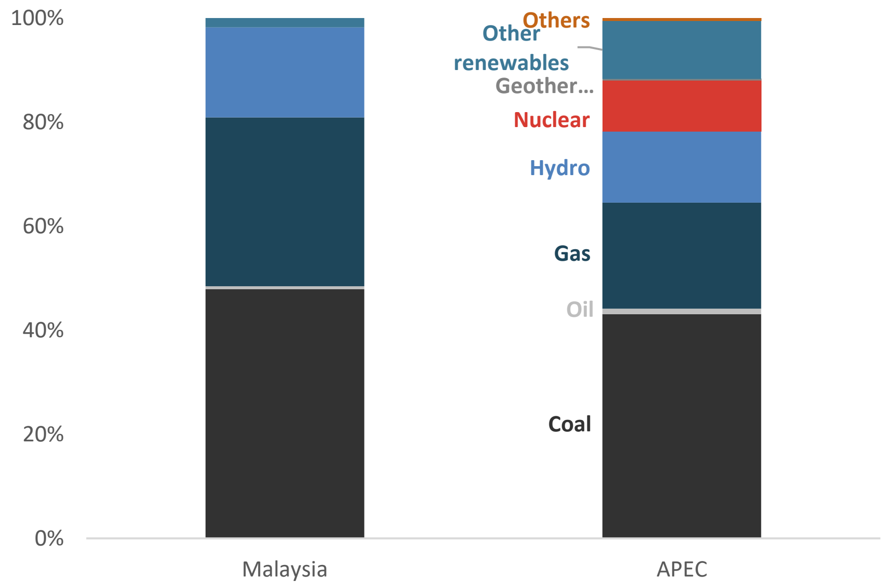
Figure 8: Malaysia electricity generation by fuel, 2000 to 2021



Source: EGEDA (2023)

Malaysia's electricity generation in 2021 featured a larger proportion of coal, gas and hydro compared to the APEC region, with oil comprising half and other renewables representing a significantly smaller portion (Figure 9). This comparison highlights Malaysia's heavier reliance on coal and gas in electricity generation relative to the APEC region. Although Malaysia has established a nuclear agency and has periodically reviewed nuclear options, as of 2021 there are no nuclear power generation plants.

Figure 9: Electricity generation fuel share, Malaysia and APEC, 2021



Source: EGEDA (2023)

Refining

Malaysia has invested heavily in refining activities during the past two decades to meet its demand for petroleum products with domestic supplies. Malaysia had an oil refining capacity of 955 thousand barrels daily (5.84 PJ), an increase from 625 thousand barrels (3.82) daily in 2020. Oil refinery capacity in Malaysia has been increasing since 2012, reaching a maximum of 625 thousand barrels per day. The import and export difference of petroleum products is at 20%. The production of petroleum products from refineries consists of petrol (24.53%), diesel (44.34%), LPG (3.24%), ATF and AV Gas (11.85%), non-energy (9.42%), fuel oil (5.80%), refinery gas (0.75%) and kerosene (0.07%).

Energy transition

Emissions

As a rapidly developing economy, Malaysia's economic growth and advancement are highly dependent on the cumulative efforts of all its sectors, from manufacturing and transportation to logistics and construction. As its population grows, development ramps up, and the economy progresses, Malaysia's energy consumption is parallel with GDP growth.

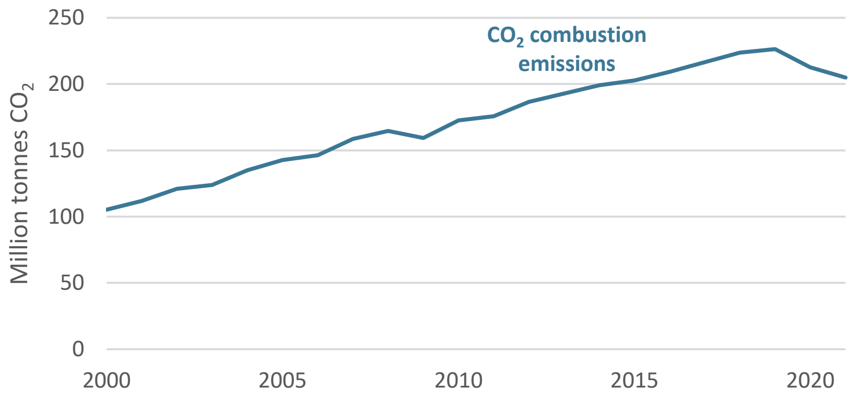
As a visible outcome of a higher standard of living, more people now own and use energy-consuming technology-based appliances and devices. Urbanisation and commercialisation have also increased electricity consumption, with more offices, factories, shopping centres, and other entertainment outlets in operation.

As a result of this growth in energy use, Malaysia has witnessed a consistent rise in CO_2 emissions. This growth in emissions surpassed the growth rate of fossil fuel utilisation in energy supply, primarily driven by the rise in coal consumption for electricity generation during this time frame.

The Twelfth Malaysia Plan, spanning 2021 to 2025, outlines Malaysia's commitment to reaching net zero greenhouse gas (GHG) emissions by 2050. Through this, the economy hopes to decrease GHG emissions by 32%. The National Energy Transition Roadmap (NETR) (2023) will also play a key role.

At the same time, the National Energy Policy 2022-2040 (DTN) establishes the groundwork for a just and inclusive energy transition, which is important because such a large transition can create and increase inequalities for those affected the most.

Figure 10: Malaysia CO_2 combustion emissions (million tonnes), 2000 to 2021



Source: EGEDA (2023)

Energy security

NETR has developed the Responsible Transition (RT) Pathway 2050 to shift Malaysia's energy systems from fossil fuel-based to greener and low-carbon options. Malaysia's main electricity resource for decades has been non-indigenous, mostly in the form of imported coal. NETR targets phasing out coal and reducing fossil-fuel reliance from 96% in 2023 to 77% in 2050. Natural gas is set to be a transitional fuel and the primary contributor of TPES, followed by renewables that include solar, hydro and bioenergy, collectively contributing 23% of TPES in 2050 from 4% in 2023.

Over the last two years, Petronas and international investors have directed their attention towards exploration in Malaysia, especially in the Sarawak and Sabah basins. Most of these oil and gas discoveries were situated offshore in East Malaysia. Apart from extending the estimated oil and gas production duration, these discoveries will help stabilise the escalating dependence on imported oil and natural gas.

APEC Energy Goals

There are two energy-related objectives that APEC member economies have agreed to meet as a collective: to improve energy intensity and double the share of modern renewables.

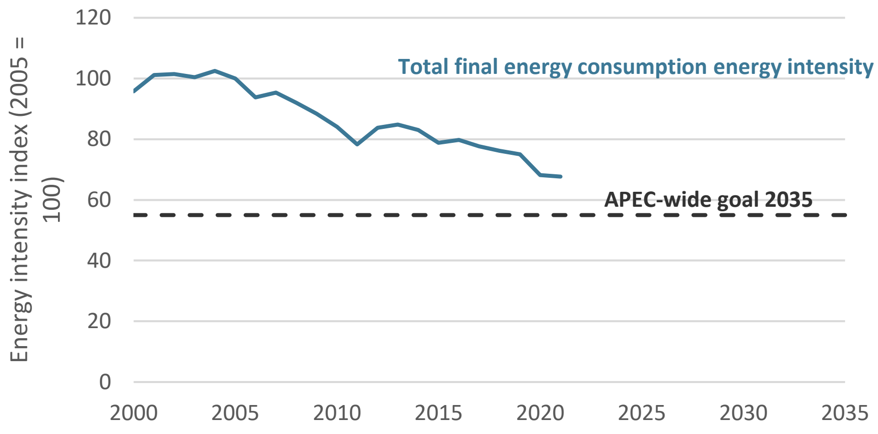
Energy intensity goal

In 2011, APEC member economies agreed to increase their ambition to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

APEC is on track to achieve this energy intensity improvement. The goal does not impose individual economic targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

Malaysia's total final energy consumption energy intensity (excluding non-energy) has been improving at an average rate of 2.0% annually, reaching a total reduction of 26% in 2021 compared to 2005 (Figure 11).

Figure 11: Malaysia total final energy consumption intensity index, 2000 to 2021 (2005 = 100)



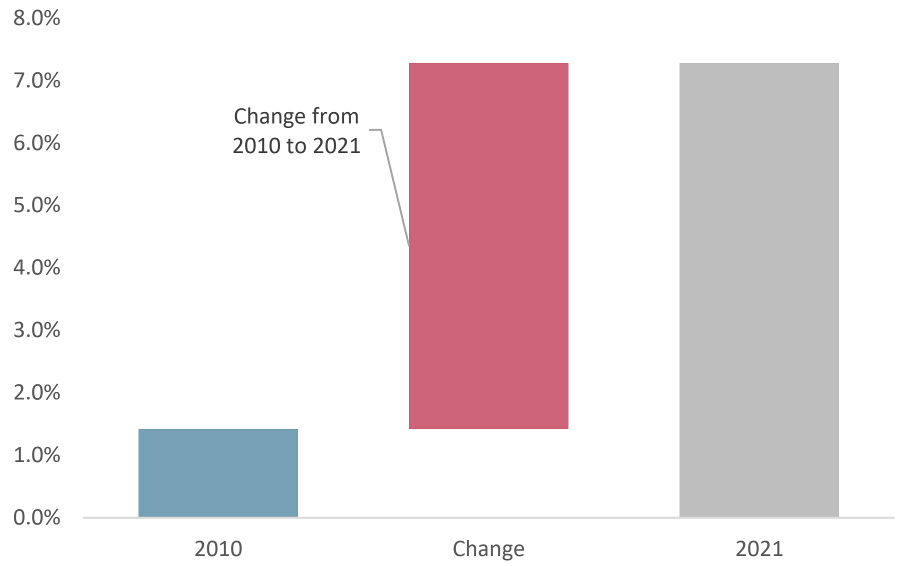
Source: EGEDA (2022)

Doubling of renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix from 2010 to 2030. There is no economy-level goal for individual member economies, but improvements by individual economies will contribute to the doubling goal.

Since the inception of the National Renewable Energy Policy and Action Plan (NREPAP) in 2010, various renewable energy programmes have been implemented. Malaysia's utilization of modern renewables has been on the rise. By 2021, the proportional share in was 7%, compared to 1.4% in 2010 (Figure 12). Looking forward, MYRER (2021) is expected to guide renewable sources to reach 70% of the renewable energy mix (installed capacity) in 2050.

Figure 12: Malaysia modern renewable energy share, 2010 and 2021



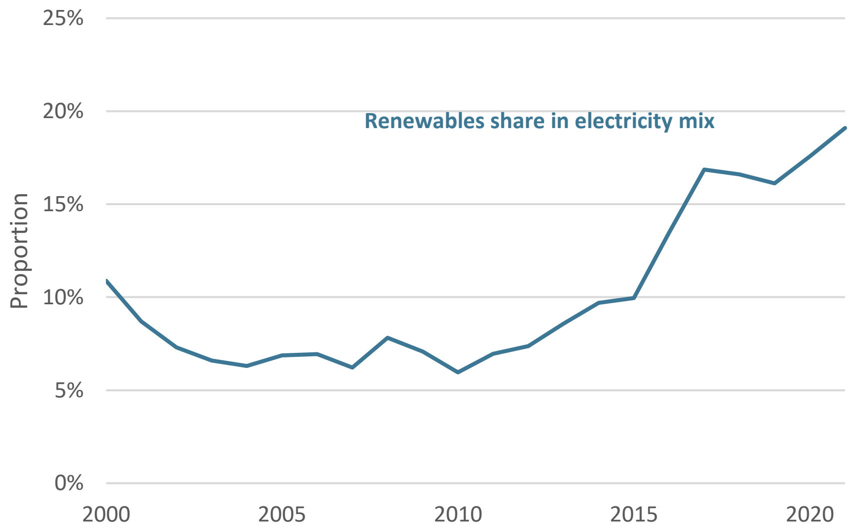
Source: EGEDA (2023)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

In 2021, Malaysia's electricity generation from renewables reached 19%, tripling the level seen in 2010 (Figure 13). Moreover, there was significant growth in renewables-based electricity generation, increasing from 7 TWh in 2010 to 34 TWh in 2021. This growth was guided by policies and plans, such as the various renewable energy (RE) plans, the feed-in tariff (FiT) scheme, solar auctioning, the rooftop solar quota under the Large-Scale Solar (LSS), Net Energy Metering (NEM), and the Self Consumption (SELCO) Programme.

In addition to the rise in renewables-based electricity generation in 2021, the annual increase in the renewables share was also partly attributed to the decline in electricity generation from fossil fuels, specifically oil and gas.

Figure 13: Malaysia renewable generation share, 2000 to 2021



Source: EGEDA (2023)

Energy Policy

Energy policy	Details	Reference
National Petroleum Policy 1975	To ensure the efficient utilisation of indigenous petroleum resources to facilitate domestic, industrial and economic development while ensuring effective regulation and domestic majority control in the oil and gas industry's ownership, management and operation.	Ministry of Economy
National Energy Policy 1979	To achieve an efficient, secure and environmentally sustainable supply of energy.	Ministry of Economy
National Depletion Policy 1980	To prolong the lifespan of domestic oil and gas reserves by safeguarding against over-exploitation and prioritising domestic needs for future energy security, with production caps imposed on oil and natural gas reserves.	Ministry of Economy
Four-Fuel Diversification Policy 1981	To enhance the reliability and security of the energy supply by reducing over-dependence on oil as the single fuel source by diversification to four primary fuels: oil, natural gas, hydroelectricity and coal.	Ministry of Energy Transition and Water Transformation
Five-Fuel Diversification Policy 2000	To introduce RE as an alternative fuel source to complement the four focus fuel sources identified in the Four-Fuel Diversification Policy and encourage efficient energy utilisation.	Ministry of Energy Transition and Water Transformation
National Policy on the Environment 2002	To promote continuous economic, social and cultural progress and enhance the quality of life of Malaysians through environmentally sound and sustainable development. This includes stewardship of the environment, continuous improvement of environmental quality and sustainable use of natural resources, and consumption and production patterns.	Ministry of Natural Resources and Environmental Sustainability
National Biofuel Policy 2006	To promote the use of biofuels, in alignment with the Five-Fuel Diversification policy, as an environmentally friendly, sustainable, and viable energy source to reduce dependency on fossil fuels and promote the well-being of all stakeholders in agricultural and commodity-based industries through stable and remunerative prices.	Ministry of Plantation and Commodities
National Green Technology Policy 2009	To promote energy efficiency while enhancing economic development to facilitate the growth of the green technology industry, increase domestic capability and capacity in green technology development, ensure sustainable development and conservation of the environment for future generations, and enhance public awareness of green technology.	Ministry of Natural Resources and Environmental Sustainability
National Renewable Energy Policy and Action Plan 2009	To enhance the utilisation of indigenous RE resources to contribute towards domestic supply security and sustainable socio-economic development by increasing RE contribution in the domestic power generation mix, facilitating the growth of the RE industry, ensuring reasonable RE generation costs, conserving the environment for future generations, and enhancing awareness on the role and importance of RE.	Ministry of Energy Transition and Water Transformation

Energy policy	Details	Reference
National Policy on Climate Change 2010	To promote the effective management of resources and enhanced environmental conservation to strengthen economic competitiveness and improve quality of life, integrate climate change considerations into domestic policies, and strengthen institutional and implementation capacities to address challenges and opportunities related to climate change.	Ministry of Natural Resources and Environmental Sustainability
New Energy Policy 2010	To promote energy security, economic efficiency, and environmental and social objectives through the five key pillars of energy pricing, supply, efficiency, governance, and change management. Highlights include the gradual reduction of energy subsidies, such as gradual gas price revisions to converge with the market pricing, initiatives to secure and manage reliable energy supply with third-party access (TPA) and the building of Re-Gasification Terminals (RGTs) and RAPID and FiT for RE sources and encouraging studies on alternative energies for increased energy source diversification, increased energy efficiency and various enablers such as energy sector governance.	Ministry of Economy
Nationally Determined Contribution to the UNFCCC 2015	To unconditionally decrease the GHG emission intensity of GDP by 35% in 2030 compared to the 2005 level and by a further 10% on the condition of receipt of climate finance, technology transfer and capacity building from developed economies.	Ministry of Natural Resources and Environmental Sustainability
National Energy Efficiency Action Plan 2016	To enhance energy efficiency with a target of 8% reduction (saving up to 594 MWh) in electricity demand by 2025 through energy efficiency initiatives, enabled by the implementation of the energy efficiency plan, strengthening of the institutional framework and capability development, implementation of a sustainable funding mechanism and promotion of private sector investment in energy efficiency initiatives.	Ministry of Energy Transition and Water Transformation
Green Technology Master Plan 2017-2030	Outlines the strategic plans/immediate course for green technology development to create a low-carbon and resource-efficient economy.	Ministry of Natural Resources and Environmental Sustainability
Green Technology Financing Scheme 1.0, 2.0 and 3.0	A special financing scheme to support the development of green technology in the energy, building, manufacturing, transport, waste management and water sectors.	Malaysia Green Technology Corporation
Malaysia's Roadmap Towards Zero Single-Use Plastics 2018-2030	Towards zero single-use plastics for a cleaner and healthier environment in Malaysia by 2030.	Ministry of Natural Resources and Environmental Sustainability

Energy policy	Details	Reference
National Automotive Policy 2020	To encourage new growth areas through the integration of technologies such as the Next Generation Vehicle (NxGV), Mobility as a Service (MaaS) and Industrial Revolution 4.0 (IR4.0) that are in line with the development of future technologies.	Ministry of International Trade and Industry
Peninsular Malaysia Generation Development Plan 2020 (2021-2039)	Electricity demand is projected to grow by 0.6% p.a. for 2021-2030 and 1.8% p.a. for 2030-2039. To achieve the RE capacity mix target from 20% to 31% by 2025, large hydro resources will be included as part of the RE for consistency and 1 178 MW of new RE capacities will be developed in Peninsular Malaysia from 2021 onwards. To increase RE capacity to 40% by 2035, an additional 2 414 MW of RE capacity will be developed. The total new RE capacity would consist of 93% solar and 7% non-solar energy. The plan is also to develop 6 077 MW of new capacity (thermal energy and RE) by 2030 and 9 924 MW of new capacity (thermal energy and RE) beyond 2030.	Energy Commission
Low Carbon Mobility Blueprint 2021-2030	To focus on improving vehicle fuel economies and emissions, adopting EVs, low-emission vehicles and alternative fuels, and reducing GHG emissions and energy via mode shifts.	Ministry of Natural Resources and Environmental Sustainability
National Low Carbon Cities Masterplan 2021	To help guide the implementation of low-carbon developments and initiatives.	Ministry of Natural Resources and Environmental Sustainability
Nationally Determined Contribution to the UNFCCC 2021	To unconditionally decrease GHG emission intensity of the GDP by 45% in 2030 compared to the 2005 level.	Ministry of Natural Resources and Environmental Sustainability
The Twelfth Malaysia Plan 2021-2025	A medium-term plan for Shared Prosperity Vision 2030, with the objective of “A Prosperous, Inclusive, Sustainable Malaysia”. Under the plan, the energy sector will address the energy trilemma, especially on energy security and sustainability.	Ministry of Economy
National OGSE Industry Blueprint 2021-2030	To help shape the Oil & Gas Services and Equipment (OGSE) industry and adapt to the rapidly evolving needs of the global market.	Ministry of Economy
Malaysia Renewable Energy Roadmap 2022-2035	To support further decarbonisation of the electricity sector in Malaysia through the 2035 milestone, from 2022 to 2035.	Ministry of Energy Transition and Water Transformation
Sabah Gas Master Plan 2022	A collaborative effort between the Sabah State Government and Petronas to sustainably pursue the full potential of Sabah's domestic natural gas industry.	Sabah State Government PETRONAS

Energy policy	Details	Reference
Third Industrial Master Plan (IMP3) 2030	Manufacturing: to grow at 5.6% annually, contribute 28.5% to GDP in 2020, and total investments of MYR 412.2 billion (MYR 27.5 billion annually). Non-government services: to grow at 7.5% annually and contribute 59.7% to GDP in 2020, and total investments of MYR 687.7 billion (MYR 45.8 billion annually).	Ministry of International Trade and Industry
Post COVID-19 Development Strategy 2030	To ensure Sarawak can embark on a full-fledged transformation by capitalising on megatrends around the world such as globalisation, the new industrial revolution, circular economy, and transition towards a low carbon economy.	Economic Planning Unit Sarawak
National Energy Policy 2022-2040	To enhance macroeconomic resilience and energy security, achieve social equitability and affordability, and ensure environmental sustainability. The document is subject to reviews every three years to ensure that the targets are achievable and to keep the policy in line with international development in the energy transition pace.	Ministry of Economy
National Energy Transition Roadmap 2050	To accelerate energy transition efforts. This roadmap is vital for steering Malaysia's shift from a traditional fossil fuels-based economy to a high-value green economy. The NETR requires a whole-of-economy approach, encompassing federal and state governments, industry, the public, and the international community.	Ministry of Economy
Hydrogen Economy and Technology Roadmap 2050	To guide the development of Malaysia's hydrogen economy. This roadmap is a supporting document to the National Energy Policy 2022-2040 (NEP), which will pave the way to achieving environmentally sustainable, long-term energy security for Malaysia, driven by technological innovation.	Ministry of Science, Technology, and Innovation

Notable Energy Developments

Energy development	Details	Reference
Energy Efficiency and Conservation Act 2023	To strengthen the regulatory framework of Energy in Malaysia, EECA will implement initiatives and implementation to reach the economy target on energy saving.	Energy Commission
Electric motorcycle rebate	Electric motorcycle incentive scheme provides buyers of electric bikes with a rebate to encourage them to switch from petrol to electric bikes.	Ministry of International Trade and Industry
Sustainability Achieved Via Energy Efficiency (SAVE) 4.0	A programme that grants an e-rebate to domestic households that purchase energy-efficient air conditioners and refrigerators with 4-star or 5-star energy efficiency labels from the Energy Commission (ST)	Ministry of Energy Transition and Water Transformation
Renewable Energy Capacity	The enhanced RE capacity mix target will rise from the previous goal of 40% by 2035 to 70% by 2050.	Ministry of Economy Sustainable Energy Development Authority (SEDA) Malaysia
Solar and wind energy projects in Malaysia	Masdar and MIDA have agreed through a MoU signed during COP28 for an implementation roadmap to advance the development of 10GW of clean energy projects in Malaysia.	Malaysian Investment Development Authority
Floating Solar and Centralised Solar Park Projects	TNB with Majuperak Holdings Berhad (MHB), a government-linked company, to develop a substantial 100-megawatt (MW) ground-mounted solar project in Perak.	Tenaga Malaysia Berhad Majuperak Holdings Berhad
Imbalance Cost Pass-Through (ICPT) Rates 2023	A mechanism to reflect changes in the cost of electricity generation, specifically fuel costs, for every six months. The government of Malaysia has also decided to introduce a targeted subsidy scheme for ICPT implementation period from 1 July 2023 until 31 December 2023, with the implementation of the targeted subsidy scheme.	Tenaga Malaysia Berhad

Useful Links

Bank Negara Malaysia – www.bnm.gov.my

Department of Statistics Malaysia – www.dosm.gov.my

Energy Commission – www.st.gov.my

Grid System Operator – www.gso.org.my

Malaysia Energy Information Hub – www.meih.st.gov.my

Malaysia Green Technology Corporation – www.mgtc.gov.my

Malaysian Palm Oil Board – www.mpob.gov.my

Ministry of Economy – www.epu.gov.my

Ministry of Energy Transition and Water Transformation

Ministry of Natural Resources and Environmental Sustainability

Ministry of Finance – www.mof.gov.my

Ministry of Investment, Trade, and Industry – www.miti.gov.my

Ministry of Plantation and Commodities – www.mpic.gov.my

Ministry of Science, Technology, and Innovation – www.mosti.gov.my

PETRONAS – www.petronas.com

Prime Minister's Office – www.pmo.gov.my

Sabah Electricity Sdn. Bhd. – www.sesb.com.my

Sarawak Energy Berhad – www.sarawakenergy.com

Sustainable Energy Development Authority (SEDA) Malaysia – www.seda.gov.my

Single Buyer Department – www.singlebuyer.com.my

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Ministry of Economy, Twelfth Malaysia Plan (12MP) 2021-2025, https://rmke12.ekonomi.gov.my/en

Ministry of Economy,

Ministry of Economy, National Energy Policy (DTN) (2022), https://www.ekonomi.gov.my/sites/default/files/2022-09/Dasar_Tenaga_Negara_2022-2040.pdf

Ministry of International Trade and Industry (2030), New Industrial Master Plan (NIMP) 2030, https://www.nimp2030.gov.my/

Ministry of Natural Resources and Environmental Sustainability (2023), Fourth Biennial Update Report Under the United Nations Framework Convention on Climate Change, https://unfccc.int/documents/624776

Ministry of Science, Technology, and Innovation (MOSTI), Hydrogen Economy and Technology Roadmap (2023), https://www.mosti.gov.my/en/penerbitan/?d=LzIwMjM%3D&m1dll_index_get=0

Petronas (2023), Petronas Activity Outlook 2024 – 2026, https://www.petronas.com/activity-outlook-2024-2026/

Sustainable Energy Development Authority (SEDA) Malaysia (2023), Malaysia Renewable Energy Roadmap (MYRER), https://www.seda.gov.my/reportal/myrer/

Tenaga Malaysia Berhad (TNB) (2023), Imbalance Cost Pass-Through (ICPT) mechanism, https://www.tnb.com.my/faq/icpt-english

Mexico

Introduction

Mexico's favourable geographic location, with access to the Atlantic and Pacific Ocean and close to the United States, allows it to import natural gas produced in the US through its robust and interconnected pipeline system. Increased demand for US natural gas globally has positioned Mexico as a potential exporter of US gas. In 2023, Mexico's first gas liquefaction terminal, New Fortress Altamira Fast LNG (FLNG), started operations and a second liquefaction terminal is expected to come online in 2024. Mexico's Comisión Federal de Electricidad (CFE), which holds most of the pipeline capacity, is a key player in the development of these projects, together with the private sector.

Despite having abundant hydrocarbon resources and being one of the top 10 economies globally in terms of shale oil and gas reserves, Mexico's oil and gas production has been insufficient to satisfy a growing energy demand. In 2014, Mexico enacted energy reforms to open the sector to private sector participation and thereby increase energy production.

In 2021, Mexico's natural gas production fell to its lowest level in 45 years. However, the last two years saw a partial reversal to the downward trend in production. Gas production in 2023 reached 4 995 million cubic feet per day, a 4% increment over the volumes reported in 2022. Exploration and extraction contracts awarded to the private sector since the 2014 energy reform have contributed to this growth trajectory; private entities extracted 4.9% of the gas produced in 2023.

In 2023, crude oil production reached 1.65 million barrels per day, a 1.9% increment over the value reported the previous year. The private sector saw an 11% growth in crude oil production while Mexico's oil company, Petróleos Mexicanos (PEMEX), reported a marginal growth of 0.7% in the same year. The low crude oil production growth was largely driven by productivity decline in mature fields, which represent the largest share of producing assets.

The government has an energy self-sufficiency strategy with the objective of increasing domestic production of crude oil, gas and refined products. PEMEX is the key pillar of this strategy. The Energy Ministry's key infrastructure project consists of a new refinery with a capacity of 340 000 barrels per day, which is in the state of Tabasco and is expected to begin operations in the second half of 2024.

Table 1: Mexico's macroeconomic data and energy reserves

Key data [a, b]		**Energy reserves** [c, d]	
Area (million km²)	2.0	Oil (billion barrels)	6.1
Population (million)	127	Gas (trillion cubic feet)	6.3
GDP (2017 USD billion PPP)	2 582	Coal (million tonnes)	1 211
GDP per capita (2017 USD PPP)	20 255	Uranium (kilotonnes U < USD 130/kgU)	1 800

Source: a SRE (2023); b World Bank (2023); c BP (2023); d UN (2023)

Note: Reserves are total proved reserves and identified recoverable resources for uranium.

In November 2022, during COP27, Mexico's government made the commitment to increase its Nationally Determined Contributions by 5% in order to reduce greenhouse emissions by a total of 35% below 2005 levels by 2030. Mexico seeks to deploy more than 30 additional gigawatts of combined wind, solar, geothermal and hydroelectricity capacity by 2030, with a goal of reaching more than 40 gigawatts of combined wind and solar power (SRE, 2022).

Energy Supply and Consumption

Total primary energy supply

Mexico's energy production has declined by 42% since oil production peaked at 11 058 PJ in 2004. Total primary energy supply, which includes imports, exceeded domestic production for the first time in 2016, and it is expected that this trend will continue unless the decline in crude oil and gas production is reversed. The production of these hydrocarbons started to show signs of stabilisation since 2019 due to new developments in the Sureste Basin.

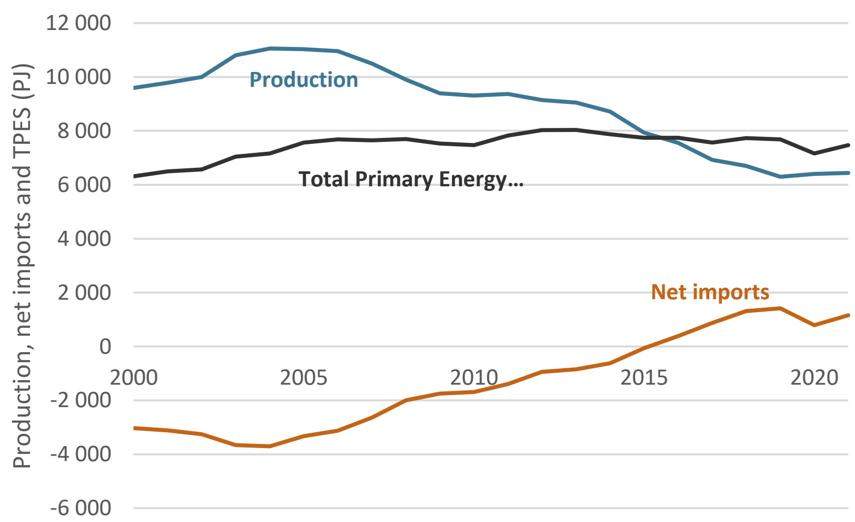
Mexico was a net energy exporter up to 2015. Mexico energy exports consist mostly of crude oil but were outpaced by an increase in natural gas and oil refined products imports from the United States. The decline in oil and gas production exacerbated the reliance on US fuels; the volume of net energy imports tripled from 2016 to 2021.

The United States-Mexico-Canada Agreement (USMCA) is the framework for energy trade between North American economies. Due to the USMCA and geographical proximity to the United States, Mexico receives relatively affordable oil refined products and gas imports from the United States.

Over the next decades, natural gas imports are expected to continue increasing to satisfy growth in domestic demand, and, potentially, to be re-exported from Mexico to the international market. Due to its geographic location and logistical advantages, several liquefied natural gas (LNG) projects in Mexico are being considered to expand the trade of US gas. Most of these projects are geared to the Asian and European markets. Several additional LNG export projects have been announced and one is currently under construction: Sempra's Costa Azul project in Baja California.

Over the long term, as the Asian and European markets pursue decarbonisation strategies, Mexico could become well positioned to export LNG, as well as low-carbon fuels such as green and blue hydrogen.

Figure 1: Mexico's energy supply, production, and net imports (PJ), 2000 to 2021

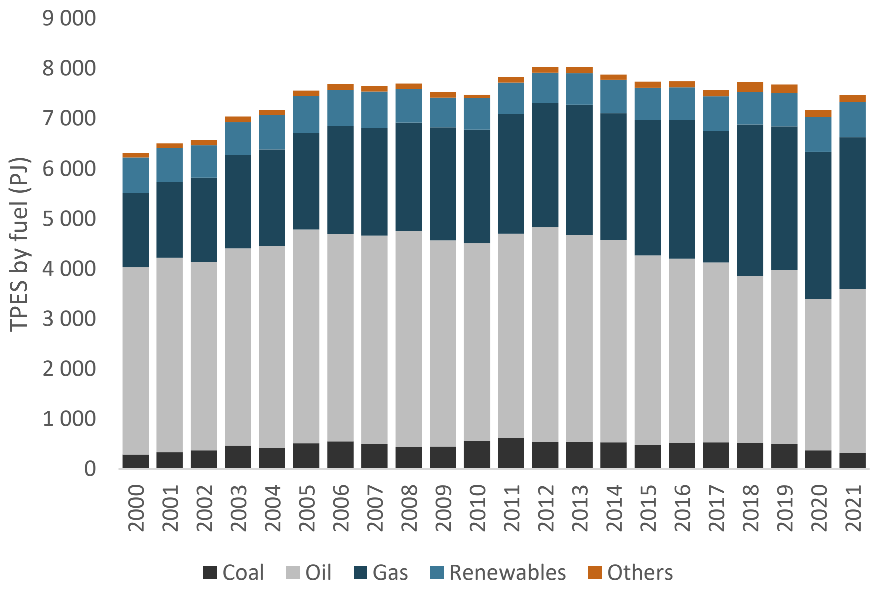


Source: EGEDA (2023)

From 2010 to 2019, Mexico's total primary energy supply (TPES) volume grew modestly (4%) before contracting by 3% in 2020. In terms of composition, fossil fuels still represent the largest share (89%), with oil accounting for the largest share (44%) in 2021.

In 2021, TPES saw a 4.2% annual increase as economic activities reactivated. Oil saw the largest increase at 8.1%, due to a slight increase in production and increased imports of oil refined products. In the same year, coal supply contracted by 13%. A fuel switch in power generation is increasingly displacing coal from Mexico's energy mix, as less carbon-intensive natural gas increases its share. In the same year, natural gas supply increased by 3%.

Figure 2: Mexico's energy supply by fuel (PJ), 2000 to 2021

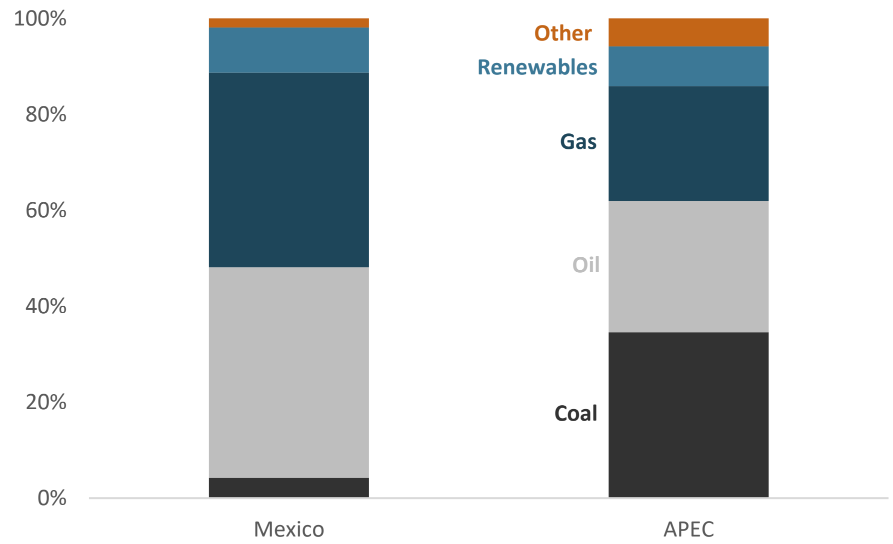


Source: EGEDA (2023)

Natural gas is also replacing oil supply. From 2010 to 2021, the share of oil supply in TPES reduced from 53% to 44%, while the share of natural gas supply increased from 30% to 41%. Since mid-2000s, a host of factors, including an abundance of affordable US gas and natural gas infrastructure build-out, has allowed Mexico to increase its gas supply even amid the contraction in domestic supply. An extensive integrated pipeline network allows natural gas to reach demand centres to supply the industrial, building and power sectors.

Mexico has great potential for renewable energy generation. Wind and solar penetration have been rapidly increasing during the last decade; however, modern renewables still lag behind hydro and thermal generation. In 2021, the renewables supply increased by 3%, driven by supply growth in wind, solar and hydro. Solid biomass and geothermal showed a slight contraction.

Figure 3: Energy supply mix – Mexico and APEC, 2021



Source: EGEDA (2023)

One of the main differences between Mexico's energy mix and APEC's is the low share of coal in the energy supply mix. In comparison to the

APEC region, Mexico has readily available domestic and imported natural gas, which makes it a more competitive fuel than coal for applications such as power generation.

In Mexico, the share of oil in the energy supply mix is larger (44%) than in APEC (27%). This is due to Mexico's domestic production and imports of oil refined products. Mexico has six oil refineries, and it is building a seventh, called Dos Bocas, located in the state of Tabasco in the southern region of Mexico.

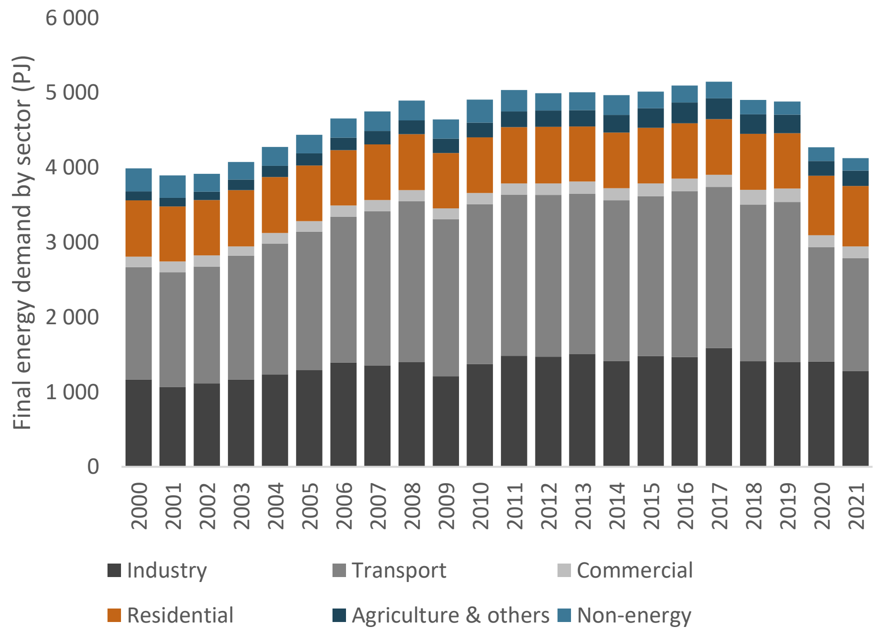
The new refinery will have a capacity of 340 000 barrels per day. The current government aims to increase Mexico's energy self-sufficiency, by increasing domestic fuel production. Currently, about 60% of Mexico's refined products are imported from the United States.

Total final consumption

In 2021, total final consumption (TFC) in Mexico continued to decline, showing a 3.4% contraction compared to the previous year (including non-energy consumption). Economic activity struggled to rebound to pre-pandemic levels as COVID-19 cases remained high, affecting especially industrial energy consumption, which showed a 9% contraction from 2020 to 2021.

TFC in the transport and commercial sectors also experienced further contractions in 2021. The transport sector saw a 2.4% contraction while the commercial sector saw a 1.4% decrease in its final energy consumption. The fall in final consumption in the transport sector was a result of work-from-home policies, while the commercial sector final consumption was affected by social distancing policies and economic uncertainty.

Figure 4: Mexico's final consumption by sector (PJ), 2000 to 2021

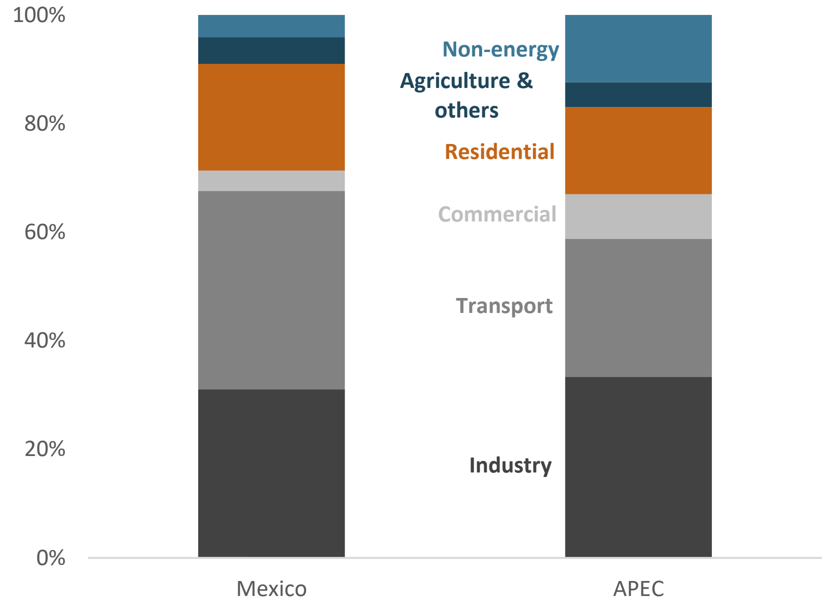


Source: EGEDA (2023)

Mexico's TFC has been largely driven by the transport sector, making up 36% of total consumption. The mountainous geography, extensive trade with the United States, and sizeable vehicle ownership make this sector the dominant energy consumer. The transport sector in Mexico is largely dependent on oil refined products such as diesel and gasoline.

The industry sector is the second largest consumer at 31% of TFC. This sector is heavily reliant on electricity and natural gas consumption.

Figure 5: Final consumption by sector, Mexico and APEC, 2021

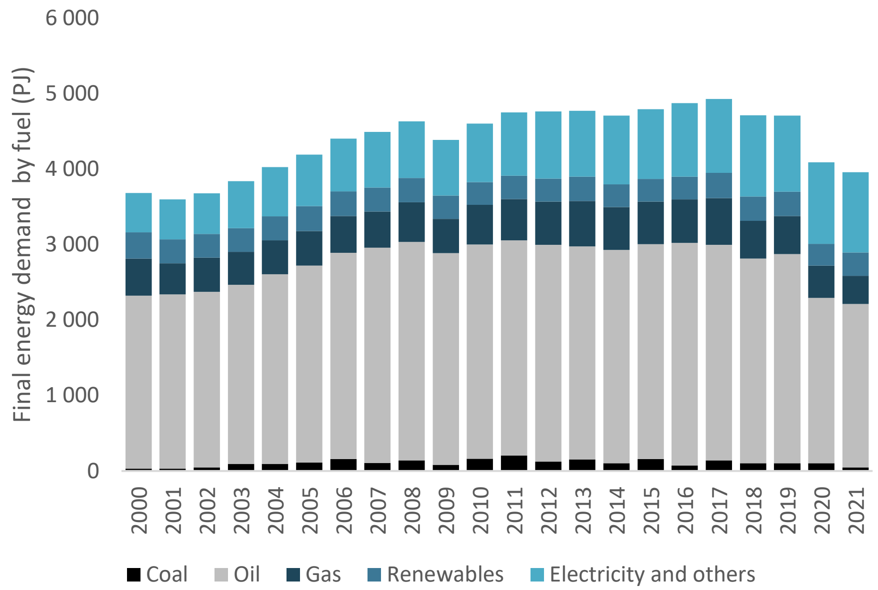


Source: EGEDA (2023)

Final energy demand

In 2021, final energy demand in Mexico contracted by 3.2% from the already low levels of 2020 (excluding non-energy consumption). Economic activity was still limited as COVID-19 cases remained high, especially during the first half of 2021. Final energy demand contraction affected electricity and fuels; however, renewables final energy demand increased. Renewables surged by 7.8% in 2021 as the use of solid biomass rebounded. Coal demand saw the largest annual drop at 52%; this was the result of a sharp contraction in coal demand for manufacturing.

Figure 6: Mexico's final energy demand by fuel (PJ), 2000 to 2021

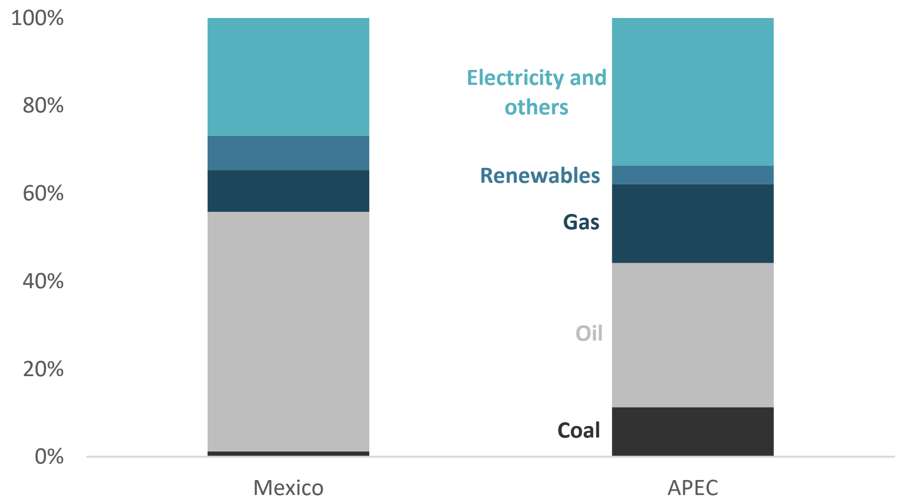


Note: Does not include non-energy sector consumption of energy products.

Source: EGEDA (2023)

Mexico is heavily reliant on fossil fuels to meet its final energy demand. In 2021, oil represented the largest share of final energy demand at 54%. Mexico's domestic oil production and access to oil refined products imports from the United States explain why the economy is more reliant on oil than the APEC region in general. Although Mexico has a sizeable total gas supply, a large portion of it is used to produce electricity. The gas share of final energy demand is 9.5%, half of the share for the APEC region total. The coal share in Mexico's final energy demand mix is noticeably low at 1.2% due to its limited requirements in Mexico's industry sector.

Figure 7: Final energy demand fuel share, Mexico and APEC, 2021



Source: EGEDA (2023)

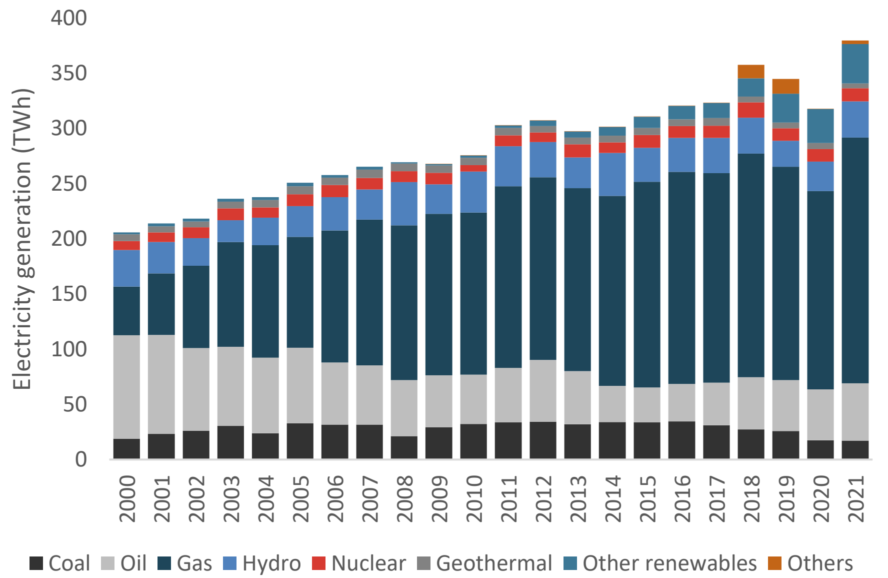
Renewable energy in Mexico, with a share of 7.8% of final energy demand, is almost double the share observed in the APEC total. The majority of final energy demand for renewables arises from the use of solid biomass for domestic use such as cooking and water heating. Electricity comprises 27% of final energy demand in Mexico, which is below the electricity's share in the APEC total (33%). The high penetration of oil products and the use of solid biomass for domestic activities have limited a larger role of electricity in Mexico.

Transformation

Power sector

In 2021, total electricity generation in Mexico increased by 19% from 2020 levels. The rebound in electricity generation was driven by natural gas generation. Even though final energy demand for electricity contracted slightly in 2021, the generation level observed was the highest on record as Mexico sharply decreased electricity imports from the United States. Mexico's power sector also experienced a sharp increase in losses.

Figure 8: Mexico's electricity generation by fuel, 2000 to 2021



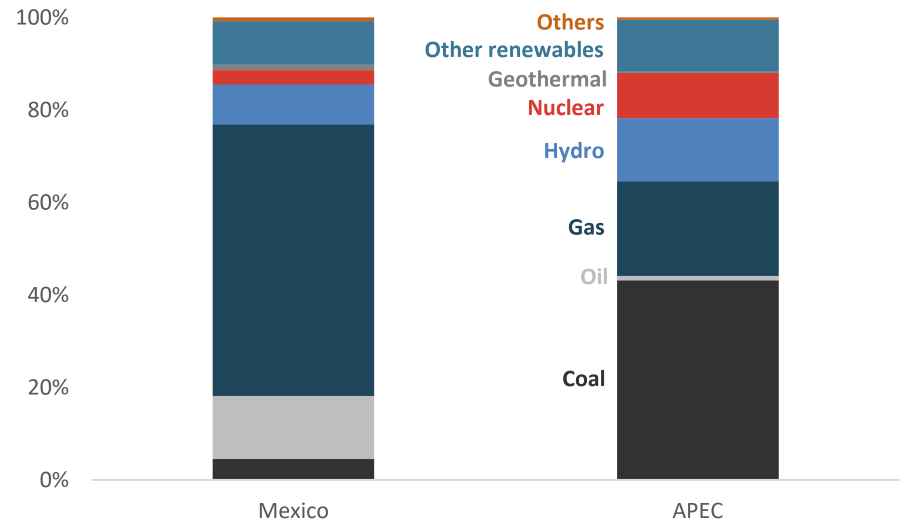
Source: EGEDA (2023)

Mexico's CFE is the largest electricity generator in the economy. It has a large power generation fleet that runs mainly on coal, oil and natural gas. The private sector accounts for 46% of total electricity generation and its main sources of electricity generation are natural gas and renewables.

In 2021, 58% of total electricity in Mexico was generated with gas. Mexico's gas pipeline capacity has expanded significantly, and its ability to import natural gas at a relatively affordable cost has contributed to a fuel switch from coal and oil to natural gas. In comparison, in the APEC region, high domestic availability for coal at competitive prices has led to coal being the dominant source of electricity. Similar to gas, Mexico's domestic production of oil and refined products imports from the United States make oil, to a lesser extent, a competitive fuel for power generation. Oil generation accounted for 13% of total electricity generation.

In 2021, renewable electricity had a smaller share in Mexico than in the APEC region. Hydro, geothermal, and other renewables (e.g., solar and wind) accounted for 19% of total generation in Mexico, while these sources accounted for 25% of generation the APEC region. Mexico's CFE recently announced the development of new renewable energy projects, and has also set out the objective of increasing investment in renewables in its 2023-2027 business plan.

Figure 9: Electricity generation fuel share, Mexico and APEC, 2021



Source: EGEDA (2023)

In Mexico, the domestic availability of hydrocarbons and renewables has discouraged nuclear capacity additions.

Refining

Mexico has the policy priority of increasing its domestic refining capacity. The economy is building its seventh refinery, Dos Bocas, in the state of Tabasco that will have a capacity of 340 000 barrels per day. In recent years, Mexico's government-owned oil company, PEMEX, acquired the Texas Deer Park refinery to have increased control over its refined product imports from the United States.

Energy Transition

Emissions

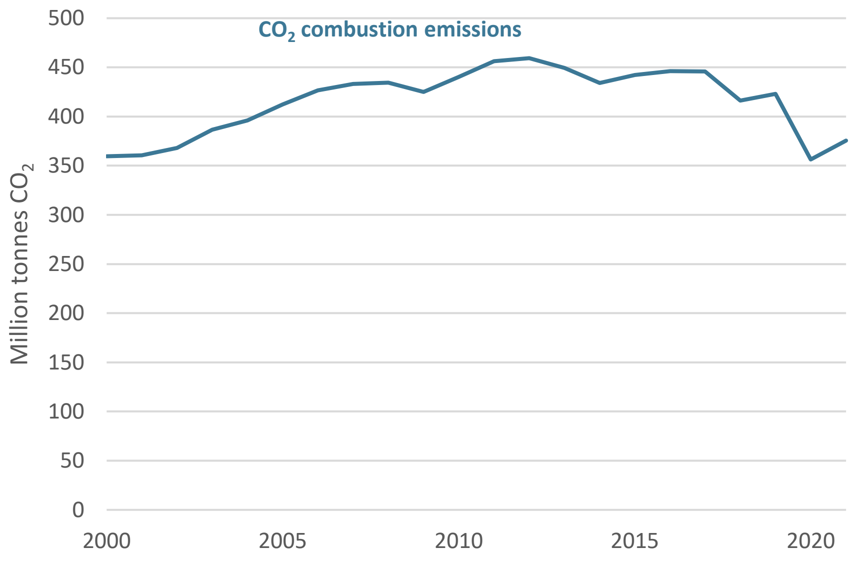
Mexico's CO_2 emissions follow the same trend as final energy consumption; the trajectory in emissions reported between 2000 and 2021 is more influenced by changes in final energy consumption than by decarbonisation efforts. However, Mexico has started to implement emissions reduction measures, especially in the power sector.

In November 2022, during COP27, Mexico's government made the commitment to reduce greenhouse emissions by 35% by 2030. Increased investments in renewable power generation are expected to help meet this goal.

The decline in coal and oil use in the power sector has been the largest driver of CO_2 emissions reductions efforts in Mexico. From 2000 to 2010, oil use in the power sector declined by half, while natural gas saw a 70% increase. From 2010 to 2021, electricity capacity additions came from less intensive carbon sources than during the prior decade. Natural gas generation increased by 18%, oil-fired generation remained flat, and renewable electricity increased by 90%.

Coal generation in Mexico started to decrease abruptly after peaking in 2016. Electricity generation from coal shrank by 50% between 2016 and 2021; natural gas was used to displace this fuel.

Figure 10: Mexico CO_2 combustion emissions (million tonnes), 2000 to 2021



Source: EGEDA (2023)

Energy security

Mexico has abundant hydrocarbon resources and renewable energy potential. Oil and natural gas production in Mexico have been on a declining trend due to lack of investment in upstream activity and a natural depletion of its large oilfields. At the same time, macroeconomic factors have been increasing demand for energy in Mexico. The decline in domestic production coupled with increased demand is expanding the need for energy imports from the United States. Over the last decade, Mexico's imports of oil refined products and natural gas have increased significantly.

The current development plan focuses on increasing energy security in Mexico by increasing domestic oil and gas production, as well as midstream capabilities. Although the production of hydrocarbons has stabilised, further efforts are still needed to ensure continuous successful upstream operations. Mexico will need to invest in natural gas storage as well as diversify its energy supply base to reduce its exposure to abrupt market changes and geopolitical challenges.

APEC Energy Goals

There are two energy-related objectives that APEC member economies have agreed to meet as a collective: to improve energy intensity and to double the share of modern renewables.

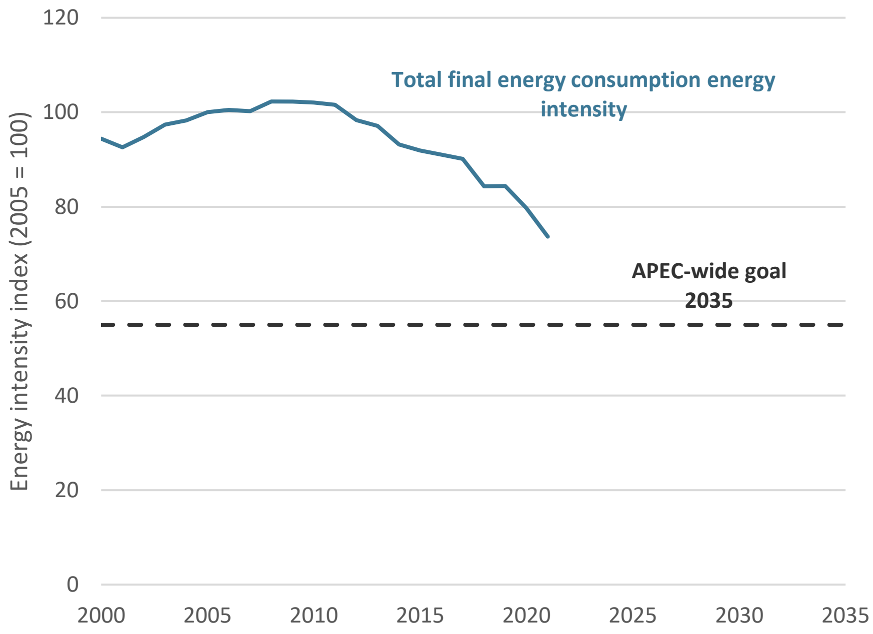
Energy intensity goal

In 2011, APEC member economies agreed to increase their target to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

APEC is on track to achieve this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

Total final energy consumption intensity in Mexico has decreased by 26% from the 2005 baseline. Most of the energy efficiency gains in this time frame are attributed to the residential sector. Mexico focused on improvements in energy-efficient construction, appliances and lighting (CEPAL, 2018).

Figure 11: Mexico's total final energy consumption intensity index, 2000 to 2021 (2005 = 100)

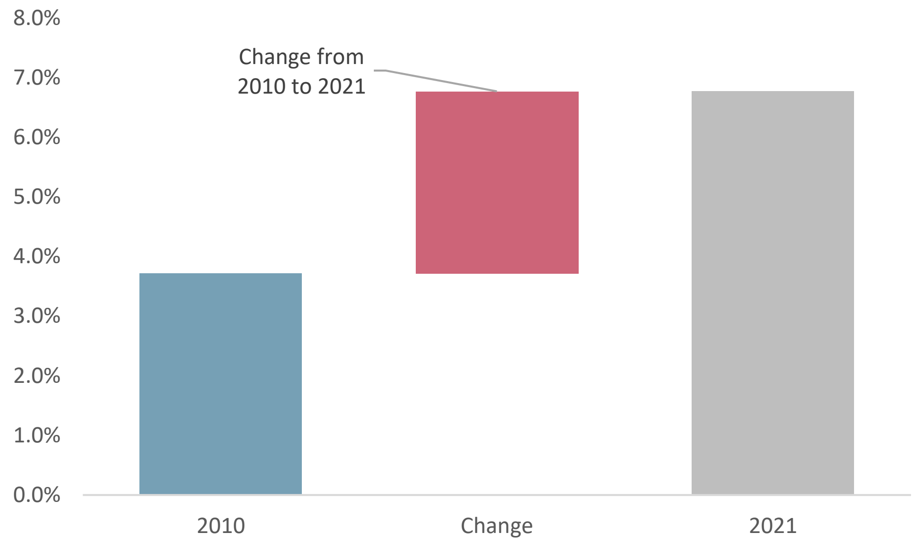


Source: EGEDA (2023)

Doubling of renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period 2010 to 2030. There is no economy-level goal for individual member economies, but improvements by individual economies will contribute to the doubling goal.

Figure 12: Mexico's modern renewable energy share, 2010 and 2021



Source: EGEDA (2023)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

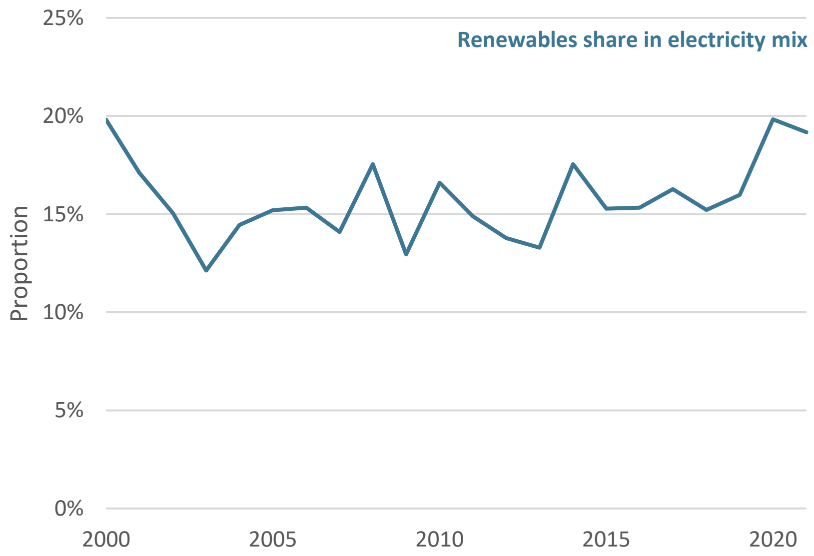
From 2010 to 2021, there was a 3.1% increase in Mexico's modern renewable share, reaching a total of 6.8% in 2021. Increased private sector participation in electricity generation contributed to an acceleration in wind and solar capacity growth. Mexico has the potential to be one of the most competitive producers of wind and solar energy in the world. For this reason, it is expected that the CFE will play an increased role in the development of modern renewable energy projects.

Mexico's renewable electricity generation share in 2021 was 19%, 1%

lower than its share in 2000. One of the reasons why Mexico's renewables share in electricity mix has remained flat is that natural gas generation expanded more rapidly to cover most of the growth in electricity demand. Additionally, participation of the private sector in renewable generation projects has only been possible since 2014 when the energy reform was implemented.

The government of Mexico has been cautious in its approach to incorporating larger volumes of renewable energy, due in part to grid reliability concerns. It is likely that new investments across the energy sector will come from close private-public sector partnerships. The government is increasingly interested in developing new renewable energy projects to satisfy its growing energy demand, although there is not a clear time frame or scale for these projects.

Figure 13: Mexico's renewable generation share, 2000 to 2021



Source: EGEDA (2023)

Energy Policy

Energy policy	Details	Reference
National Development Plan 2019-2024	This plan outlines the main policy objectives and priorities of the current six-year (2018–2024) presidential administration.	Office of the President
Energy Sector Program 2020-2024 (PROSENER)	PROSENER is a planning instrument that determines the current administration's strategies and actions towards achieving six priority objectives: to ensure energy self-sufficiency, strengthen state-owned companies, organise research and development activities, attain energy efficiency and sustainability, ensure universal energy access and make the energy sector a lever of development.	Official Federal Gazette
Transition Strategy to Promote the Use of Cleaner Technologies and Fuels	The Transition Strategy serves as the medium- and long-term guiding instrument for the government policy regarding clean energy obligations, sustainable energy use and energy productivity improvements.	Official Federal Gazette
Crude Oil and Oil Products Perspectives 2023-2037	This report includes information regarding the current state of crude oil and oil products production in Mexico. The document outlines the efforts to integrate new infrastructure projects.	Ministry of Energy
Natural Gas Perspectives 2023-2037	This report includes information regarding the current state of natural gas production in Mexico. The document outlines the efforts to integrate new infrastructure projects.	Ministry of Energy
Electric System Perspectives 2023-2037	This report includes information regarding the current state of the electric system in Mexico. The document outlines the efforts to integrate new infrastructure projects.	Ministry of Energy
Paris Agreement Nationally Determined Contribution (NDC) 2022 Update	In November 2022, during COP27, the Mexican Government submitted an updated NDC. The submission includes an unconditional emissions reduction target from business-as-usual by up to 35% in 2030 for all greenhouse gases.	Ministry of Environment and Natural Resources (SEMARNAT)
Paris Agreement Nationally Determined Contribution (NDC) 2020 Update	Mexico updated its NDC in 2020, but it did not improve upon the ambitions of its original NDC, in which the economy pledged to reduce greenhouse gas emissions by 22% by 2030, compared to a business-as-usual 2013 baseline. No additional emission reduction or decarbonisation plans have been published to date.	Ministry of Environment and Natural Resources (SEMARNAT)

Energy policy	Details	Reference
National Electricity System's Development Program 2023-2037 (PRODESEN)	This programme details the annual plans for the power sector with a 15-year horizon. It includes key elements for generation capacity additions and retirements as well as for grid extensions and modernisation.	Ministry of Energy (SENER)
Oil and Gas Exploration and Production Five-year Plan 2020-2024	This is a planning instrument that identifies the priority areas for oil and gas exploration and production, emphasising the potential for onshore and shallow-water resources. It excludes the development of any unconventional resources for the time being. The document also reaffirms the administration's moratorium on oil and gas auctions.	Ministry of Energy (SENER)
Five-year Plan for the Expansion of the National Integrated Transportation and Storage System of Natural Gas (SISTRANGAS) 2020-2024	This five-year plan provides an overview of the natural gas transportation and storage infrastructure as well as the consumption and supply observed in recent years. The planning document details a set of infrastructure projects that can help expand the storage and transportation networks.	Ministry of Energy (SENER)
National Program for the Sustainable Use of Energy 2020–2024 (PRONASE)	This instrument establishes actions, projects and activities derived from the Transition Strategy for the accomplishment of the stated energy efficiency goals.	Official Federal Gazette
Energy Efficiency Roadmap	This roadmap on energy efficiency details the energy efficiency goals, potential and sectoral scenarios and the sectoral barriers to tapping into the full energy efficiency potential.	National Commission for the Efficient Use of Energy (CONUEE)
Energy Transition Law (LTE)	The LTE provides a framework for clean energy, energy efficiency and greenhouse gas emission reduction. It establishes four planning instruments: a strategy to meet the clean energy and energy efficiency goals, two special programmes to implement this strategy and a programme focused on smart grids. The clean energy goals for power generation are as follows: 25% in 2018, 30% in 2021, and 35% in 2024.	Official Federal Gazette
Second Regulation of the Energy Transition Law	This secondary regulation or *reglamento* specifies, in greater detail, the obligations given in the LTE. Among other issues, it provides the requirements for the methodologies involved in planning and publishing progress reports and other clean energy benchmarking data.	Official Federal Gazette
Roadmap for Building Energy Codes and Standards for Mexico	This document provides a pathway and policy framework for increasing energy efficiency in Mexico's building sector.	Ministry of Energy (SENER)

Energy policy	Details	Reference
Minimum Energy Performance Standards for 12 Appliance Groups	This set of standards regulates the energy consumption of appliances that, due to their energy demand and massive use, offer substantial energy and cost savings to end users.	National Commission for the Efficient Use of Energy (CONUEE)
National Program for Energy Management Systems (PronasgeN)	This programme aims to support and bring together Energy Management Systems (EnMS), contributing to EnMS market consolidation in Mexico. Case studies have demonstrated energy efficiency improvements of at least 10% in industrial facilities upon implementing EnMS.	Official Federal Gazette
Guidelines for the Prevention and Comprehensive Control of Methane Emissions from the Oil and Gas Sector	These guidelines apply to new and existing sources across the value chain. Under the regulation, facilities must develop a Program for Prevention and Integrated Control of Methane Emissions (PPCIEM). As a starting point, facilities must identify all sources of methane and calculate an emissions baseline (base year must be within the last five years).	Ministry of Environment and Natural Resources (SEMARNAT)
Pilot Emissions Trading System (ETS)	In 2020, this pilot ETS began its operations as part of a two-phase process to gradually establish a fully-fledged ETS. The pilot ETS covers the power, oil and gas and industrial sectors, which account for approximately 40% of Mexico's greenhouse gas emissions. Entities with annual emissions from direct sources greater than 100 kt-CO_2 were covered under the pilot.	National Commission for the Efficient Use of Energy (CONUEE)
Municipal Energy Efficiency Project (PRESEM)	PRESEM focuses on making energy efficiency investments in selected municipal sectors (pumping water systems, street lighting and public buildings).	Department of Industry, Science, Energy and Resources
Electricity Subsidies for the Residential and Agricultural Sectors	The Ministry of Finance (SHCP) provides subsidised electricity rates to most users in the residential and agricultural sectors. The final rates vary due to inflation but remain constant in real time. This rate was roughly 0.12 USD/kWh in 2020, which was about 46% of the total cost of the service.	Inter-American Development Bank (IADB)
Statistical Record 2021	This is a compendium of data on natural gas and petrochemicals, and it is presented in a clearly summarised and accessible format on a monthly basis.	Ministry of Energy (SENER)

Notable Energy Developments

Energy development	Details	Reference
Amendment to the Electricity Industry Law	After approval in both legislative chambers, this amendment – proposed by the President – was published in March 2021. The ultimate purpose of the law is to strengthen the national Comisión Federal de Electricidad (CFE). Some of the changed provisions in the law include granting a dispatch preference for CFE power plants, removing the obligation for service suppliers to procure electricity, and revoking self-supply permits.	Official Federal Gazette
Electricity Industry Law Court Suspension	The recently approved amended electricity law is in an ongoing judiciary process. It was granted a definitive suspension by a Mexican court, citing competition concerns and irreparable environmental damage. Accordingly, the new amendment cannot take effect until a tribunal or the Supreme Court of Justice makes a decision.	Official Federal Gazette
Amendment to the Hydrocarbons Law	This presidential initiative was passed into law in May 2021. Among other provisions aimed at enhancing PEMEX (the state-owned company), the law grants the Ministry of Energy and the Energy Regulatory Commission (CRE) power to suspend or revoke permits for oil and gas midstream activities, including international trade, should they pose any imminent danger to security, energy security or the economy.	Official Federal Gazette
Hydrocarbons Law Partial Suspension	As with the Electricity Industry Law, this amendment was also challenged in court. However, unlike the Electricity Industry Law, a court granted a partial suspension of certain provisions of the law. The process is ongoing, and a tribunal or the Supreme Court of Justice can overturn such a ruling.	Reuters
Revocation of Asymmetrical Regulation to PEMEX	This law amendment takes away the CRE’s faculty to impose asymmetrical regulations for PEMEX's oil, gas, fuel and petrochemical activates. Asymmetrical regulation measures were initially aimed at limiting PEMEX's former monopoly of storage and sales of these products.	Official Federal Gazette
Reliability Energy Policy	The Ministry of Energy published the Policy on Reliability, Stability, Continuity and Quality in the National Electric System in May 2020, imposing stricter rules for new non-CFE generation permits and additional restrictions for wind and solar plants. After a series of injunctions, a federal judge ordered its general suspension. In March 2021, SENER cancelled the application of the policy ahead of the legislative vote for amending the Electricity Industry Law, which contains many of the same provisions.	Official Federal Gazette

Energy development	Details	Reference
Supreme Court's Invalidation of the Reliability Energy Policy	The above-mentioned Reliability Energy Policy was the subject of a constitutional controversy promoted by the Federal Economic Competition Commission. Mexico's Supreme Court of Justice invalidated some of the key points of this policy, considering them unconstitutional.	Supreme Court of Justice
National Centre for Energy Control of Mexico (CENACE), Resolution to Guarantee the Efficiency, Quality, Reliability, Continuity and Stability of the National Electric Grid	In April 2020, CENACE, the grid operator, indefinitely suspended pre-operational tests for new solar and wind projects and modified the rules for grid access. CENACE tried to justify these as part of a series of measures to assure grid stability amidst decreases in demand caused by the COVID-19 pandemic. Private generators began legal proceedings, and a court definitively suspended the procedure in June 2020.	National Centre for Energy Control of Mexico (CENACE)
PEMEX's Purchase of the Deer Park Refinery	The state-owned oil company PEMEX agreed to a USD 596 million deal to buy Shell's majority interest in the joint venture 340 000 bpd refinery in Deer Park, Texas. PEMEX has acquired full ownership of the refinery, thus increasing its share of gasoline and diesel.	PEMEX
Construction of the Dos Bocas Refinery	A key aim of Mexico's oil policy is to boost domestic refining. The construction of the emblematic Dos Bocas refinery was one of the landmark infrastructure projects of this administration. The 340 000 bpd refinery, with a wholly government-funded investment of more than USD 8 billion, is expected to be operational by 2024 and to increase refining capacity by 25%.	Dos Bocas Refinery
Lakatch Dry Natural Gas Offshore Field	Located in the state of Veracruz. Joint venture between New Fortress Energy and PEMEX. Potential production capacity of 300 million cubic feet per day over 10 years starting in 2024. Some 190 million cubic feet per day will be sold to New Fortress Energy who will liquefy and sell the gas to the international market. Initial LNG production of 1.4 million tonnes per year will increase to 7 million tonnes per year.	Argus Media
Announcement of Coatzacoalcos LNG Export Project	CFEnergia, CFE, gas commercialisation unit. Capacity: 4.5 million tonnes per year. Export project from the port of Coatzacoalcos in the Gulf of Mexico, to sell gas to the international market.	Ministry of Energy (SENER)

Energy development	Details	Reference
Altamira Floating LNG Terminal	Located in the state of Tamaulipas. US firm New Fortress Energy and CFE joint venture. Total capacity estimated: 4.2 million tonnes per year. LNG exports directed to Europe.	New Fortress Energy LNG
Energia Costa Azul LNG Export Project Under Construction	Located in the state of Baja California. Sempra Energy and TotalEnergies joint venture. Total capacity estimated: 3.5 million tonnes per year. Gas exports directed to Asia.	SEMPRA
Commissioning of First Phase of CFE Solar Park in Sonora	State-owned utility company CFE with private sector. Located in the state of Sonora, in the port of Penasco.	Presidencia de Mexico

Useful Links

Banco de México (Banxico) – www.banxico.org.mx

Centro Nacional de Control de Energía (CENACE) – www.cenace.gob.mx

Centro Nacional de Control del Gas Natural (CENAGAS) – www.cenagas.gob.mx

Comisión Federal de Electricidad (CFE) – www.cfe.gob.mx

Comisión Nacional para el Uso Eficiente de la Energía (CONUEE) – www.conuee.gob.mx

Comisión Nacional de Hidrocarburos (CNH) – www.cnh.gob.mx

Comisión Regulatoria de Energía (CRE) – www.cre.gob.mx

Comisión Nacional de Seguridad Nuclear y Salvaguardias (CNSS) – www.cnsns.gob.mx

Instituto Mexicano del Petróleo (IMP) – www.imp.mx

Instituto de Investigaciones Eléctricas (IIE) – www.iie.org.mx

Instituto Nacional de Investigaciones Nucleares – www.inin.gob.mx

Instituto Nacional de Estadística y Geografía (INEGI) – www.inegi.org.mx

Petróleos Mexicanos (PEMEX) – www.pemex.com

Presidencia de la República – www.gob.mx/presidencia

Rondas México – https://rondasmexico.gob.mx/

Secretaría de Energía (SENER) – www.gob.mx/sener

Secretaría de Hacienda y Crédito Público (SHCP) – www.gob.mx/hacienda

Secretaría del Medio Ambiente y Recursos Naturales (SEMARNAT) – https://www.gob.mx/semarnat

Sistema de Información Energética (SIE) – http://sie.energia.gob.mx

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SRE (2022), https://www.gob.mx/sre/prensa/conclusion-of-mexico-s-participation-at-the-27th-conference-of-the-parties-on-climate-change?idiom=en

CEPAL (2028), https://www.cepal.org/es/publicaciones/43612-informe-nacional-monitoreo-la-eficiencia-energetica-mexico-2018

New Zealand

Introduction

Despite being one of the most geographically isolated economies in the world, New Zealand thrives due to its strong integration into international trade and financial markets. The economy benefits from abundant natural resources, high global demand for its premium agricultural products, and a robust services-based economy

When compared with almost all other developed economies, New Zealand is a renewables powerhouse. Abundant hydro, geothermal, and wind resources meant that renewables accounted for 87% of electricity generation in 2023.

In 2023, the newly elected New Zealand Government announced a commitment to double renewable electricity generation by 2050, through removing regulatory barriers, and building new electricity generation, transmission, and distribution. They also announced the commitment to repeal the 2018 ban on new offshore exploration for oil and gas. This comes at the same time as downward revisions in gas reserves. New offshore exploration may alleviate current scarcity issues for the short- to long-term.

COVID-19 movement and activity restrictions were still in place in New Zealand in 2021, with the largest city, Auckland, subject to the most stringent pandemic policies.

Despite these restrictions, New Zealand's annual growth rate climbed to 4.6% in 2021, surpassing pre-pandemic levels (World Bank, 2021).

The growth can be partially attributed to government pandemic support measures. This support has brought about a higher government debt burden and contributed to elevated inflation.

The Reserve Bank of New Zealand has responded to these inflationary pressures by raising interest rates. Inflation has fallen from near 7%, to 4.7% in December 2023 (StatsNZ, CPI, 2024). However, persistently high energy prices in recent years, and housing supply shortages (leading to rising rents), are challenging efforts to control inflation. This economic pressure has impacted energy transition plans, such as abandonment of a proposed biofuel mandate that was intended to help decarbonise the transport sector.

Table 1: New Zealand macroeconomic data and energy reserves

Key data [a]		**Energy reserves** [b]	
Area (million km^2)	268	Oil (billion barrels)	0.07
Population (million)	5.1	Gas (trillion cubic feet)	1.5
GDP (2017 USD billion PPP)	225	Coal (million tonnes)	16 000
GDP per capita (2017 USD PPP)	44 042	Uranium (kilotonnes U < USD 130/kgU)	-

Source: a World Bank (2022); b Ministry of Business, Innovation and Employment (2023);

Note: Oil and gas reserves are total proved reserves and coal is in-ground resources.

Energy Supply and Consumption

Total primary energy supply

TPES (total primary energy supply) in New Zealand in 2021 was 829 PJ, which was a 1.5% annual increase. The increase was associated with the beginning of a return to normal activity levels after COVID-19, especially in the industrial and transport sectors.

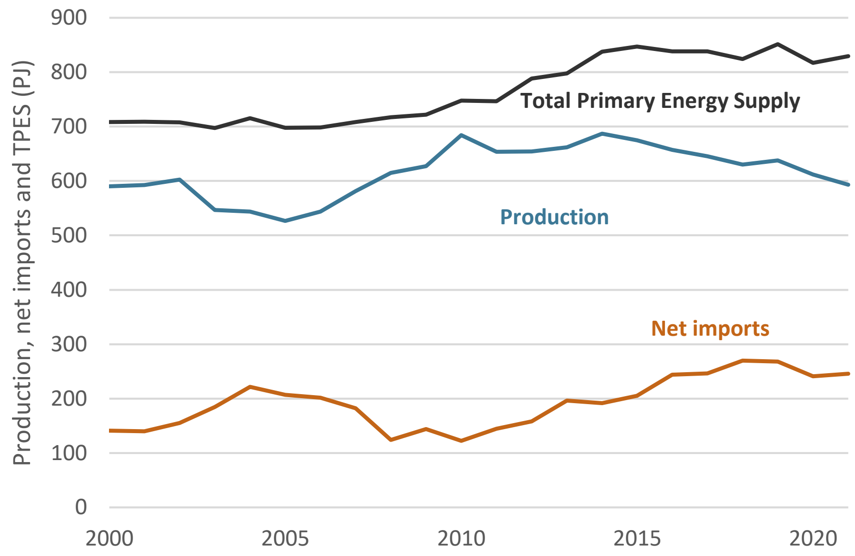
Production of fossil fuels (252 PJ) continued to stagnate. The oil and gas exploration ban that the Government has committed to remove has contributed to this stagnation, given that offshore oil and natural gas exploration and production could only occur within a permitted area. New Zealand's crude and coal production is mostly exported, so New Zealand's current transition to more renewable energy has limited impact on the current production of these energy commodities.

Most of New Zealand's energy exports are coal (35 PJ, 51%) and crude oil (25 PJ, 37%). Refined products exports (8 PJ, 12%) constituted the remainder in 2021, though these exports have now ended with the closure of Marsden Point oil refinery (New Zealand's only refinery) in April 2022.

New Zealand's energy imports were mostly made up of crude oil (145 PJ), refined products (130 PJ) and coal (37 PJ) in 2021. The energy content of these imports was the same as in 2020, however, New Zealand imported 15 PJ less crude oil and fully offset this with a 69% increase in coal imports (15 PJ) for electricity generation.

The economy maintains a high share of renewables in its energy mix, at 41% of TPES in 2021, which was facilitated by an 85% renewable electricity generation share (excluding combined heat and power plants).

Figure 1: New Zealand energy supply, production, and net imports (PJ), 2000 to 2021



Source: EGEDA (2023)

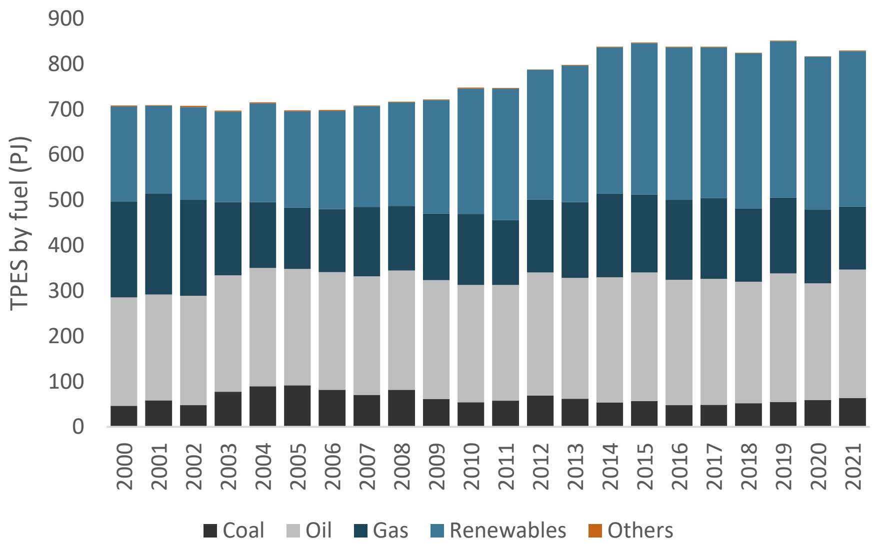
The main sources of renewable energy supply are hydro (25%) for electricity, biomass (11%) for direct use in manufacturing, and geothermal (59%) for electricity generation.

While geothermal makes up a large portion of TPES, its conversion efficiency is low (15%) resulting in a misleading view of available renewable energy in the economy. Almost 200 PJ of geothermal input energy translates into only 30 PJ of electricity generation. A small amount is used for direct heat in industry (4 PJ), buildings (3 PJ) and agriculture (0.4 PJ).

Natural gas production fell 13% (24 PJ) in 2021. The largest contributor to this fall was the Pohokura field, where production fell 31% (17 PJ). The fall in production aligns with increasing gas scarcity, exacerbated by a 342 PJ downward revision to proven plus probable (2P) gas reserves estimates between 2021 and 2023, to 1 635 PJ (MBIE 2023).

New Zealand's 139 PJ of gas supply is consumed by the transformation sector (28%), end use demand sectors (43%), and the non-energy sector (25%). Electricity generation accounts for almost all the gas consumed by transformation, whereas gas consumed by end use sectors is mostly for industrial process heat, including heat for food processing and chemicals production (fertiliser and methanol). The non-energy sector consumes natural gas as a feedstock for chemicals production.

Figure 2: New Zealand energy supply by fuel (PJ), 2000 to 2021



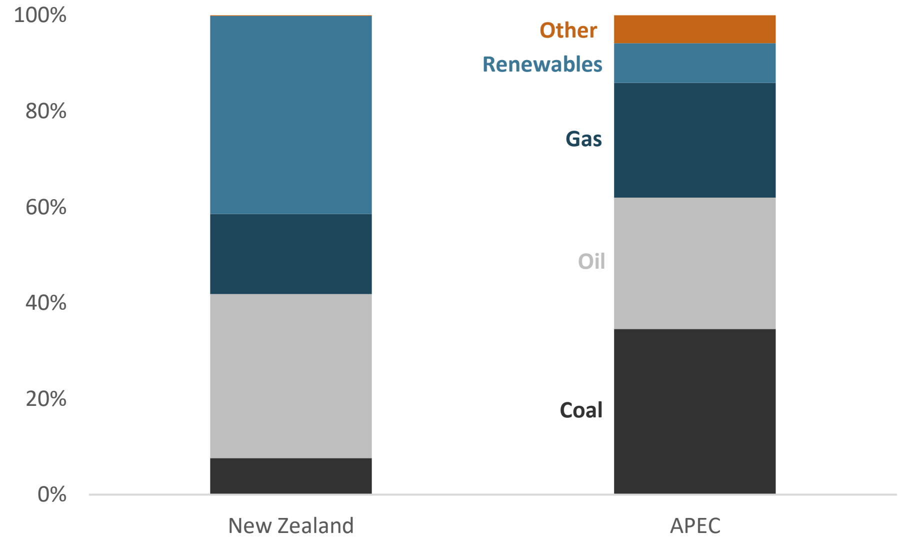
Source: EGEDA (2023)

New Zealand has a much larger proportion of renewable energy supply than for the APEC region. Geothermal electricity generation inflates this figure, but New Zealand still has a larger supply of hydro and biomass than the APEC region.

The supply of coal in New Zealand is lower than for APEC, due to a greater reliance on renewable energy sources for electricity generation.

Oil supply for New Zealand is much higher than for APEC, accounting for 48%, compared to only 33% for APEC. More than 80% of the oil is used in transport, supported by New Zealand's high rate of car ownership, which is among the highest in the world (around 0.7 cars per person).

Figure 3: Energy supply mix – New Zealand and APEC, 2021



Source: EGEDA (2023)

Total final consumption

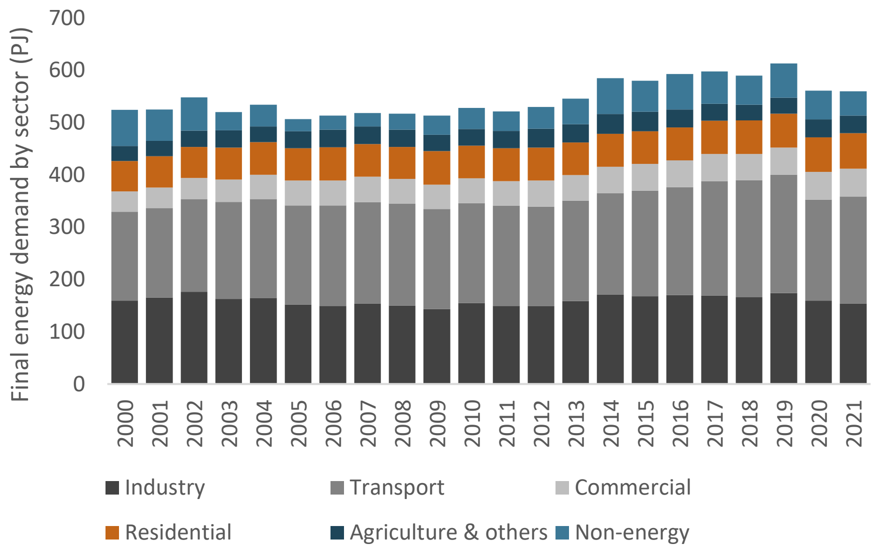
In 2021, New Zealand's total final consumption was little changed from 2020, at 560 PJ.

Transport saw a 13 PJ (7%) increase in refined product demand, which is associated with less COVID-19 travel restrictions. This was dominated by an 8 PJ (10%) increase in demand for diesel, which aligns with increased freight activity to support a rebound in the construction, manufacturing, and agricultural sectors. The lower increase in gasoline demand in 2021 was associated with continued COVID-19 travel restrictions and lower tourism.

Jet fuel and fuel oil for domestic aviation and shipping dropped by 16% (2 PJ) and 25% (1 PJ) in 2021. New Zealand data shows that energy use for domestic and international aviation and shipping has yet to return to pre-COVID-19 levels as of September 2023 (MBIE 2023). International transport was impacted to a greater degree than domestic transport. Jet fuel for international transport (captured within the bunkers supply category in EGEDA statistics) fell from 23 PJ to 14 PJ. Diesel and fuel oil, for international maritime transport, fell from 8 PJ to 5 PJ.

Fluctuations in the domestic natural gas price and international methanol prices impact demand for natural gas from the chemicals industry. High prices for gas in 2021 were part of the reason for an 8 PJ (18%) decrease in natural gas demand for non-energy use and a 4 PJ (17%) decrease by the chemicals end-use sector. But it wasn't solely due to production adjustments to the short-term impact of higher prices. Natural gas consumption was also lower due to Methanex mothballing its Waitara Valley methanol plant in early 2021, which was the smallest of Methanex's three plants in New Zealand.

Figure 4: New Zealand final consumption by sector (PJ), 2000 to 2021



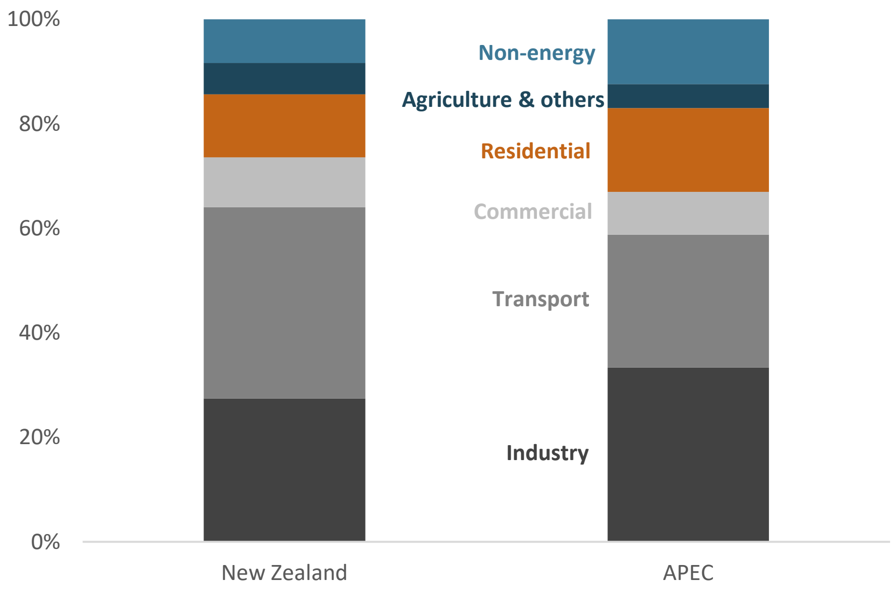
Source: EGEDA (2023)

Transportation continues to be the leading energy consumer, accounting for more than one-third of total final consumption. As of 2021, transport energy use is still much lower than pre-COVID-19 (2019) levels. Recent data for 2023 suggests that transport energy use has finally returned to 2019 levels, even when considering changes in behaviour, such as higher rates of working from home (MBIE 2023). Part of the return to pre-COVID-19 levels is because international borders were fully reopened and all quarantine requirements dropped in 2022 (DPMC 2023), which led to more tourism and immigration.

In 2021, the residential sector saw an increase in energy use of 2.3%, which was partially a result of colder weather conditions. The commercial sector saw an increase in demand of 1.0%, which is mostly due to an easing of COVID-19 restrictions compared to 2020, leading to more retail and office activity.

The decrease in natural gas use by the chemicals subsector, was complemented by a 1.5 PJ (50%) decrease in demand from the wood, pulp and paper manufacturing sectors, mostly due to the closure of the Norske Skog Tasman Mill in June 2021. This mill also used geothermal energy for heat, leading to a small reduction in industrial geothermal consumption of 0.4 PJ. The closure of the Marsden Point oil refinery in 2022 has also caused a significant decrease in gas consumption, yet to be observed in the EGEDA statistics.

Figure 5: Final consumption by sector, New Zealand and APEC, 2021

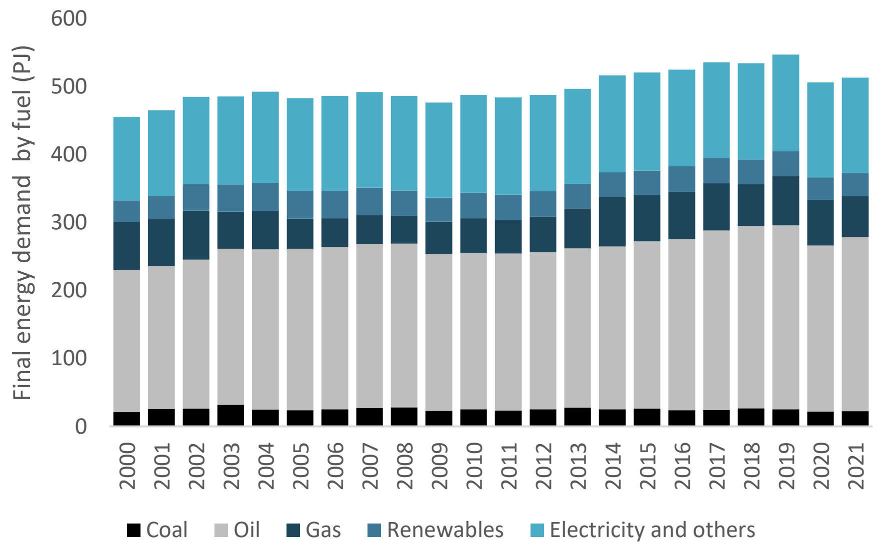


Source: EGEDA (2023)

Final energy demand

Electricity consumption in New Zealand represents all demand in the electricity and others category in Figure 6. The relative use of electricity in New Zealand is comparable to other APEC economies in the industrial, residential and commercial sectors. However, New Zealand is small enough that its only aluminium smelter (Tiwai Point) is influential enough to account for a significant proportion of electricity consumption – 13% in 2021. Plans for the smelter are a significant component in the economy's electricity generation planning.

Figure 6: New Zealand final energy demand by fuel (PJ), 2000 to 2021



Source: EGEDA (2023)

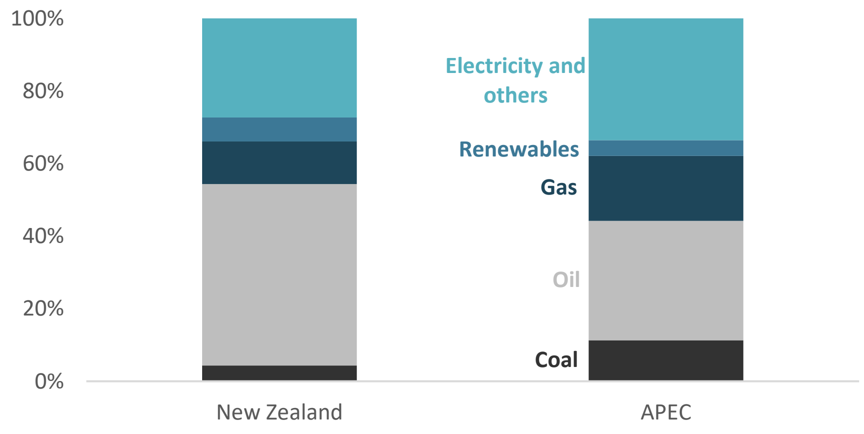
Note: Does not include non-energy sector consumption of energy products.

Almost all direct use of coal in New Zealand (which excludes 45 PJ of coal use for electricity generation, cogeneration and non-energy use) is consumed by the industrial sector for process heat. Within the industrial sector, 15 PJ (73%) of this is used by food and beverage manufacturers, mainly by dairies for drying milk into milk powder.

Most direct use of renewable energy (geothermal heat, solar thermal heat, biomass, biogas, renewable waste and liquid biofuels) in New Zealand is consumed by the industrial sector for process heat. Biomass accounts for 17 PJ of the 26 PJ of renewable energy consumption by the industry sector. Remaining biomass consumption is spread between residential (8 PJ), commercial (3 PJ) and agriculture (0.5 PJ) sectors.

Oil accounts for a much higher proportion of New Zealand's energy demand than for APEC. Renewables consumption is also relatively higher in New Zealand. The end-use consumption share of coal, natural gas and electricity in New Zealand are all much lower than for the APEC region.

Figure 7: Final energy demand fuel share, New Zealand and APEC, 2021



Source: EGEDA (2022)

Transformation

Power sector

In New Zealand, hydropower is the leading source of electricity generation due to the economy's favourable natural landscape. However, 2021 was an example of what can occur during a dry year. The South Island, where most of New Zealand's hydro storage lakes are located, experienced dry conditions due to the La Niña phenomenon during the first half of 2021; both hydro storage and inflows were below the 90-year average for the first half of the year.

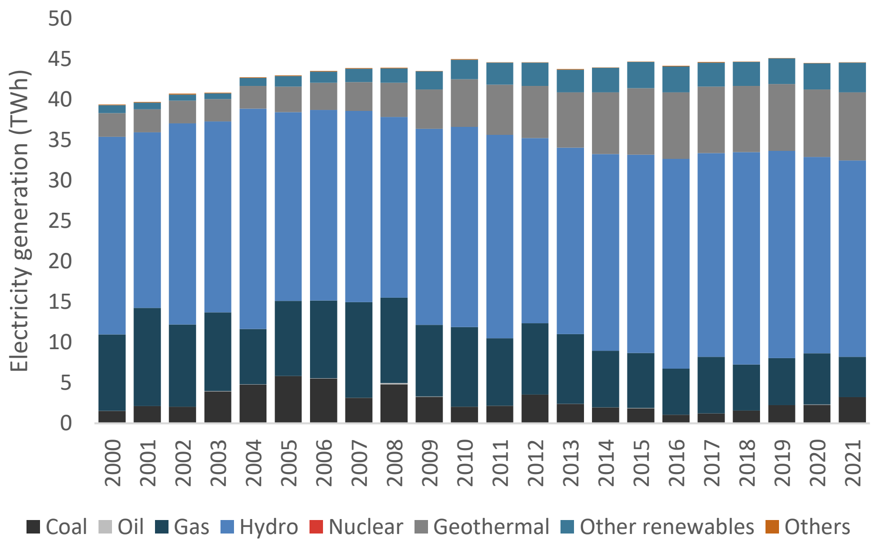
Geothermal energy plays a significant role in New Zealand's generation mix, accounting for 1 035 MW (10%) of installed capacity and 18% of generation in 2021. This energy source, like hydro, provides baseload generation, so it is especially important for enabling the energy transition by balancing the low capacity-factor and non-dispatchable generation from solar and wind.

Wind is becoming a major player in the generation mix, accounting for about 6% of total electricity generation in 2021. Solar is also increasing (0.5% generation in 2021), though solar radiation potential is much lower in New Zealand than for many other APEC economies. New Zealand's favourable wind conditions have contributed to significant growth without subsidies. In late 2023, consultation on regulations to enable offshore renewable energy development was completed. Current wind capacity and expected installations are all onshore. These new offshore regulations have the potential to drive even more growth in wind capacity and generation.

Low rainfall (hydrological conditions), cold weather, and the high price of gas meant that coal increased 7.2% of New Zealand's electricity generation in 2021, up from 5.2% in 2020. The Huntly Power Station is the only coal-fired power station in the economy and accounts for about 5% of the total installed capacity. Huntly also uses gas; some units of the power station are flexible enough to switch between using either coal or gas.

Like coal, natural gas generation is flexible enough to be turned on or off according to supply from renewable sources. Despite low hydro potential in 2021 (low lake levels), high gas prices meant that gas generation was less favoured than coal. Gas generation fell by 7% in 2021 relative to 2020.

Figure 8: New Zealand electricity generation by fuel, 2000 to 2021



Source: EGEDA (2023)

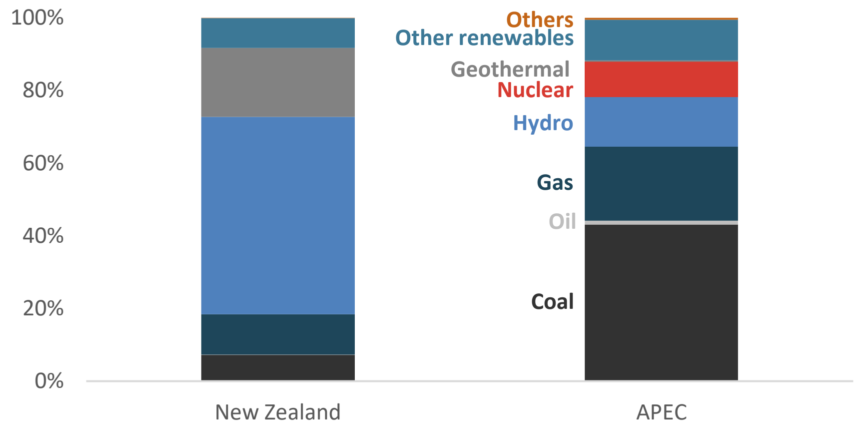
The average wholesale electricity price in the first three months of 2021 was nearly three times higher than the prices seen over the same period in 2020. Favourable hydro conditions pushed prices down in the second half of 2020, with the prices in the final three months of the year decreasing by 36% from an average of NZD 113/MWh in 2020 to NZD 73/MWh in 2021.

During 2021, there was an agreement between the Tiwai Point aluminium smelter and Meridian Energy to do an electricity swap as part of a demand response to dry hydrology conditions. The electricity swap allowed the smelter to be compensated for voluntarily reducing its electricity consumption, to assist Meridian to meet electricity demand for its other New Zealand customers.

Before 2023, the Tiwai Point aluminium smelter had exclusive access to approximately 400 MW of the Manapouri dam hydroelectric plant (total capacity of 854 MW). Transmission network upgrades mean that the Manapouri dam can now provide all its power to New Zealand's main grid.

Tiwai Point is now negotiating with multiple grid scale generators about signing a long-term contract (scale of 5 to 15 years) for electricity. A long-term agreement would support private investment in new generation, given that these investments are currently subject to the risk of Tiwai Point closing and excess Manapouri generation being unleashed onto the wholesale electricity market. These business developments in 2021 reflect a movement to a more fair and sustainable relationship between the Tiwai Point smelter and the rest of New Zealand.

Figure 9: Electricity generation fuel share, New Zealand and APEC, 2021



Source: EGEDA (2023)

Refining

The closure of New Zealand's Marsden Point refinery was due to dwindling profits and increased competition from overseas refineries. The decision was finalised halfway through 2021 and the refinery closed on 31 March 2022. In the last ten years, the refinery has been producing around half of New Zealand's gasoline and diesel consumption requirements and almost all jet fuel. Imported crude was relied on due to indigenous crude production being too sweet for the Marsden Point refinery. This meant that New Zealand was still subject to price movements in the international oil market. Fuel from the refinery was also traded at the same price as the international market, so the closure will likely have a limited impact on consumer prices. A minimum fuel stockholding obligation for fuel importers will come into effect on 1 January 2025. This is expected to improve fuel security.

Energy Transition

In May 2023, the government announced a conditional partnership with New Zealand Steel to use electric arc furnaces to replace half of the coal being used at New Zealand's only steel mill. The project is scheduled for completion as early as mid-2026. This has the potential to reduce almost 8 PJ of coal use (most of which is in coke ovens). The government portion of the funding for this project was provided through the Government Investment in Decarbonising Industry fund.

New Zealand's share of renewables in electricity generation is among the highest in the world, at 87% in 2023. Additional gains in the short- to medium-term are uncertain given that fossil fuels provide valuable baseload and backup functions. This topic is explored in the *APEC Energy Demand and Supply Outlook, 8th Edition* with an update available in the *9th Edition*, due for publication second half of 2025.

New Zealand's government has a plan to significantly increase the number of public EV chargers across New Zealand with a goal of 10 000 charging points by 2030. This will support the EV transition by helping to reduce charging anxiety for EV owners.

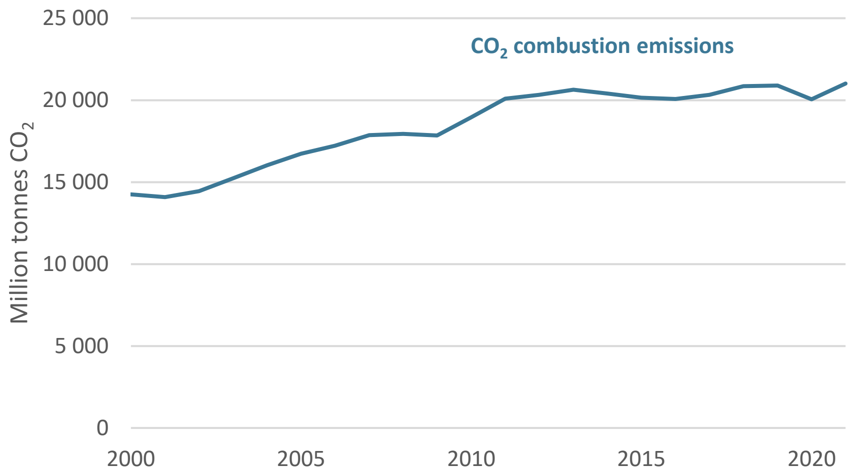
Emissions

Since 1990, New Zealand has seen a 31% increase in CO_2 combustion emissions from the energy sector. These emissions were initially rising to 2005, declined, and then have followed an upward trend since 2010, with a 7.0% drop in 2020 due to COVID-19, and rebound in 2021. The long-term increase since 1990 is mostly due to growth in transport CO_2 combustion emissions, which increased by 76%.

To help meet its 2050 climate goals, New Zealand has adopted a system of emissions budgets. The first Emissions Reduction Plan (ERP), released on 16 May 2022, outlines strategies and actions for the

2022–2025 period and sets the course for future budgets. The new Government is expected to consult on the second emissions reduction plan in late 2024.

Figure 10: New Zealand CO_2 combustion emissions (million tonnes), 2000 to 2021



Source: EGEDA (2023)

Energy security

On 9 August 2021, New Zealand saw its highest ever peak electricity demand. This demand, combined with insufficient available electricity generation, led to supply interruptions that affected more than 34 000 households. Meeting the challenge of increasing peak demand cannot be met by increasing non-dispatchable solar and wind capacity. A complementary increase in flexible and dispatchable generation assets or storage is required to facilitate a much higher build-out of solar and wind to meet this increasing peak demand. Demand-side solutions are also being explored to play a part.

Closing the Marsden Point oil refinery has implications for how oil stocks are held. In late 2021, New Zealand held 25% of its domestic oil stock as crude oil. By late 2022, the share had fallen to 12%, and will likely fall further as Marsden Point is decommissioned and the remaining crude oil is removed.

In November 2022, the government unveiled a policy package aimed at bolstering fuel resilience. This move was in response to the closure of Marsden Point, evolving geopolitical dynamics, and the ongoing transition towards a low-carbon energy sector. The policy's key elements include:

- Minimum fuel stockholding requirement: from 1 January 2025, fuel importers with access rights to bulk storage facilities will be under an obligation to maintain a minimum stock of fuel: an average of 28 days for gasoline, 24 days for jet fuel, and 21 days for diesel
- Reserve diesel stock: the government is exploring various strategies to manage a reserve diesel stock within New Zealand, targeting a volume of approximately 70 million litres. This quantity aligns with the economy's diesel consumption over seven days.

APEC Energy Goals

There are two energy-related objectives that APEC member economies have agreed to meet as a collective: to improve energy intensity and double the share of modern renewables.

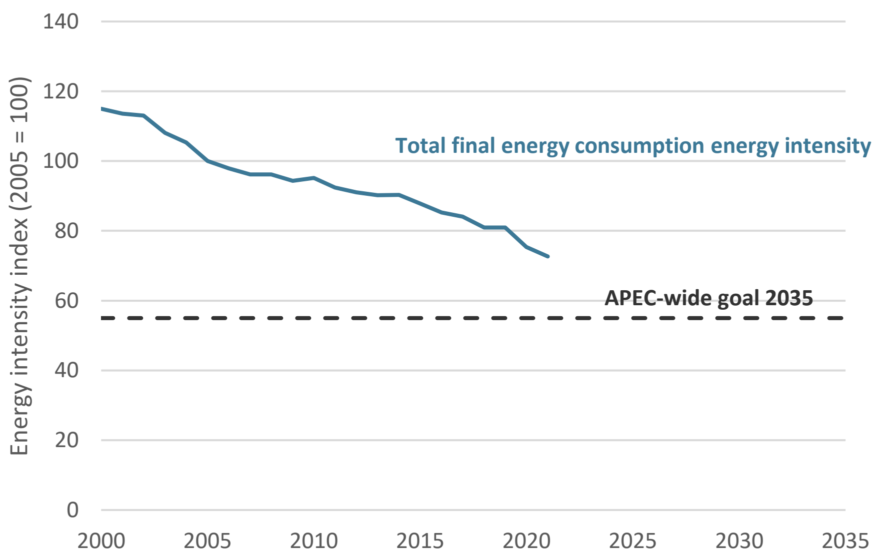
Energy intensity goal

In 2011, APEC member economies agreed to increase their ambition to reduce energy intensity by 45% in 2035, relative to a 2005 baseline.

The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

APEC is on track to achieve this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

Figure 11: New Zealand total final energy consumption intensity index, 2000 to 2021 (2005 = 100)



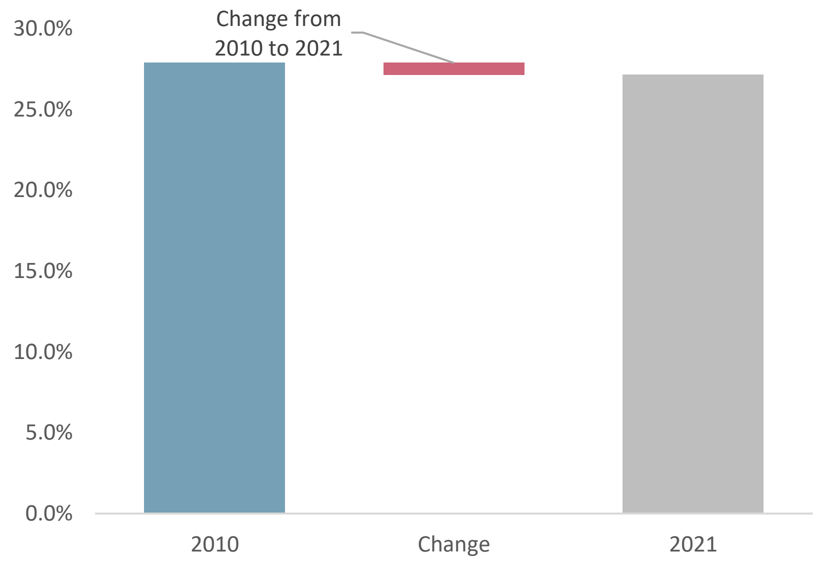
Source: EGEDA (2022)

In 2021, New Zealand's energy intensity was 2.3 PJ per billion USD purchasing power parity (PPP) of GDP, which represents a 27% improvement since 2005. This improvement is occurring at a similar pace to that of the wider APEC region.

Doubling of renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period 2010 to 2030. There is no economy-level goal for individual member economies, but improvements by individual economies will contribute to the doubling goal.

Figure 12: New Zealand modern renewable energy share, 2010 and 2021



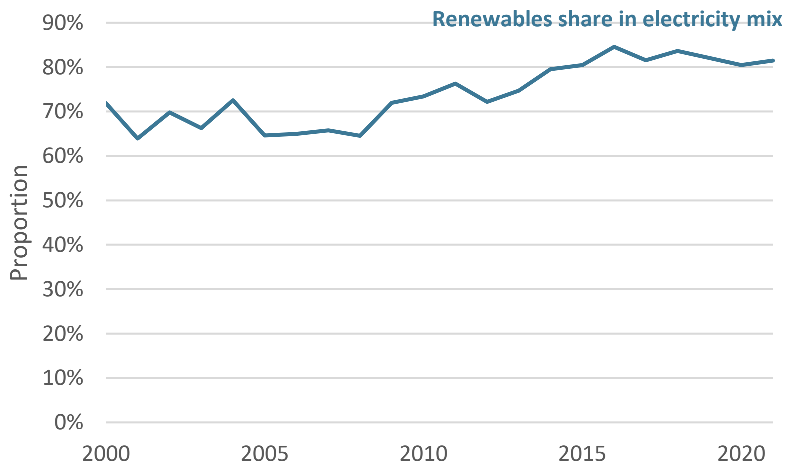
Source: EGEDA (2023)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

New Zealand has the highest proportion of modern renewables in its energy mix of all other APEC member economies, at 27.1% in 2021 and 30% in 2023. APEC's overall renewables share has increased to 9.9% in 2021. New Zealand has the potential to contribute to APEC's goal of doubling renewables by 2030, but its current high share makes additional contributions more difficult than for most other APEC economies.

The use of renewables in electricity generation has been increasing in recent years due to the installation of new renewable energy capacity. However, dry weather affecting the levels of water in hydro storage lakes has impacted continued growth. Dry weather in 2020 and 2021 was a large contributing factor to the share of renewable generation falling to 80% and 81% respectively, down from 84% in 2019.

Figure 13: New Zealand renewable generation share, 2000 to 2021



Source: EGEDA (2023)

Energy Policy

Energy policy	Details	Reference
Climate Change Response (Zero Carbon) Amendment Act	In 2019, the Climate Change Response (Zero Carbon) Amendment Act set into law new domestic 2050 targets of net zero emissions of all greenhouse gases other than biogenic methane by 2050, and 24% to 47% below 2017 biogenic methane emissions by 2050, including 10% below 2017 biogenic methane emissions by 2030.	Ministry for the Environment
NDC 2030 Target (2021-2030)	Updated in 2021, the NDC sets a headline target of a 50% reduction of net emissions below the gross 2005 level by 2030.	Ministry for the Environment
Emissions Trading Scheme	This is currently limited to domestic credits and excludes agriculture; the emissions limits are set on a five-year basis. The first period runs from 2021 to 2025, with a budget of 354 $MtCO_2eq$. It contains price ceiling and price floor mechanisms to maintain market stability. Currently, it excludes emissions from the agricultural sector.	Ministry for the Environment
Oil and Gas Exploration Ban Repeal	The Crown Minerals Amendment Bill ended all new offshore oil and gas exploration and limited onshore exploration to a small region. However, the Government has committed to repeal this ban.	Ministry of Business, Innovation and Employment
New Zealand Energy Efficiency and Conservation Strategy (NZEECS)	Between 2017 and 2022, NZEECS had the aim of decreasing the intensity of industrial emissions. The role and scope of a revised energy efficiency and conservation strategy will be considered in due course.	NZEECS
The Gas Amendment Act 2021	Parliament has passed an Act that will improve information disclosure and increase the maximum financial penalty for breaching gas regulations.	Ministry of Business, Innovation and Employment
Māori and Public Housing Renewable Energy Fund	The government has allocated NZD 28 million to trial small-scale renewable energy technologies to help decrease energy bills and encourage greater use of heating, leading to warmer and healthier homes.	Ministry of Business, Innovation and Employment
Funding for Heaters and Insulation	Warmer Kiwi Homes is a government programme offering grants covering two-thirds of the cost of ceiling and underfloor insulation.	Energy Efficiency and Conservation Authority
Public Sector Decarbonisation	The Carbon Neutral Government Program requires public sector agencies to measure and publicly report their emissions and deliver offsets. The Program is backed by the NZD 200 million State Sector Decarbonisation Fund.	Energy Efficiency and Conservation Authority

Notable Energy Developments

Energy development	Details	Reference
Marsden Point Oil Refinery Converted into an Import Terminal	In 2022, Refining NZ shut down New Zealand's only oil refinery and it is being converted into an import terminal with the potential to improve New Zealand's security of supply.	Argus Media
New Zealand's Battery Project Cancellation	New Zealand's new government has cancelled the 3-8.5 TWh Lake Onslow pumped hydro project. It was only in the planning stage at the time of cancellation.	Ministry of Business, Innovation and Employment
Emissions Reduction Plan (ERP) Released in 2022	Chapter 11 of the ERP outlines how New Zealand will meet its first emissions budget (2022-2025) and sets out the government's long-term vision for the energy sector in 2050. The Transport chapter (10) is also related to energy.	Ministry for the Environment
Hydrogen Development	New Zealand issued an Interim Hydrogen Roadmap in August 2023. Numerous hydrogen projects are currently under development or investigation in New Zealand, including partnerships with Singapore; Japan, and Korea signalling their intention to jointly develop hydrogen technology and supply in the future.	Ministry of Business, Innovation and Employment
Geothermal Research Funding	GNS (The Institute of Geological and Nuclear Sciences) was awarded a NZD 10 million grant by the Ministry of Business, Innovation and Employment (MBIE) Endeavour Fund research program in 2019 to undertake a five-year project on supercritical geothermal resources in New Zealand.	GNS Science
Investigation into Power Outages	An investigation was completed regarding the power outages that left more than 34 000 households without electricity on 9 August 2021.	Ministry of Business, Innovation and Employment
Resource Strategy for Minerals and Petroleum	In 2019, the government developed a Resource Strategy for minerals and petroleum, intended to cover 2019 to 2029.	Ministry of Business, Innovation and Employment
Review of the Energy Efficiency Regulatory System for Products and Services	In December 2021, the Energy and Resources Minister decided a new five-year energy efficiency and conservation strategy was to be developed. This will replace the current New Zealand Energy Efficiency and Conservation Strategy 2017-2022 (NZEECS), which set the overarching policy direction for government support and intervention for promoting energy efficiency, energy conservation and the use of renewable sources of energy.	Ministry of Business, Innovation and Employment
New Energy Research Development Centre (Ara Ake)	MBIE has funded Ara Ake, which provides support and funding for energy innovators to help them commercialise and enter the market.	Ara Ake

Energy development	Details	Reference
Electricity Price Review (EPR)	The EPR investigated whether the current electricity market delivered a fair and equitable price to consumers. Following the government’s response, agencies are now progressing several work streams related to it.	Ministry of Business, Innovation and Employment
Huntly Coal Power Station Transition Plan	The Huntly Power Station, New Zealand's only coal power station, has been determined to be able to be maintained to 2030 and could be extended to at least 2040. There is an intention to trial biomass as an alternative fuel to coal.	Genesis Annual Report 2022

Useful links

Emissions Reduction Plan – https://environment.govt.nz/what-government-is-doing/areas-of-work/climate-change/emissions-reduction-plan/

Energy statistics and modelling (Ministry of Business Innovation and Employment [MBIE]) – https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/

Energy and Natural Resources homepage (MBIE) – https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/

Energy in New Zealand annual report (MBIE) – https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-publications-and-technical-papers/energy-in-new-zealand/

Industrial heat pumps for process heat – https://www.eeca.govt.nz/insights/eeca-insights/industrial-heat-pumps-for-process-heat/

IEA Energy Policy Review for New Zealand – https://www.iea.org/reports/new-zealand-2023

Energy minister announcements - https://www.beehive.govt.nz/minister/hon-simeon-brown

Associate Energy Minister announcements - https://www.beehive.govt.nz/minister/hon-shane-jones

References

EGEDA (Expert Group on Energy Data Analysis, APEC Energy Working Group) (2021), *APEC Energy Database* – https://www.egeda.ewg.apec.org/egeda/database_info/index.html

Energy statistics and modelling (Ministry of Business Innovation and Employment [MBIE]) – https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/

Department of the Prime Minister and Cabinet (DPMC) – https://www.dpmc.govt.nz/our-business-units/covid-19-group

Papua New Guinea

Introduction

Papua New Guinea (PNG) is an island economy predominantly located on the eastern half of the island of New Guinea, the second-largest island in the world. This eastern portion of New Guinea, along with around 600 additional smaller islands, stretches from just south of the equator to near Cape York, Australia. PNG is the largest of the Pacific Island economies, encompassing a total land area of 462 840 square kilometres. Its significant islands include New Britain, New Ireland and Bougainville. The capital, Port Moresby, is situated in the south-eastern part of New Guinea, facing the Coral Sea. There are 839 known languages of Papua New Guinea, making it the most linguistically diverse economy in the world. It is also one of the most rural economies, with only 13.25% of its population living in urban centres in 2019. Most of its people live in customary communities.

PNG is an economy with abundant natural resources, encompassing a wide range of minerals and renewables such as vast forests, rich marine ecosystems with substantial tuna stocks, and fertile land suitable for agriculture in certain regions. However, its challenging geography, characterised by steep mountains and scattered islands, increases the costs and complexities of infrastructure development.

Compounding these difficulties are issues such as law-and-order challenges in some areas and the customary land title system, which pose obstacles for external developers. However, these obstacles provide a valuable safeguard for cultural heritage and community rights, which is especially important for ensuring an equitable ('just') energy transition and economic development process.

PNG has a high rate of poverty and poor infrastructure. The poor infrastructure can be seen in the low rate of access to electricity. Only about 20% of the population has access to the grid, and so households use alternative energy sources, especially fuelwood.

One of PNG's key policy documents is the National Energy Policy 2017-2027, which expresses an overarching policy on energy that will help to provide the enabling environment to achieve PNG's main energy goals:

- The 2030 target for 70% electricity access to all households in PNG (National Electrification Rollout Plan).
- 100% renewable electricity by 2050.

The National Energy Policy 2017-2027 also gave rise to the National Energy Authority Act 2021, which establishes the National Energy Authority (NEA) and provides for the roles and functions of the NEA including policy, regulation, and implementation of energy projects. The NEA is also intended to take over the regulation of the electricity sector from publicly owned PNG Power and has been empowered to collect energy statistics from private companies.

Subsistence agriculture serves as a primary livelihood for nearly 80% of the population and, along with large-scale agriculture, contributes approximately 30% to the Gross Domestic Product (GDP). Palm oil is one of the top export commodities from PNG.

The mining sector, with its deposits of gold, silver, oil, gas, nickel, cobalt, copper, oil and gas, is a major economic driver, accounting for about three quarters of the economy's export revenue. PNG's nickel and cobalt reserves are significant and are important materials for the energy transition. These are currently extracted from the Ramu nickel-cobalt mine.

Papua New Guinea (PNG) exports more than twice its total energy use as liquefied natural gas (LNG), amounting to 430 PJ, with the majority destined for China and Japan. It is crucial for PNG to optimize the returns from its gas resources to bolster economic growth. Various factors, including project agreements, regulatory requirements, economic incentives, social responsibility, energy security concerns, and strategic partnerships, have prompted private gas companies (P'ynyang and PNG LNG) to commit to supplying 15% of their gas extraction to the domestic market. This decision aligns with the National Energy Policy, which plans to utilize this gas for industrial purposes or electricity generation in the 2030s.

The Medium-Term Development Plan IV (MTDP4) 2023-2027 is key to the economy avoiding an overreliance on its mining industry (the 'Dutch Disease'). The MDTP4 aims to improve all key socio-economic and environmental development initiatives. Key priorities include promoting agriculture and fisheries development, enhancing infrastructure, supporting small to medium-sized enterprises (SMEs), and improving access to finance for businesses.

In 2021, PNG's GDP was USD 36.5 billion (2017 USD purchasing power parity [PPP]). Before the COVID-19 pandemic in 2020, PNG's GDP growth rate had been increasing at an average rate of 1.8% every year since 2000. However, in 2020 and 2021, PNG was hit hard by the COVID-19 pandemic, and this is probably the cause of a 3.2% decrease in GDP between 2019 and 2020 and then only a 0.1% improvement between 2020 and 2021 (IMF). However, as of January 2024, it has since bounced back to around 4% GDP growth per annum for the last two years.

Because of its largely informal economy, PNG has substantial difficulty in estimating data for its wide range of informal energy use as well as other economic statistics. For example, the population recorded in Table 1 was revised upwards by almost 1 million from 8.8 million in 2020 to 9.9 million in 2021.

Table 1: PNG's macroeconomic data and energy reserves

Key data [a]		**Energy reserves** [b, c]	
Area (million km^2)	462 840	Oil (billion barrels)	0.16
Population (million)	9.9	Gas (trillion cubic feet)	5.8
GDP (2017 USD billion PPP)	36.5	Coal (million tonnes)	-
GDP per capita (2017 USD PPP)	3 670	Uranium (kilotonnes U < USD 130/kgU)	-

Source: a World Bank (2022); b BP (2022); c UN (2022)

Note: Reserves are total proved reserves and reasonably assured recoverable resources for uranium.

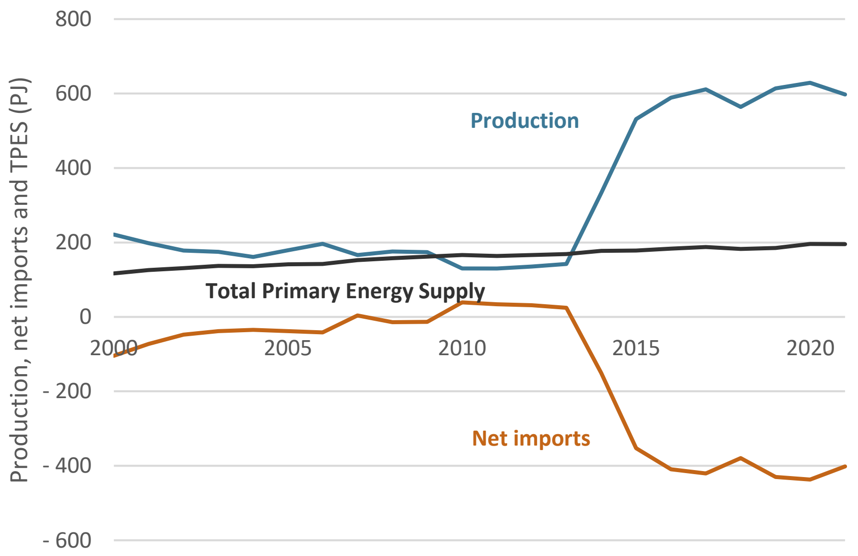
Energy Supply and Consumption

Total primary energy supply

In 2021, the Total Primary Energy Supply (TPES) was 196 PJ, just under a quarter higher than 2010. The growth was driven by increased oil and gas supply in the transport and industry sectors. Renewable energy supply remained steady with most demand coming from residential fuelwood use.

Renewable sources were the largest contributor to TPES in 2021, making up 42%. Oil was a close second, contributing 41%. Oil was used in the transport, industry, and electricity generation sectors. Natural gas accounted for 18%.

Figure 1: PNG's energy supply, production, and net imports (PJ), 2000 to 2021



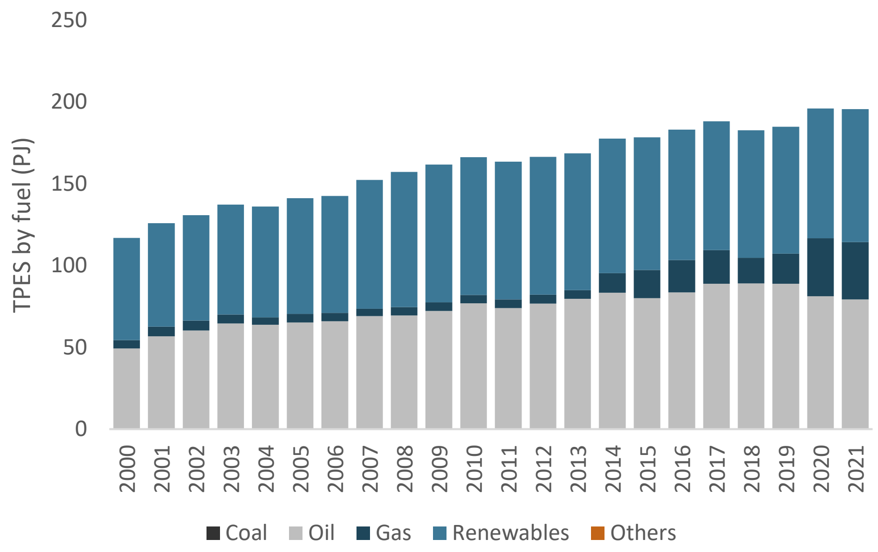
Source: EGEDA (2023)

Most of PNG's refined oil supply is split mainly between imported diesel (28 PJ) and heavy fuel oil (20 PJ), with a small amount (1.5 PJ) of gasoline supply and jet fuel (2.4 PJ). This is unique in comparison to the rest of the APEC region, where gasoline is one of the refined oils with the highest supply. It is different in PNG because of the relatively low road transport activity, and higher ratio of diesel to gasoline fuelled vehicles. The economy also exports all its naphtha (25 PJ), which is an output from its oil refinery.

Crude oil makes up about 50 PJ of the economy's oil supply. The economy exports all its oil production (about 50 PJ) but also imports the same amount to be used in its refinery.

PNG has abundant gas resources, with significant production starting in the mid-2010s. In 2021, 92% of the gas production was exported as LNG, totalling 430 PJ, compared to 35 PJ of TPES for domestic use. The high volume of exported gas results in a large negative net import balance. Total gas supply has doubled since 2019.

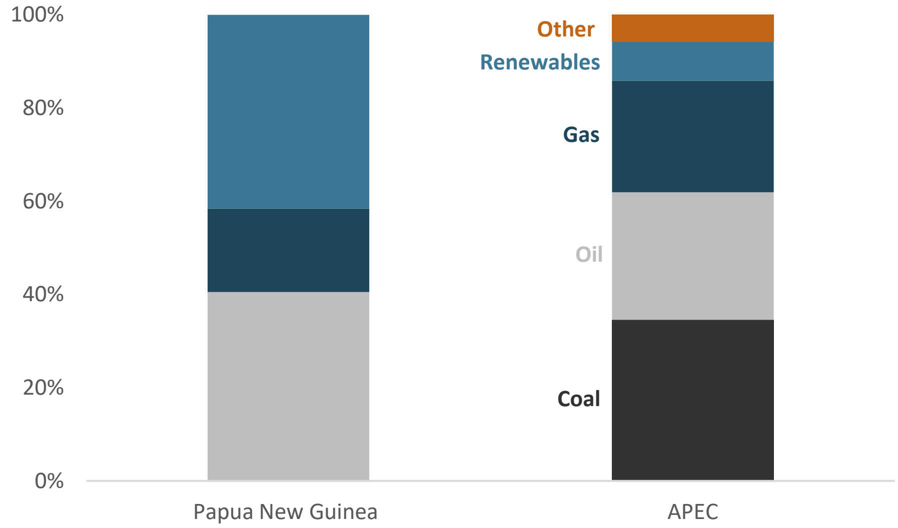
Figure 2: PNG's energy supply by fuel (PJ), 2000 to 2021



Source: EGEDA (2023)

In PNG, all the gas that is used as well as what is transformed into LNG, makes its way through the PNG LNG plant (475 PJ capacity pa.), which is near Port Moresby. Of the 35 PJ of domestic use, the plant uses about 25 PJ of gas in the production process (which is considered own use and losses). The last 10 PJ of domestic use is split between auto producers (off-grid-connected industrial producers) (5 PJ), and the Port Moresby Gas Power Plant (5 PJ), which is connected to the Port Moresby main grid.

Figure 3: Energy supply mix – PNG and APEC, 2021



Source: EGEDA (2023)

TPES of renewables in PNG is primarily (86%, 70 PJ) traditional biomass, which is mostly used for residential use, while a small amount is used by industry – mainly palm oil plants using their own waste for heat and electricity production. It should be noted that there is substantial difficulty in correctly estimating traditional biomass use, so this value is subject to significant uncertainty. As such, any indicators involving this estimate should be treated carefully.

Besides the use of biomass, 4% of renewables TPES is hydro (3 PJ) and geothermal (3 PJ) for electricity generation. The geothermal TPES is slightly exaggerated because of the low conversion efficiency of geothermal energy to electricity.

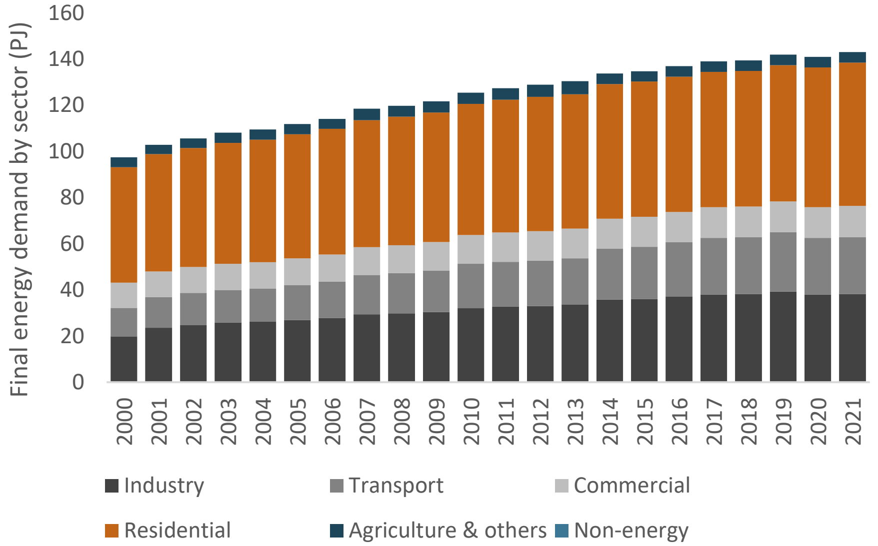
PNG's TPES composition differs significantly from the wider APEC region since the economy lacks coal-fired electricity generation and any significant coal consumption. Oil and renewables have a larger share of TPES compared to the APEC average.

Total final consumption

In 2021, PNG's total final energy consumption was around 143 PJ. The residential sector accounted for about 43% of energy use, followed by the industrial sector (27%) and the transport sector (17%). Even though it makes up about 30% of GDP, the agricultural sector accounted for 5 PJ (3%) of energy use, of which the majority (about 93%) was diesel.

Energy demand in PNG has been growing since 2000, albeit at a slower pace than GDP. The transport and industrial sectors have almost doubled their energy use, which is because of an increase in industrial output and transport activity. This highlights the crucial role of energy in driving economic growth.

Figure 4: PNG's final consumption by sector (PJ), 2000 to 2021



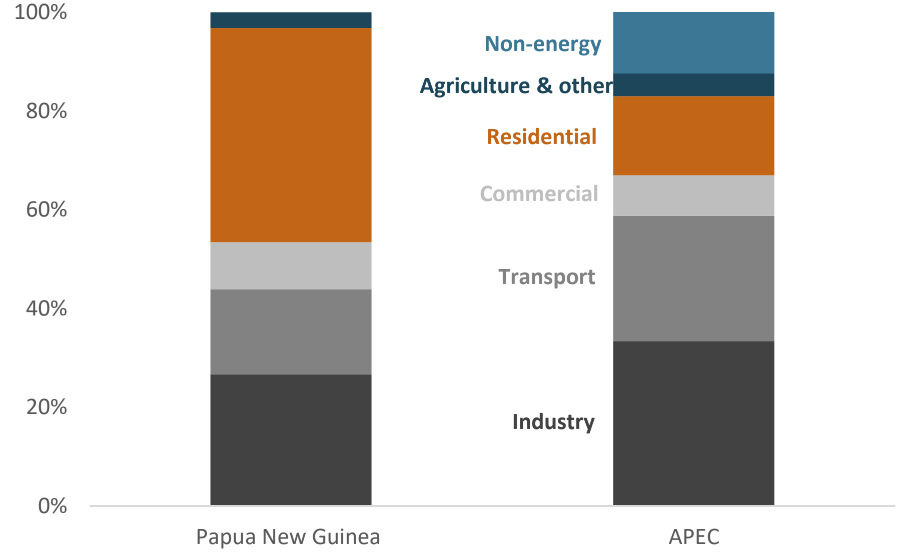
Source: EGEDA (2023)

Papua New Guinea's underdeveloped road infrastructure, absence of used car quality import controls and high rural population reduces transport efficiency and energy use in the sector. The few roads available are poorly maintained, and key regions like the populous Highlands are not even connected by road to the capital, Port Moresby. Despite a slight increase in road infrastructure from 2000 to 2015, the subsequent decline and rapid population growth have reduced per capita road availability, according to the Asian Transport Outlook. These conditions have curbed the growth of transport activity and energy use for road vehicles, making it modest compared to other APEC economies. PNG’s NEA will work with Customs PNG and the Transport department to develop a regulation on used vehicle quality standards and Engine capacities.

The residential sector is the largest energy consumer (43% of total final consumption),but has only seen a 24% increase since 2000 (total final consumption of all sectors increased by 47%). This comes from the fast growth of the other sectors, which is to be expected as the economy develops.

In the densely populated Highlands region, it is cold all year round and this increase the need for fuelwood for heating. This increases the demand for biomass, which increases the environmental and health challenges associated with traditional biomass use. Throughout PNG, replacing the reliance on traditional biomass for cooking, heating and lighting with cleaner alternatives could have significant health impacts for the population and preserve the local ecosystems.

Figure 5: Final consumption by sector, PNG's and APEC, 2021

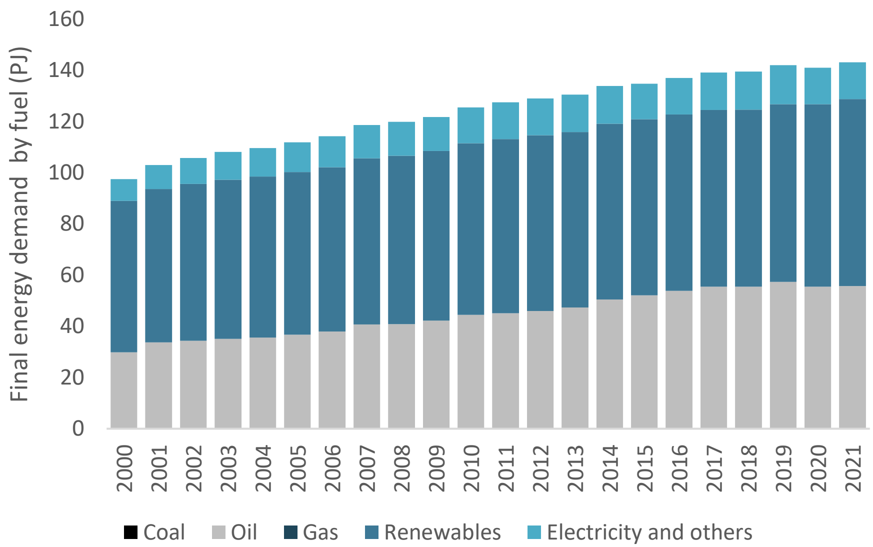


Source: EGEDA (2023)

Final energy demand

PNG's energy demand in 2021 was dominated by oil (39%) and renewables (51% of which is fuelwood for residential use). The residential sector accounted for 43% of final energy consumption, while the industrial sector accounted for 27% and the transport sector 17%. Electricity consumption was 10% of final energy demand and is mostly consumed by the industrial sector. Renewable energy, mostly fuelwood, contributes the largest share of final energy consumption.

Figure 6: PNG's final energy demand by fuel (PJ), 2000 to 2021

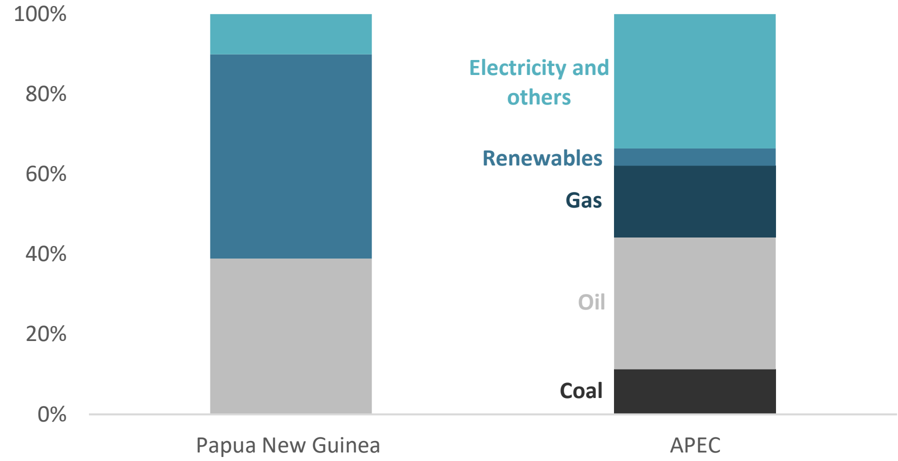


Source: EGEDA (2023)

Note: Does not include non-energy sector consumption of energy products.

Compared to the rest of APEC, PNG's energy use comprises much more oil and renewables. This largely stems from PNG having no use of coal and a negligible amount of gas use, so the other fuel types take their place. Use of renewables is especially high compared to other economies.

Figure 7: Final energy demand fuel share, PNG and APEC, 2021



Source: EGEDA (2023)

Transformation

Power sector

PNG's electricity network is relatively undeveloped. Only around 21% of the population have access to the electricity network, and it is known to have reliability issues. Because of the dispersed population and rough topography, building the network to reach people in rural areas is extremely challenging technically and financially.

Because of the rough topology of the land, the electricity network is currently split into different grids. The three main grids are the Port Moresby, Gazelle and Ramu grids, while there are at least 19 geographically isolated mini grids that serve smaller provincial centres.

These mini grids are almost entirely powered by diesel and fuel oil generators, which results in high generation costs.

Given the geographical constrains of the economy, the government of PNG, through the NEA, has developed the Off-Grid Regulation 2023, which will be the enabling mechanism to drive the implementation of the NEROP plan to connect 70% of PNG's population to the grid by 2030, but strictly from renewable energy sources. This is also expected to be with financial assistance from other APEC economies. This will help to stimulate economic activity, quality of life and improve energy intensity. It will probably also involve connecting the grids, which may help with improving network stability.

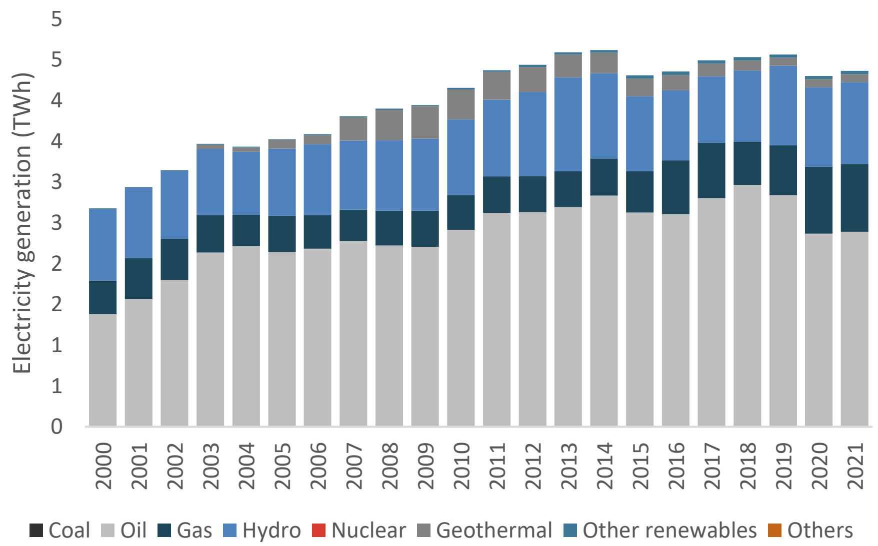
Partly due to the poor transmission infrastructure, PNG's electricity use is low compared to the APEC average, and total electricity generation is also low. A significant 55% of electricity generation is from diesel and heavy fuel oil, which is because of their mobility, lower upfront costs, and operational flexibility during frequent blackouts. However, the use of oil for electricity generation is relatively expensive and inefficient in the long term. So, it is expected that oil use for generation will decrease in future years with more investment in PNG's large reserves of renewable and natural gas resources.

Gas currently provides about 19% of total generation, of which 9% is from auto producers, and 10% is from the PNG LNG plant and is connected to the Port Moresby Grid. Hydropower is the largest source of renewable electricity (23%) and geothermal contributes 2%. There is a small amount of generation using biomass (0.2%) in the palm oil plantations and biogas (0.6%) from other auto producers.

Estimates show that two-thirds of electricity generation and consumption in PNG is carried out by industrial sector auto producers, such as mining facilities or plantations, which are quite far away from urban centres and are not often connected to the grid. However, in some cases they do supply their excess power to their small local grids, which helps to improve grid stability and access in these areas.

One other area of improvement has been the development of off-grid solar for lighting, which means that around 60% of the population has access to electricity if off-grid solar (for lighting) is considered (this does not count towards the NEROP). However, fuelwood, charcoal, liquid petroleum gas (LPG) and kerosene are still needed for cooking and heating.

Figure 8: PNG's electricity generation by fuel, 2000 to 2021

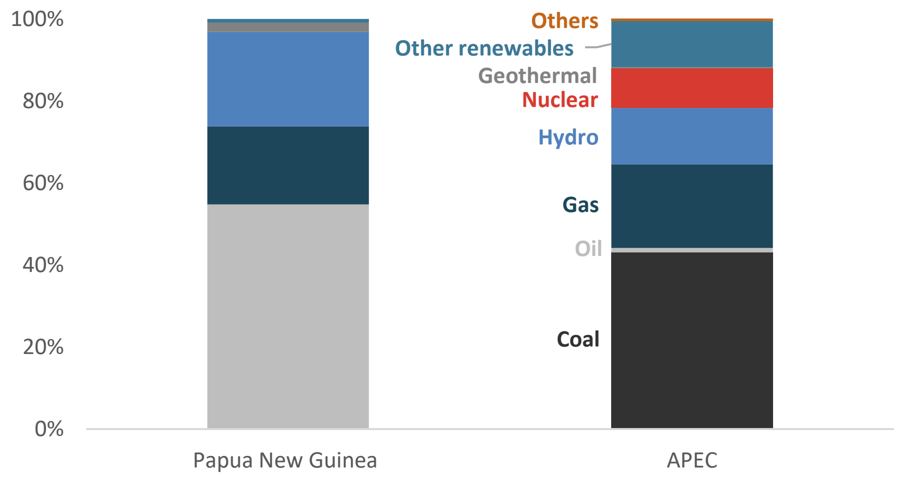


Source: EGEDA (2023)

PNG uses a large proportion of oil for generation compared to the APEC average, as it relies heavily on low-capacity oil generators for electricity generation. The prominence of hydro and geothermal generation in PNG is partly due to the small amount of generation capacity needed to make those sources significant, relative to the APEC average and the economy's total.

In terms of input fuel quantities, there was 20 PJ of fuel oil use, 10 PJ of natural gas and 6 PJ of diesel use for electricity generation. The remaining generation came from renewables. It is estimated that these inputs generated 16 PJ of electricity, although there could be significant margin of error, especially because of the difficulty of estimating the electricity output of diesel generators.

Figure 9: Electricity generation fuel share, PNG and APEC, 2021



Source: EGEDA (2023)

Refining

PNG has an oil refining capacity of 33 thousand barrels per day (73 PJ per year), and the economy produced 56 PJ of petroleum products in 2021. This is not enough to satisfy domestic consumption, so the economy imports most of the refined oil it uses, and most of its production is actually exported. Furthermore, the crude oil that is refined in PNG is currently imported.

The economy's LNG plant, just outside of Port Moresby, has a capacity of 8.3 mtpa, which is equivalent to 475 PJ of natural gas, and produced 430 PJ of LNG in 2021. There is a new project, the Papua LNG project, which is expected to be completed by the end of 2027, and will increase the plant's capacity to almost 14 mtpa.

One benefit of the development of the LNG plant is that the residential sector has been able to use LPG (of which total consumption was 0.2 PJ), which is a cleaner alternative to kerosene (kerosene makes up about 2.4 PJ of total residential energy use) or fuelwood (69 PJ) for heating and cooking.

Energy Transition

PNG's energy transition goes hand-in-hand with its growth. One of PNG's biggest challenges is building the infrastructure it needs to enable the supply of new energy types to its population. This is made even harder by the difficult topography of the economy.

The major project of increasing access to electricity will help to give 70% of the population alternatives to fuelwood and kerosene. Increased access will probably also result in an increase in the reliability of the electricity network. These two improvements may help to counter the reliance on oil generators, which are especially used because they can be transported to remote areas, require less capital, and provide backup capabilities.

The economy has abundant gas resources, and currently exports most of its gas as LNG. There are potential areas where this gas could be used domestically, such as electricity generation and production of other fuels (e.g., ammonia, LPG), or for industrial purposes. Also, if the rest of the world transitions to gas instead of coal and oil, LNG exports could become more profitable for the economy.

Besides traditional biomass, which includes fuelwood, the economy also has significant potential for non-traditional renewable energy, especially renewable electricity generation types. As the government continues to invest in electrification and renewable energy, the energy mix in PNG is expected to shift away from imported oil and towards renewable energies and natural gas, which are more economically and environmentally sustainable energy sources for the future.

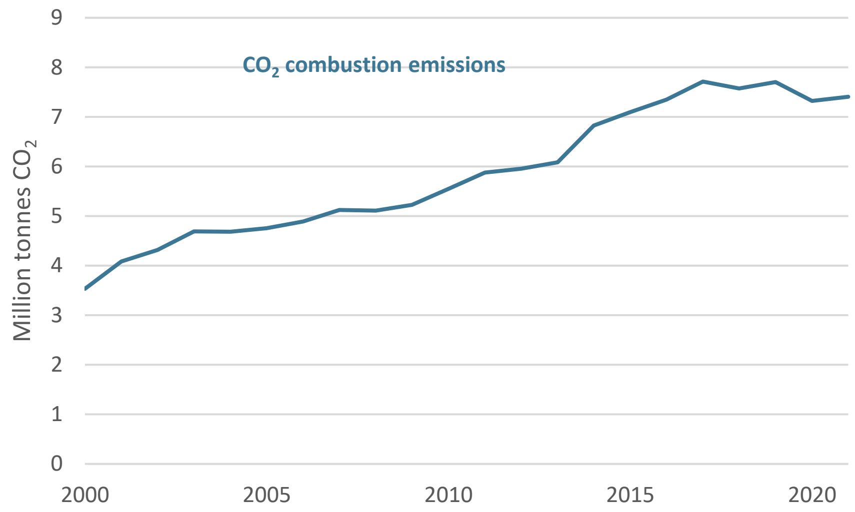
Energy transition topics are further covered in the PNG chapter of the APEC Energy Demand and Supply Outlook.

Emissions

PNG emitted about 7 million tonnes of CO_2 in 2021, but this is only about one thousandth of APEC's total emissions. PNG's low amount of emissions is expected to grow quickly over time as the economy increases power generation, as well as industrial and transport activity.

The majority of PNG's emissions currently come from electricity generation (40%), transport (20%) and industry (20%). The emissions from burning fuelwood are not considered.

Figure 10: PNG's CO_2 combustion emissions (million tonnes), 2000 to 2021



Source: EGEDA (2023)

Energy security

PNG's energy security issues are defined by its reliance on imports for most of its oil use (40% of total consumption). In 2023, there was a 30-day shortage of aviation fuel in PNG, forcing local airlines to suspend flights. This was very costly for the economy, especially since much domestic transport is by aircraft. For example, the capital Port Moresby is not connected by road to the second largest city, Lae, and the nearby, highly populated, Highlands region. Similar oil shortages continue to affect the economy, which is linked to finance woes.

Means of improving the economy's energy security could include increasing the oil stockholding limits or diversifying the sources of energy supply. Improvements to the economy's financial situation will also be helpful.

PNG's effort to improve access to and reliability of its electricity network can be considered an important project for increasing energy security as it will decrease reliance on oil for electricity generation. This will in turn decrease the negative effects of oil shortages.

APEC Energy Goals

There are two energy-related objectives that APEC member economies have agreed to meet as a collective: to improve energy intensity and double the share of modern renewables.

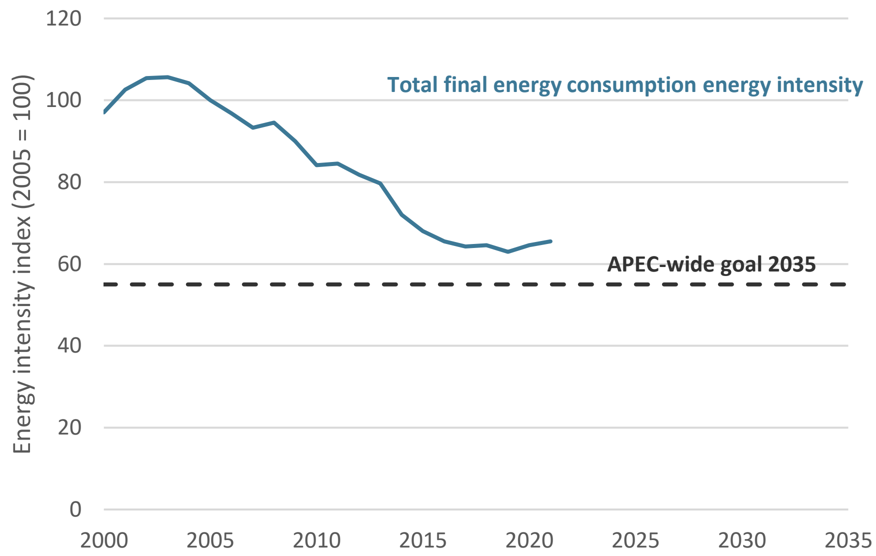
Energy intensity goal

In 2011, APEC member economies agreed to increase their ambition to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

APEC is on track to achieve this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

PNG has improved its energy intensity over the past two decades and this improvement is expected to continue, particularly with the implementation of the National Electrification Rollout Plan and the Energy Labelling and Minimum Energy Performance Standards for Appliances, Equipment and Lighting Products Regulation 2024. The economy's energy intensity was 65 PJ per billion USD PPP in 2021, which was a 34% improvement from 2000. The improvement in energy intensity is also driven by the growth of the economy through LNG exports since 2014. The APEC region has set a goal of reducing energy intensity by 45% by 2035, compared to the 2005 baseline, but this target is not applicable to individual economies.

Figure 11: PNG's total final energy consumption intensity index, 2000 to 2021 (2005 = 100)

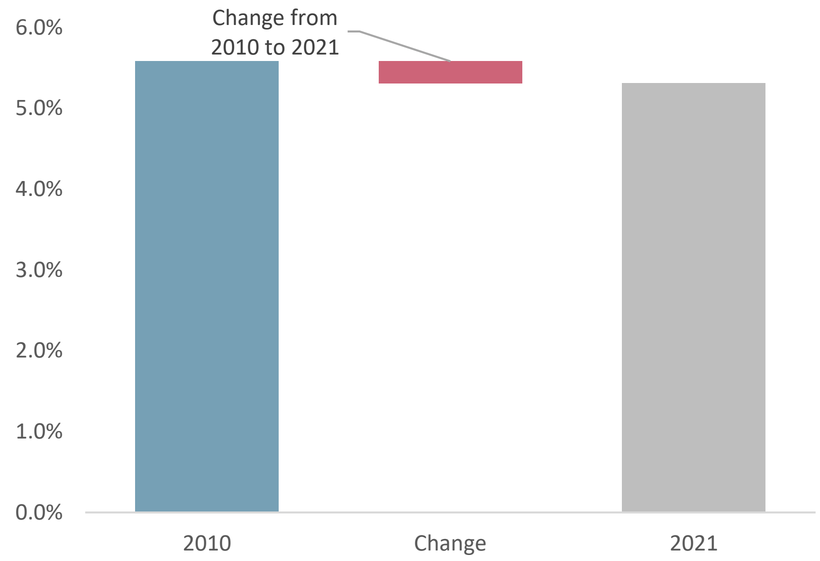


Source: EGEDA (2023)

Doubling of renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period 2010 to 2030. There is no economy-level goal for individual member economies, but improvements by individual economies will contribute to the doubling goal.

Figure 12: PNG's modern renewable energy share, 2010 and 2021



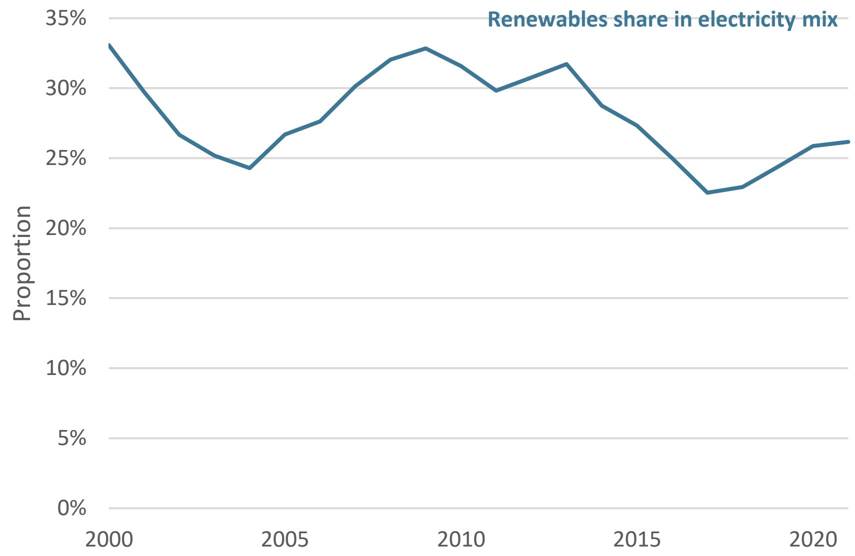
Source: EGEDA (2023)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

PNG has a modern renewable energy share of 5.8%. This has changed very little since 2010, which is because all energy types increased by about the same amount. Traditional biomass consumption is not included in PNG's modern renewables share, but if it were, the renewables share would be around 50%.

PNG has a renewable generation share of 26% and the majority of this comes from hydro (88%) and geothermal electricity generation (8%). There is a small, but quickly growing amount of solar at 0.4%. The rest comes from biogas (2%) and biomass (0.7%) generation in the industrial sector. The share of renewables in generation has remained at about the same level since 2000. The intermediate variation was due to new capacity developments such as the expansion of the Lihir Gold Mine geothermal generation scheme.

Figure 13: PNG's renewable generation share, 2000 to 2021



Source: EGEDA (2023)

Energy Policy

Energy policy	Details	Reference
100% Renewable Energy	This is a target to achieve 100% renewable electricity by 2050.	Vision 2050
National Electrification Rollout Plan (NEROP)	Rate of 70% access to electricity by 2030 and 100% by 2050.	Vision 2050, National Energy Policy 2017-2027
Enhanced Nationally Determined Contribution (NDC) (2020)	The NDC was revised to target a 78% share of installed capacity of renewable energy by 2030.	Enhanced Nationally Determined Contribution
Domestic Resource Utilisation	The government will ensure 15% of gas reserves in new oil and gas projects will be made available for domestic gas utilisation.	National Energy Policy 2017-2027
Energy Labelling and Minimum Energy Performance Standards for Appliances, Equipment and Lighting Products Regulation 2024	A drafted regulation for reducing the imports and use of low energy efficient and substandard electrical appliances into PNG.	National Energy Agency
Governance	Build stronger institutions and governance frameworks for the energy sector.	National Energy Policy 2017-2027
National Energy Authority Act 2021	Passed in April 2021, it will decommission all the regularity powers and functions of PNG Power Limited and vest them with the National Energy Authority. The National Energy Authority Act also empowers the government's ability to collect energy data from private groups for statistics.	Energy Authority Act

Notable Energy Developments

Energy development	Details	Reference
Amendment to the Mining Act and the Oil and Gas Act	The Mining Amendments introduce a 'live data' reporting obligation and give entities priority in tenement applications over 'reserved land'. The O&G Amendments give the minister greater flexibility in determining whether to grant or refuse petroleum development licences and affect the sanctity of petroleum agreements and gas agreements.	New PNG Energy laws commence
Papua LNG Project	The project participants and the government have re-affirmed their commitment to this project, and it is expected to proceed. When complete it will add six mpta of LNG production.	NASDAQ
PNG Electrification Partnership	USD 1.7 billion of international funding from Australia; Japan; New Zealand; and the United States has been pledged to support achieving the target of 70% of electrification by 2030. Some of this money is already being committed to projects.	Post Courier
Proliferation of Off-grid Solar Lighting	Some 60% of Papua New Guinean households are now using off-grid solar technology with off-grid solar lighting products and battery-based torches and lanterns, which are now effectively replacing kerosene lamps.	PNG Off-Grid Report

Useful Links

United Nations – https://papuanewguinea.un.org/

The World Bank – https://www.worldbank.org/en/country/png

International Monetary Fund – https://www.imf.org/en/Countries/PNG

PNG Environmental Data Portal – https://png-data.sprep.org/

Asian Development Bank – https://www.adb.org/countries/papua-new-guinea/main

PNG Development Strategic Plan 2010-2030 – https://png-data.sprep.org/dataset/png-development-strategic-plan-2010-2030

National Energy Authority Policy Framework – https://nea.gov.pg/policy-legal-framework/

References

Asian Transport Outlook Country Profile – https://asiantransportoutlook.com/analytical-outputs/countryprofiles/profile-papua-new-guinea/

Peru

Introduction

Social unrest and climate events marked the year 2023 in Peru. The gross domestic product (GDP) contracted by 0.6% during the first three quarters compared to the previous year (Instituto Nacional de Estadísticas e Informática [INEI], 2023). A decrease of private spending in several economic sectors and the effect of El Niño phenomenon[2], which started in March 2023, contributed to a slower-than-expected economic recovery. A strong or moderate-level El Niño is expected between December 2023 and February 2024, which could affect the Peruvian energy sector in the coming year.

Despite the challenges faced in 2023, several advancements in the energy sector were observed in Peru. The Talara Refinery began its gradual and progressive start-up process in 2023 after it underwent a modernisation and upgrade process that started in 2014. The modernisation process included the expansion of the crude oil processing capacity from 65 000 to 95 000 barrels per day (bpd). The refinery is expected to fully operate by the end of 2023.

The policy to increase the use and availability of natural gas, also known as the massification of natural gas, has progressed during 2023. The Ministry of Energy and Mines (MINEM) announced that more than USD 200 million would be allocated as part of the efforts to increase the access to natural gas. In April 2023, MINEM announced its goal of reaching around 20% of households by the end of the year, incorporating 372 000 new natural gas clients.

Additionally, several renewable energy projects were announced. Punta Lomitas, the largest wind power plant in Peru with a capacity of 296 MW, started commercial operations in June (Engie, 2023). This project represents a milestone in the Peruvian electricity grid as it is one of the first major renewable energy projects developed outside the renewable energy auction scheme.

The contract to build the Peruvian side of the 500 kV transmission line between Peru and Ecuador was awarded in July 2023 (Proinversion, 2023). The project will interconnect both electric systems, taking advantage of the complementarity of Peruvian and Ecuadorian hydrologies. The line is expected to be operational by 2027.

However, Peru suffered severe droughts that affected the reservoirs of hydroelectric power plants. Consequently, natural gas-fuelled thermal plants operated at maximum capacity, and diesel-based thermal plants were utilised to satisfy the increasing electricity demand, thereby raising the cost of electricity generation (Energiminas, 2023).

To face the challenges that appear in the energy sector, Peru has diverse reserves of energy resources, encompassing fossil fuels and renewable energy. Peruvian oil reserves rank 7th and natural gas reserves rank 5th in Latin America. Peru is actively seeking investments in exploration to expand its hydrocarbon reserves.

[2] El Niño is a climate phenomenon characterised by periodic warming of sea surface temperatures in the central and eastern equatorial Pacific Ocean, disrupting normal weather patterns. In Peru, El Niño can lead to heavy rainfall and flooding in some regions, severe drought in others, and increased temperatures, impacting various activities such as fisheries and agriculture. El Niño is part of the El Niño-Southern Oscillation (ENSO) cycle and is associated with La Niña, another climate phenomenon with opposite effects. La Niña often follows El Niño as the climate system seeks to restore balance.

Table 1: Peru's macroeconomic data and energy reserves

Key data [a, b]		Energy reserves [c, d]	
Area (million km²)	1.3	Oil (billion barrels)	0.7
Population (million)	33	Gas (trillion cubic feet)	9.2
GDP (2017 USD billion PPP)	422	Coal (million tonnes)	0
GDP per capita (2017 USD PPP)	12 500	Uranium (kilotonnes U < USD 130/kgU)	33

Source: [a] INEI (2023, June 10); [b] World Bank (2022); [c] Energy Institute (2023); [d] Nuclear Energy Agency & International Atomic Energy Agency (2023)

Note: Reserves are total proved reserves and reasonably assured recoverable resources for uranium.

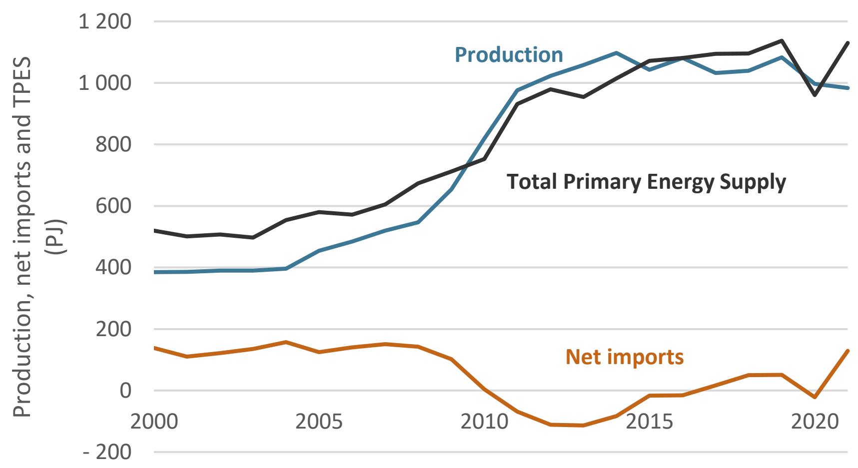
Energy Supply and Consumption

Total primary energy supply

Energy statistics for 2021 show a rebound of energy consumption from the levels observed in 2020, during the peak of the COVID-19 pandemic. The total energy supply increased 17.5%, reaching 1 130 PJ in 2021 from 961 PJ in 2020. Specifically, the gas supply increased 19.5%, going from 266 PJ in 2020 to 318 PJ in 2021. The oil supply increased 21.5%, going from 385 PJ in 2020 to 467 PJ in 2021. Meanwhile, the supply of renewables increased 9.4%, growing from 289 PJ in 2020 to 316 PJ in 2021. However, this level of total energy supply is still lower than the 2019 level of 1 137 PJ.

Interestingly, domestic primary energy production decreased 1.4% during 2021. According to MINEM, domestic fossil fuel production fell 4.4% in 2021[3], a second year in a descending trend. Natural gas and associated natural gas liquids production decreased 4.7%, while domestic oil production decreased 3.5%. Due to insufficient domestic demand, natural gas production has decreased, leading to the need to reinject into the wells. This process restricts the processing of associated liquid, which in turn forces the import of crude oil to refine oil products. Additionally, restrictions that originated during the 2021 pandemic have further impacted the domestic production of natural gas and crude oil. As a result, in 2021, Peru returned to being a net importer of energy as the increase of energy demand had to be satisfied by fuel imports.

Figure 1: Peru's energy supply, production, and net imports (PJ), 2000 to 2021



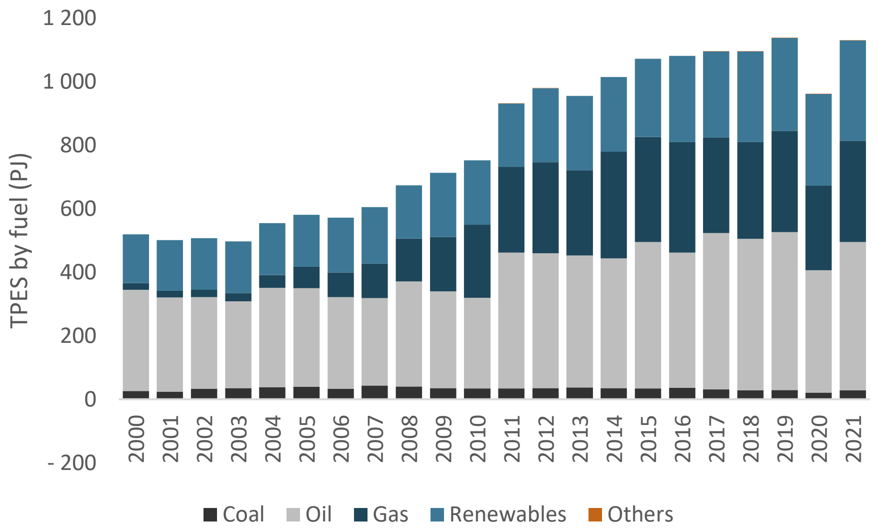
Source: EGEDA (2023)

In contrast to the domestic production of hydrocarbon, renewable energy

[3] In Peruvian statistics, primary energy supply considers the energy content of natural gas and its associated liquids.

production, namely hydroenergy and biomass, increased 9.4%. Most of the renewable energy is used in electricity generation where renewable energy plants have priority to dispatch electricity to the grid. There was also an increase in the production of traditional biomass for cooking consumption in buildings.

Figure 2: Peru's energy supply by fuel (PJ), 2000 to 2021



Source: EGEDA (2023)

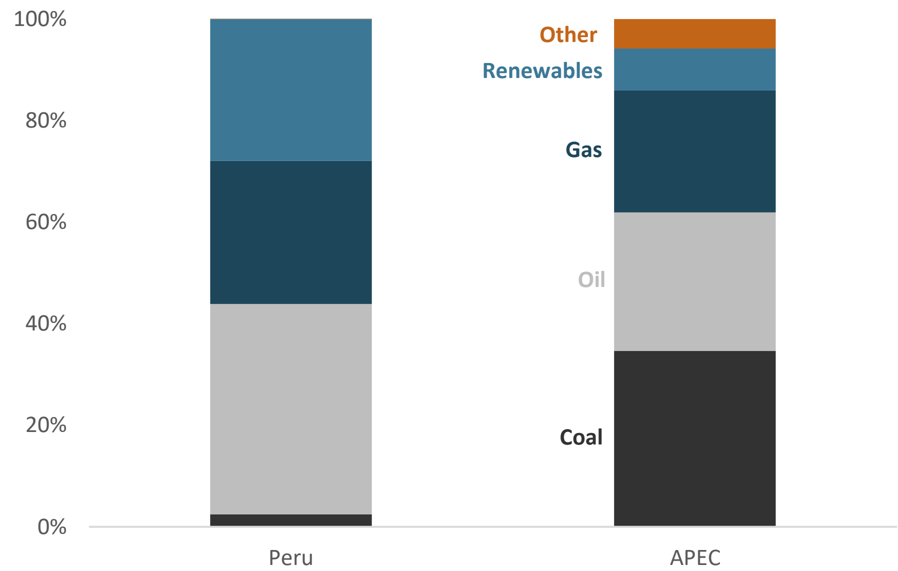
Coal supply reached 28 PJ in 2021, growing from 21 PJ in 2020. This growth is explained by an increase of coal demand in industry, mainly in cement and metallurgy. There is also a growth of coal demand in electricity generation, mainly in auto producers.

In 2021, natural gas and renewable energies supplied around 56% of the energy in Peru. Most of these fuels are used in power generation. In contrast, these fuels represent 32% of the energy supply mix in APEC.

Additionally, coal is an important fuel representing 35% of the energy supply mix in APEC, serving as a major source of electricity generation. However, in Peru, coal plays a minor role, representing just 2% of the energy supply mix.

Another important difference is observed between Peru's and APEC's energy mix is the share of oil. Oil share was 41% in Peru while it was 27% in APEC in 2021. The disparity highlights the crucial role of the transport sector in Peru, as illustrated in Figure 3.

Figure 3: Energy supply mix – Peru and APEC, 2021

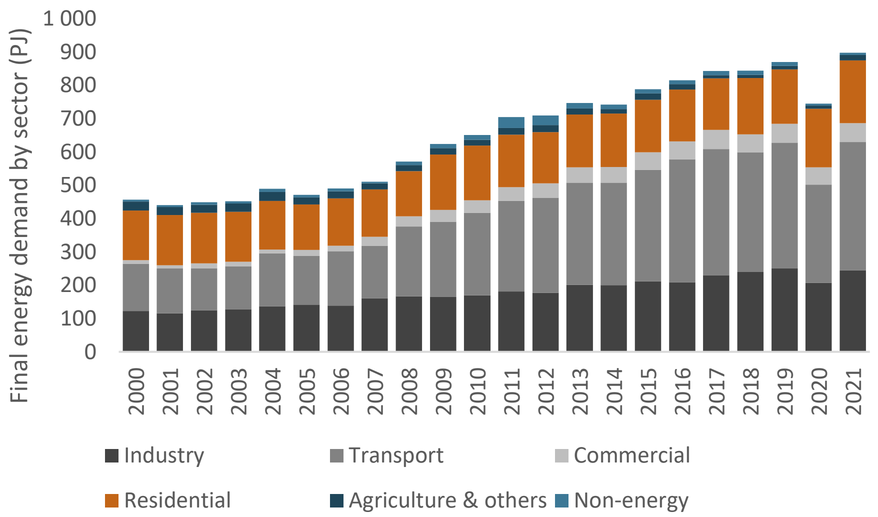


Source: EGEDA (2023)

Total final consumption

Energy demand in the residential sector grew 7.1% from 176 PJ in 2020 to 188 PJ in 2021. This growth rate was higher than the average annual rate of 1.2% between 2010 and 2021. Energy demand in the residential sector was the only one that grew in 2020.

Figure 4: Peru's final consumption by sector (PJ), 2000 to 2021



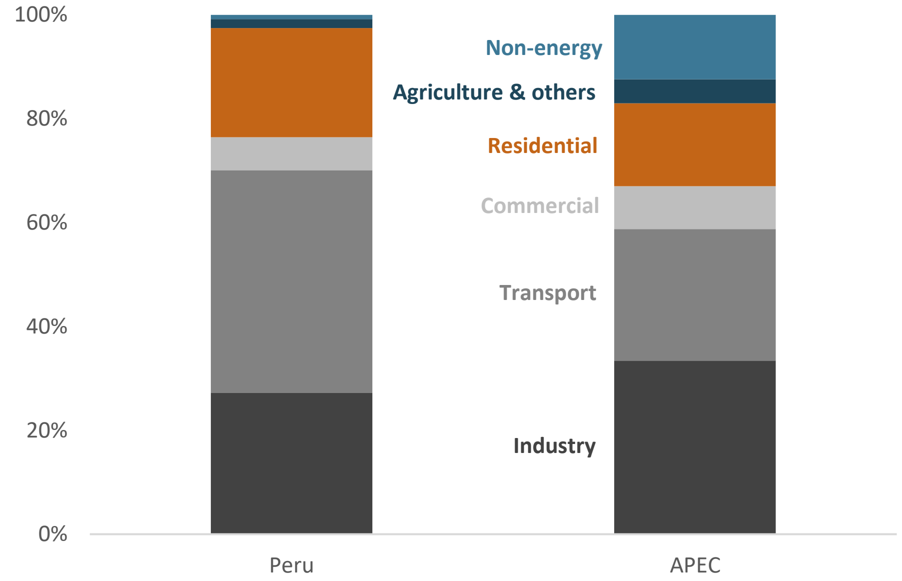
Source: EGEDA (2023)

Industry energy demand grew 18.1% from 207 PJ in 2020 to 244 PJ in 2021. However, this demand does not reach pre-pandemic levels at 251 PJ in 2019, indicating that industrial activity had not recovered despite the economic reactivation measures implemented in Peru.

Other sectors showed a big increase in energy consumption. The commercial sector grew 11.3% from 51 PJ in 2020 to 57 PJ 2021. Transport, the main energy consumer, grew 30% from 296 PJ in 2020 to 386 PJ in 2021, a response to the lift of transport restrictions that were implemented during 2020.

Despite the observed growth in total final consumption across all sectors in 2021, the overall trend following the pandemic suggests a slower rate of growth compared to pre-pandemic levels. This effect is more likely due to slower-than-expected economic growth.

Figure 5: Final consumption by sector, Peru and APEC, 2021



Source: EGEDA (2023)

Another important difference is observed in the share of non-energy, which includes the use of fuels as a raw material for non-energy products such as lubricants. In APEC, non-energy use represented 12% of final energy consumption in 2021 while it is 0.8% in Peru.

Final energy demand

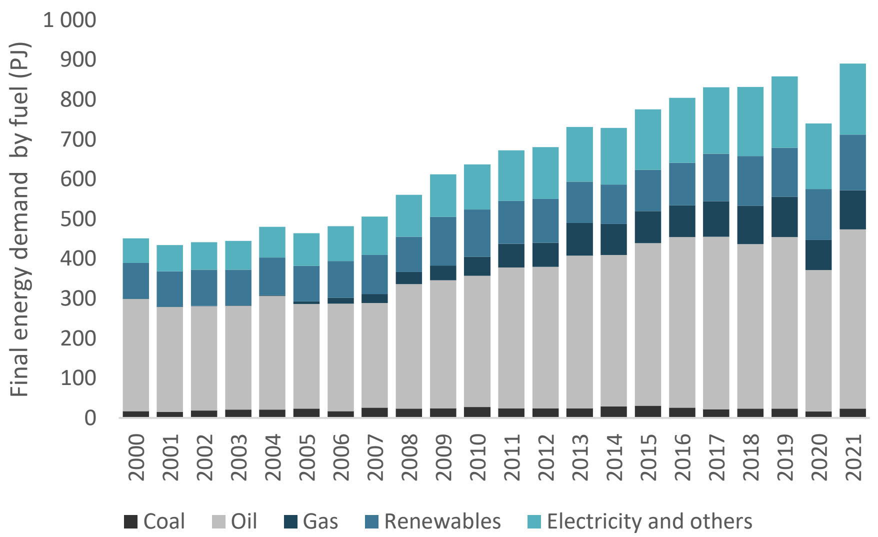
Demand for all fuels grew in 2021. The highest growth was observed in coal consumption, almost 46% from 16 PJ in 2020 to 23 PJ in 2021, mainly due to an increase of coal consumption in industry. Natural gas demand grew 29.4% from 76 PJ in 2020 to 98 PJ in 2021, however this demand did not reach the levels of 2019 at 102 PJ.

Oil products demand grew 26.6%, from 356 PJ to 451 PJ, mainly due to the reactivation of the transport sector. This demand is 4.6% higher than the 2019 level, meaning the demand for oil products is aligned with the previous historical trend.

Renewable energy demand grew 9.4% going from 128 PJ in 2020 to 140 PJ in 2021. Renewable energy is the only fuel with constant growth during the 2020 and it accounts for the increase of the use of fuelwood in the residential sector.

Finally, electricity demand grew 9.4%, going from 164 PJ in 2020 to 179 PJ in 2021, almost the same demand reported in 2019.

Figure 6: Peru's final energy demand by fuel (PJ), 2000 to 2021



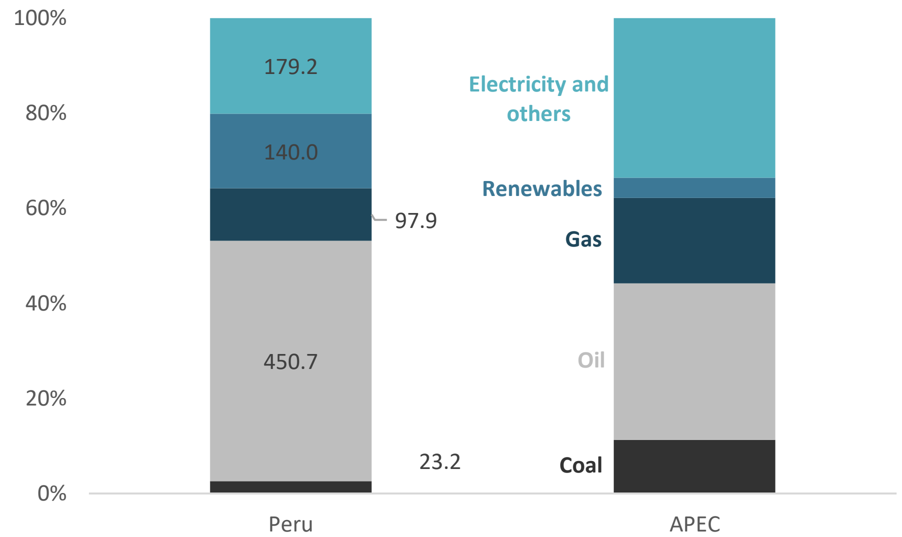
Source: EGEDA (2023)

Note: Does not include non-energy sector consumption of energy products.

Peru's final energy demand fuel share did not change drastically when compared with previous years, where oil and oil products satisfy almost half of the final energy demand. The most important oil products are diesel, mainly commercialised as a blend with 5% of biodiesel and known as DB5, and gasoline, mainly commercialised as a blend with 7.8% of ethanol, and known as gasohol. These products are primarily used in road transport. Additionally, LPG is used in buildings for cooking and water heating, although a small share is also used in vehicles.

The share of electricity in the final energy demand is bigger in APEC, where it represents 34%, than in Peru, where it represents 20%. This difference suggests the potential for increasing the electrification of the end-use energy demand in Peru by switching away from oil products mainly used in transport (e.g., electrification of transport) and industry.

Figure 7: Final energy demand fuel share, Peru and APEC, 2021



Source: EGEDA (2023)

Natural gas appeared in Peru's final energy demand mix in 2004 when

Camisea, the main natural gas project, started operation. Since then, natural gas has increased its share in the final energy demand to approximately 11% in 2021. In final energy consumption, demand of natural gas has not completely recovered its 2019 level although it experienced constant growth in the residential sector. The share of natural gas in the final energy demand in Peru is half of what is observed in APEC, indicating the challenges to expand natural gas coverage in the economy, although advancements are reported constantly.

Transformation

Power sector

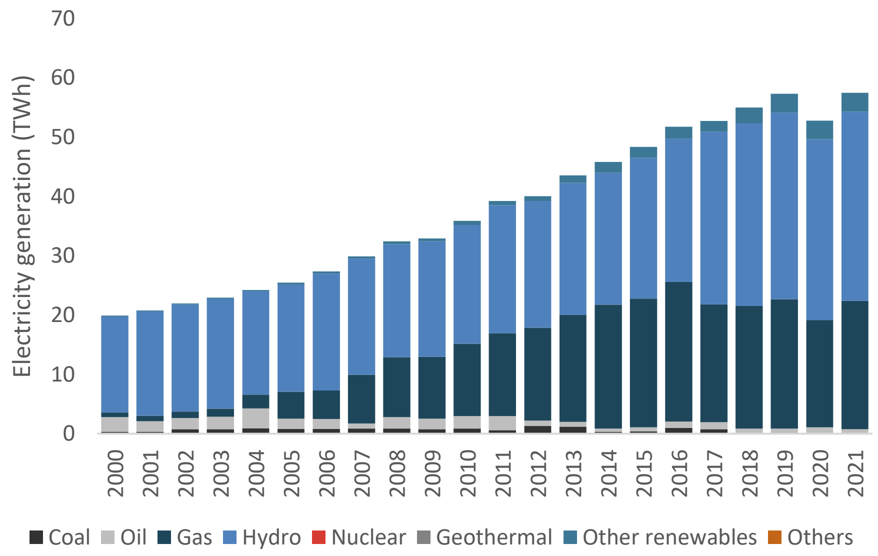
In 2021, Peru's electricity generation totalled 57 517 gigawatt hours (GWh), a growth of 8.9% from 2020. Renewable sources provided 61.1% of electricity: hydropower produced 55.5% and non-conventional renewable energy produced 5.6% of electricity. Electricity produced from hydropower and renewable energy grew 4.6% and 2.4% respectively. The rest of the electricity was produced mainly in thermal plants, mainly natural-gas-based in combined cycle. Only a small share of electricity, around 1.3%, came from coal and diesel (EGEDA, 2023).

Natural gas-based power generation grew 19.5% from 18 105 GWh in 2020 to 21 633 GWh in 2021. Power generation from coal and diesel fell 28.4% from 2020.

While the impact of the droughts experienced in 2023 will be observed in future Overviews, the Peruvian electricity generation fuel mix in 2021 already indicated a potential vulnerability to extreme weather events that may affect renewable energy resources. This vulnerability is noteworthy as it corresponds to more than half of electricity generation.

In 2023, the reduction of water resources for electricity generation was compensated by an increase of thermal generation, including diesel and coal plants.

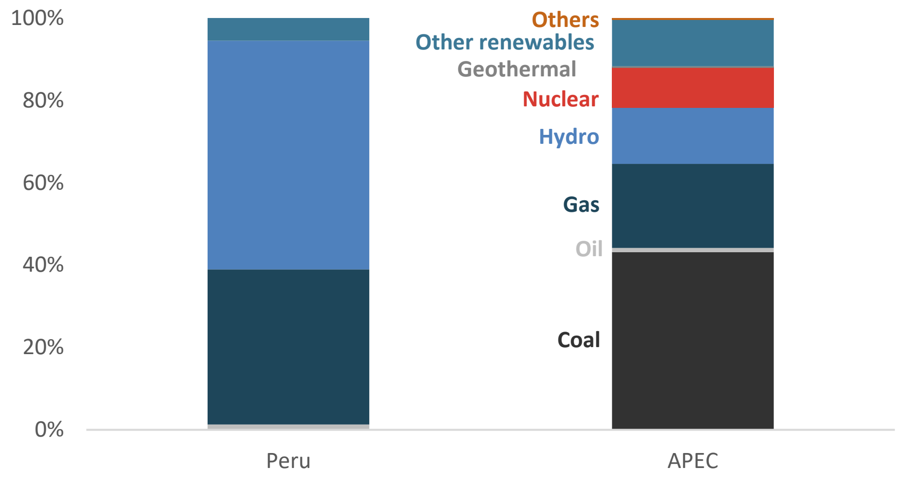
Figure 8: Peru’s electricity generation by fuel, 2000 to 2021



Source: EGEDA (2023)

Peru exhibits a relatively clean electricity generation mix compared to other APEC economies. According to the National Greenhouse Gas Inventory Report of Peru 2019 (MINAM, 2023), electricity generation accounts for 6.7% of greenhouse gas emissions in the energy sector. The newly announced projects are predominantly centred around solar and wind power plants. Nevertheless, there remains a need to secure investments in clean and energy efficient power generation projects to ensure a stable electricity supply, especially in the southern region of Peru. Exploiting its high potential of renewable energy, the southern region of Peru could reduce the dependency on electricity transmission from the central region and on local fossil fuel generation in the future.

Figure 9: Electricity generation fuel share, Peru and APEC, 2021



Source: EGEDA (2023)

Refining

The Talara Refinery began its gradual and progressive start-up process in 2023 after it underwent modernisation and upgrading. The modernisation includes the expansion of the crude oil processing capacity from 65 000 to 95 000 barrels per day (bpd). The refinery is expected to operate at 100% by the end of 2023.

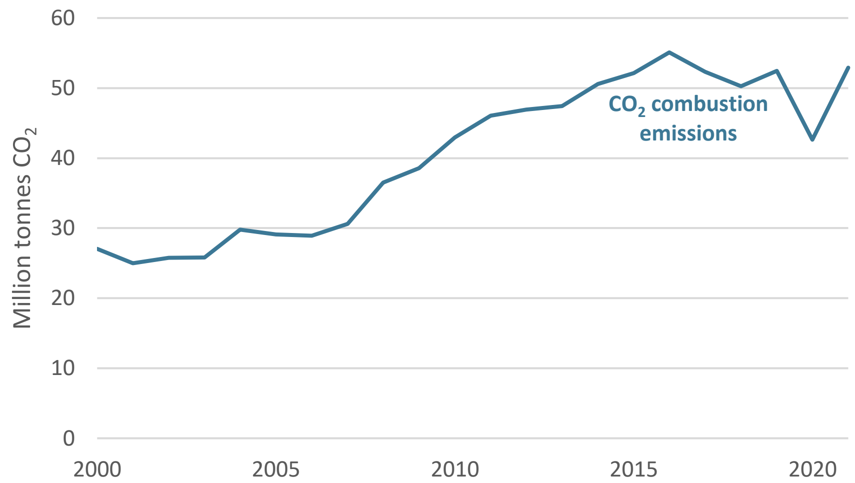
Energy Transition

Emissions

CO_2 combustion emission rebounded in 2021, as expected, due to the economic reactivation. The emissions increased by 24.1%, rising from 42 617 kt-CO_2 in 2020 to 52 909 kt-CO_2 in 2021. This increase meant that emissions in 2021 were slightly higher than those in 2019 by 0.8%.

This growth can be attributed to an increase of energy demand and consumption, particularly in diesel and gasoline. Additionally, there was an increase in the use of emitting fuels such as traditional biomass, which had been on a declining trend before the pandemic.

Figure 10: Peru CO_2 combustion emissions (million tonnes), 2000 to 2021



Source: EGEDA (2023)

Energy security

The diversification of the energy matrix, with an emphasis on renewable energy and energy efficiency, along with the development of the natural gas industry, are important objectives outlined in the Peru's National Energy Policy 2010-2050. These are regarded as two cornerstones of the strategy to strengthen energy security.

In recent years, Peru has experienced extreme weather events, making it a priority to promote investments that contribute to achieving the aforementioned goals. Electricity generation has been adversely affected by droughts, attributed to the effects of the El Niño phenomenon, which reduced hydroenergy production in 2023. Additionally, Peru faced LPG shortages several times in 2023 due to extreme sea conditions, a phenomenon that is becoming more frequent. Lima, the capital city of Peru, heavily relies on sea transport for its LPG supply. During shortages, vehicular LPG supply, the fuel used in light passenger vehicles, is restricted to protect LPG supply to buildings (El Comercio, 2023a)

APEC Energy Goals

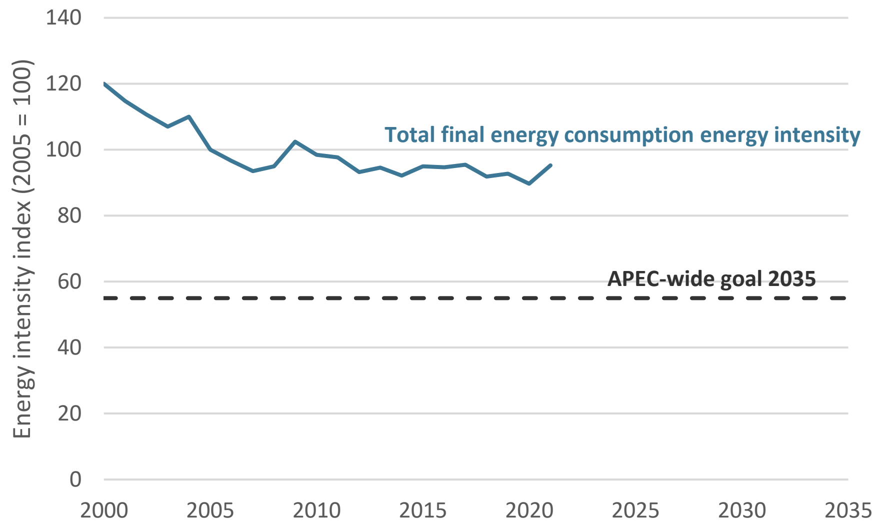
There are two energy-related objectives that APEC member economies have agreed to meet as a collective: to improve energy intensity and to double the share of modern renewables.

Energy intensity goal

In 2011, APEC member economies agreed to increase their target to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

APEC is on track to achieve this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

Figure 11: Peru's total final energy consumption intensity index, 2000 to 2021 (2005 = 100)



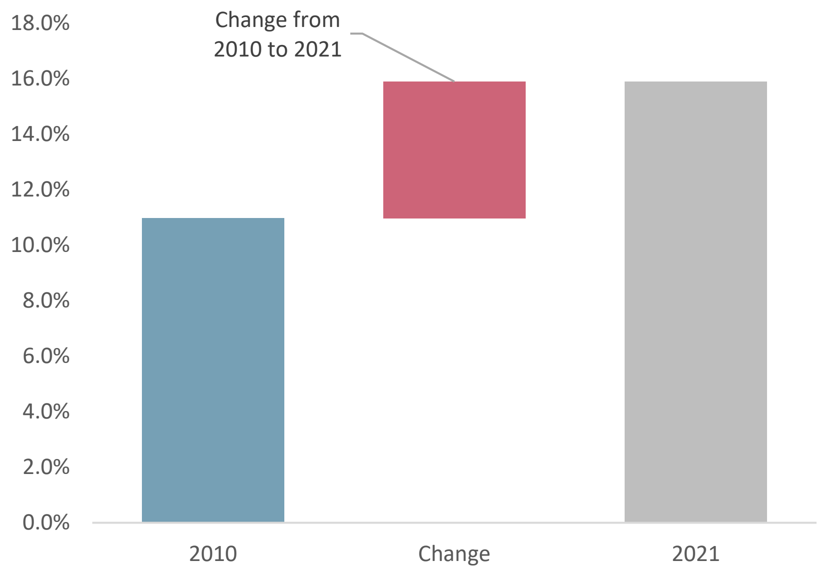
Source: EGEDA (2023)

The energy intensity index increased by 5.5% in 2021. This increase can be attributed primarily to the slower-than-expected economic growth in Peru during 2021. It is anticipated that the decreasing trend will resume when economic growth accelerates in the coming years.

Doubling of renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period 2010 to 2030. There is no economy-level goal for individual member economies, but improvements by individual economies will contribute to the doubling goal.

Figure 12: Peru's modern renewable energy share, 2010 and 2021

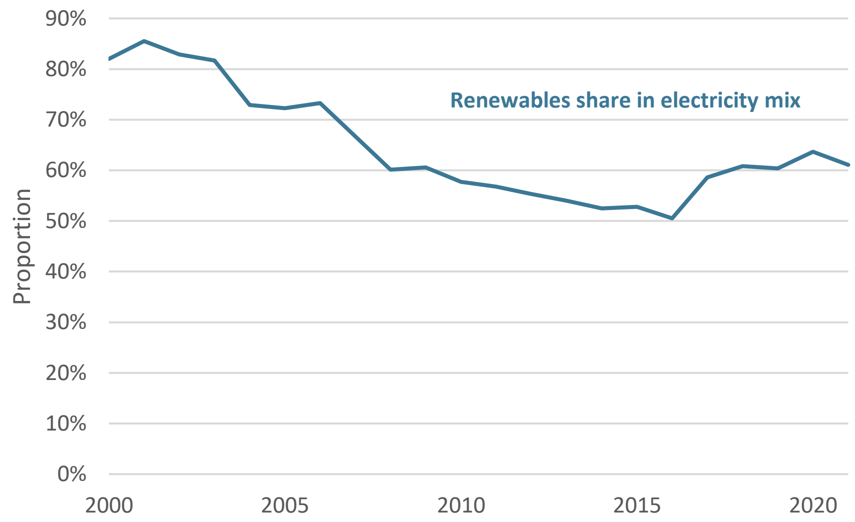


Source: EGEDA (2023)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Peru's modern renewable energy share was 15.9% in 2021, showing a decrease from the 19% reported in 2020. This decline can be attributed to a growth in demand, mainly satisfied by fossil fuel, particularly in the transport and industry sectors. Peru's share of modern renewable energy remains one of the highest among APEC economies, comparable to Indonesia at 16.6% and Thailand at 14%, ranking 6th in the region. Considering the untapped potential for renewable energy in Peru, doubling the economy's share of modern renewable energy to 30% by 2030 appears feasible.

Figure 13: Peru's renewable generation share, 2000 to 2021



Source: EGEDA (2023)

The renewable share in electricity mix did not show improvement in 2021, as a slight decrease of 3% was observed. This decrease was maily due to increased thermal generation to meet additional electricity demand. Although the Puntal Lomitas wind farm started operating in 2023, the share of renewable energy generation is expected to decrease due to the impact of droughts affecting hydroenergy.

Energy Policy

Energy policy	Details	Reference
Natural Gas Massification	Massification of natural gas via the use of the Social Energy Inclusion Fund. The government plans to build a natural gas distribution network for seven regions.	ProInversion
National Plan for Rural Electrification	The objective of the Rural Electrification Plan is to achieve a reduction in greenhouse gas emissions using renewable energy in rural areas for the provision of electricity. In 2018, rural electrification reached 87% of coverage; economy-wide electrification was 92%. The policy target is to reach 100% by 2022.	Ministry of Energy and Mines
The Southern Peruvian Gas Pipeline	This pipeline will increase the natural gas transportation capacity to 800 million cubic feet per day by 2025 through the following pipelines: • Camisea-Lima (500 km); Peru LNG (300 km). • Ica-Marcona (300 km); Marcona-Mollendo loop (500 km). • Central Highlands-Trujillo (1 100 km); Trujillo-Piura (500 km); Piura-Tumbes (400 km).	Ministry of Economy and Finance
Electric Vehicle Charging Infrastructure	Peru has approved statutory provisions for the charging infrastructure and electricity supply for electric vehicles. A proposal for specific regulations for the installation and operation of electric vehicle charging stations has been presented.	Ministry of Environment
Energy Efficiency Audits	In 2021, Peru approved legal requirements for energy efficiency audits to promote energy efficiency in public and private buildings.	Ministry of Environment
Energy Efficiency Labelling Regulation	In 2017, the technical regulation for energy efficiency labelling for 12 types of equipment was approved. However, the requirement of presenting a certificate of conformity before using the labels was postponed.	Ministry of Energy and Mines
Energy Efficiency Standards	A new set of technical specifications for washing machines and lights for street lighting has been approved. The government is obligated to acquire new products according to these new specifications.	Ministry of Energy and Mines
Nationally Determined Contribution (NDC)	Peru has updated the unconditional and conditional NDCs. The unconditional target changed from 20% to 30% and the conditional target changed from 30% to 40% emission reductions by 2030.	Ministry of Environment
Declaration of Climate Emergency as Utmost Interest	Peru declared the climate emergency as an emergency of the utmost interest and prioritised actions to implement NDCs, including setting a goal of achieving 20% non-conventional renewable energy in the electricity mix.	Ministry of Environment

Energy policy	Details	Reference
Road map for Smart Grids in Distribution 2023-2030	This document proposes actions to modernize the electric distribution system that includes regulatory reforms and development of incentives and financing of smart grid projects.	Ministry of Energy and Mines

Notable Energy Developments

Energy development	Details	Reference
Punta Lomitas Started Operation	The Punta Lomitas, 296 MW wind project, started operation in June 2023. This project has an investment of USD 300 million.	Ministerio de Energia y Minas
Talara Refinery Started Operation	The project involves the construction and extension of facilities aimed at increasing refining capacity from 65 000 to 95 000 barrels per day (bpd), producing cleaner fuels, reducing imports of such products, and thereby improving Peru's trade balance. The Talara Refinery began its gradual and progressive start-up process in 2023 after it underwent a modernisation and upgrade process that started in 2014.	Petroperú
500 kV Transmission Line Between Peru and Ecuador	The contract to build the Peruvian side of the 500 kV transmission line between Peru and Ecuador was awarded in July 2023 (Proinversion, 2023). The project will interconnect both electric systems, taking advantage of the complementarity of Peruvian and Ecuadorian hydrologies. The line is expected to be operational by 2027.	Proinversion

Useful links

Government

Central Reserve Bank, *Banco Central de Reserva* – https://www.bcrp.gob.pe/

Committee for the Efficient Operation of the System**,** *Comité de Operación Económica del Sistema Interconectado Nacional* – https://www.coes.org.pe/portal/

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The Philippines

Introduction

The Philippines continues its efforts to ensure universal energy access. Spanning 7 641 islands and three major regions – Luzon, Visayas, and Mindanao – achieving 100% household electrification posed a formidable challenge. Nonetheless, as of December 2021, the economy achieved a commendable 95% household electrification rate. Luzon leads with a 99% electrification rate, closely trailed by Visayas at 97%, and Mindanao at nearly 86%. Remarkably, the National Capital Region (housing the economy's capital, Manila), and the administrative region of CARAGA, have both attained total electrification status (DOE, 2022).

The economy is steadfast in its pursuit of enhancing energy infrastructure resilience. The Philippines faces recurring natural calamities, including typhoons, earthquakes and volcanic eruptions. According to the 2022 World Risk Index, the Philippines ranked highest among 193 economies in terms of disaster vulnerability, sustaining billions of pesos in damage and losses primarily from tropical cyclones alone (NEDA, 2023).

In 2018, a circular issued by the Department of Energy (DOE) mandated all energy industry participants to devise and submit their Resiliency Compliance Plans (RCPs). A supplemental policy was issued in 2022 to further enhance and broaden the scope of the Energy Resiliency Policy and expand the membership of the Task Force on Energy Resiliency. In the APEC Energy Working Group (EWG), the Philippines is co-chair of the Energy Resiliency Task Force alongside the United States. These initiatives underscore the economy's commitment to fortifying its energy infrastructure against diverse challenges.

In tandem with energy resiliency policies, discussions on navigating the challenges of the energy transition are underway. The proposed strategy to facilitate this transition in the Philippines includes the following key components: 1) accelerate the deployment of renewable energy projects and clean energy technologies and solutions; 2) build and develop a green and smart transmission system; 3) build and expand the necessary port infrastructure to support offshore wind and other marine-based energy resource development projects, and; 4) voluntary early decommissioning and/or repurposing of existing coal-fired power plants.

In alignment with this proposed strategy, the DOE shall continue and further intensify the implementation of the Energy Efficiency and Conservation Act and Electric Vehicle Industry Development Act rollout.

Table 1: The Philippines' macroeconomic data and energy reserves

Key data [a, b]		Energy reserves [c, d]	
Area (thousand km^2)	343	Oil (million barrels)	3.9
Population (million)	113	Gas (billion cubic feet)	265
GDP (2017 USD billion PPP)	921	Coal (million tonnes) [d]	2 370
GDP per capita (2017 USD PPP)	8 095	Uranium (kilotonnes U < USD 130/kgU)	

Sources: a gov.ph, b (World Bank, 2024), c, d (DOE, 2021)
Note: Reserves are total proved reserves and reasonably assured recoverable resources for uranium.

Other notable issuances related to the energy transition include: a) Coal Moratorium entitled, *Advisory on the Moratorium of Endorsements for Greenfield Coal-fired Power Projects in line with improving the Sustainability of the Philippines Electric Power Industry*; b) enabling policies to encourage the deployment and adoption of advanced and emerging technologies for power generation, such as the energy storage systems, and c) DC2024-01-0001 entitled, *Providing a National Policy and General Framework, Roadmap, and Guidelines for Hydrogen in the Energy Sector.*

The Philippines is one of the fast-growing economies in SEA APEC region. The economy has struggled from the effects of the COVID-19 pandemic but was able to start its recovery. In 2021, its GDP rebounded by 5.7% to USD 922 billion (2017 USD PPP). Relatedly, the GDP per capita increased by 4.1%.

Since the enactment of the Renewable Energy Act in 2008, the Philippines has made considerable progress in advancing its domestically produced energy sources, consequently increasing the renewable share in the economy's energy mix. In view of the expected huge amount of renewable energy capacities that will be added in the grid, the DOE has formulated the Smart and Green Grid Plan (SGGP). This will assist the DOE in making policy decisions, enhancing technical competencies, identifying policy gaps and challenges, as well as recommending appropriate solutions through policy development and government interventions.

The SGGP aims to complement the 2023-2050 Philippine Energy Plan encapsulating the strategic plans and programmes of the government geared towards the holistic development of the transmission sector in the near-term horizon and beyond.

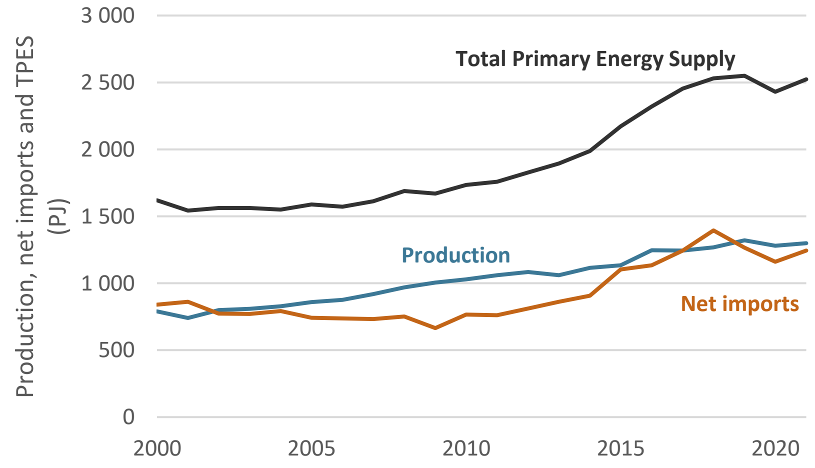
The Philippines has a modest amount of domestic resources. As of December 2021, indigenous petroleum production reached 7 million barrels of crude oil, 23 million barrels of condensate, and 843 billion cubic feet of natural gas, while coal production stood at 81 million tonnes (DOE, 2022).

Energy Supply and Consumption

Total primary energy supply

The Philippines has historically been a predominant net importer, primarily of oil and coal. While net imports had been on a declining trajectory in the preceding two years, they experienced a notable rebound of 7.3% in 2021. This resurgence was primarily in response to the heightened domestic energy demand resulting from the resumption of economic activities and the relaxation of pandemic-related quarantine restrictions.

Figure 1: The Philippines' energy supply, production, and net imports (PJ), 2000 to 2021

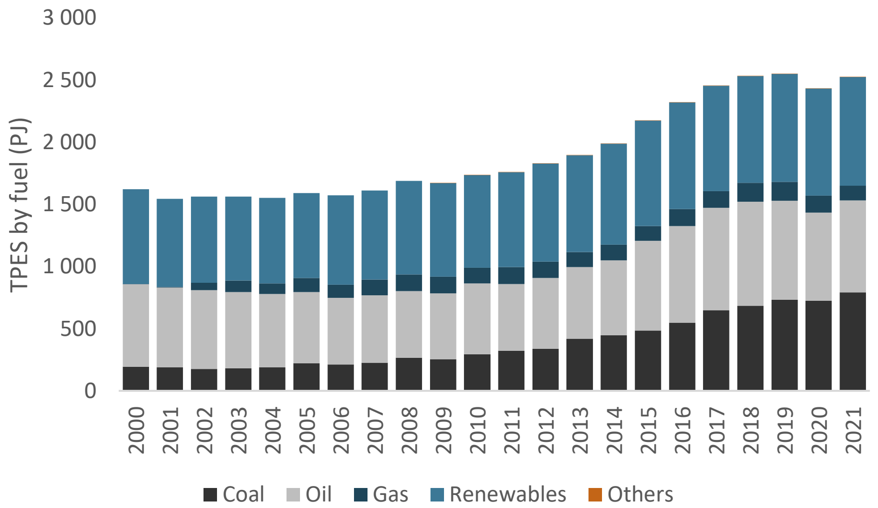


Source: EGEDA (2023)

Notably, both coal and oil imports contributed to this uptrend significantly. Coal imports saw a 5.8% increase in 2021, while oil imports surged by 8.2%, bringing back its share of total imports close to its historical value of 60% or above (Figure 1).

In 2021, the initial steps toward recovery from the widespread impact of the COVID-19 pandemic began. Notably, the Philippines experienced a rebound in its total primary energy supply (TPES), rising by 3.8% to reach 2 523 PJ. The increase in oil imports led to a more than 4% rise in oil supply. Conversely, other fuel sources, including non-renewable energy wastes, saw a significant decline of more than 40% during the same period. The looming depletion of the economy's single gas source, coupled with a scheduled maintenance shutdown at the gas platform, has contributed to a dip in the gas supply of more than 14% (DOE, 2022).

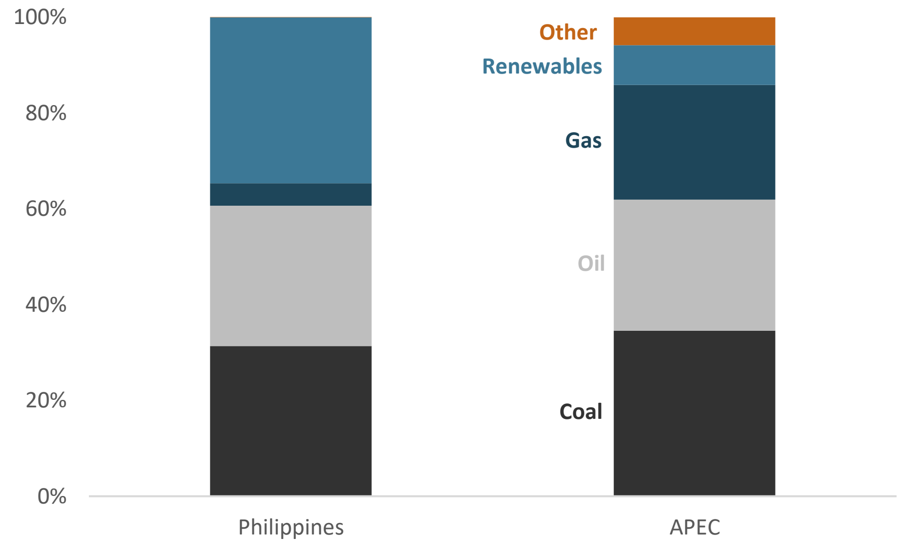
Figure 2: The Philippines' energy supply by fuel (PJ), 2000 to 2021



Source: EGEDA (2023)

Renewables and coal, together constituting more than 60% of the economy's energy supply, showed notable increases of 2% and 9%, respectively. Biomass and geothermal, the leading contributors within the renewables sector, maintained their prominence. While biomass output saw a slight increase of 0.6%, geothermal output experienced a minor decline of 0.7%. Despite efforts to stabilise domestic oil supply through increased imports, the rise was modest. Meanwhile, coal maintained its position as the largest fuel source of the economy (Figure 2).

Figure 3: Energy supply mix – The Philippines and APEC, 2021



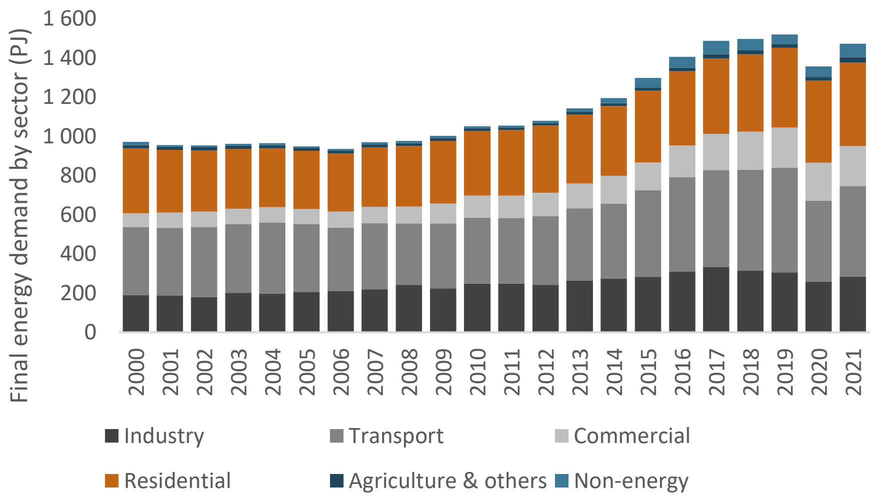
Source: EGEDA (2023)

While it may possess a smaller energy supply compared to other economies within APEC, the Philippines stands out for its commitment to harnessing domestic energy sources. Notably, renewable energy, primarily generated locally, held a relatively prominent position within the economy in 2021, surpassing the APEC average. The share of oil in the energy mix remained comparable to the APEC average. Similarly, coal, predominantly utilised for power generation, maintained a proportionate share in line with APEC levels. However, gas and other fuel sources constituted a relatively smaller portion of the energy mix compared to the broader APEC region (Figure 3).

Total final consumption

In 2021, the gradual relaxation of community quarantines, accelerated vaccination efforts, and a resurgence in major economic activities helped the Philippines in its pandemic recovery. This resurgence was further bolstered by the reopening of key transportation routes economy-wide. These collective efforts propelled the economy's total final consumption (TFC) to surge by 8.5%, reaching 1 473 PJ compared to the previous year's level of 1 357 PJ (Figure 4).

Figure 4: The Philippines' final consumption by sector (PJ), 2000 to 2021

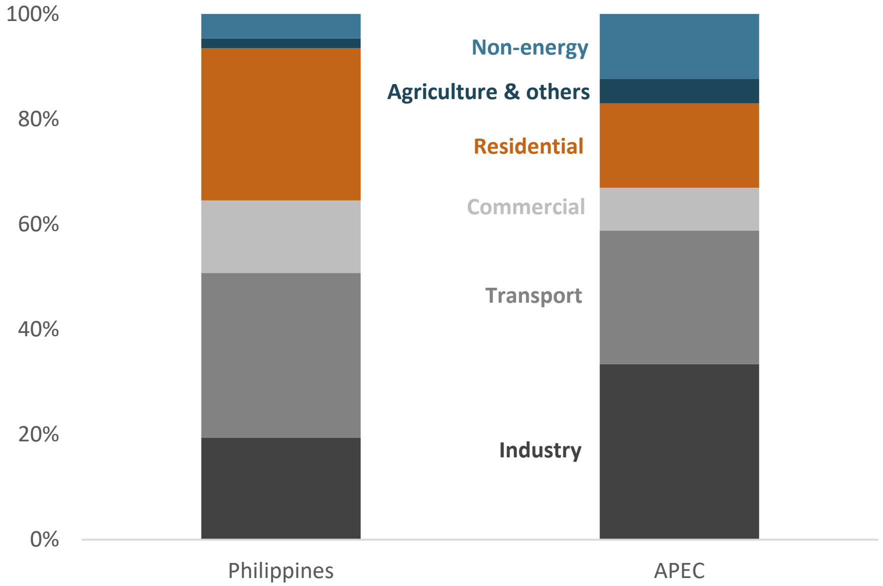


Source: EGEDA (2023)

During the year, all end-use economic sectors saw an increase in their energy consumption. The transport sector reclaimed its position as the most energy-intensive sector, contributing 31% to the total final consumption. Benefitting from reduced mobility restrictions, it experienced a notable 12% acceleration in energy utilisation. Following closely, the household sector accounted for a 28% share, albeit with a modest 1.5% increase in energy consumption. This growth reflects the gradual return of employees to work, even with the continued adoption of alternative work arrangements.

Industry and services sectors rebounded from the downturn of the previous year, each recording notable increases in energy consumption: 10% for industry and 5.2% for services. The relaxation of community quarantines allowed most establishments to resume operations, with expanded workforce capacities. Together, these sectors accounted for a significant portion of TFC, totalling 33%. Consequently, the demand for energy forms used as raw materials surged by 26%, reflecting the reopening of major factories and the resumption of assembly lines. Agriculture emerged as the fastest-growing sector, with a remarkable 51% increase in energy usage, driven by the need to maintain production despite sectoral challenges. Even with its vital role, agriculture remains the smallest contributor to TFC, holding a modest share of 1.9% (DOE, 2022).

Figure 5: Final consumption by sector, The Philippines and APEC, 2021



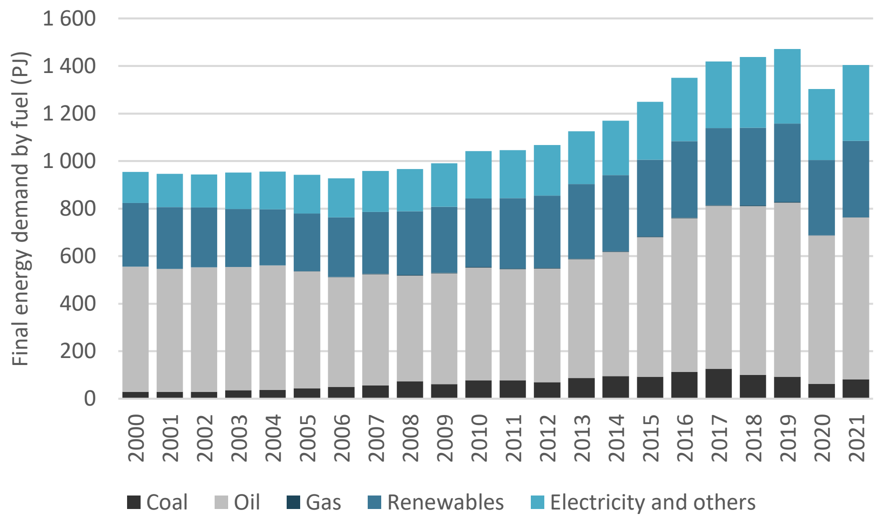
Source: EGEDA (2023)

The transport, residential, and services sectors held greater prominence in the Philippines compared to the broader APEC region. While these sectors were directly impacted by the pandemic, they displayed resilience and began to recover following the relaxation of quarantine restrictions (Figure 5).

Final energy demand

Total final energy consumption (TFEC-excluding non-energy) expanded by 7.7% to just over 1 404 PJ in 2021. Despite the waning impact of the COVID-19 pandemic, gas consumption continued its downward trend, nearly halving. Electricity emerged as a major fuel source, constituting 23% of the Philippines' TFEC, with a growth of 6.5%. Additionally, renewables saw a modest increase of 1.8% during the same period.

Figure 6: The Philippines' final energy demand by fuel (PJ), 2000 to 2021

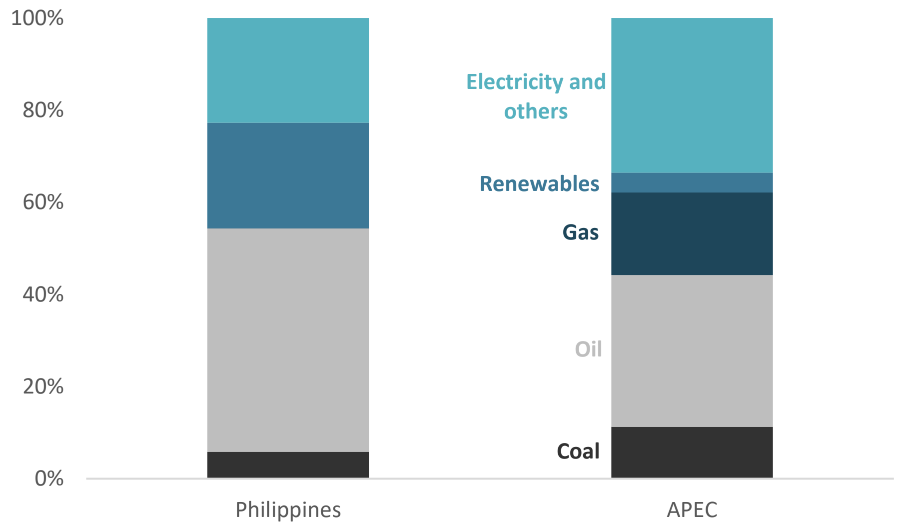


Source: EGEDA (2023)

Coal consumption, primarily associated with industrial use, rebounded by 30%, signalling a resurgence in industrial activity. Meanwhile, oil consumption, predominantly utilised for transportation purposes, increased by almost 9.3%. In the household sector, electricity remained the primary fuel source, with households accounting for the majority of consumption, holding a 40% share. However, consumption levels saw a slight decline of 2% compared to the previous year's 12% acceleration. This slowdown can be attributed to strict adherence to quarantine ordinances aimed at curbing the spread of the COVID-19

With the support of guidelines addressing business continuity concerns, the industry, services, transport, and agriculture sectors experienced a recovery in electricity consumption in 2021. These sectors saw growth rates of 8%, 1.9%, 28%, and 86%, respectively, rebounding from the contraction experienced in 2020 (Figure 6).

Figure 7: Final energy demand fuel share, the Philippines and APEC, 2021



Source: EGEDA (2023)

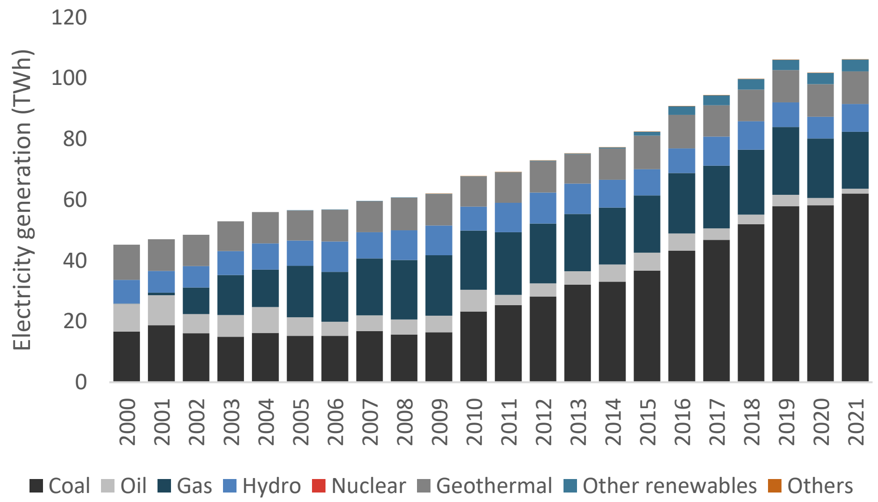
The Philippines maintained its dependence on oil for transportation needs, as reflected in its relative share compared to APEC as a whole. With many households still relying heavily on biomass for their energy needs and the economy's growing utilisation of renewable sources, the share exceeded that of APEC. While electricity consumption is lower in the Philippines compared to APEC, its proportion in the economy's fuel mix remains significant. Direct coal usage is confined to specific industrial sub-sectors in the Philippines, resulting in a smaller share compared to APEC (Figure 7).

Transformation

Power sector

The Philippines' electricity generation surged by 4.3%, reaching 106 TWh in 2021 (Figure 8). Notably, the contribution from oil, which had been fluctuating over the past decade, experienced a substantial 35% decrease, marking the most significant decline among the various fuel sources for power generation. Conversely, coal, comprising over 50% of the economy's power generation mix, exhibited a robust 6.7% increase (62 TWh), primarily driven by the commissioning of new coal-fired power plants during the year.

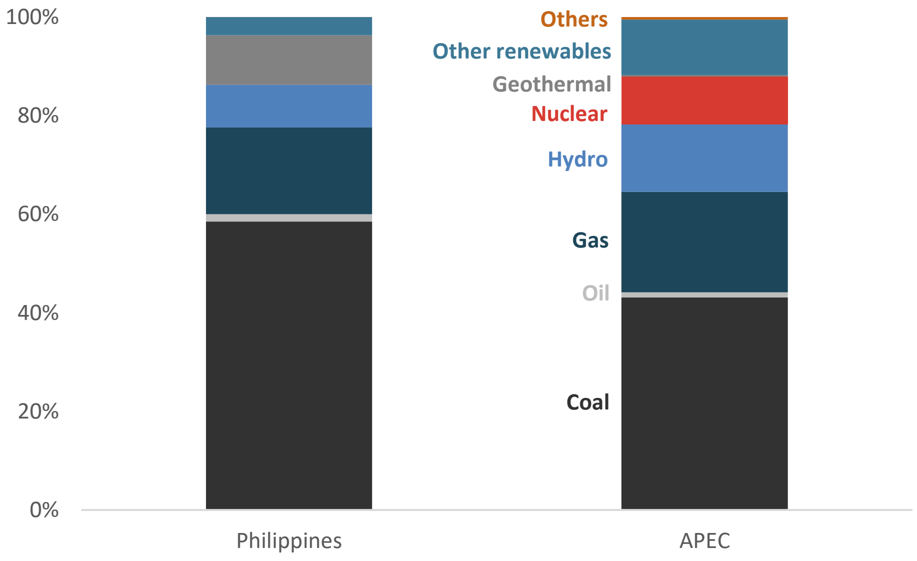
Figure 8: The Philippines' electricity generation by fuel, 2000 to 2021



Source: EGEDA (2023)

Renewable energy sources collectively experienced the most substantial surge in power generation. Specifically, biomass, solar, and other renewables witnessed a notable 10% increase in output in 2021. The remarkable expansion in capacity from solar, biomass, and hydroelectric power installations played a crucial role in meeting the Philippines' energy demand throughout the year. Despite a slight dip in geothermal electricity generation by nearly 1%, hydropower production rebounded significantly by 28% in 2021, largely due to the effects of the climate pattern, La Niña.

Figure 9: Electricity generation fuel share, the Philippines and APEC, 2021



Source: EGEDA (2023)

Although geothermal power generation experienced a marginal decrease in 2021, its relative share remains noteworthy when compared to APEC. Given the Philippines' heavy reliance on coal for electricity generation, its share stands out prominently relative to its APEC counterparts. Meanwhile, oil-based power generation slightly exceeds the APEC average, whereas gas, owing to depleting reserves, falls below the current APEC level. The relative shares of other generation sources either stand at zero (in the case of nuclear) or are smaller compared to the APEC-wide power generation mix (Figure 9).

Energy Transition

The Philippines made a significant commitment to address climate change by submitting its Nationally Determined Contribution (NDC) to the United Nations Framework Convention on Climate Change. The NDC outlines a bold target: a 75% reduction in greenhouse gas (GHG) emissions compared to the business-as-usual scenario spanning 2020-2030. This mitigation goal comprises both unconditional and conditional elements, with 2.7% being unconditional and 72% conditional upon receiving resources from developed economies. These resources are essential for implementing mitigation actions across various sectors including agriculture, waste management, industrial processes, product use, transport, and energy (NEDA, 2023).

Under the Marcos Administration's Philippine Development Plan 2023-2028, the transition to a low-carbon economy stands out as a key strategy in the government's efforts to address climate change and bolster disaster resilience (NEDA, 2023). This underscores the economy's commitment to sustainable development and emphasises the importance of collaborative efforts on both economy and international levels to tackle the challenges posed by climate change.

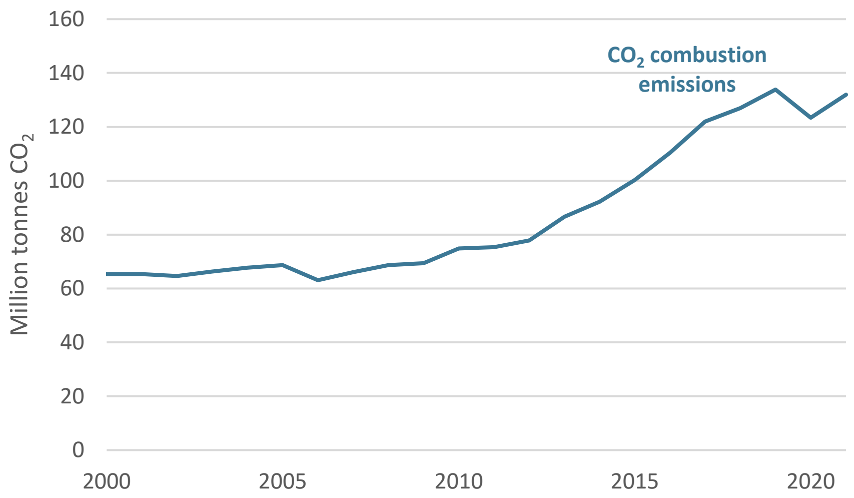
Emissions

In 2021, the total GHG emissions experienced a significant rebound, increasing by 6.9% to reach 132 $MtCO_2eq$, compared to 123 $MtCO_2eq$

in 2020. The resumption of economy-wide economic activity and the easing of mobility restrictions drove this resurgence.

Notably, emissions from the utilisation of coal in power generation and cement manufacturing emerged as the primary contributors to the overall GHG emissions. Following closely behind was the consumption of oil in the transport sector.

Figure 10: The Philippines' CO_2 combustion emissions (million tonnes), 2000 to 2021



Source: EGEDA (2023)

Energy security

Energy security stands as a paramount pillar within the Philippine Energy Plan (PEP) 2020-2040, underscoring its commitment to fostering a robust and resilient economy. Embracing a forward-looking approach, the PEP 2020-2040 champions the advancement and prudent utilisation of both established and emerging technologies, ensuring optimal efficiency and sustainability in energy practices (DOE, 2023).

Recent events, including the COVID-19 pandemic, rapid shifts in technology, and geopolitics, have presented notable challenges to the economy's supply security, particularly in areas such as liquefied petroleum gas (LPG). For instance, in February 2022, the global price of LPG experienced a sharp escalation. Sanctions levied against Moscow prompted buyers to seek alternative sources, exacerbating the situation. Coupled with soaring spot premiums and freight rates, these factors collectively exerted significant upward pressure on LPG prices.

These events called for the economy to increase the use of alternative fuels and explore more of the economy's local energy sources such as renewables. The depletion of the Philippines' sole natural gas resources is also threatening a shortage of more than 20% in the power supply. With the introduction of liquefied natural gas (LNG) in the Philippines, it now has two receiving and regasification facilities for imported LNG that will support the five existing gas-powered plants within the economy (DOE, 2023).

By the end of December 2021, the Philippines sustained a 38-day inventory level of crude oil and petroleum products, totalling 2 610 million litres. This comprised 26 days of in-economy stocks (onshore) and an additional 13 days' worth of crude oil and petroleum products in transit (DOE, 2022).

The Philippines stands as a signatory to the ASEAN Petroleum Security Agreement (APSA), which was initiated in 1986. APSA's primary goal is to foster regional collaboration in ensuring energy security during periods of oil oversupply or undersupply. While APSA has yet to be ratified, the Philippines, as an active member of ASEAN, eagerly awaits its enactment, recognising the crucial role it can play in enhancing regional energy stability.

As economic activities rebound following the COVID-19 pandemic, the government remains steadfast in assuring consumers of a reliable and consistent power supply. Throughout previous years, efforts persisted in rehabilitating and refurbishing both grid and off-grid facilities, with notable expansions in installed capacities also documented. These ongoing initiatives underscore the commitment to bolstering infrastructure and ensuring the resilience of the economy's energy supply.

APEC Energy Goals

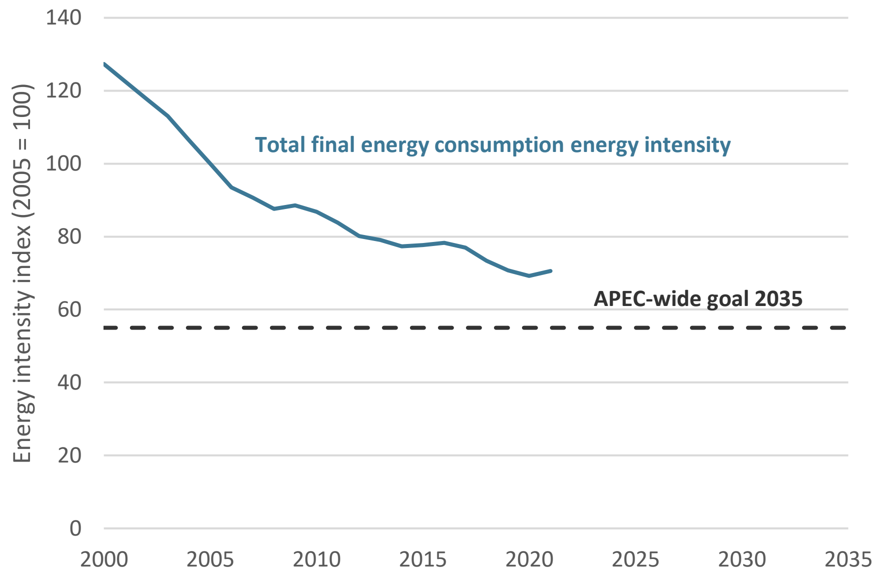
APEC member economies have collectively committed to achieving two significant energy-related objectives: improving energy intensity and doubling the share of modern renewables.

Energy intensity goal

In 2011, APEC member economies agreed to increase their target to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal from 2007 was a 25% improvement by 2030.

APEC is currently making strides toward achieving this energy intensity improvement target. While the goal does not mandate specific targets for individual economies, it allows for tracking the progress of each APEC member relative to the overall proportional improvement.

Figure 11: The Philippines' total final energy consumption intensity index, 2000 to 2021 (2005 = 100)



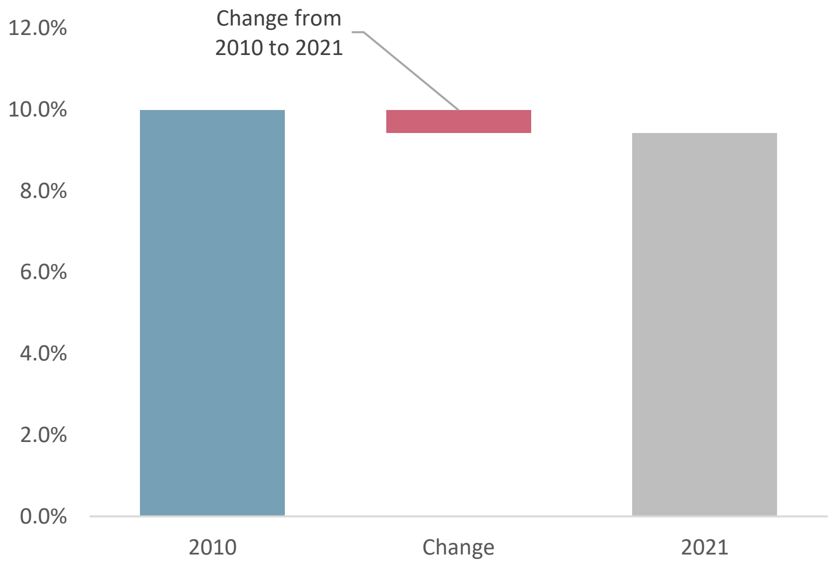
Source: EGEDA (2023)

The Philippines has witnessed a steady annual improvement in final energy intensity, averaging 2.2% since 1990. By 2021, the final energy intensity had improved to 30% compared to 2005 levels. This trend is likely to persist, buoyed by recent initiatives such as RA 11285, also known as the Energy Efficiency and Conservation Act of 2019. This legislation has transitioned energy efficiency efforts from voluntary to mandated activities, indicating a promising trajectory for continued enhancement in energy efficiency.

Doubling of renewables

The second energy goal aims to double the proportion of modern renewables in the APEC energy mix from 2010 to 2030. While there is no specific target set for individual member economies, advancements made by each economy will collectively contribute to achieving the overarching doubling goal.

Figure 12: The Philippines' modern renewable energy share, 2010 and 2021



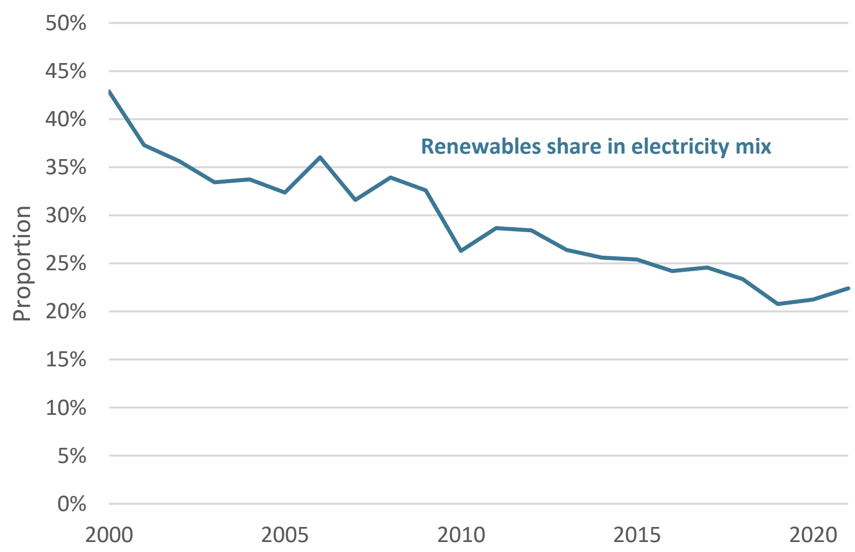
Source: EGEDA (2023)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

The enactment of the Renewable Energy Act in 2008 marked a significant step towards propelling the Philippines' renewable energy sector forward, emphasising the utilisation of locally sourced energy. Subsequent efforts have been dedicated to promoting renewable resource adoption, both for end-users and power generation. However, despite these endeavours, the share of renewables in final energy consumption experienced a marginal decrease from 10% in 2010 to 9.4% in 2021. If the economy aspires to double the share of renewables in the final energy demand by 2030, an additional increase of 10.5% would be necessary (Figure 12).

In 2021, there was a notable 10% increase in the share of renewables within the power generation mix compared to the previous year. However, a closer examination reveals a concerning long-term trend. Since 2010, the share of renewables in power generation has been steadily declining at an average annual rate of 1.4%. This trend has resulted in a decrease in the share of renewables from 26% in 2010 to 22% in 2021 (Figure 13).

Figure 13: The Philippines' renewable generation share, 2000 to 2021



Source: EGEDA (2023)

Significant adjustments are necessary to effectively double the share of renewables in the power generation mix. To achieve this objective, the trend must experience an average annual increase of 10%, ultimately reaching 53% by 2030. This underscores the critical need for concerted efforts and innovative strategies to accelerate the integration and adoption of renewable energy sources within the power generation infrastructure.

Energy Policy

The energy sector is continuously guided by its long-term vision known as *AmBisyon Natin 2040* (NEDA, 2023). The sectoral roadmap was formulated to realise this vision, which is updated for each energy subsector. It contains long-term objectives, deliverables, and targets consistent with the Strategic Focus Areas cited in PEP 2020-2040 and will provide direction on how to achieve the clean energy path (DOE, 2022).

Energy policy	Details	Reference
NDC Targets	This policy targets an economy-wide 75% reduction of GHG emissions by 2030, relative to the business-as-usual scenario from 2000 to 2030. Of the 75% reduction target, identified policies and measures (PAMS) account for 11% or 365 $MtCO_2eq$ reduction from the business-as-usual (BAU)/Reference Scenario. Of this total, the energy sector is expected to contribute 46 $MtCO_2eq$ (13% share of the total), which translates to a 1.4% reduction in the sector's GHG emission over the BAU. PAMS yet to be identified will account for 64% avoidance, thereby completing the target of 75% GHG.	UNFCC
Philippine Development Plan PDP 2023-2028	A plan framed by the new administration's 8-Point Socioeconomic Agenda which seeks to address both short-term issues and medium-term constraints to growth and inclusion.	NEDA
Philippine Energy Plan (PEP) 2020-2040 *Towards a Sustainable and Clean Energy Future*	The DOE's blueprint to secure the economy's energy future was created following regional consultations and information, education, and communication campaigns (IECs). This is a comprehensive energy blueprint supporting the government's long-term vision known as *AmBisyon Natin 2040*. PEP 2020-2040 is a transformational plan to bring in more of the clean energy fuels and technologies that will dominate the economy's portfolio of plans and programmes for the next two decades.	Department of Energy
Power Development Plan 2020-2040	This is a master plan that integrates all the development plans for the generation, transmission, distribution, and supply sectors in grid and off-grid areas. It also outlines the recent developments in the electricity market and in off-grid and missionary areas, household electrification, and institutional support mechanisms.	Department of Energy
Republic Act (RA) 9367 (Biofuels Act 2006)	Approved on 12 January 2007, this act directs the use of biofuels by establishing the biofuel programme and appropriating funds for the said programme and for other purposes.	Department of Energy
RA 9513 (Renewable Energy Act of 2008)	Approved on 16 December 2008, this act promotes the development, utilisation and commercialisation of renewable energy resources and for other purposes.	Department of Energy

Energy policy	Details	Reference
RA 11285 (Energy Efficiency and Conservation Act of 2019)	This act institutionalises EE and C, enhancing the efficient use of energy and granting incentives to energy efficiency and conservation projects. It facilitates the implementation of projects and programmes under the National Energy Efficiency and Conservation Plan (NEECP).	Department of Energy
RA 11234 (Energy Virtual One Stop Shop Act of 2019)	This act was established for the purpose of streamlining the permitting process of power generation, transmission, and distribution projects. An online platform was built to streamline the processing of energy-related applications.	Department of Energy
RA 11646 (Microgrid Systems Act)	An act that was promulgated to promote the use of microgrid systems to accelerate the total electrification of unserved and underserved areas in the Philippines. The Philippines Department of Energy will lead the implementation of the National Total Electrification Roadmap.	Department of Energy
RA 11697 (The Electric Vehicle Industry Development Act of 2022)	An act establishing the Comprehensive Roadmap for the Electric Vehicle (EV) Industry to accelerate the development, commercialisation and utilisation of EVs.	Department of Energy
National Renewable Energy Program (NREP)	The NREP outlines the policy framework stipulated in Republic Act 9513. The strategies set out in the Biofuels Act of 2006 form part of the implementation of the Renewable Energy Law, which is included in the NREP. A 20-year RE target capacity in addition to tripling the 2010 installed capacity from 5 440 MW to 15 300 MW by 2030.	Department of Energy
National Energy Efficiency and Conservation Plan (NEECP) 2023-2050	The NEECP is a comprehensive framework and plan that institutionalises energy efficiency and conservation in the Philippines across key sectors of the economy in accordance with the EE and C Act.	Department of Energy
RE Roadmap	This focuses on attaining the target of at least a 35% renewable energy share in the power generation mix by 2030 and 50% by 2040.	Department of Energy

Energy policy	Details	Reference
FiT Installation Target (MW)	Policy mechanism under RE Law • Run-off river hydro (250 MW). • Biomass (250 MW). • Wind (400 MW). • Solar PV (500 MW). • Ocean (10 MW).	Department of Energy
Biofuels Roadmap	The aim is to continue the implementation of blending targets set in the Biofuels Act of 2006, with the following measures from 2020 to 2040: • Implement a 5% biodiesel blend (B5) and maintain 10% ethanol (E10). • Revisit the biofuel blend requirements and available feedstock. • Implement Research and Development (R&D) activities and demonstration projects using Jatropha, waste cooking oil, microalgae, rubber and seed oil for biodiesel; and sweet sorghum, cassava, microalgae, Nipa sap, and cellulosic material for bioethanol.	Department of Energy
Power Generation Roadmap	Short-term goals (2021–2022): • Implement the coal moratorium. • Establish guidelines for power plant decommissioning. • Firm up the privatisation plan for the government's remaining power generation assets. Long-term goals (2023-2040): • Utilize cleaner technologies for power generation. • Increase flexibility in power generation.	Department of Energy
Off-Grid Development Roadmap	Energy access for all by 2040 • Graduation and rationalisation of the Universal Charge-Missionary Electrification (UC-ME) subsidies in off-grid areas, while the "electricity access for all by 2040" is the objective of the Total Electrification Program (TEP).	Department of Energy
Alternative Fuels and Energy Technologies (AFET) Roadmap	This roadmap lays down the framework for the adoption and commercialisation of emerging and efficient energy technologies in the economy. Medium-term goal (2020-2022): • Identification of AFETs for application. Long-term goal (2023–2040): • Preparation of the regulatory and infrastructure requirements of the identified AFETs.	Department of Energy
Upstream Oil and Gas Roadmap	This roadmap focuses on attaining the following objectives by 2040: • Increase indigenous petroleum reserves to 116 million barrels oil and 5.9 TCF gas. • Produce 66 million barrels crude oil and 3.5 TCF natural gas.	Department of Energy

Energy policy	Details	Reference
Upstream Coal Roadmap	Targets the increase of delineated mineable coal reserves up to 766 million tonnes by the end of 2040 with additional reserves of 65 million tonnes in the medium term and 223 million tonnes in the long term.	Department of Energy
Downstream Oil Roadmap	Improved policy governing the downstream oil industry to ensure a continuous supply of high quality and the right quantity of petroleum products in the market by 2040.	Department of Energy
Downstream Natural Gas Roadmap	To establish a world-class, investment-driven, and efficient natural gas industry that makes natural gas the preferred fuel by all end-use sectors by 2040.	Department of Energy
Energy Efficiency and Conservation Roadmap	Measurable reduction in energy intensity and consumption per year versus BAU by 2040: • Medium-term and long-term framework focusing on two priority areas, namely, the Strengthening and Sustaining of EE and C policies and initiatives.	Department of Energy
Executive Order (EO) 116	Establishes the NEP-IAC, an inter-agency task force led by the DOE which is tasked to conduct a study for the adoption of the economy position on Nuclear Power Plant (NPP) in accordance with pertinent International Atomic Energy Agency (IAEA) guidelines, relevant laws, rules and regulations.	Department of Energy
DC2018-01-0001	Adoption of Energy Resiliency in the Planning and Programming of the Energy Sector to Mitigate Potential Impacts of Disasters	Department of Energy
DC2020-11-0024	Adopting the Guidelines Governing the 3rd Open and Competitive Selection Process (OCSP3) in the award of the Renewable Energy Service Contract, and for other purposes	Department of Energy
DC2022-02-0002	Prescribing the Policies and Programs to Promote and Enhance the Development of Biomass Waste-to-Energy (WTE) Facilities	Department of Energy
DC2022-06-0028	Supplementing DC 2018-01-0001 on the Energy Resiliency Planning and Programming of the Energy Sector to Mitigate Potential Impacts of Disasters	Department of Energy

Notable Energy Developments

The Philippines EWG representative reported the following at EWG 66 hosted by Thailand on 28-29 November 2023.

Energy development	Details	Reference
Natural Gas as a Transition Fuel and Recognised to Aid in the Gradual Shift from Traditional Coal to Cleaner Sources of Energy	Two receiving and regasification facilities for imported liquefied natural gas recently went into commercial operation in the Philippines. These facilities will support the five existing gas-powered plants and aid in the energy transition plans of the government for cleaner energy.	Department of Energy
Additional Strategic Investment to Strengthen the Philippines' Renewable Energy Sector	The President of the Philippines inaugurated the largest wind farm, which is situated in the northern part of the economy. It is a 160 MW onshore wind farm with USD 200 million worth of investment. Likewise, the Philippines Department of Energy has awarded six Solar Energy Operating Contracts with a combined capacity of 610.5 MW for the construction of large-scale floating solar projects in Laguna Lake.	Department of Energy
Formulation of the Smart and Green Grid Plan	The Philippines Department of Energy formulated the Smart and Green Grid Plan (SGGP), which will assist the DOE in making policy decisions, enhance technical competencies, identify policy gaps and challenges, as well as recommend appropriate solutions through policy development and government interventions. The SGGP aims to complement the 2023-2050 Philippine Energy Plan encapsulating the strategic plans and programmes of the government geared towards the holistic development of the transmission sector in the near-term horizon and beyond.	Department of Energy

Useful links

Asian Development Bank – www.adb.org

Climate Change Commission (CCC) – www.climate.gov.ph

Department of Energy, Republic of the Philippines (DOE) – www.doe.gov.ph

Department of Science and Technology (DOST) – www.dost.gov.ph/

Department of Trade and Industry (DTI) – www.dti.gov.ph/

Department of Transportation (DOTr) – www.dotr.gov.ph

Independent Electricity Market Operator of the Philippines (IEMOP) – www.iemop.ph

National Power Corporation (NPC) – www.napocor.gov.ph

National Transmission Corporation (TransCO) – www.transco.ph

Philippine National Oil Company (PNOC) – www.pnoc.com.ph

Philippine Electricity Market Corporation (PEMC) – www.wesm.ph

World Bank – https://www.worldbank.org/en/country/philippines

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– (2022). Philippine Energy Situationer and Key Energy Statistics, https://www.doe.gov.ph/energy-statistics?q=energy-statistics/2021-energy-supply-and-demand-situationer.

– (2022). Energy Sector Accomplishment Report 2016-2022. https://www.doe.gov.ph/esar

– (2023). Philippine Energy Plan 2020-2040: *Towards Sustainable and Clean Energy Future.* https://www.doe.gov.ph/pep

EGEDA (Expert Group on Energy Data Analysis, APEC Energy Working Group) (2022), *APEC Energy Database.* https://www.egeda.ewg.apec.org/egeda/database_info/index.html

NEDA (National Economic and Development Authority) (2023). Philippine Development Plan 2023-2028. https://neda.gov.ph/philippine-development-plan-2023-2028/

WB (World Bank) (2024). https://databank.worldbank.org/source/world-development-indicators.

Russia

Introduction

Russia has the largest land area globally, spanning more than 17 million square kilometres in both Eastern Europe and Northern Asia. The combination of geography and population settlement in Russia makes it necessary for the economy to use a significant amount of energy to provide comfortable living conditions for most of the population for most of the year, which is one of the critical factors contributing to the economy having the highest energy intensity of GDP among APEC economies.

These factors have determined the development in Russia of not only centralised power supply systems but also of centralised heat supply systems, which, in turn, has led to the widespread development of thermal power plants with combined heat and power generation. Now Russia has the world's largest district heat supply systems in most major cities.

Its population of 146 million people lives mostly in urban areas (74%), and 68% of the population lives in the European part of Russia, which accounts for 21% of the territory.

In 2021, Russia's GDP grew by more than 5% to 4 112 billion 2017 USD PPP due to the economy's gradual recovery after the COVID-19 pandemic. GDP remained the 4th largest in APEC. Russia's GDP per capita grew by more than 5%, similar to GDP growth.

Russia remained the third-largest energy producer in APEC. More than half of this energy was consumed within the economy, while the rest was exported. Russia was the world's largest energy exporter overall, exporting about 28 EJ in 2021.

Russia was the third-largest power producer in APEC, accounting for 6.2% of APEC's total electricity generation in 2021, and the largest heat producer.

Russia has significant reserves of fossil fuels and uranium.

Table 1: Russia macroeconomic data and energy reserves

Key data [a, b]		Energy reserves [c, d]	
Area (million km^2)	17.1	Oil (billion barrels)	108
Population (million)	146.4	Gas (trillion cubic feet)	1 321
GDP (2017 USD billion PPP)	4 112	Coal (million tonnes)	162 166
GDP per capita (2017 USD PPP)	28 668	Uranium (kilotonnes U < USD 130/kgU)	206

Source: a ROSSTAT (2023); b World Bank (2023); c Energy Institute (2023); d UN (2023)

Note: Reserves are total proved reserves and reasonably assured recoverable resources for uranium.

Energy Supply and Consumption

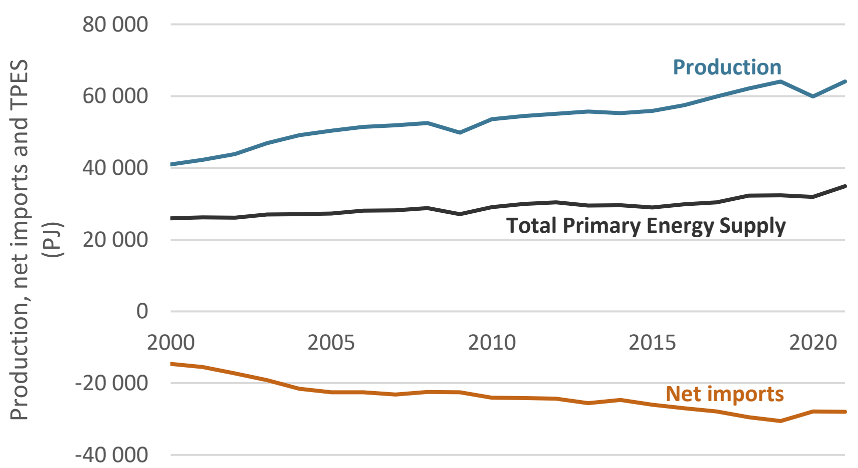
Total primary energy supply

Russia is the third-largest energy producer in both APEC and the world, after China and the US. Russia's total primary energy supply (TPES) in 2021 was 34 886 PJ, a 10% increase compared to 2020 levels.

Energy production has grown consistently since 2000 with a compound annual growth rate (CAGR) of 2.4%. The only year of decline for the period was in 2009 due to lower domestic consumption. In 2020, production declined more than 6%, and in 2021, it rebounded to 2019 levels due to a recovery in demand mostly on domestic markets.

Net exports grew at a much higher rate than production, with a CAGR of 3.9% from 2000 to 2019, but declined by nearly 9% in 2020. In 2021, net exports remained similar to 2020 levels.

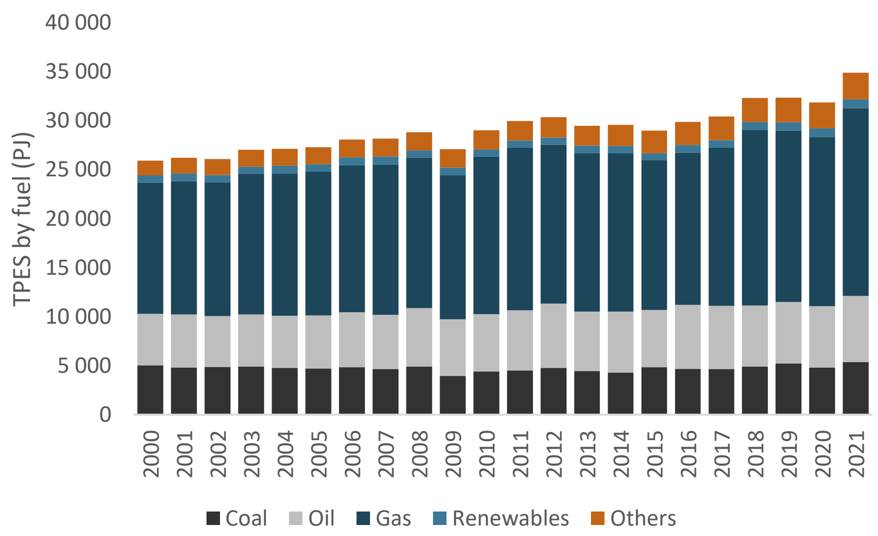
Figure 1: Russia's energy supply, production, and net imports (PJ), 2000 to 2021



Source: EGEDA (2023)

Russia's TPES fuel mix was virtually unchanged for 2000-2021; natural gas accounted for more than half, with a slight decrease in the share of coal. In 2021, the TPES fuel mix comprised the following: natural gas (55%), crude oil and petroleum products (19%), coal (15%) and renewables and others, including nuclear and hydro (11%). For the 2000-2019 period, TPES volumes of coal remained stable; oil increased by 19%, others, including nuclear and hydro, increased by 67%, and renewables increased by 10%, while the volume of gas increased by 31% or over 4 000 PJ. In 2021, TPES increased by more than 9% due to increased generation from gas-fired power plants.

Figure 2: Russia's energy supply by fuel (PJ), 2000 to 2021

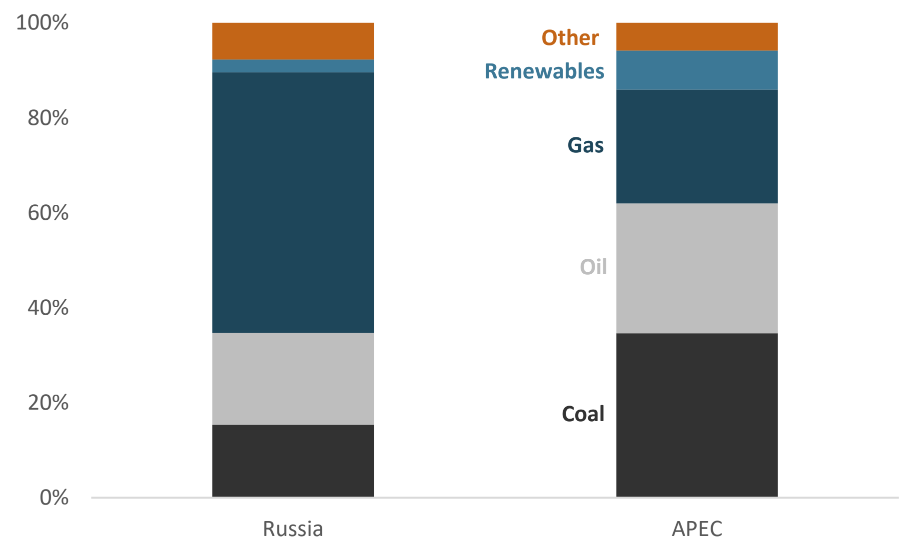


Source: EGEDA (2023)

Russia's TPES fuel mix is substantially different from the entire APEC region. The share of natural gas in Russia is more than twice as high, which is explained by its large natural gas reserves and the predominance of gas-fired power plants, which account for more than 70% of the electricity produced by thermal power plants.

Gas consumption is distributed unevenly across the regions, as the developed network of distribution pipelines is concentrated in the western part of the economy. In contrast, the shares of coal and renewables in Russia are less than half of APEC's. The modest share of renewables in electricity generation is due to the uneven distribution of renewable energy sources, a large share of which is concentrated in remote areas, and limited government support for new projects.

Figure 3: Energy supply mix – Russia and APEC, 2021



Source: EGEDA (2023)

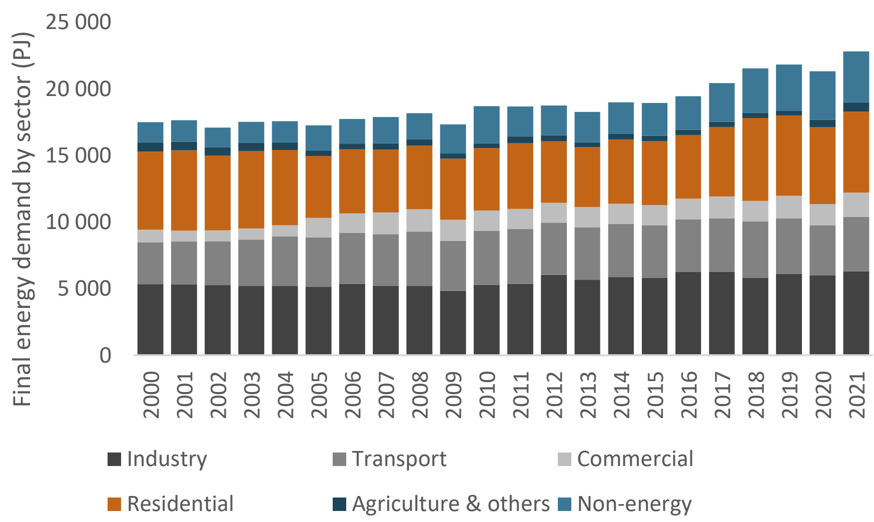
Total final consumption

Russia's final consumption in 2021 was 22 800 PJ, almost 7% higher than in 2020. Russia remained the third-largest energy consumer in APEC after China and the US.

The industrial (6 309 PJ, 28%) and the residential sector (6 085 PJ, 27%) accounted for the two most significant shares of final energy consumption. Energy consumption in industry grew by 5% compared to 2020 levels and exceeded 2019 levels by 3%. In residential buildings, consumption slightly increased largely due to seasonal factors. One of the main reasons residential buildings is the largest consuming sector is the significant energy consumption for heating for more than half of the year. According to EGEDA, consumption in buildings began to increase significantly from 2017. This notable increase was due to the rise in gas consumption in residential buildings, which does not correspond to the member economy statistics. The third-largest sector was transport (4 090 PJ, 18%). Energy consumption in the transport sector grew by 8% but hasn't exceeded pre-pandemic levels.

Non-energy use has more than doubled since 2000, accounting for 17% of Russia's energy use in 2021. Agriculture and the commercial sector accounted for the remaining 11%.

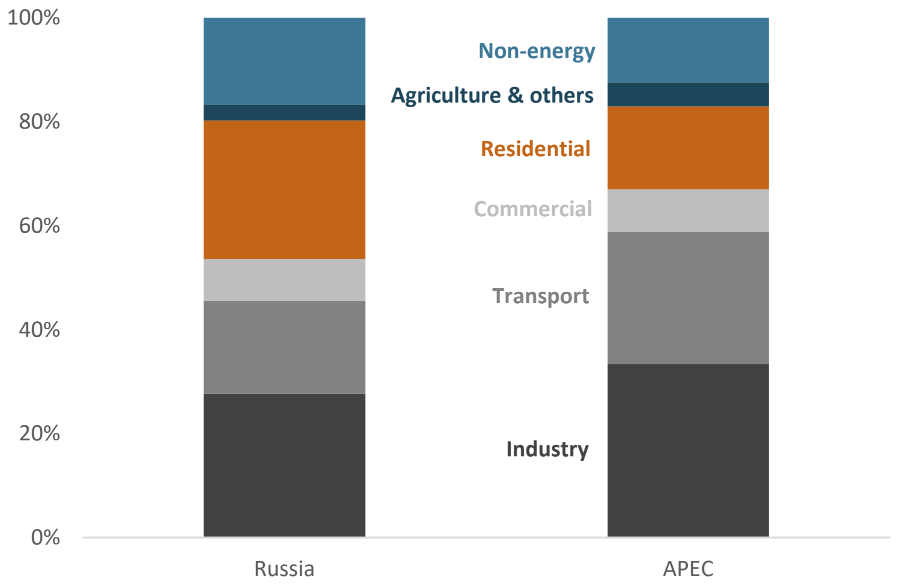
Figure 4: Russia's final consumption by sector (PJ), 2000 to 2021



Source: EGEDA (2023)

Russia, like APEC, has the same major consumer sectors: industry, transport and residential. Their overall share is almost the same, accounting for about three-quarters of total consumption. However, the fraction of each sector is different in Russia and APEC. The share of the residential sector in Russia is much higher than in APEC due to its significant heat consumption, while the share of industry and transport is lower. The non-energy use share is higher than in APEC due to the considerable consumption of petroleum products and natural gas as a feedstock in the chemical industry.

Figure 5: Final consumption by sector, Russia and APEC, 2021

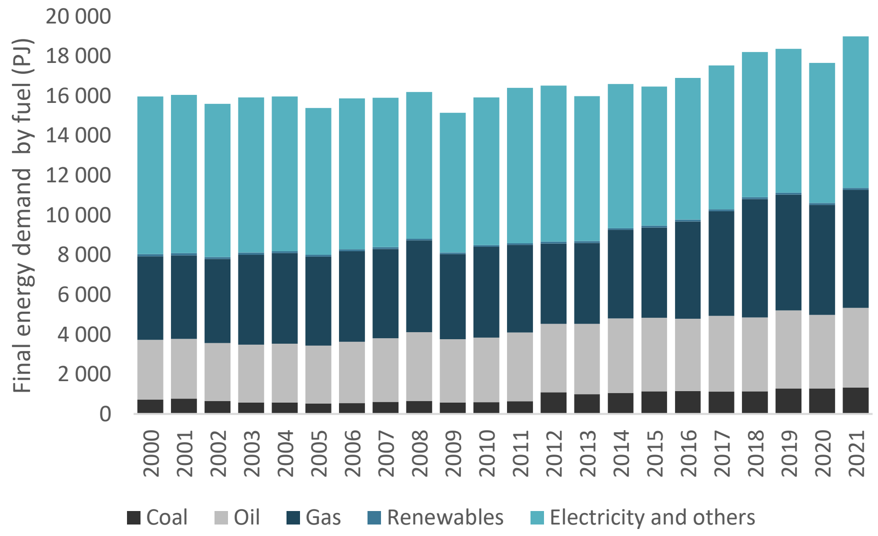


Source: EGEDA (2023)

Final energy demand

Russia's final energy consumption in 2021 was 18 991 PJ, almost 8% higher than in 2020. About 40% of the final energy consumption in 2021 was supplied by electricity and heat, the share of which decreased by 10% compared to 2000 due to a significant decrease in heat consumption. Correspondingly, the share of fossil fuels increased from 50% in 2000 to 59% in 2021. Natural gas accounts for more than half of the consumption of fossil fuels, and oil and petroleum products for slightly more than a third. Despite a slight increase in consumption, the share of coal is gradually decreasing. According to EGEDA, gas consumption has started to increase significantly since 2017. EGEDA reports a significant increase in gas consumption starting in 2017, which is attributed to increased gas use in residential buildings. Russia's official statistics do not report any significant increase in gas consumption over this period.

Figure 6: Russia's final energy demand by fuel (PJ), 2000 to 2021

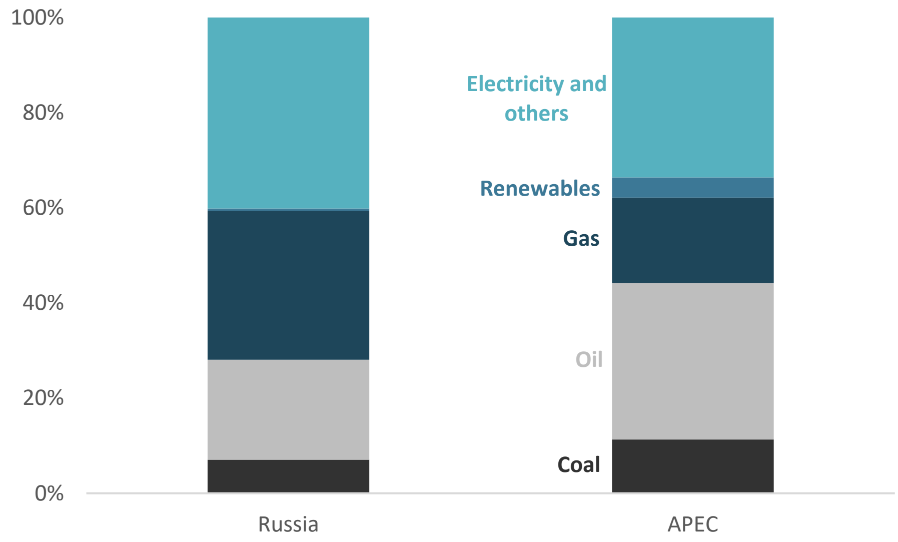


Source: EGEDA (2023)

Note: Does not include non-energy sector consumption of energy products.

In Russia, fossil fuels accounted for almost 60% of final energy consumption in 2021, 2% less than the APEC total. Electricity and heat accounted for about 40%. In the APEC region, the share of electricity (and to a much lesser extent heat) was almost a third.

Figure 7: Final energy demand fuel share, Russia and APEC, 2021



Source: EGEDA (2023)

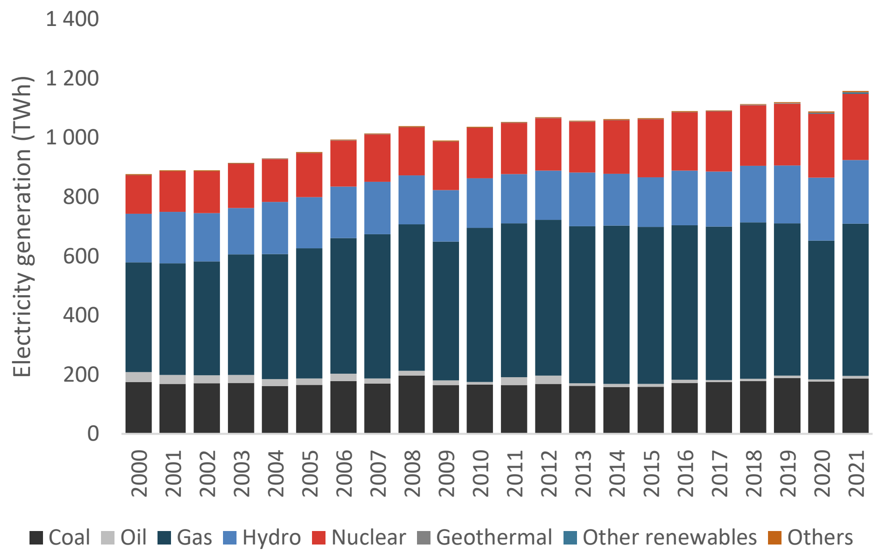
Transformation

Power sector

Electricity generation has grown consistently since 2000 (with a few exceptions) with a CAGR of 1.3%. In 2020, Russia generated almost 3% less than the previous year. In 2021 electricity generation exceeded pre-pandemic levels by 6% to 1 158 TWh. Fossil fuels accounted for the largest share of this generation (61%), of which natural gas contributed more than 70%. The remaining 40% of electricity generation came from hydropower and nuclear power in roughly equal shares.

Electricity generation at gas-fired power plants reached 2019 levels and accounted for two-thirds of the increase in electricity generation in 2021.

Figure 8: Russia’s electricity generation by fuel, 2000 to 2021



Source: EGEDA (2023)

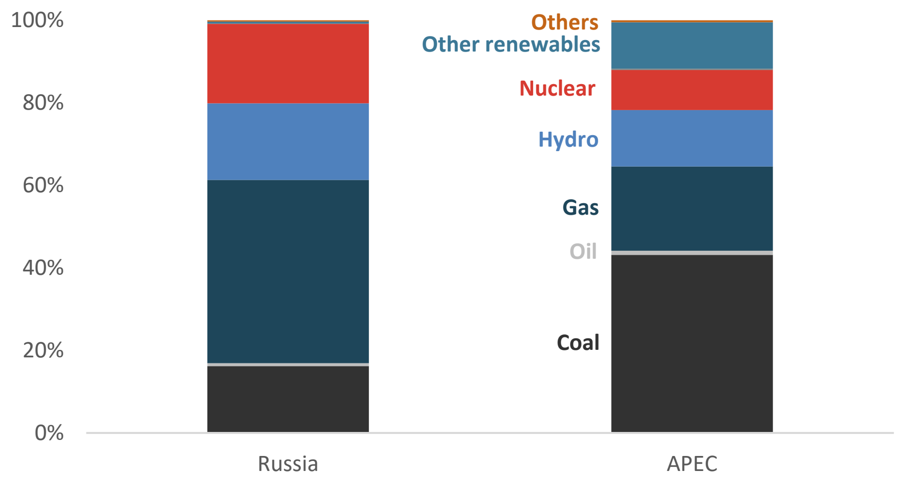
The fuel mix for power generation in Russia and the APEC region is quite similar in terms of the shares of fossil and non-fossil fuels. In Russia, fossil fuels comprise 61% of the generation mix, and in APEC, they account for 65%. However, the fossil fuels with the largest share in Russia and APEC differ. Natural gas accounts for a much larger share

(44%) in Russia, while coal accounts for a much larger share (43%) in APEC.

The share of hydro is also different, amounting to 19% in Russia and 14% in APEC. Nuclear energy in Russia accounts for 19%, more than twice as much as in APEC.

Russia lags far behind in solar and wind power generation in relation to the APEC-wide region. In APEC, the share of other renewables (primarily solar and wind) in 2021 exceeded 11%, while that share is lower than 1% in Russia.

Figure 9: Electricity generation fuel share, Russia and APEC, 2021



Source: EGEDA (2023)

Refining

Oil refinery capacity in Russia in 2021 was about 6.9 million barrels per day (Energy Institute, 2023), which is the third highest in the world after the US and China. In 2021, 54% of all produced oil was refined domestically (EGEDA, 2023). Diesel fuel (30%), fuel oil (18%), motor gasoline (15%) and naphtha (10%) dominated in the petroleum product output mix. More than half of the top three refined products by volume are exported. The share of fuel oil exports in 2021 was 90%, naphtha – 68%, and diesel – 47%.

Energy transition

The presidential decree On Reducing Greenhouse Gas Emissions, adopted in November 2020 led to significant activity. It instructed the government of the Russian Federation to develop a Strategy for Socio-Economic Development of the Russian Federation with Low Greenhouse Gas Emissions until 2050.

The Strategy of Socio-Economic Development of the Russian Federation with Low Greenhouse Gas Emissions up to 2050 was approved at the end of October 2021, just before the COP26 summit. The strategy recognises the development of nuclear power generation and the expansion of the Agriculture, Forestry and Other Land Use (AFOLU) absorption capacity as the most significant contributors to the reduction of greenhouse gas net emissions. From the point of view of the global community, both areas seem insufficient to reduce Russia's contribution to greenhouse gas emissions. Nevertheless, even these statements demonstrate significant progress in understanding the problem and finding feasible ways to reduce greenhouse gas emissions. Currently, this strategy is the only document concerning strategic development until 2050 in the Russian Federation.

In 2021, essential documents were adopted that set the contours of the development of energy subsectors that promote decarbonisation: the Federal Law – On Limiting Greenhouse Gas Emissions (July 2021), The concept of the development of hydrogen energy in the Russian

Federation until 2035 (August 2021), The concept for the development of production and use of electric vehicles in the Russian Federation until 2030 (August 2021).

The Federal Law, On Limiting Greenhouse Gas Emissions, provides the introduction of a staged model for regulating such emissions. This includes the introduction of mandatory carbon reporting, collected and summarised by the authorised government body.

The document also introduces the notion of a greenhouse gas emission reduction target. Set by the government on the scale of the Russian economy, the target will take into account the AFOLU and the need to ensure sustainable and balanced socio-economic development. The law proposes the creation of a roster of greenhouse gas emissions. This roster will be the state information system, which the authorised federal executive body will maintain.

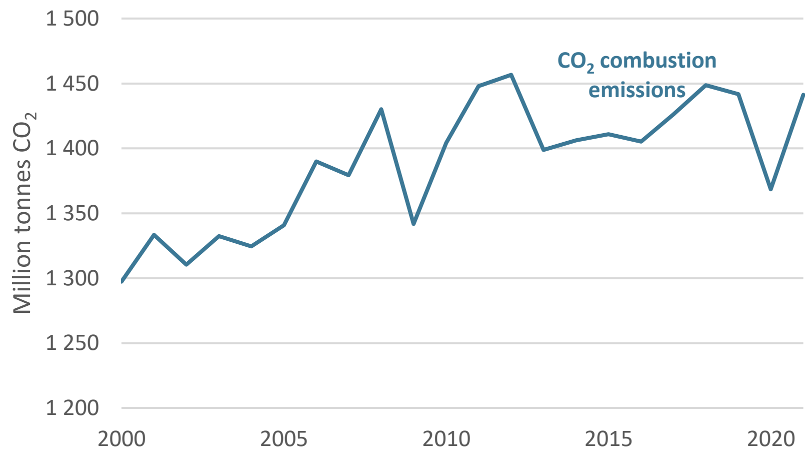
The Climate Doctrine of the Russian Federation was adopted in October 2023 by the presidential decree. The document notes Russia's significant contribution to achieving the United Nations Framework Convention on Climate Change goals. Within the framework of long-term socio-economic development of the Russian Federation, it is envisaged to achieve, considering domestic interests and development priorities, a balance between anthropogenic greenhouse gas emissions and their absorption no later than 2060. To achieve this goal, additional measures have been identified to decarbonise economic sectors and increase the absorption capacity of managed ecosystems. Implementation of these measures will make it possible to ensure that by 2030 the volume of greenhouse gas emissions will be at the level of 1 673 million tonnes of CO_2 equivalent (54% of the 1990 level). Russia's goal is to decrease CO_2 emissions by 20 million tonnes by 2035 and to achieve a balance between anthropogenic greenhouse gas emissions and their absorption no later than 2060.

Emissions

CO_2 combustion emissions have increased steadily since 2000 due to economic growth and development after the recession of the 1990s. The decrease in emissions, particularly in 2009 and 2020, reflects the decline in economic activity during economic crises.

After a significant decrease in 2013, the level of emissions has remained at about the same level for four years. This notable increase in 2017-2018 was mainly due to the rise in gas consumption in residential buildings, which does not correspond to the domestic statistics. The goal is to decrease CO_2 emissions by 20 million tons by 2035. Moreover, according to the Low Carbon Social and Economic Development Strategy of the Russian Federation to 2050 Russia's net GHG emission must be reduced by 80% from the 1990 level and by 60% from the 2019 level in 2050

Figure 10: Russia's CO_2 combustion emissions (million tonnes), 2000 to 2021



Source: EGEDA (2023)

Energy security

In 2019, the Doctrine of Energy Security of the Russian Federation was adopted by decree of the President of the Russian Federation. According to the Doctrine, Russia, as a major exporter of energy resources, seeks on the one hand, to provide a reliable supply of energy to consumers within the economy, and on the other hand, to ensure energy supplies to the world market.

The Doctrine refers to the following as external challenges to energy security: shifting the centre of global economic growth to the Asia-Pacific region; a slowdown in global demand for energy resources and a change in its mix, including the replacement of petroleum products by other types of energy resources and the development of energy saving and energy efficiency; an increase in the world resource base of hydrocarbons; increased competition among energy exporters; changes in the international regulatory framework in the energy sector and conditions of the world energy markets, strengthening the position of consumers; the growth of LNG production and its share on the world energy markets; the formation of a global natural gas market; an increase in the share of renewable energy sources in the global energy balance, and in general increased international efforts to implement climate policy and accelerate the transition to a green economy.

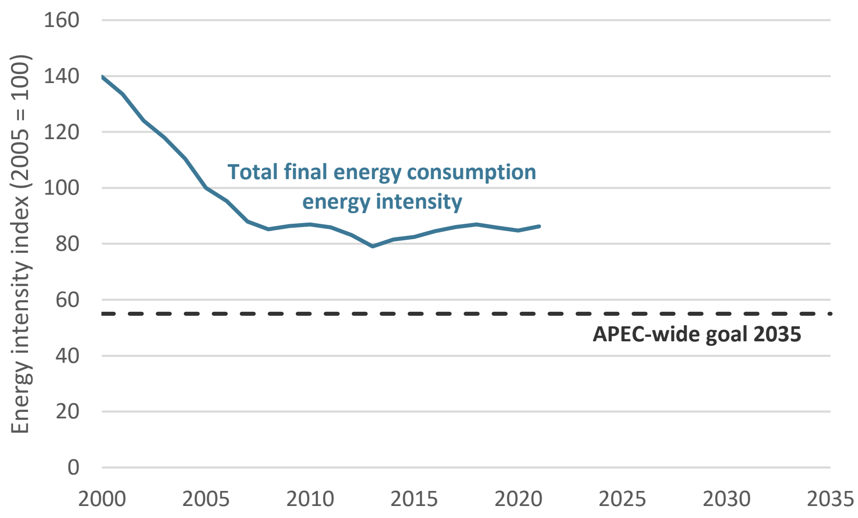
APEC Energy Goals

There are two energy-related objectives that APEC member economies have agreed to meet as a collective: to improve energy intensity and double the share of modern renewables.

Energy intensity goal

In 2011, APEC member economies agreed to increase their ambition to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline. APEC is on track to achieve this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement. As the northernmost economy in the APEC region with vast Arctic territories (28% of its land area), Russia is the most energy-intensive economy in the APEC region. However, improvements are taking place. In 2020, Russia's total final energy consumption (excluding non-energy) intensity improved by 14% compared to that in 2005.

Figure 11: Russia's total final energy consumption intensity index, 2000 to 2021 (2005 = 100)

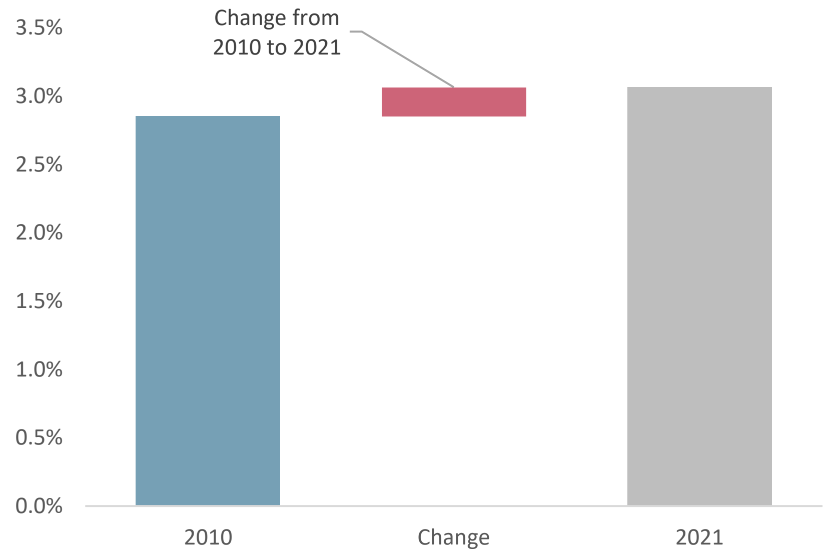


Source: EGEDA (2023)

Doubling of renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period 2010 to 2030. There is no economy-level goal for individual member economies, but improvements by individual economies will contribute to the doubling goal. Russia's share of modern renewables to final energy consumption in 2010 was 2.9%. In 2021, this share increased to 3.1%, as shown in Figure 12. This slight increase highlights the complexities of expanding renewables in Russia. As a result of competition, over the past 8 years, prices for electricity from renewable energy generation facilities have decreased by 85% for wind power plants and by 87% for solar power plants and are closer to global analogues.

Figure 12: Russia's modern renewable energy share, 2010 and 2021

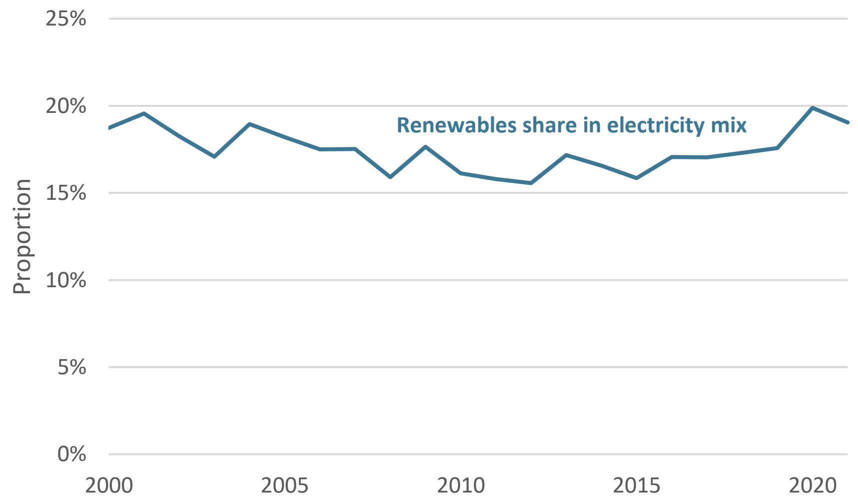


Source: EGEDA (2023)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

The share of electricity generated by renewable energy sources in 2000-2021 averaged 17-18%. Large hydropower plants (HPPs) generate almost all electricity. In this regard, changes in the share of HPPs in some years are associated with low-water periods. The share of generation by solar and wind power plants is less than 1%. The modest share of renewables in electricity generation is due to the uneven distribution of renewable energy sources, a large share of which is concentrated in remote areas, and limited government support for new projects.

Figure 13: Russia's renewable generation share, 2000 to 2021



Source: EGEDA (2023)

However, large shares of Russia's electricity generation is carbon-free, with 20% of electricity from nuclear power plants, 20% from hydropower, and 2% from modern renewable sources.

Energy Policy

Energy policy	Details	Reference
Export of energy resources	Russia's Energy Strategy 2035, adopted in 2020, assumes an increase in energy exports by 9-15% by 2024 compared to 2018.	Ministry of Energy
LNG production	Planned increase on liquefaction capacity to 46-65 mtpa by 2024 and 80-140 mtpa by 2035 (2.4-3.4 times growth to 2018 level); development of x (or x mtpa) small-scale LNG plants.	Ministry of Energy
LNG exports	The Russian Government intends to ease restrictions on exports of LNG and allow new companies to export on their own, unlike exports of pipeline gas, where Gazprom is a monopoly.	Ministry of Energy
Gas processing	Russia's Energy Strategy 2035 assumes the share of processed natural gas liquids (NGLs) will increase to 30% by 2024 and to 35% by 2030.	Ministry of Energy
Hydrogen exports	Start hydrogen exports up to 0.2 mtpa by 2024, 2-12 mtpa by 2035, 15-50 mtpa by 2050.	The Russian Government
Oil production	Russia's Energy Strategy 2035 assumes that oil production by 2024 will remain at the current level of 11.6-11.7 million bpd, with a possible reduction to 10.2 by 2035.	Ministry of Energy
Gas consumption in the transport sector	Russia's Energy Strategy 2035 assumes an increase of gas consumption in the transport sector to 2.7 bcm by 2024 and to 10-13 bcm by 2035.	Ministry of Energy
Use of associated gas	Russia's Energy Strategy 2035 assumes the use of associated gas will increase to 90% by 2024 and 95% by 2035.	Ministry of Energy
Own use in gas pipelines	Russia's Energy Strategy 2035 assumes a reduction of unit consumption of energy as own use in gas pipelines of 12% by 2024 and 17% by 2035, with respect to the 2018 level.	Ministry of Energy
Thermal efficiency in the power sector	Russia's Energy Strategy 2035 assumes an increase of the thermal efficiency in the power sector to 43% by 2024 and 48% by 2035.	Ministry of Energy
Share of regions with access to the domestic gas transportation system	Russia's Energy Strategy 2035 assumes an increase in the share of regions with access to the domestic gas transportation system to 75% by 2024 and 83% by 2035.	Ministry of Energy
Russia's Energy Security Doctrine	Energy security is the foundation of domestic and economic security. Russia employs a multi-level approach to ensuring energy security, based on a balance of interests and risk minimization. Through government regulation, legislative, and other measures designed to achieve strategic goals: ensuring uninterrupted energy supply, fulfilling export contracts, and meeting international obligations. The Doctrine's principles are legality, priority of the domestic market, stability of the regulatory framework, resource, financial, and personnel security of the fuel and energy complex, rational	Ministry of Energy

Energy policy	Details	Reference
	resource management and energy efficiency, public-private partnership, consideration of the interests of all stakeholders and the population, integration into international security systems, environmental safety requirements, and the continuity of the energy security process. Key initiatives include improving energy security governance, maintaining the mineral and raw material base of the fuel and energy complex and the main production facilities of fuel and energy organizations at a level necessary to ensure energy security. The Doctrine envisions international legal protection of the interests of Russian fuel and energy organizations and power engineering, support for the export of their products, technologies, and services. Planned import substitution in critically important areas of activity for the sustainable functioning of the fuel and energy complex, including the localization of production of foreign equipment or the creation of its domestic analogues, the development of technologies (including information and communication technologies) and software. One of the strategic tasks is ensuring the technological independence of the Russian fuel and energy complex. Russia is carrying out targeted activities to implement new approaches to the development of low-carbon energy throughout the entire life cycle in the field of nuclear power generation, hydrogen energy, renewable energy sources, and energy storage systems, using new domestic breakthrough high-tech solutions for the entire technological chain of production and use of energy resources, meeting the requirements of economy, environmental friendliness, and reliability at the same time. Such solutions in the global space determine not only the level of competitiveness and technological independence, as one of the strategic positions in ensuring an acceptable level of energy security, but also play a key role in shaping the basis for the energy of the future. In the modern manifestations of new challenges and rapidly transforming hybrid threats in the aggravated period of geopolitical relations, the priority activity of the Russian Federation is aimed at protecting domestic priorities, preserving sustainable economic development, and the quality of life of the domestic population. To ensure timely response: to energy security challenges and threats, operational response to trends in their changes, monitoring of external and internal threats and risks in the field of energy security is carried out, including the development of pre-emptive measures to minimize possible damage associated with existing and potential threats, continuous assessment of the impact on ongoing changes, revision of the focus of measures and the choice of the most effective ways to manage energy security in accordance with the updated tasks of the strategic directions of development of the energy sector of the Russian Federation. Energy security risk management is carried out within the framework of the energy policy of the Russian Federation.	
Greenhouse gases emission level	Russia's NDC proposes reducing GHG emissions to 70% by 2030 from the 1990 baseline. The NDC level of emissions was approved by presidential decree in November 2020.	Presidential Decree

Energy policy	Details	Reference
Carbon Neutrality Commitment	After the approval of the low-carbon development strategy, the President of Russia announced that Russia will achieve carbon neutrality by 2060.	The Russian Government
Limiting Greenhouse Gas Emissions	The Federal Law, On Limiting Greenhouse Gas Emissions, provides the introduction of a staged model for regulating such emissions. This model includes the introduction of mandatory carbon reporting, collected and summarised by the authorised government body. Subject to regulation will be the largest emitters of greenhouse gases with a mass equivalent of 150 000 tonnes of CO_2 per year or more for the period until 1 January 2024. Such companies will have to report starting on 1 January 2023. Those who produce 50 000 tons of CO_2 per year or more are subject to regulation from 1 January 2024. They will have to submit reports on greenhouse gas emissions on 1 January 2025. The document also introduces the notion of a greenhouse gas emission reduction target. Set by the government on the scale of the Russian economy, the target will take into account the AFOLU and the need to ensure sustainable and balanced socio-economic development. The law proposes the creation of a roster of greenhouse gas emissions. This roster will be the state information system, which the authorised federal executive body will maintain.	Federal Law
Development of electric transport	The Concept for the Development of Production and Use of Electric Vehicles in the Russian Federation until 2030 provides three scenarios for the development of electric transport until 2030. The target scenario proposes an increase in production of electric vehicles to 217 000 units (100 times) by 2030, an increase in the share of electric vehicles in the overall vehicle fleet to 15%, and an increase in the number of charging stations to more than 14 000 units (eight times).	The Russian Government
Increase renewable energy sources	Russia plans to increase the level of renewable energy sources by 2030, not counting large hydroelectric power plants, to 12.1 GW, Specifically, doubling the existing indicator, and in the longer term, by 2050, to achieve even more intensive growth in this segment - up to 9% in the generation structure or 67 GW.	Ministry of Energy

Notable Energy Developments

Energy development	Details	Reference

Arctic LNG-2	The project includes the construction of three LNG trains, with a capacity of 6.6 mtpa of LNG each. The total LNG capacity of the three trains will be 19.8 mtpa. Arctic LNG is currently under construction. Arctic LNG 2's first train built on a concrete gravity-based floating foundation was towed to the western shore of the Gydan Peninsula in summer 2023 and is set to produce the first LNG in the first quarter of 2024. It is expected to reach full capacity by 2025.	Novatek
Gazprom LNG Portovaya	In September 2022, an LNG plant with a capacity of 1.5 million tonnes per year was put into operation near the Portovaya compressor station. The plant consists of two trains.	Gazprom
Increase in the capacity of oil pipeline system East Siberia Pacific Ocean	The capacity of the pipeline part of the ESPO oil pipeline system was increased by 4% in 2022. The capacity of the Kozmino oil port was increased from 36 to 43 million tons per year.	Transneft
Power of Siberia	Gas supplies began on 2 December 2019. Design capacity of 38 billion cubic metres of natural gas exports to China will be reached by 2025. At the end of 2022, the Kovykta gas-condensate field was connected to the gas pipeline system. In 2023, gas supplies amounted to about 23 bcm.	Gazprom
Power of Siberia 2	Gazprom continues surveys for the route of the new Power of Siberia 2 pipeline, which will make it possible to supply gas from the Yamal Peninsula fields to China via Mongolia with a planned export capacity of about 50 bcm per year. The feasibility study for the construction of the pipeline section that will pass through Mongolia, which is named Soyuz Vostok, was completed in January 2022.	Gazprom
The Sakhalin Experiment	A set of measures to achieve hydrocarbon neutrality in the Sakhalin region, including: 1. stimulation and implementation of technologies to reduce greenhouse gas emissions and increase their absorption 2. formation of an independent verification system 3. creation of a system for the circulation of hydrocarbon units and quota fulfilment units. As part of the experiment, the first greenhouse gas emission quotas in Russia were established, Emitters who exceed the quotas will be charged one thousand RUB per ton of CO_2-equivalent, This experiment will facilitate achievement of carbon neutrality in the constituent entities of the Russian Federation and on an economy scale, and contribute to achieving the goals of the Strategy for the long-term development of the Russian Federation with low greenhouse gas emissions until 2050.	

Useful links

Ministry of Energy of the Russian Federation – http://minenergo.gov.ru/en

Ministry of Natural Resources and Environment of the Russian Federation – https://www.mnr.gov.ru/en/

Ministry of Economic Development of the Russian Federation – https://en.economy.gov.ru

Federal State Statistics Service of the Russian Federation – https://eng.gks.ru

Ministry of Industry and Trade of the Russian Federation – https://minpromtorg.gov.ru/en/

Federal Customs Service – https://eng.customs.gov.ru

Federal Tariff Service – http://www.fstrf.ru/eng

AtomEnergoProm – http://atomenergoprom.ru/en/

Rosseti, Public Joint Stock Company (PJSC ROSSETI) – http://www.rosseti.ru/eng/

Association NP Market Council – http://www.en.np-sr.ru/index.htm

Gazprom – http://www.gazprom.com/

Rosneft – https://www.rosneft.com/

RusHydro – http://www.eng.rushydro.ru/

Transneft – http://www.en.transneft.ru/

Central Dispatching Department of Energy Sector – http://www.cdu.ru/en/

Singapore

Introduction

Singapore continues to excel across all elements of the energy triangle (economic development and growth, environmental sustainability, and energy security and access indicators) based on the latest assessment by the World Economic Forum (WEF), reflecting Singapore's robust existing energy systems and growing readiness to energy transition. Continuing to be at the forefront of Asia Pacific's energy transition, Singapore, in collaboration with the International Energy Agency (IEA), is to establish an IEA Regional Cooperation Centre that is expected to be operational in the second half of 2024. The Centre will provide various services from policy guidance to capacity building for Southeast Asia and beyond, in addition to scaling up renewables and other clean energy technology deployments.

For decades, Singapore has been one of the top three global oil trading and refining hubs, capitalising on its strategic location. Given increasing demand for LNG in the region as well as potential growth in green hydrogen demand, Singapore is now ramping up efforts to establish itself as a key trading centre for both fuels.

The Maritime and Port Authority (MPA) has allocated incentives for vessels calling at Singapore, such as port due concessions and co-funding for building LNG-fuelled bunker tankers. In addition, agreements have also been made between Singapore and other ports worldwide to initiate the use of LNG as a bunker fuel. CMA CGM, a global shipping and logistics company, had its containership CMA CGM SCANDOLA fuelled with 7 100 m^3 of LNG from FueLNG Bellina, Singapore's first LNG bunkering vessel. With Singapore developing hydrogen as a major decarbonisation pathway, this could help facilitate the economy to become a renewable energy hub in the future, given its ambitious plan to procure low-carbon electricity from neighbouring economies.

Table 1: Singapore macroeconomic data and energy reserves

Key data [a, b]		Energy reserves	
Area (million km^2)	728	Oil (billion barrels)	0
Population (million)	5.5	Gas (trillion cubic feet)	0
GDP (2017 USD billion PPP)	587.6	Coal (million tonnes)	0
GDP per capita (2017 USD PPP)	107 741	Uranium (kilotonnes U < USD 130/kgU)	0

Source: a DOS (2023); b World Bank (2022)

Note: Reserves are total proved reserves and reasonably assured recoverable resources for uranium.

Energy Supply and Consumption

Total primary energy supply

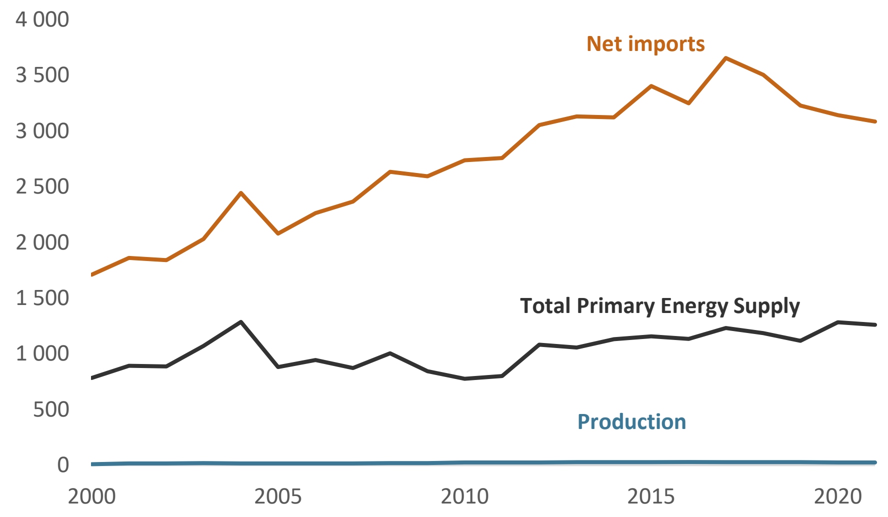
Being a net energy-importing economy, Singapore imported a total of 6 256 PJ of energy commodities in 2021, 60% and 32% of which were petroleum products and crude oil, respectively. Imported crude oil serves the needs of Singapore's oil refineries whose refined products accounted for more than 98% (or 3 120 PJ) of the economy's total exports to the neighbouring APEC economies. Import of gas increased by 4% in 2021 from 2020 levels, attributed to increased piped natural gas procurement from Indonesia and Malaysia, in parallel to the decline in LNG imports.

Such decline was likely driven by increased LNG spot price in 2021.

Looking at the overall net energy imports, Singapore registered a decline of 1.9% between 2020 and 2021, attributed mainly to lower petroleum products imports (Figure 1). The economy's total energy supply in 2021 totalled 1 259 PJ, down by 1.9% from 2020 levels.

The Port of Singapore remained connected to the global maritime in 2021 despite the COVID-19 pandemic, and thus its energy demand rebounded modestly from 2020 levels. International aviation also recorded a positive increase of 2% between the same period, on the back of the gradual recovery of the aviation and tourism-related sectors.

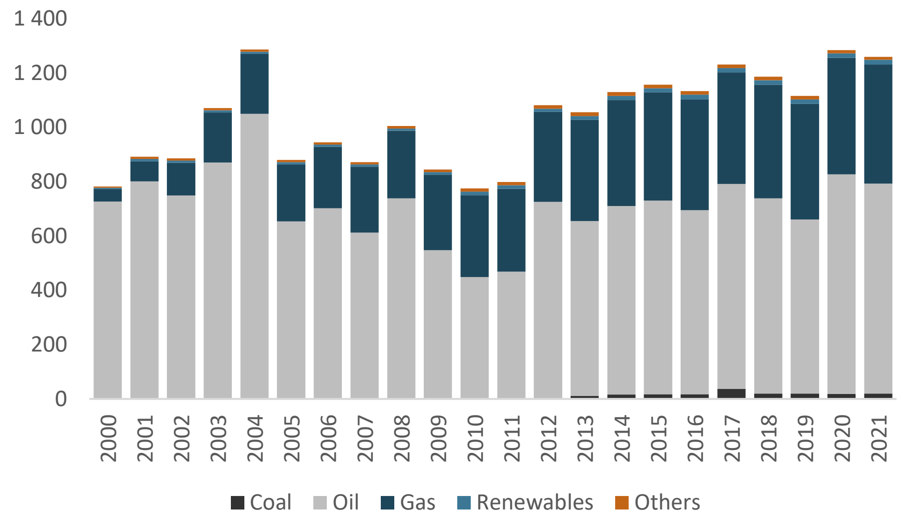
Figure 1: Singapore energy supply, production, and net imports (PJ), 2000 to 2021



Source: EGEDA (2023)

Despite the dominance of oil (crude oil and petroleum products) in Singapore's energy supply mix (Figure 2), its share has been dwindling over the past two decades, given the increased role of natural gas in the economy's supply mix. In addition to piped natural gas imports from Indonesia and Malaysia, Singapore has been procuring LNG since 2013, with Australia accounting for most of the economy's LNG imports.

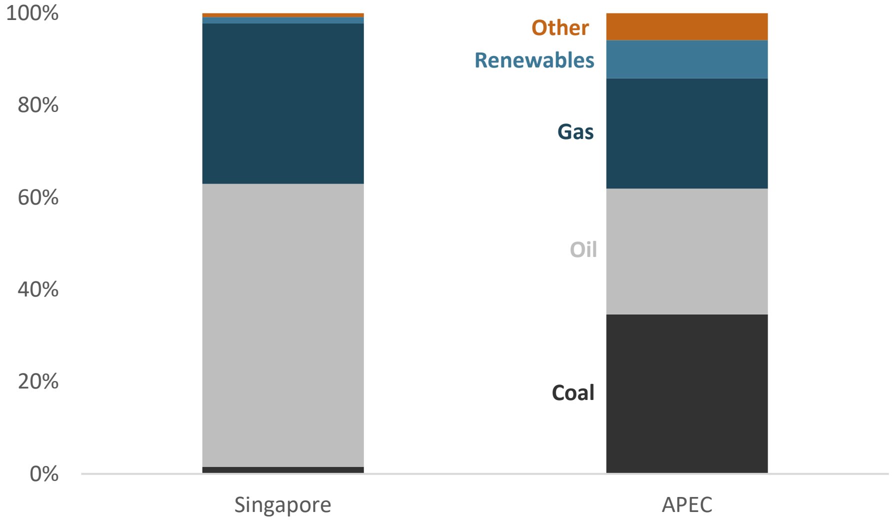
Figure 2: Singapore energy supply by fuel (PJ), 2000 to 2021



Source: EGEDA (2023)

With respect to APEC, Singapore was more dominant on the shares of oil and gas than APEC was in 2021. At the same time, the share of coal in Singapore was significantly lower than APEC's coal share, given marginal utilisation in the economy's power sector. Renewables share was also significantly lower than APEC's share, attributed to constraints in land size, low wind speeds and lack of hydro and geothermal resources.

Figure 3: Energy supply mix – Singapore and APEC, 2021



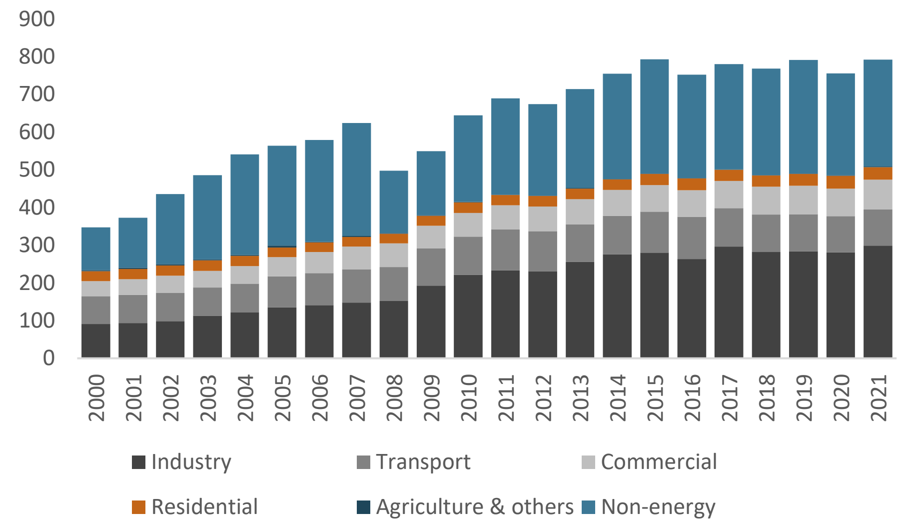
Source: EGEDA (2023)

Total final consumption

The gradual easing of COVID-19 restrictions in Singapore drove the rebound in the sectoral final consumption in 2021, which reached 792 PJ (Figure 4). Industry, commercial and non-energy sectors were responsible for most of this consumption increase, while transport and residential sectors recorded marginal declines.

The industry and non-energy sectors remained the largest contributors to Singapore's final consumption, accounting for 38% and 36% in 2021, respectively. Thanks to the large-scale petrochemical industry in Jurong Island, Singapore has grown to become one of Asia's and one of the world's leading petrochemical hubs, housing over 100 firms that operate an integrated mix of refining and petrochemical productions.

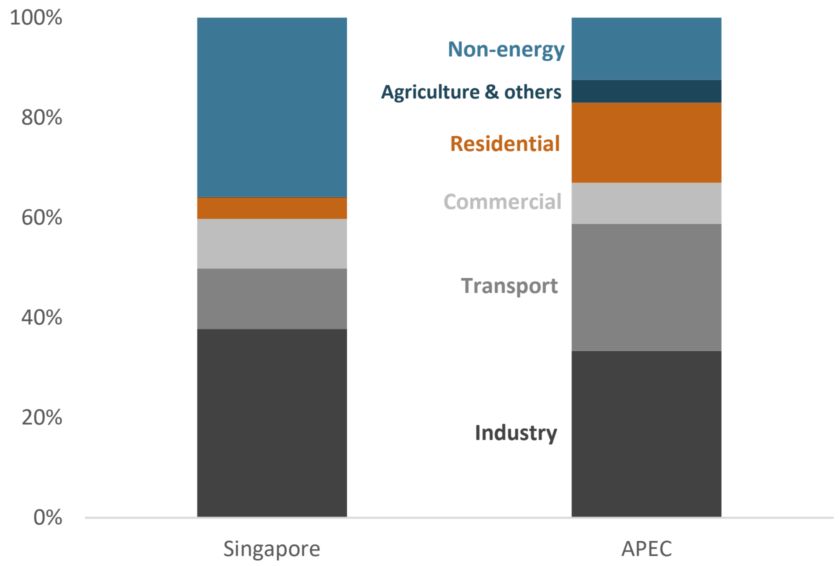
Figure 4: Singapore final consumption by sector (PJ), 2000 to 2021



Source: EGEDA (2023)

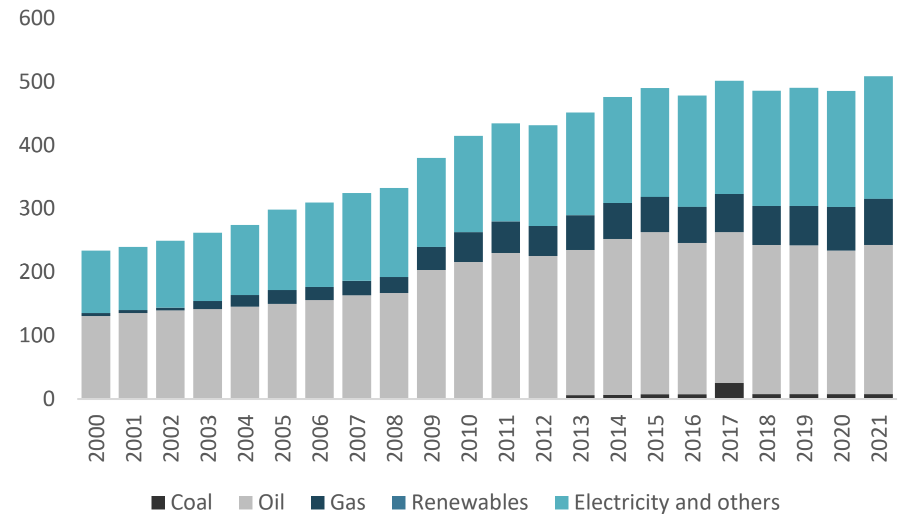
Singapore was well positioned above APEC in terms of the non-energy sector and industry sectors in 2021, given the significance of the economy's petrochemical landscape (Figure 5). Similarly, Singapore was also ahead of APEC in terms of the commercial sector's share. Being a small-city economy, residential and transport activities were lower than other economies, resulting in lower shares of these sectors compared to those of APEC.

Figure 5: Final consumption by sector, Singapore and APEC, 2021



Source: EGEDA (2023)

Figure 6: Singapore final energy demand by fuel (PJ), 2000 to 2021



Source: EGEDA (2023)

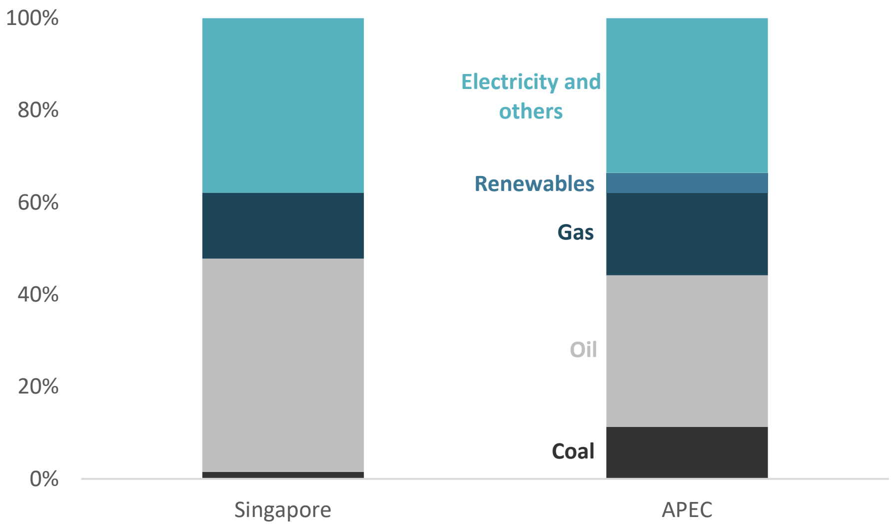
Note: Does not include non-energy sector consumption of energy products.

Final energy demand

Singapore's final energy demand grew by 4.7% to reach 508 PJ in 2021 (Figure 6). Oil (petroleum products), gas and electricity demands increased significantly on the back of growth in industrial activities between 2020 and 2021, while increased commercial sector's activities contributed to significant rise in electricity and gas demands in that sector between the same period. Demand for coal remained marginal in the industry sector.

Singapore's final energy demand mix structure was almost identical to that of APEC, albeit with a distinct magnitude of shares (Figure 7). Oil made up a larger share of Singapore's demand mix structure than of APEC's, driven by significant use of naphtha as feedstock for its petrochemical industry. Likewise, the share of electricity in Singapore was slightly higher than APEC's, given the 100% access to electricity that has been achieved in Singapore.

Figure 7: Final energy demand fuel share, Singapore and APEC, 2021



Source: EGEDA (2023)

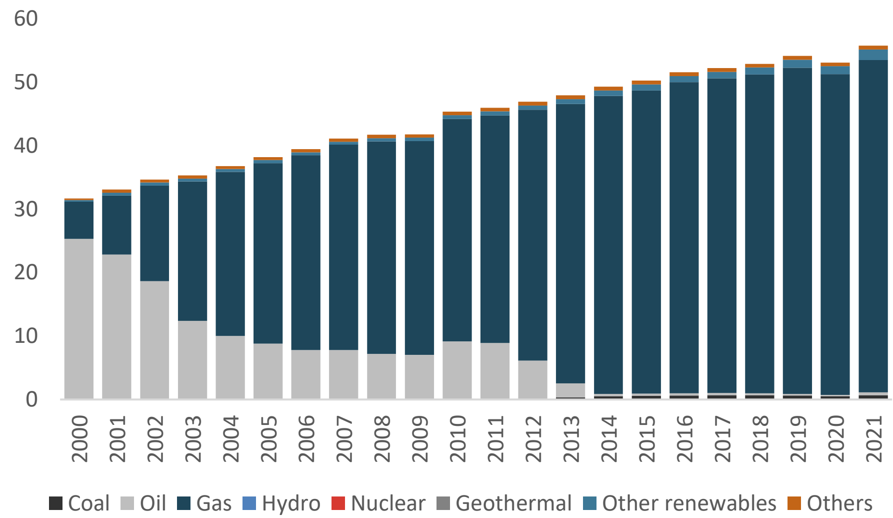
Transformation

Power sector

Electricity generation in Singapore rose by more than 5%, reaching 55 789 GWh in 2021 from 2020 levels (Figure 8). Of the total electricity, 95% came from natural gas, while coal and oil accounted for marginal shares of 1.2% and 1.0%, respectively. Parallel to electricity generation increase, Singapore's peak demand grew from 7 376 MW in August 2020 to 7 725 MW in October 2021.

Total electricity generation capacity stood at 12 179 MW in 2021, up by 1.3% in the previous year. This increase was primarily due to a significant jump in solar PV generation capacity, which rose by approximately 46.4%. The increase was primarily due to a significant jump of 154.5 MWac in solar PV generation capacity, most of which came from private sector.

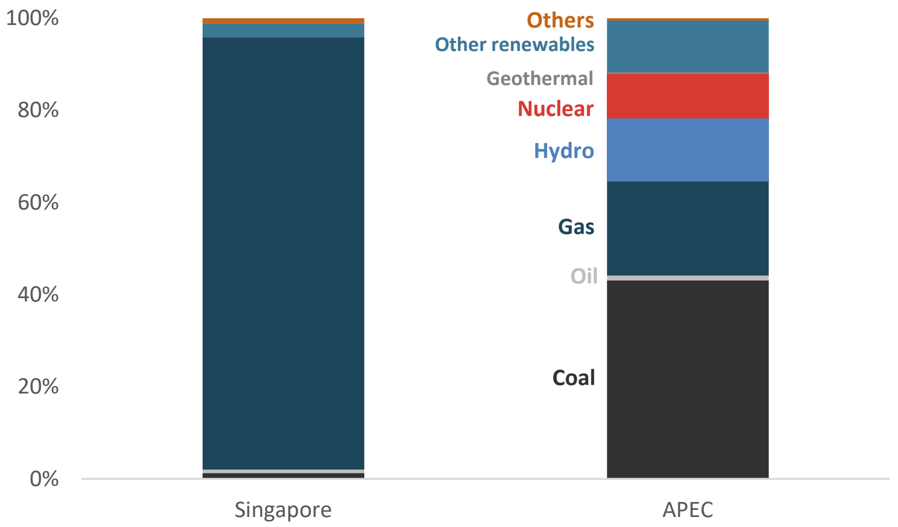
Figure 8: Singapore electricity generation by fuel, 2000 to 2021



Source: EGEDA (2023)

With respect to APEC, the prevalence of natural gas in Singapore's electricity generation fuel share placed Singapore well above APEC in terms of gas share in 2021 (Figure 9). Conversely, Singapore had proportionally less electricity generation from coal and renewables than that of APEC.

Figure 9: Electricity generation fuel share, Singapore and APEC, 2020



Source: EGEDA (2023)

Refining

Singapore is home to more than 100 refinery and petrochemical firms, thus making the economy one of the leading refinery and petrochemical hubs in the world. In line with the recovery of demand for oil products after the onset of COVID-19 pandemic, refinery activities gradually rebounded in 2021. Crude oil input volume increased by 1.3% from 0.65 mb/d to 0.66 mbd between 2020 and 2021, while input of refinery feedstocks also rose by 13.2% from 0.14 mb/d to 0.16 mbd between the same period.

To make Singapore's Jurong Island refinery hub more sustainable, the economy aims to implement at least 2 million tonnes of carbon capture by 2030. Shell and Exxon Mobil, whose plants are on the island, expressed their interest in building carbon capture and storage units in Southeast Asia. In addition, Singapore also set a target to increase the output of sustainable products by 1.5 times from 2019 levels.

Energy transition

Over the last five decades, Singapore has transformed its power generation landscape from oil to natural gas. The penetration of solar energy also has increased significantly. In order for Singapore to meet its net zero emissions goal by 2050, Singapore introduced the '4 Switches' strategy that focuses on the following: 1) natural gas as the dominant fuel, 2) increasing solar PV capacity to at least 2 GWp by 2030, in addition to at least 200 MW of energy storage beyond 2025, 3) tapping on cost-competitive regional power grids, and 4) exploring emerging low-carbon solutions that could potentially reduce the carbon footprint.

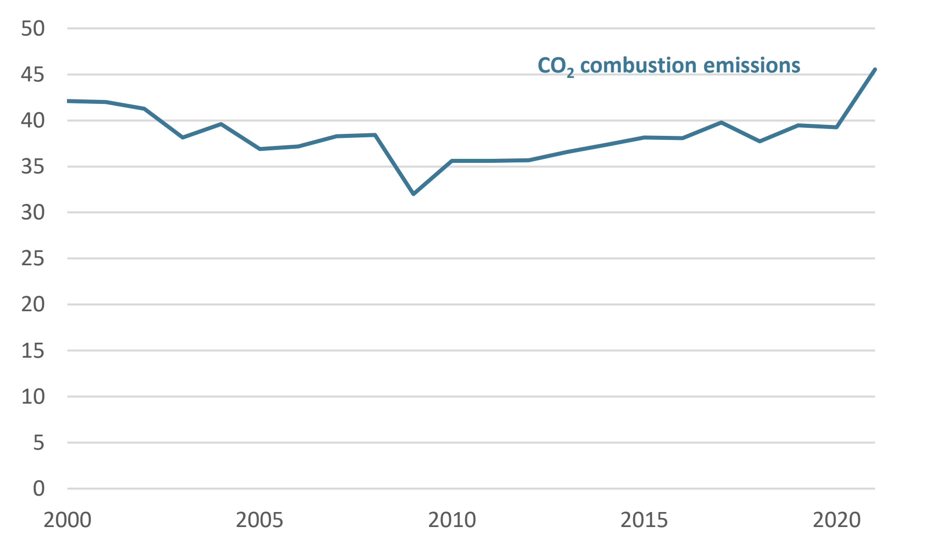
A new Future Energy Fund worth initially at SGD 5 billion will be set up by the government to help construct critical infrastructure required to realise Singapore's shift to low-carbon electricity.

Emissions

Singapore's CO_2 emissions reached the highest level yet in 2021, totalling 45.5 million tonnes (Figure 10). The significant increase of 16% from 2020 levels was attributed to the resumption of economic activities after the onset of COVID-19 pandemic.

Singapore unveiled new two-tier emission standards for its new and repowered thermal power plants to leverage on developing clean and efficient thermal plants. Tier 1 standard, which has an emissions threshold of 0.355 tonnes of CO_2-equivalent per MWh, is applicable for efficient power plants (for example, plants with combined cycle gas turbine units) that run regularly. Tier 2 units will need to keep within an emissions cap in a year, to allow the entry of other generation technologies that are less efficient but essential for ensuring energy security and flexibility to operate. Thermal power plants that fall under these tiers also will be required to be able to absorb at least 30% of hydrogen by volume, with the ability to uptake 100% of hydrogen in the future.

Figure 10: Singapore CO_2 combustion emissions (million tonnes), 2000 to 2021



Source: EGEDA (2023)

Energy security

Energy security is key to achieving Singapore's net zero emissions ambition. Ensuring a stable and robust gas-centric power system is vital in addressing potential energy shortages and volatility in electricity prices in Singapore.

Given Singapore's pragmatic approach in having natural gas as the main source of the economy's electricity generation in the next few decades, Singapore recently announced that it will establish a centralised gas procurement framework, which will be under the purview of a central gas company (Gasco). From 2024, Gasco will function to centralise the procurement of gas and supply of gas for the power sector by aggregating gas input from generation utilities. Through this establishment, Singapore is hoping to diversify its gas import sources to reduce supply risk and enter long-term contracts to provide more stable supply and prices.

In addition, Singapore LNG (SLNG) plans to add a second LNG import terminal at the end of this decade on top of the existing terminal. The new import terminal, with a capacity of 5 million tonnes per annum (mtpa), will potentially utilise the concept of FSRU (Floating Storage and Regasification Unit), offering greater flexibility in redeploying it at any location when necessary.

Singapore has set a target to import up to 4 gigawatts (GW) of low-carbon electricity by 2035. This will constitute around 30%, or about one-third of Singapore's electricity supply. This will contribute to efforts in developing an ASEAN Power Grid, which would drive investments in low-carbon projects, accelerate renewable energy developments in the region, and enhance mutual energy security and grid resilience. In June 2022, the Lao PDR-Thailand-Malaysia-Singapore Power Integration Project (LTMS-PIP), which imports up to 100 megawatts (MW) of renewable hydropower from Lao PDR to Singapore via Thailand and Malaysia using existing interconnections, successfully commenced. In 2023, Singapore awarded Conditional Approvals to projects from various sources, comprising 1 GW from Cambodia, 2 GW from Indonesia and 1.2 GW from Viet Nam.

APEC Energy Goals

There are two energy-related objectives that APEC member economies have agreed to meet as a collective: to improve energy intensity and double the share of modern renewables.

Energy intensity goal

In 2011, APEC member economies agreed to increase their ambition to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

APEC is on track to achieve this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

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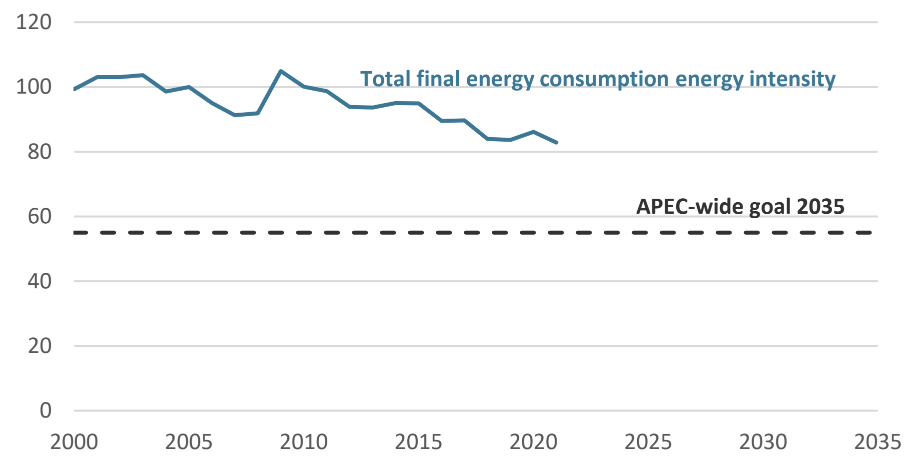

Source: EGEDA (2023)

Following an increase in 2020 due to the COVID-19 pandemic, Singapore's energy intensity reduced by 4% in 2021 (Figure 11), as its GDP rebounded considerably by almost 9% with energy demand growth slowed by almost 5%. From 2005 levels, Singapore has reduced its energy intensity by 17% in 2021, halfway through to achieving its target of 36% intensity reduction by 2030.

Doubling of renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period 2010 to 2030. There is no economy-level goal for individual member economies, but improvements by individual economies will contribute to the doubling goal.

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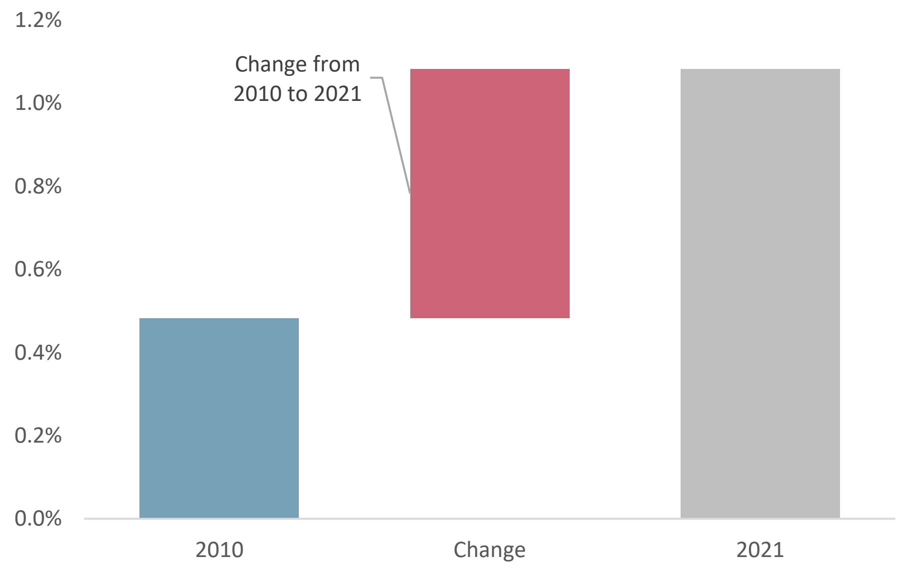


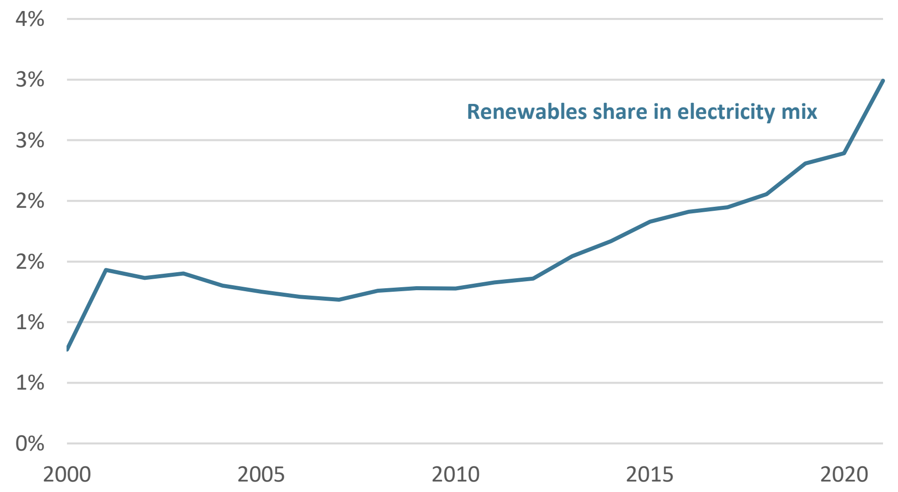
Source: EGEDA (2023)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Singapore had a very low modern renewable energy share in 2010, given the prevalence of fossil fuels in its supply mix. The low renewable energy share in the economy is primarily due to the small size of the city economy and its dense urban landscape, which challenge the adoption of conventional variable wind and solar renewables at an island-wide scale. Beyond land constraints, Singapore is alternative energy-disadvantaged and solar is the only viable form of renewable energy.

Renewables accounted for 3% of Singapore's total electricity mix in 2021, a significant jump from 2020 levels (Figure 13). This was driven by the considerable increase in electricity generation from solar, from 499 GWh to 761 GWh between 2020 and 2021, as Singapore continues to steadily scale up its solar capacity targets in both economy-wide and housing unit targets throughout the current decade.

Figure 13: Singapore renewable generation share, 2000 to 2021



Source: EGEDA (2023)

Energy Policy

Energy policy	Details	Reference
Singapore Carbon Tax	Carbon tax will be raised to SGD 25 per tonne of CO_2 equivalent in 2024 and 2025, and SGD 45 per tonne of CO_2 equivalent in 2026 and 2027. This will further rise to SGD 50-80 per tonne of CO_2 equivalent by 2030.	National Climate Change Secretariat (2023)
National Hydrogen Strategy	In October 2022, Singapore announced a National Hydrogen Strategy to develop hydrogen as a major decarbonisation pathway to support the transition towards net zero emissions by 2050. Depending on technological developments and the development of other energy sources, hydrogen could supply up to half of Singapore's power needs by 2050. The five key thrusts are: • Experimenting advanced hydrogen technologies that are commercially ready. • Investment in research and development. • Collaboration with international partners to establish hydrogen supply chain. • Undertaking long-term land and infrastructure planning, and • Supporting workforce training and development.	Ministry of Trade and Industry (2022)
Nationally Determined Contribution (NDC)	Singapore's second update of its first NDC mentions the aim of reducing emissions to around 60 million tonnes of CO_2 equivalent in 2030, after peaking its emissions earlier.	National Climate Change Secretariat (2022)
Long-Term Low Emissions Development Strategy (LEDS)	Singapore strengthened its long term LEDS to a commitment to achieve net zero emissions by 2050.	National Climate Change Secretariat (2022)
Singapore Green Building Masterplan (SGBMP) – 4th edition	Serving as a roadmap to decarbonise Singapore's buildings, the SGBMP aims to achieve an '80-80-80' target by 2030: • 80% of the buildings by gross floor area to be green by 2030. • 80% of new developments to be Super Low Energy, and • 80% improvement in energy efficiency, relative to 2005 levels, for best-in-class buildings by 2030.	Building and Construction Authority (2022)
Electric Vehicles Vision	Singapore aims to reduce peak emissions from land transport by 80% by or around mid-century, primarily through electrification of vehicles: • Every Housing & Development Board (HBD) town to be an EV-ready town by 2025. • Displacement of 400 diesel buses with electric buses by 2025. • 60 000 EV charging points by 2030. • Half of Singapore's public buses and taxi fleet are electrified by 2030. • 100% of vehicles to run on cleaner energy by 2040.	Land Transport Authority (2023)
Green Efforts in Schools	Singapore aims to: • Achieve a two-thirds reduction of net carbon emissions from the schools sector.	Singapore Green Plan 2030 (2021)

Energy policy	Details	Reference
	• Achieve the goal of making 20% of schools carbon neutral.	
Green Energy	Singapore aims to: • Deploy at least 2 GWp of solar energy, capable of generating electricity for 350 000 households, by 2035. • Have best-in-class power generation technology that meets emission standards and reduces carbon emissions.	Singapore Green Plan 2030 (2021)
Greener Infrastructure and Buildings	Singapore aims to: • Decrease energy consumption of desalination process from 3.5 kWh/m^3 (current) to 2 kWh/m^3 by 2025, and further to 1 kWh/m^3 by 2030. • Make Tuas Nexus, the economy's first integrated waste and used water treatment facility, 100% energy self-sufficient by 2025. • Green 80% of its buildings (by gross floor area) by 2030. • Have 80% of new buildings to be super low energy buildings (by gross floor area) from 2030. • Have 80% improvement in energy efficiency of best-in-class green buildings by 2030 from 2005 levels.	Singapore Green Plan 2030 (2021)
Sustainable Towns and Districts	Singapore aims to reduce energy consumption in existing HDB towns by 15% by 2030.	Singapore Green Plan 2030 (2021)
Sustainable Aviation	Singapore aims to: • Have electrified new airside light vehicles, forklifts, and tractors at Changi Airport from 2025. • Have all airside vehicles running on cleaner energy at Changi Airport by 2040.	Singapore Green Plan 2030 (2021)
Sustainable Maritime	Singapore aims to: • Have all new harbour craft operating in port waters powered by electricity, B100 biofuels and other net zero fuels from 2030.	Singapore Green Plan 2030 (2021)
SolarNova Programme	Targeting 540 MWp of solar on HDB housing blocks by 2030.	Housing & Development Board (2022)
Adjusted Early Turnover Scheme (ETS)	ETS provides an incentive to deregister older, more polluting vehicles and replace them with newer, less emitting models. The incentive comes in the form of a discounted certificate of entitlement on the registration of the new vehicle. Under the adjusted ETS, existing Euro II, III and IV Category C diesel vehicles are eligible for the ETS incentive. This will commence from 1 April 2023 to 31 March 2025.	Land Transport Authority (2023)

Notable Energy Developments

Energy development	Details	Reference
Centralised Gas Procurement and Supply	The Ministry of Trade and Industry (MTI) and the EMA will establish an entity called Gasco that functions to centralise the procurement and supply of gas for the power sector through gas aggregation from the generation companies. Gasco will procure the additional gas needed when the electricity demand exceeds the gas supply.	Energy Market Authority (2023)
Future Energy Fund	Singapore is to set up a dedicated fund to support infrastructure investment for its energy transition towards a net zero future. Examples of infrastructure include undersea cables to facilitate the import of low-carbon electricity, and hydrogen terminals and pipelines.	Energy Market Authority (2024)
Residential Demand Response Programme (R-DR)	The EMA and SP Group will be piloting a Residential Demand Response (R-DR) programme, involving households equipped with smart meters provided by SP Group. Households will receive alerts from an SP app to temporarily reduce or defer their electricity usage during demand peaks.	Energy Market Authority (2023)
Low- or Zero-Carbon Ammonia for Power Generation and Bunkering Project	The EMA and Maritime Port Authority of Singapore (MPA) have shortlisted six consortiums for a closed Request for Proposal (RFP) for a low- or zero- carbon ammonia for power generation and bunkering project on Jurong Island: • 55-65 MW of electricity from imported low- or zero-carbon ammonia via gas turbine/combined-cycle gas turbine. • Facilitate ammonia bunkering at a capacity of at least 0.1 mtpa, starting with shore-to-ship bunkering followed by ship-to-ship bunkering.	Energy Market Authority (2023)
New Emission Standards for Power Generation Units	Emission standards are expected to be enforced for new and repowered fossil fuel-fired power generation units from 2024 onwards.	Energy Market Authority (2023)
Singapore's Second LNG Terminal	Singapore LNG (SLNG) will develop and operate the second LNG terminal in Singapore with a capacity of 5 mtpa. The terminal, which will potentially be based on the floating storage and regasification unit (FSRU), is aimed to be operational by the end of this decade.	Singapore LNG Corporation (2023)
Energy Storage System (ESS)	In February 2023, Sembcorp Industries (Sembcorp) and EMA officially opened the Sembcorp Energy Storage System (ESS). The ESS is Southeast Asia's largest utility-scale ESS at 285 MWh. It enhances Singapore's grid resilience by mitigating solar intermittency.	Energy Market Authority (2023)

Useful links

Building and Construction Authority – https://www1.bca.gov.sg/

Department of Statistics Singapore – https://www.singstat.gov.sg

Economic Development Board – https://www.edb.gov.sg/

Energy Efficiency Programme Office – http://www.e2singapore.gov.sg/

Energy Market Authority – https://www.ema.gov.sg

Housing & Development Board – https://www.hdb.gov.sg/cs/infoweb/homepage

Land Transport Authority – https://www.lta.gov.sg

Ministry of National Development – https://www.mnd.gov.sg/

Ministry of the Environment and Water Resources – https://www.mewr.gov.sg

Ministry of Trade and Industry – https://www.mti.gov.sg

National Environment Agency – https://www.nea.gov.sg

National Climate Change Secretariat – https://www.nccs.gov.sg/

Public Utilities Board – https://www.pub.gov.sg/

Singapore Department of Statistics – https://www.singstat.gov.sg/

Singapore LNG Corporation (SLNG) – https://www.slng.com.sg/website/index.aspx

Solar Energy Research Institute of Singapore (SERIS) – http://www.seris.nus.edu.sg/

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Chinese Taipei

Introduction

Chinese Taipei's GDP in 2021 reached 1 334 billion (2017 USD purchasing power parity (PPP)), a 6.5% increase from the 2020 level. The population in 2021 stayed at the 23 million level, but it is expected that there will be a decreasing trend in population in the coming decades. In addition, Chinese Taipei's GDP per capita still remained at a high level relative to the APEC region, at USD 57 062 PPP in 2021.

Chinese Taipei has limited energy reserves. According to data from the CIA's World Factbook, Chinese Taipei holds only 1 million tonnes of proven coal reserves, 2.4 million barrels of proven oil reserves, and 6.2 billion cubic metres of proven gas reserves (CIA, 2024). While there is limited crude oil and natural gas production, the economy heavily relies on energy imports.

In March 2022, Chinese Taipei proposed the policy framework for the 2050 net zero emissions target. The previous greenhouse gas (GHG) net emissions target was 50% of the 2005 level by 2050; the new and ambitious GHG net emissions target is net zero by 2050. Twelve key strategies were proposed to achieve this target, including integrating wind, solar PV, hydrogen, innovative energy, storage, carbon capture, utilisation and storage (CCUS), energy efficiency, etc. (NDC, 2022).

In December 2022, under the 2050 net zero emissions target, Chinese Taipei further announced the Phased Goals and Actions Toward Net-Zero Transition, which targeted 27-30% of renewables, 50% of gas-fired and 20% coal-fired power generation by 2030. By 2050, the target is 60-70% of renewables, 9-12% of hydrogen, and 20-27% thermal power generation with CCUS in power generation. Chinese Taipei also updated its NDC to enhance net emission reduction by 20% to 23-25% against the 2005 level by 2030, with reference to the Paris Agreement to ensure a basis to strengthen reduction ambitions and reach the net zero emissions goal by 2050.

In addition, Chinese Taipei amended the Greenhouse Gas Reduction and Management Act, renaming it the Climate Change Response Act in February 2023. This includes a binding 2050 net zero emission target (Article 4), defined roles among governments (Article 8), a carbon fee mechanism (Article 28), the creation of the GHG Management Fund (Article 32), and transition action programmes (Article 46). Legislative changes were also initiated in energy-related regulations, including revisions to the Renewable Energy Development Act and Energy Administration Act to facilitate energy transition.

Table 1: Chinese Taipei's macroeconomic data and energy reserves

Key data [a]		Energy reserves [b]	
Area (million km^2)	0.03	Oil (million barrels)	2.4
Population (million)	23	Gas (billion cubic metres)	6.2
GDP (2017 USD billion PPP)	1 334	Coal (million tonnes)	1
GDP per capita (2017 USD PPP)	57 062	Uranium (kilotonnes U < USD 130/kgU)	--

Source: a IMF (2023); b CIA (2024)

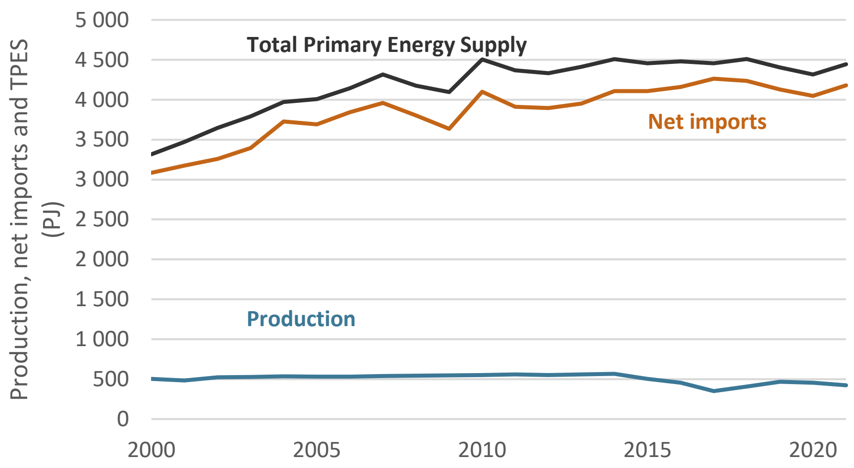
Note: Reserves are total proved reserves and reasonably assured recoverable resources for uranium.

Energy Supply and Consumption

Total primary energy supply

The total primary energy supply (TPES) in Chinese Taipei goes up by 3% to 4 446PJ in 2021 (Figure 1). This increase can be attributed to the significant rise in coal (+7.4%) and gas (+8.8%), which comprised 35% and 22% of TPES in 2021, respectively. In addition, renewable energy increased by 6% between 2020 and 2021, which comprised only 2% of TPES in 2021, while oil in TPES decreased by 1.5%, continuing the downward trend of its (34%) share of TPES in 2021, with a relatively low compound annual growth from 2000 to 2021 (0.0%).

Figure 1: Chinese Taipei's energy supply, production, and net imports (PJ), 2000 to 2021

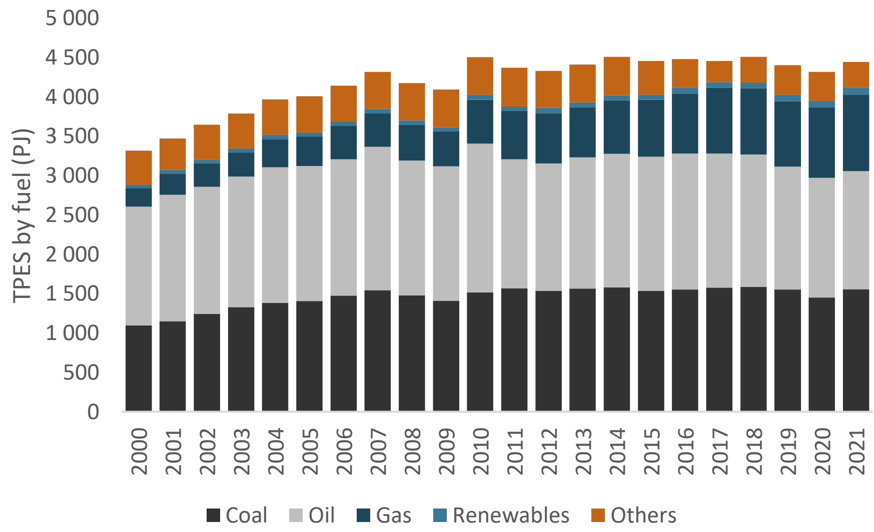


Source: EGEDA (2023)

Chinese Taipei is heavily dependent on foreign energy supplies. In 2021, net imports accounted for more than 90% of TPES, and continually grew by 3.3% (from the 2020 level (Figure 1).

Oil and coal account for the majority of Chinese Taipei's energy supply, with a total of 3 056 PJ (almost 70% of TPES) in 2021. Coal is mainly used for power generation, and the oil supply is mainly used as a feedstock for the economy's fuel refinery. Gas supply, which is mainly used for power generation and industrial processes, has consistently grown for the last two decades, and increased by 8.8% to 973 PJ in 2021(Figure 2). To achieve its energy transition target, Chinese Taipei has actively promoted renewable energy in recent years. In fact, there is an increasing trend in renewables: renewables in TPES increased by 6% to 87.8 PJ in 2021, mainly caused by a significant rise in geothermal (375%) and other non-hydro renewables (13.9%).

Figure 2: Chinese Taipei's energy supply by fuel (PJ), 2000 to 2021

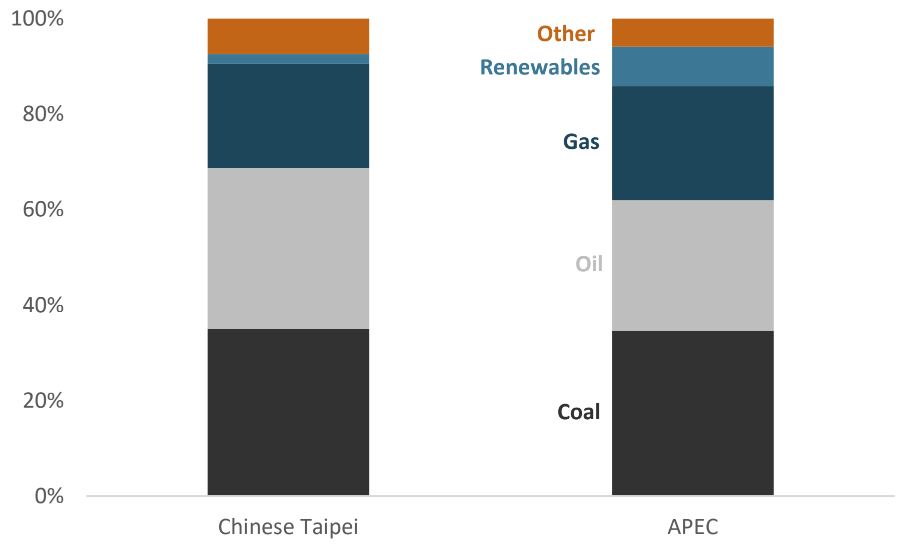


Source: EGEDA (2023)

Regarding the percentage shares, compared to the aggregate APEC

TPES, the Chinese Taipei TPES contains a higher share of oil and coal but a lower share of renewable energy than the APEC region.

Figure 3: Energy supply mix – Chinese Taipei and APEC, 2021

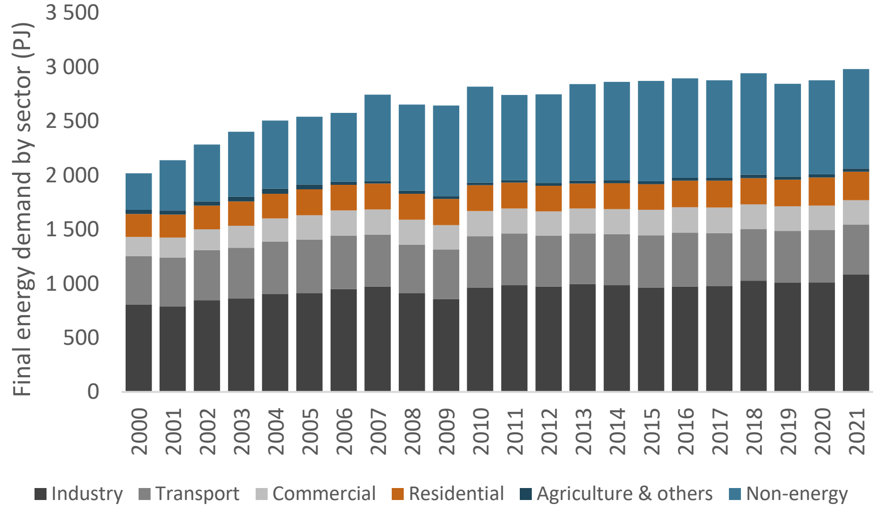


Source: EGEDA (2023)

Total final consumption

Total final consumption (non-energy included) in Chinese Taipei in 2021 was 2 980 PJ, which was 3.6% higher than the 2020 level (Figure 4). The increase can be attributed to the rise in demand by the industry and non-energy sectors in 2021. The former reached its highest recorded point in the past 20 years, while the latter was still lower than the 2018 level.

Figure 4: Chinese Taipei's final consumption by sector (PJ), 2000 to 2021

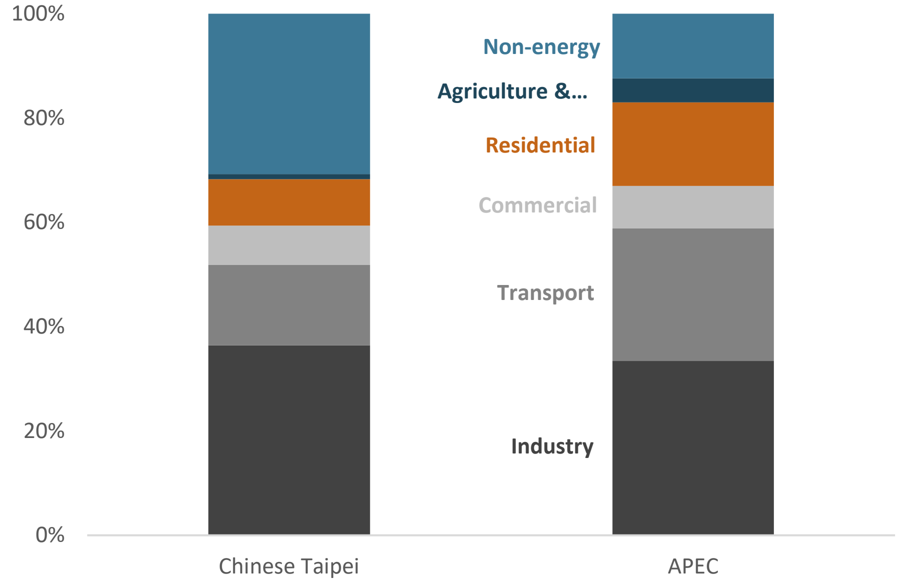


Source: EGEDA (2023)

The industrial sector, the largest energy-consuming sector, increased by 7.4% in 2021, with a 36% share in TFC in 2020. It is worth noting that the machinery sector mainly comprises of electrical and electronic machinery. In 2021, Chinese Taipei's transport sector slightly declined by 5.2% to 459.2 PJ and accounted for a 15%share of TFC due to the pandemic outbreak in late April 2021.

In 2021, the share of the non-energy sector in TFC in Chinese Taipei (around 31%) remained much greater than the whole APEC economy (12%). This reflects the extensive use of petroleum products as feedstock for the economy's refining and petrochemical industry. In contrast, except for the industry sector, the shares of the other sectors (transportation, buildings, agriculture, and others) were all less than the APEC region (Figure 5).

Figure 5: Final consumption by sector, Chinese Taipei and APEC, 2021



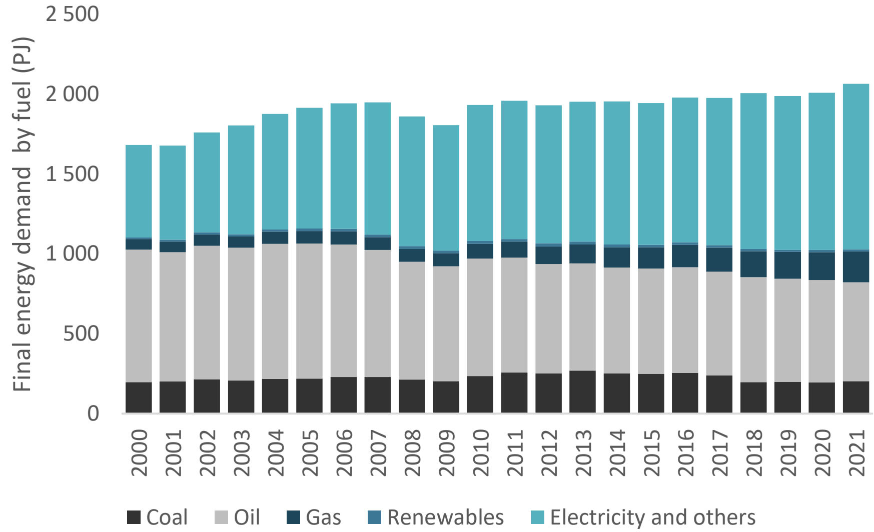
Source: EGEDA (2023)

Final energy demand

Total final energy consumption (TFEC) (non-energy excluded) in Chinese Taipei in 2021 was 2 063 PJ, slightly higher than the 2020 level. Increases were in coal, gas, and electricity and others, where oil and renewable both declined (Figure 6).

From 2010 to 2021, the compound annual growth rate (CAGR) of TFEC was 0.6%. Although the CAGR of coal (-1.3%), oil (-1.6%) and renewables (-2.8%) were all negative, these falls were offset by the positive CAGR of gas (6.9%) and electricity (1.8%). The strong growth trend in gas was mainly due to contributions from the industrial sector, while the moderate growth trend in electricity and others resulted from the industrial and residential sectors.

Figure 6: Chinese Taipei's final energy demand by fuel (PJ), 2000 to 2021

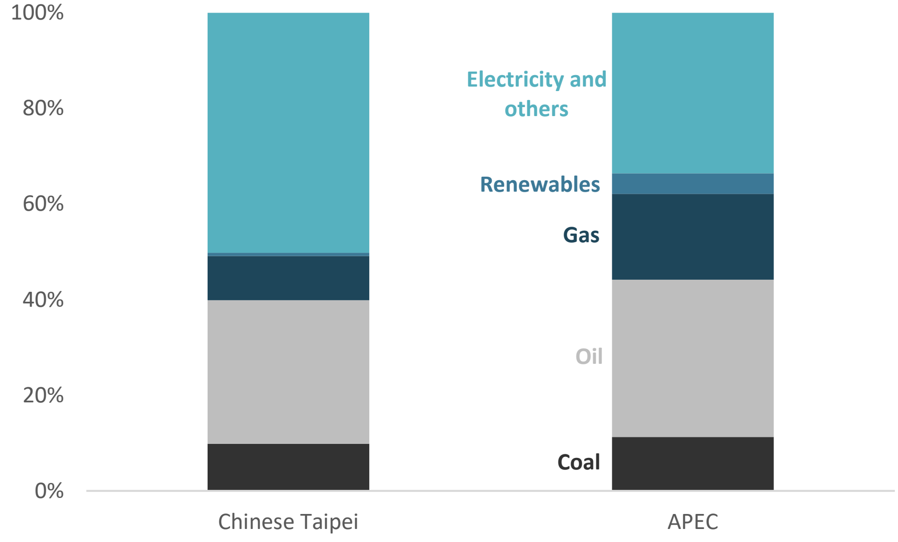


Source: EGEDA (2023)

Note: Does not include non-energy sector consumption of energy products.

In 2021, electricity and others accounted for half of TFEC (50%) in Chinese Taipei, greater than most APEC economies except for Hong Kong, China. The relatively high share of electricity and others in TFEC was mainly due to the higher electrification rate of the industry and building sectors, especially in regard to electrical and electronic machinery. The share of oil in TFEC was 30%, which was slightly less than the whole APEC economy. The share of oil in TFEC was mainly driven by the transport sector, and it is expected to decrease with the rise of electric vehicle (EV) adoption (Figure 7).

Figure 7: Final energy demand fuel share, Chinese Taipei and APEC, 2021



Source: EGEDA (2023)

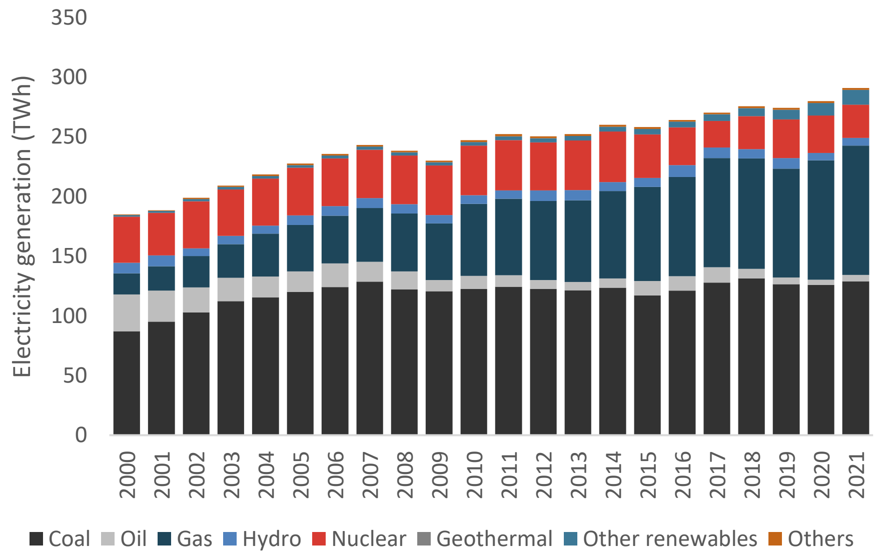
Transformation

Power sector

Chinese Taipei's electricity generation was 291 TWh in 2021, 3.9% higher than in 2020 (Figure 8). The electricity generation mix in Chinese Taipei was dominated by fossil fuel power plants (coal, gas and oil), with a share of more than 83% in 2021. Among fossil fuel power plants, coal accounted for the largest share, accounting for 44% of electricity generation, followed by gas (37%) and then oil (2%) in 2021.

From 2010 to 2021, the CAGR of the electricity generated by nuclear (-3.6%), oil (-6.4%), and hydro (-0.8%) was negative, while electricity generated by renewables (5.7%), gas (5.5%), and coal (0.5%) was positive. It is worth noting that nuclear power dropped by 12% in 2021, reflecting the decommissioning of Chinese Taipei's current nuclear power plant. According to the CAGR of electricity generation, Chinese Taipei has transitioned to more gas and renewables and reduced the amount of electricity generated by oil and nuclear during the past decade.

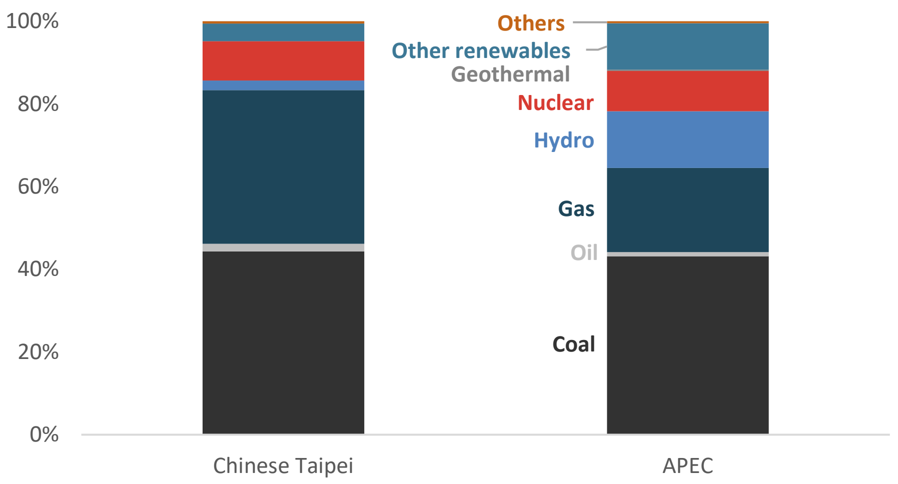
Figure 8: Chinese Taipei's electricity generation by fuel, 2000 to 2021



Source: EGEDA (2023)

In 2021, coal constituted nearly half of Chinese Taipei's electricity generation, mirroring the broader APEC economy trend (Figure 9). Notably, the share of gas-fired electricity generation in Chinese Taipei was much higher than the overall APEC economy. This percentage is anticipated to rise further, aligning with Chinese Taipei's ambitious energy transition policy, where gas-fired generators are considered a viable option for reducing GHG emissions compared to coal-fired generation.

Figure 9: Electricity generation fuel share, Chinese Taipei and APEC, 2021



Source: EGEDA (2023)

Refinery

The refining market in Chinese Taipei is an oligopoly dominated by two companies, CPC and FPCC (Formosa Petrochemical Corp. Company). CPC is a public-owned enterprise primarily focused on gasoline and diesel production, mainly for meeting domestic oil demands. FPCC, on the other hand, specialises in producing petrochemical products, with an emphasis on exporting petrochemical products, gasoline and diesel.

Currently, three refineries are operating in Chinese Taipei: CPC Taoyuan Refinery (200 kb/day), CPC Dalian Refinery(400 kb/day), and FPCC Mailiao Refinery(540 kb/day); total capacity currently reaches 1 140 kb/day. CPC Dalian Refinery and FPCC Mailiao Refinery are highly integrated with petrochemical production.

However, due to China's cancellation of the Cross-Straits ECFA (Economic Cooperation Framework Agreement) tariff preferences on petrochemical products, the short-term refining market in Chinese Taipei is expected to be sluggish. With the massive adoption of EVs for the coming decades – based on the net zero policy – Chinese Taipei's refineries may respond by developing high-quality petrochemical production lines.

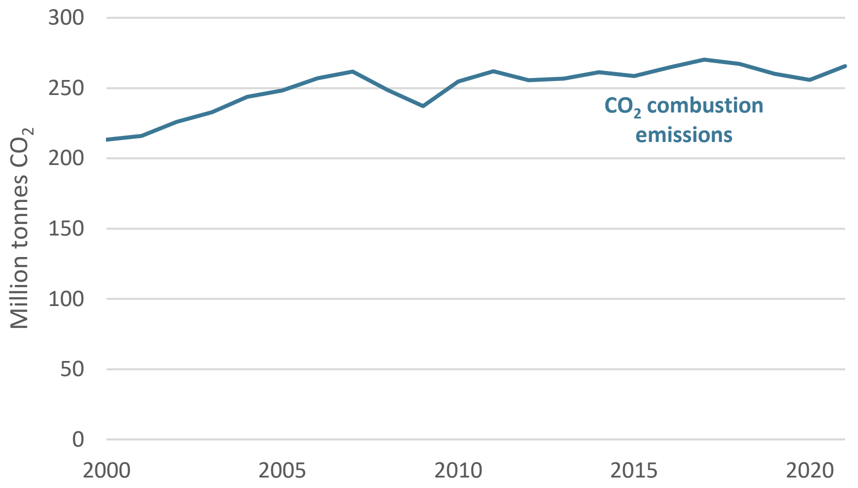
Energy Transition

To stabilise the power supply, improve air quality, and create a nuclear-free homeland, Chinese Taipei aims to achieve 60-70% renewables, 20-27% thermal power with CCUS, 9-12% hydrogen, and 1% others in its power mix by 2050. All of the economy's the nuclear power plants are also expected to be decommissioned by 2025. In addition, the GHG emission reduction goal was initially set to be 24±1% lower than the 2005 level by 2030 and reach the net zero emissions goal by 2050, which is committed legally in the Climate Change Response Act.

Emissions

The CO_2 combustion emissions in Chinese Taipei have decreased since 2017. However, in 2021, the rebound emissions were 266 million tonnes of CO_2, around 3.9% higher than the 2020 level (Figure 10). In addition, the emissions level has exceeded 250 million tonnes of CO_2 since 2010, 7% higher than the 2005 level. At the current reduction speed, it seems challenging to achieve the net zero GHG emission goal by 2050.

Figure 10: Chinese Taipei's CO_2 combustion emissions (million tonnes), 2000 to 2021



Source: EGEDA (2023)

Energy security

Promoting energy transition in Chinese Taipei is driven by the goal of enhancing energy security. The strategic approach involves maximising renewable energy utilisation over the coming decades, coupled with substantial investments in grid infrastructure, demand flexibility, and electric energy storage. This is aimed at reducing dependency on imported energy and ensuring stability in the energy supply. Additionally, as part of the energy transition plan, there is an increased focus on natural gas usage. Existing LNG terminals are being expanded, with five additional LNG terminals currently under construction or in the planning stage. Diversifying LNG import sources and establishing long-term LNG contracts are also seen as measures to bolster energy security and address potential energy crises.

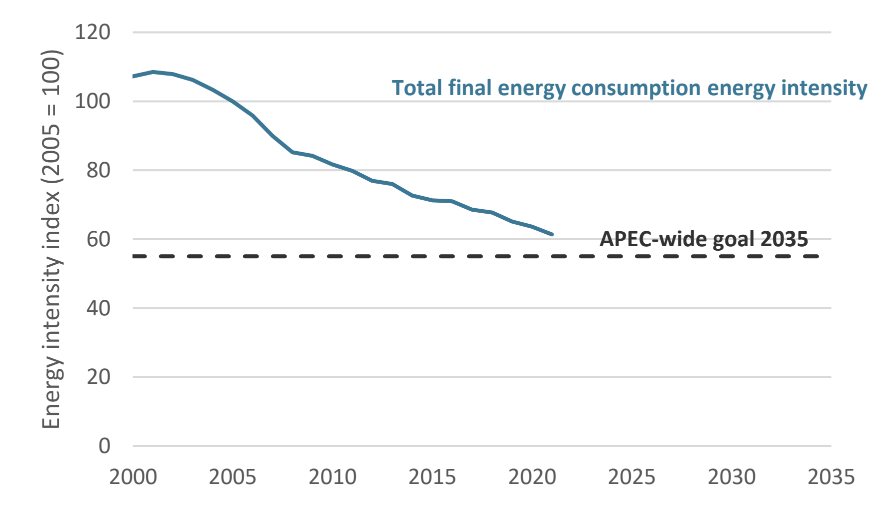
APEC Energy Goals

There are two energy-related objectives that APEC member economies have agreed to meet as a collective – to improve energy intensity and to double the share of modern renewables.

Energy intensity goal

In 2011, APEC member economies agreed to increase their target to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was to improve by 25% by 2030, relative to the 2005 baseline. APEC is on track to achieve this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

Figure 11: Chinese Taipei's total final energy consumption intensity index, 2000 to 2021 (2005 = 100)



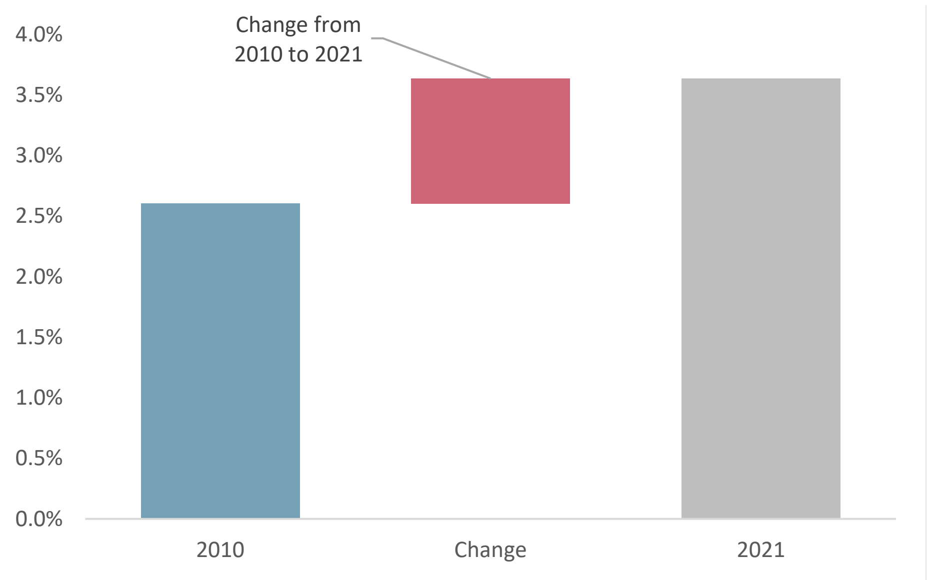
Source: EGEDA (2023)

In 2021, the final energy intensity of Chinese Taipei's TFEC improved by 39%, compared with the 2005 level (Figure 11). A similar energy intensity trend is also seen in energy intensity based on TPES and TFC.

Doubling of renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period 2010 to 2030. There is no economy-level goal for individual member economies, but improvements by individual economies will contribute to meeting the doubling goal.

Figure 12: Chinese Taipei's modern renewable energy share, 2010 and 2021



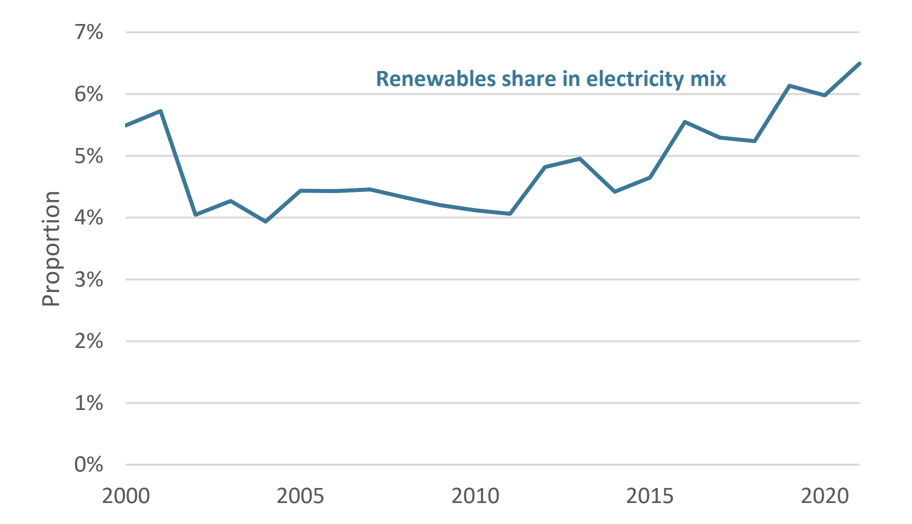
Source: EGEDA (2023)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Chinese Taipei's share of modern renewables in TFEC was 2.6% in 2010. It increased to 3.6% in 2021, representing a 39% improvement from 2010 to 2021 (Figure 12). The APEC-wide doubling goal will require the share of APEC's modern renewables to reach 12% by 2030.

The electricity generation of renewable energy increased slightly by 14.8% in 2021, and its share also went up from 6.0% to 6.5% in Chinese Taipei in 2021 (Figure 13). Notably, geothermal generation has had a significant surge – more than triple in 2021 compared to 2020.

Figure 13: Chinese Taipei's renewable generation share, 2000 to 2021



Source: EGEDA (2023)

The share of renewables in electricity generation was relatively stable in the 2000s, but has been slowly growing over the past decade since the adoption of the feed-in tariff (FiT) mechanism in 2010. It is expected that the share of renewable generation can further grow as Chinese Taipei aims to expand its share to 60-70% by 2050 (NDC, 2022).

Energy Policy

Energy policy	Details	Reference
Energy Transition Promotion Scheme	To achieve a target of 20% renewable power generation by 2025, the goal for photovoltaic (PV) energy has been set at 20 GW, while offshore wind power is expected to reach 5.6 GW by 2025. To increase the share of natural gas in power generation to 50% by 2025, the plan involves converting coal-fired generators to gas-fired ones. There will be no construction of new coal-fired power generators before 2025 to reduce reliance on coal-generated electricity. There are no plans to extend the service span of existing nuclear power plants, and the fourth nuclear power plant will not be restarted.	Ministry of Economic Affairs [MOEA] (2019)
Energy Transition White Paper	To reflect the demand and expectation of stakeholders, MOEA has released the official energy transition policy document, outlining several significant targets, policies and plans: • Achieving a 20% renewable power generation target by 2025, with specific renewable power capacity targets identified for various technologies like solar, wind, geothermal power, among others. • Decreasing the average annual energy intensity and electricity intensity by 2.4% and 2% respectively from 2017 to 2025. • Focusing on the development of electrical energy storage and the smart grid infrastructure.	Energy Administration, Ministry of Economic Affairs [MOEA] (2020)
Energy Transition White Paper – Progress Report 2022	According to the Energy Transition White Paper's plan, the Energy Administration is tasked with proposing a progress report annually and a comprehensive review report every five years. As of now, progress reports have been issued twice, in 2021 and 2022.	Energy Administration, Ministry of Economic Affairs[MOEA] (2022)
Climate Change Response Act	On 15 February 2023, the President announced the amendment renaming the Greenhouse Gas Management Act to the Climate Change Response Act. Key revisions include: • Setting a legally binding long-term goal of achieving net zero greenhouse gas emissions by 2050. • Incorporating discussions on a just transition into policy dialogues to improve information disclosure and public involvement. • Introducing a carbon fee mechanism targeting significant greenhouse gas emitters and establishing a dedicated fund to incentivise investments in low-carbon fuels, negative emission technologies, energy efficiency and renewable energy. • Establishing a distinct chapter dedicated to climate change adaptation, emphasising capacity building, science-driven assessments, and the formation of a governance	Ministry of Environment [MOE] (2023)

Energy policy	Details	Reference
	framework.	
Update of NDC	Chinese Taipei's NDC is based on its 2015 INDC, which set a target to reduce net emissions by 20% against the reference year (2005) by 2030. The updated NDC aims to enhance the reduction target further to 23-25% by 2030, with reference to Article 3 of the Paris Agreement (common but differentiated responsibilities) to ensure a basis to strengthen reduction ambitions and endeavour to reach the net zero emission goal by 2050.	Climate Change Administration, Ministry of Environment [MOE] (2023)
Regulations for Periodic Regulatory Goals and Approaches of the Greenhouse Gas Emissions	In accordance with Article 10 of the Climate Change Response Act (formerly known as the Greenhouse Gas Reduction and Management Act), the GHG regulatory objectives are set on a five-year cycle, encompassing periods from 2016 to 2020, 2021 to 2025, and 2026 to 2030. Each sector is required to devise action plans and submit annual progress reports. The GHG regulatory goals should encompass the following elements: • Economy-wide periodic regulatory objectives. • Periodic regulatory goals for sectors including energy, industry, building, transportation, agriculture, and the environment. • Periodic targets for electricity carbon emission factors. • The latest annual progress report was released in September 2022. • The third phase of regulatory objectives will be released by 2024.	Climate Change Administration, Ministry of Environment [MOE] (2022)
Pathway to Net-Zero Emissions in 2050	In March 2022, Chinese Taipei officially introduced the Pathway to Net-Zero Emissions in 2050, outlining the action steps to achieve the 2050 net zero emissions. Key points from the pathway include: • Establishment of four major transition strategies: energy transition, industrial transition, lifestyle transition, and social (just) transition. • Setting a target for achieving net zero emissions by 2050. • Aiming for a net zero power generation mix by 2050, 60-70% renewable power generation, 9-12% hydrogen power generation, and 20-27% thermal power generation with CCUS by 2050. • Allocating nearly NTD 900 billion (approximately USD 29 billion) by 2030 for major plans related to the 2050 net zero transition. • Initiating updates to climate-related laws and regulations, including the Climate Change Act, the Energy Administration Act, the Electricity Act, the Renewable Energy Development Act, and so on.	NDC (2022)

Energy policy	Details	Reference
Phased Goals and Actions Toward Net Zero Transition	In December 2022, Chinese Taipei released a set of supplementary policy documents outlining the roadmap for achieving the Pathway to Net-Zero Emissions in 2050. Significant points from these documents include: • Strengthening the target to achieve a net emission reduction of 24±1% compared to the reference year (2005) by 2030, aligning with the objectives outlined in the COP26 Glasgow Climate Pact. • Introducing 12 key strategies for the 2050 net zero transition, encompassing areas such as wind and solar energy, hydrogen technologies, innovation in energy, power systems, and energy storage, energy efficiency and conservation, CCUS, carbon-free and EVs, resource recycling and zero waste management, carbon sinks, promoting green lifestyles, green finance, and ensuring a just transition for affected communities.	NDC (2022)
Energy Administration Act (Branches Regulations revision)	According to Paragraph 2, Article 12 of the Energy Administration Act, energy users whose consumption meets the criteria set by the central Competent Authority are required to submit their energy consumption data to said authority. The regulations titled Categories, Quantities, Items, Efficiency, Period, and Methods for the Submission of Energy Consumption Which Shall Be Reported by the Energy Users under the Energy Administration Act underwent revisions in 2021 and 2023. These revisions encompass: • Mandatory annual reporting of the 12-month operational energy performance indicators for HVAC and compressed air systems, such as kW/RT for HVAC and kW/CMM for compressed air systems (only for the energy users whose HVAC system capacity reaches 1 000 RT and over, compressed air system power reaches 500 HP and more). • Energy users engaged in electricity trading are permitted to report their energy savings to fulfil the legally mandated 1% measured electricity savings requirement. • Energy users operating data centres are required to report the environmental temperature settings and indicate whether they have installed submetering systems for Power Usage Effectiveness (PUE) measurement.	Ministry of Economic Affairs [MOEA](2023)
Hydrogen Fuel as an Energy Source in Law	In July 2023, Chinese Taipei enacted a revision to broaden the legal definition of energy, officially designating hydrogen fuel as an energy source within the framework of Article 2, Paragraph 6 of the Energy Administration Act. This revision serves as an interim measure, explicitly authorising the governance scope of designated energy products as a regulatory foundation until specific legislation solely focused on hydrogen is established.	Ministry of Economic Affairs [MOEA] (2023)

Energy policy	Details	Reference
Renewable Energy Development Act (Act Revision)	In May 2023, Chinese Taipei made significant revisions to the Renewable Energy Development Act, the primary legislation governing renewable energy initiatives. Key changes include: • Mandating that new, expanded, or renovated buildings install solar PV power generation systems of specific capacity. • Implementing explicit administrative protocols for the development of geothermal energy resources. • Eliminating restrictions related to territorial sea areas, returning to more precise technical definitions in the legislation.	Ministry of Economic Affairs [MOEA] (2022)
Commodity Tax Act (Act Revision)	In June 2023, the Chinese Taipei made amendments to Article 11-1 of The Commodity Tax Act. The revised article specifies that from 15 June 2023, to 14 June 2025, individuals purchasing new refrigerators, air conditioners (cooling/heating), or dehumidifiers (hereinafter referred to as energy-efficient appliances) certified by the Ministry of Economic Affairs as level 1 or level 2 in energy efficiency grading, and not intended for resale, exchange, or return, will be eligible for a maximum tax reduction of NTD 2 000 (USD 64) per unit on the Commodity Tax.	Ministry of Finance [MOF] (2023)
Parking Facility Act (Act Revision)	In November 2022, Chinese Taipei introduced amendments to Article 27-1 of The Parking Facility Act. The updated article mandates that public parking facilities must be furnished with designated spaces and charging infrastructure for EVs.	Ministry of Transportation and Communications [MOTC] (2022)
2022 Long-term Power Development Plan	In June 2023, based on the requirement of Article 91 of the Electricity Act, Chinese Taipei released the 2022 Long-term Power Development Plan report, which reveals the electricity consumption projection trend from 2023 to 2029 and the power generator planning to 2029. The key information includes: • Electricity consumption growth rate will reach 2.03% on average between 2023 and 2029. • The ratio of renewable energy in power generation will reach 15.5% in 2025 and 20% in October 2026 to fulfil the energy transition target.	Energy Administration, Ministry of Economic Affairs [MOEA] (2022)
Subsidies for Energy-Efficient Residential Gas Appliances	In December 2023, Chinese Taipei announced Subsidies for Energy-Efficient Residential Gas Appliances to allocate a budget of NTD 400 million (approximately USD 128 500) in 2024. This project aims to encourage households to replace old gas stoves and purchase gas stoves and water heaters with level 1 or level 2 energy efficiency ratings. It is expected to subsidise around 230 000 energy-saving products. The maximum subsidy amount per unit is set at NTD 3 000 (around USD 96), with a limit of one gas stove and one water heater per household for application.	Energy Administration, Ministry of Economic Affairs [MOEA] (2023)

Energy policy	Details	Reference
Energy-Efficient Subsidies for Residential Appliance Replacement	In December 2022, Chinese Taipei introduced the Energy-Efficient Subsidies for Residential Appliance Replacement, earmarking a budget of NTD 8 billion (approximately USD 257 million) from 2023 to 2026. The initiative seeks to incentivise households to replace outdated air-conditioners and refrigerators with new units with Level 1 energy efficiency ratings. The maximum subsidy per unit is capped at NTD 3 000 (USD 96), with each household eligible to apply for one air-conditioner and one refrigerator under this programme.	Energy Administration, Ministry of Economic Affairs [MOEA] (2023)
Demand Response Load Management Program 2024 Update	In January 2024, Taipower updated the Demand Response Load Management Program, which encompasses planned demand response, emergency demand response, demand bidding, direct load control (exclusive to schools), and demand response by electrical energy storage (limited to regulated users under the Renewable Development Energy Act).	Taipower (2024)
Subsidies for Installation of Stationary Fuel Cell Power Generation System	In January 2022, Chinese Taipei introduced Subsidies for Installation of Stationary Fuel Cell Power Generation System to pilot the distributed generation application for the commercial planning of the decentralised power generation system. These grants restrict installations to a rated capacity of 1 kW or more, but not exceeding 500 kW. The maximum subsidy for system installation is set at NTD 70 000 (around USD 2 240) per kW.	Energy Administration, Ministry of Economic Affairs [MOEA] (2022)
2023 Feed-in Tariffs of Renewable Energy Electric Power	Since 2010, Chinese Taipei has been introducing the feed-in tariffs (FiT) mechanism to promote renewable energy and updated the FiT rate on an annual basis by holding the hearing and review board to confirm the parameters. The FiT encompasses several renewable energy technologies, including solar PV, wind, biomass, waste, small hydropower, geothermal and marine. The auction system has only been introduced in solar PV.	Energy Administration, Ministry of Economic Affairs [MOEA] (2023)
Regulations Governing Approval for Hydrogen Fuel Sales Operation at Hydrogen Refueling Stations	In November 2023, Chinese Taipei announced the Regulations Governing Approval for Hydrogen Fuel Sales Operation at Hydrogen Refueling Stations to regulate the supply facilities for hydrogen transport based on the Energy Administration Act.	Energy Administration, Ministry of Economic Affairs [MOEA] (2023)
Motor-Driven and Public Utility Equipment Subsidy Program	Since 2016, through an annual revision, Chinese Taipei has been offering grants for the replacement of motor-driven and public utility equipment in industrial sites and institutions, including hospitals and medical institutes. This grant specifically covers air compressors (3.75~200 kW), fans (0.75~200 kW), and pumps (0.75~200 kW). The subsidy for equipment installation ranges from NTD 700 to 5 000 (approximately USD 22 to 160) per kW. For small and medium-sized enterprises, this grant offers an additional 20% subsidy for each piece of equipment.	Energy Administration, Ministry of Economic Affairs [MOEA] (2023)

Energy policy	Details	Reference
Equipment Energy Efficiency Regulation Update	Chinese Taipei implemented minimum energy performance standards (MEPS) in 2000 and energy labelling in 2009 to regulate the energy performance of equipment and home appliances in the sales market, aiming to guide consumers towards more energy-efficient choices. Chinese Taipei introduced the MEPS for ventilators in July 2023 (effective from July 2024) and updated the MEPS and energy labelling for dehumidifiers in November 2023 (effective from January 2026).	Energy Administration, Ministry of Economic Affairs [MOEA] (2023)
Subsidy of Wasted-heat and Wasted-cold Recycling Application and Demonstration Program	Since 2012, as part of a periodic revision, Chinese Taipei has provided grants for wasted-heat and waste-cold recycling technologies. The initiative is directed towards energy users with contracted capacities exceeding 100 kW. The subsidy covers one-third of the project budget, with a maximum subsidy of NTD 5 million (approximately USD 160 000) per project. Three weeks of measurements for testing, adjusting, and balancing (TAB) are required.	Energy Administration, Ministry of Economic Affairs [MOEA] (2023)
Subsidy of EPC (Energy Performance Contracting) Project	Since 2010, through an annual revision, Chinese Taipei has been providing grants for energy performance contracting in factories, medical institutes, government institutions and schools. This initiative targets energy users with contracted capacities exceeding 100 kW or a cumulative contracted capacity within the same organisation exceeding 500 kW. The subsidy covers 20% of the project budget, with a maximum subsidy of NTD 5 million (approximately USD 160 000) per project. Achieving a minimum energy-saving rate of 10% for each project is a mandatory requirement. Additionally, for small and medium-sized enterprises and specific projects, this grant offers an additional 10% subsidy for each project.	Energy Administration, Ministry of Economic Affairs [MOEA] (2023)
Subsidy for System Energy Saving Project of the Commercial Service Industry	In March 2023, Chinese Taipei initiated a subsidy programme for system energy performance contracting in commercial buildings. This programme is designed for energy users with contracted capacities exceeding 100 kW. The subsidy amounts to one-third of the project budget, with a maximum subsidy of NTD 5 million (approximately USD 160 000) per project. Achieving a minimum energy-saving rate of 10% for each project is a mandatory requirement.	Administration of Commerce, Ministry of Economic Affairs [MOEA] (2023)
Subsidy for Energy Saving Equipment Replacement of the Commercial Service Industry	In March 2023, Chinese Taipei launched a subsidy programme aimed at replacing old air conditioners and lighting fixtures with new units that have Level 1 energy efficiency ratings or LED lighting. The maximum subsidy for each air conditioner is NTD 2 500 per kW (refrigeration ton), with an overall maximum subsidy of NTD 35 000. For lighting, the subsidy covers 50% of the lighting purchase amount, with a maximum subsidy of NTD 500 per unit.	Administration of Commerce, Ministry of Economic Affairs [MOEA] (2023)
Taipower 2024 SavePower	Since 2010, the Taipower SavePower programme is primarily designed to encourage the public to save energy. As long as users' electricity consumption for the current period is lower than the same period last year, they are eligible to receive a reward of NTD 0.6 per kWh. The incentives primarily target residential electricity users, and the reward amount is directly applied as a rebate on the monthly electricity bill for the corresponding month.	Taipower (2023)

Energy policy	Details	Reference
Manual of Low Embodied-carbon Building Rating System	In accordance with the international standard for whole-life carbon footprint assessment, EN15978, Chinese Taipei has developed a manual for the assessment of low-embodied carbon buildings in June 2023. This methodology is designed to align with the Green Building Certification and the Building Energy Efficiency Rating System, thereby implementing a comprehensive low-carbon building assessment system.	Architecture and Building Research Institute, Ministry of the Interior [MOI] (2023)
Green Building Evaluation Manual (2024 update) and Building Energy Efficiency Rating System (2024 update)	In December 2023, Chinese Taipei introduced the Expert Building Energy-efficiency Rating System for Existing Buildings (E-BERSe) to streamline the refurbishment of non-residential buildings. The assessment covers various aspects, including the building envelope, air conditioning, lighting, elevator, and renewable energy.	Architecture and Building Research Institute, Ministry of the Interior [MOI] (2023)
Management Measures for Greenhouse Gas Emission Reduction Quota Trading, Auction, and Transfer (drafted revision)	In December 2023, Chinese Taipei released the draft version of Management Measures for Greenhouse Gas Emission Reduction Quota Trading, Auction, and Transfer to establish the domestic carbon market by adopting the carbon pricing (carbon fee) scheme.	Ministry of Environment [MOE] (2023)

Notable Energy Developments

Energy development	Details	Reference
Carbon Pricing Policy Planning	In 2024, Chinese Taipei implemented a carbon pricing scheme. Entities subject to carbon fee collection include those in the power and manufacturing industries with annual emissions reaching 25 000 tonnes of CO_2 equivalent. The carbon fee rate will be discussed and determined in the first quarter of 2024, following submission to the review committee. Entities that successfully implement self-initiated reduction plans may apply for preferential rates.	Ministry of Environment [MOE] (2023)
Energy Administration Policy Reform	On 16 May 2023, the Legislative Yuan passed the Act of the Organization of the **Energy Administration** (EA) in its Third Reading, and the President promulgated the implementation of the Act on 7 June of the same year. Following the decree of the Executive Yuan on 26 September, 2023, the EA was officially established, the predecessor of the Bureau of Energy. One Director General, two Deputy Director Generals, and one Secretary-General lead the EA. The organisational structure of the EA includes six divisions: Energy Policy and Climate Change Division, Petroleum and Gas Development and Management Division, Electricity Development and Management Division, Energy Conservation Development and Management Division, Renewable and Prospective Energy Development Division, and Renewable Energy Facilities Promotion Division.	Energy Administration, Ministry of Economic Affairs [MOEA](2023)
Environment Protection Policy Authority Reform	On 9 May 2023, the Legislative Yuan passed the Act of the Organization of the **Ministry of Environmen**t (MOE) in its Third Reading. Following the decree of the Executive Yuan on 22 August 2023, the MOE was officially established, the predecessor of Environment Protection Administration (EPA).	Ministry of Environment [MOE] (2023)
Electricity Wholesale and Retail Price Review	Governments regulate electricity prices in Chinese Taipei. Based on Article 49, Article 9, and Article 10 of the Electricity Act, MOEA established a committee to review electricity prices and related tariff for electricity system operations. The committee conducts biannual reviews of electricity prices in March and September and provides recommendations to MOEA. On 17 March 2023, Chinese Taipei implemented an average 11% increase in electricity prices due to the rising cost of imported fuel. On 19 September 2023, Chinese Taipei decided not to adjust electricity prices but cancelled the mechanism that froze electricity prices for specific service industries during the pandemic.	Energy Administration, Ministry of Economic Affairs [MOEA](2023)

Energy development	Details	Reference
Electricity Transmission and Distribution Tariffs Review	On 29 November 2023, Chinese Taipei adjusted electricity rates. The power dispatch and transferred distribution fees increased due to higher fuel prices and infrastructure upgrades. Meanwhile, auxiliary service and transferred transmission fees decreased, influenced by private resource participation, reducing purchase prices through competitive bidding, including energy storage and self-generated power devices.	Energy Administration, Ministry of Economic Affairs [MOEA](2023)
Kuosheng Nuclear Power Plant Decommissioned	Chinese Taipei maintains its nuclear-free policy to 2025, with no life extensions or new nuclear plant construction since 2017. • Chinshan (No.1) Nuclear Power Plant decommissioned in July 2019. • Kuosheng (No.2) Nuclear Power Plant decommissioned in March 2023. • The last two reactors in Maanshan (No.3) nuclear power plant will shut down in July 2024 and May 2025.	Taipower (2023)
LNG Terminal 4 Infrastructure Plan	On 11 November 2023, the Mayor of Keelung City expressed concerns about the potential security risk related to the development of the LNG Terminal 4 and the conversion of the Hsieh-Ho oil power plant to a gas power plant in Keelung port. In response, the Keelung City Government decided to retract its agreement on the LNG Terminal 4 plan, originally set to be operational by 2029, with a projected supply capacity of 0.9 million tonnes per annum (mtpa).	Energy Administration, Ministry of Economic Affairs [MOEA](2023)
Solar PV Development in 2023	By November 2023, the additional capacity of solar PV power capacity reached a record of 2.28 GW, and the cumulative capacity of solar PV was 12 GW, which was far behind the 2025 target of 20GW.	Energy Administration, Ministry of Economic Affairs [MOEA](2023)
Wind Development in 2023	By November 2023, the additional capacity of wind power capacity reached a record of 1.08 GW, and the cumulative capacity of wind power was 2.6 GW, which was far behind the 2025 target of 5.6 GW.	Energy Administration, Ministry of Economic Affairs [MOEA](2023)
Geothermal Power Generation Development 2023	Chinese Taipei's current geothermal development capacity amounts to 61.75 MW, including Taipower’s Renze Geothermal Power Plant, with 7.29 MW that has already been connected to the grid, which officially opened on 24 October 2023. Additionally, CPC’s 4 MW Yilan Tuchang geothermal project is expected to join the grid next year, with a target of achieving a cumulative capacity of 20 MW by 2025.	Taipower (2023)
Hydrogen Development in 2023	On 14 November 2023, Taipower and Academia Sinica announced an achievement in methane pyrolysis, aiming for a hydrogen blending power generation demonstration. Taipower stated that the methane pyrolysis hydrogen technology, developed by Academia Sinica, was integrated with Chinese Taipei’s first domestic 65 kW hydrogen-blended micro gas turbine power generation system. In September 2023, they successfully operated the power generation system with a 10% hydrogen blend.	Taipower (2023)

Energy development	Details	Reference
Hydrogen Energy Development Roadmap	The government-sponsored Industrial Technology Research Institute (ITRI) has unveiled a technological development plan for the application of hydrogen energy in Chinese Taipei.	Industrial Technology Research Institute [ITRI] (2022)
The Third Pumped Hydro Power Plan	Chinese Taipei is planning to implement two new pumped-hydro power development projects, namely Shihmen (43.6 MW, two generators) and Guangming (368 MW, two generators). The aim is to have these projects operational by 2024.	Taipower (2023)
Electric Energy Storage Development in 2023	Taipower has installed a 20 MW electric energy storage system in Tainan, consisting of eight 20-foot storage containers equipped with over 1 000 lithium battery modules. The total storage capacity reaches 20 000 kilowatt-hours, equivalent to providing one hour of electricity for 40 000 households. Officially inaugurated on 6 January 2023, it not only marks the first integrated solar and storage system in Chinese Taipei but also stands as the largest electric energy storage system in Chinese Taipei.	Taipower (2023)

Useful links

NDC – https://www.ndc.gov.tw/en/Default.aspx.

MOE (Ministry of Environment) – https://www.moenv.gov.tw/

MOE Climate Change Talks platform – https://www.climatetalks.tw/

MOEA (Ministry of Economy Affairs) – https://www.moea.gov.tw/Mns/english/home/English.aspx.

EA (Energy Administration), MOEA – https://www.moeaea.gov.tw/ECW/english/home/English.aspx

Energy Statistics Information System – https://www.esist.org.tw/

MOI (Ministry of the Interior) – https://www.moi.gov.tw/english/

Architecture and Building Research Institute, MOI – https://www.abri.gov.tw/en/Default.aspx

MOTE (Ministry of Transportation and Communication) – https://www.motc.gov.tw/ch/index

Taipower – https://www.taipower.com.tw/en/index.aspx

CPC – https://www.cpc.com.tw/en/

Formosa Plastics Group – https://fpg.com.tw/tw

Renewable Energy Certification Centre (T-REC) – https://www.trec.org.tw/https://www.trec.org.tw/

Feed-in tariffs (FIT) review – https://www.moeaea.gov.tw/ECW/RENEWABLE/news/News.aspx?kind=1&menu_id=767

Electricity Price and related tariff review – https://www3.moeaea.gov.tw/ele102/Content/Messagess/contents.aspx?MmmID=654246034150461022

Minimum Energy Performance Standards (MPES) website – https://www.meps.org.tw/

Energy labelling website – https://www.energylabel.org.tw/

Manufacturing energy audit reporting system – https://emis.itri.org.tw/energyaudit/

Non-manufacturing energy audit reporting system – https://energynet.tgpf.org.tw/

Government institute, K-12 and university energy audit reporting system – https://egov8.ftis.org.tw/home

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Thailand

Introduction

Thailand has undergone remarkable economic development and urbanisation in recent decades, as quoted by the World Bank (2023). Thailand has an area of 513 120 square kilometres (km^2) and had a population of 71.6 million in 2021. In 2021, its gross domestic product (GDP) increased to approximately USD 1 220 billion, a 1.5% increase compared to the previous year. The increase was due to improved demand for goods and services both domestically and internationally, coupled with the easing of COVID-19 control measures. This includes the reopening to foreign tourists and measures implemented to stimulate the economy. Thailand is not only a sought-after tourist destination but is also a crucial economic hub within the Southeast Asia region. With a commitment to sustainable development and a focus on energy security, Thailand has been actively shaping its energy landscape to balance economic growth with environmental considerations.

Thailand faces constraint in its domestic energy resources. The production of domestic resources, primarily gas extracted from the Gulf of Thailand, continued to decline beyond the levels observed in 2020. As of the end of 2021, Thailand possessed proven reserves amounting to 95 million barrels of crude oil, 86 million barrels of condensate, and 3 445 billion cubic feet of natural gas (EPPO, 2022). Additionally, there were approximately 1.1 billion tonnes of coal reserves at the close of 2020 (EI, 2023). At the current production rates, the domestic supply of oil and natural gas is expected to be depleted within approximately three years. However, when considering probable and possible reserves, crude oil, condensate, and natural gas are projected to be available for use for 7, 12, and 9 years, respectively.

Thailand is highly dependent on energy imports, with approximately 90% of its crude oil and 30% of its gas supply coming from imports in 2021. Moreover, given that most of Thailand's proven coal reserves consist of low-calorific-value lignite coal, the economy depends on imported bituminous coal to fulfil the energy requirements of both the power and industrial sectors.

Table 1: Thailand macroeconomic data and energy reserves

Key data [a]		**Energy reserves [b, c]**	
Area (km^2)	513 120	Oil (million barrels)	181
Population (million)	71.6	Gas (billion cubic feet)	3 445
GDP (2017 USD billion PPP)	1 224	Coal (million tonnes)	1 063
GDP per capita (2017 USD PPP)	17 087	Uranium (kilotonnes U < USD 130/kgU)	n/a

Source: [a] World Bank (2023); [b] EPPO (2022); [c] EI (2023)

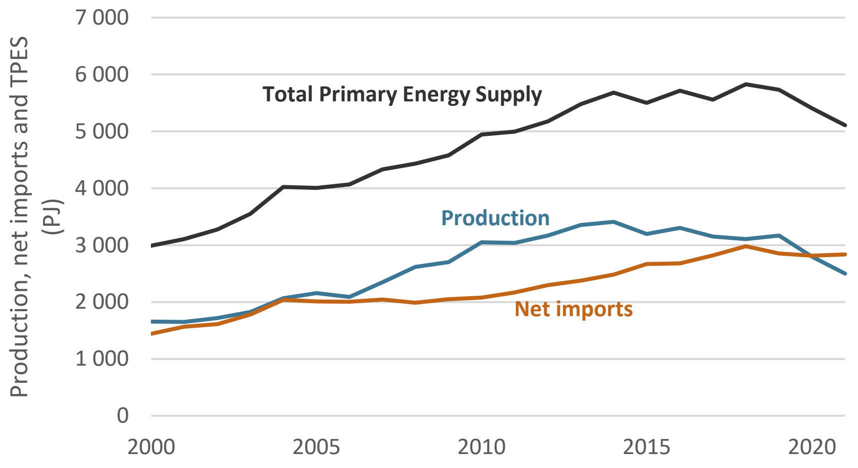
Note: Reserves are total proved reserves and reasonably assured recoverable resources for uranium.

Energy Supply and Consumption

Total primary energy supply

In 2021, Thailand experienced a notable 5.5% reduction in its total primary energy (TPES), amounting to 5 100 PJ. This marked the third consecutive year of decline, primarily influenced by pre-economic recovery from the COVID-19 pandemic. The reduction in production, attributed to depleting reserves since 2015, was further intensified in recent years. Concurrently, there was a noticeable rise in net imports, with 2020 witnessing a surpassing of net imports over domestic production (Figure 1).

Figure 1: Thailand energy supply, production, and net imports (PJ), 2000 to 2021

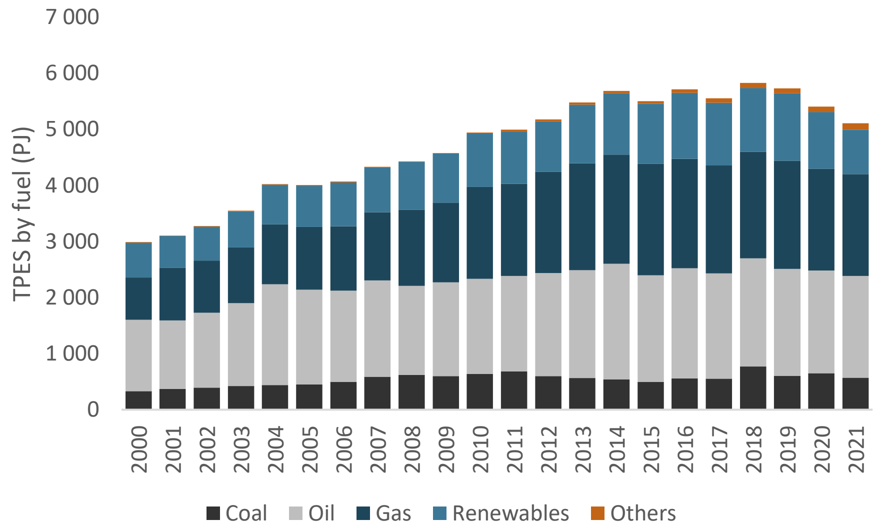


Source: EGEDA (2023)

Fossil fuels play a dominant role in Thailand's energy supply mix, with oil and gas contributing to over two-thirds of TPES (Figure 2). While all fuels observed a decline, gas maintained a stable supply. Renewables showed the highest percentage decline year-on-year at -20%, followed by coal at -10%. Despite gas supply stability, depleting domestic gas reserves led to an increased import of liquefied natural gas (LNG). The share of domestic gas production to imported gas, including both pipeline and LNG, was recorded as 70:30 in 2021.

To address the challenges and enhance energy security, the government has undertaken initiatives such as expanding LNG receiving terminals, implementing more regasification systems, and constructing gas storage tanks. These efforts aim to support higher LNG receiving capacity, with a target of reaching 46 million metric tonnes per annum (MMTPA) by 2027. Notably, the recently completed LNG receiving terminal, known as Terminal 2 or T-2, with a capacity of 7.5 MMTPA with an additional expansion capacity of 7.5 MMTPA, received its first LNG commission in 2022.

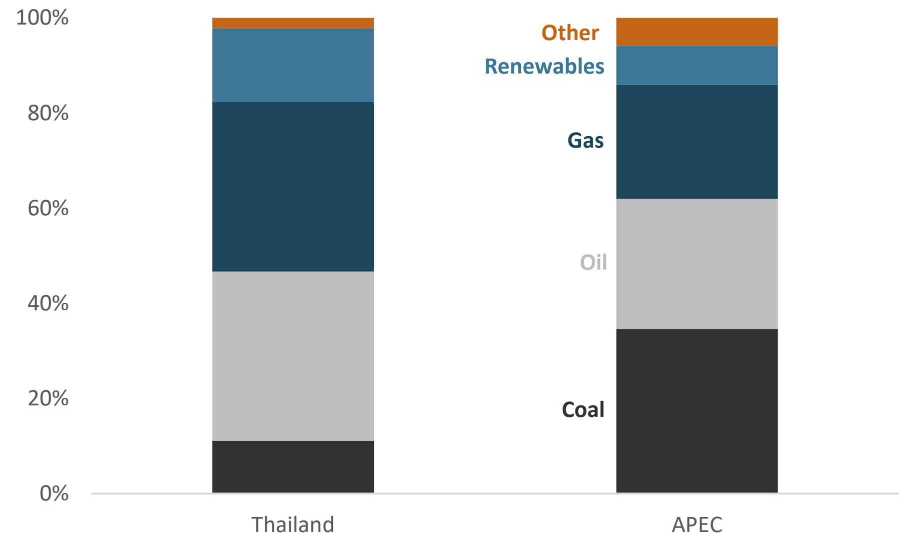
Figure 2: Thailand energy supply by fuel (PJ), 2000 to 2021



Source: EGEDA (2023)

Compared to APEC, Thailand possesses a substantially smaller proportion of coal supply (Figure 3). This is largely attributed to the economy relying on a limited coal deposit in Mae Moh for power generation. Thailand is actively transitioning towards cleaner energy sources, particularly gas, amplifying the prominence of gas in its energy mix following the discovery of domestic gas in the 1980s. As for renewables, hydro and solar energy constitute the primary sources. Notably, Thailand engages in the energy trade of hydroelectric power from Lao PDR, a move facilitated by its geographical proximity coupled with investment from Thai companies to exploit in Laos' substantial hydropower potential.

Figure 3: Energy supply mix – Thailand and APEC, 2021



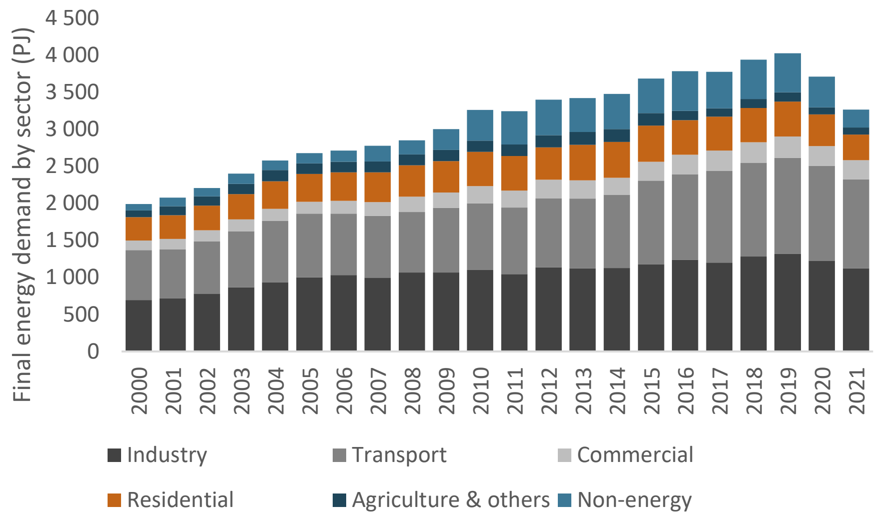
Source: EGEDA (2023)

Total final consumption

Impacts of COVID-19 to the final consumption of energy were more pronounced in 2021. Final energy consumption was further reduced across all sectors compared with the previous year (Figure 4). Total final consumption further reduced by 12% compared with 2020, driven largely by non-energy and industry in the absolute value.

The tourism industry and export industry have long been major contributing sectors to Thailand's economic growth. Despite the government efforts to promote inbound tourism such as Phuket Sandbox in July 2021 and the Test & Go scheme in November 2021, the emergence of new COVID variants hindered the success of these economic stimulus plans.

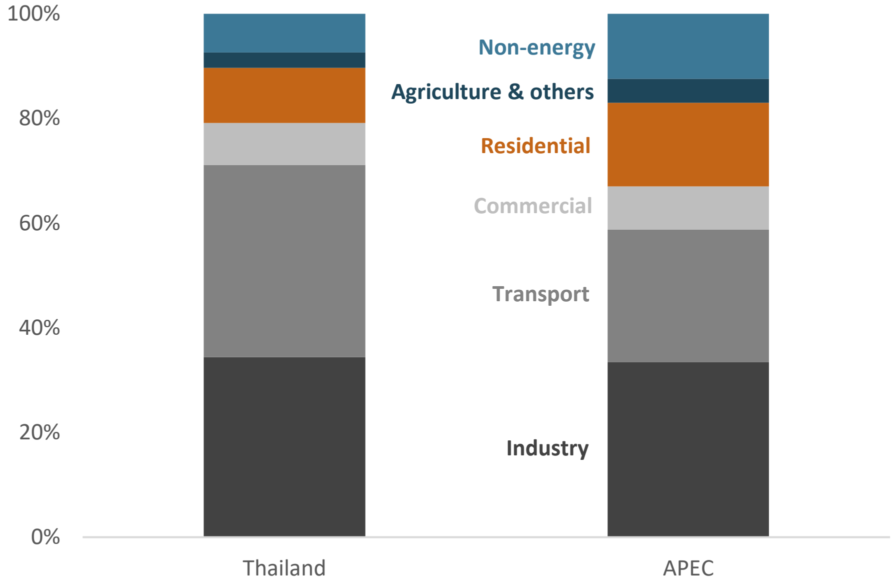
Figure 4: Thailand final consumption by sector (PJ), 2000 to 2021



Source: EGEDA (2023)

Consequently, there was a reduction of energy consumption in the commercial and transport sectors. Likewise, the industry sector, driven largely by the export of manufacturing goods, experienced a continued decline in its energy consumption. Final energy consumption of the transport and industry sectors contracted by 6% and 8%, respectively in 2021.Thailand's industry sector exhibited a comparable market share to that of APEC (Figure 5). Notably, the transportation segment surpassed APEC's share by a substantial 10 percentage points, while conversely, the residential sector lagged by 5 percentage points.

Figure 5: Final consumption by sector, Thailand and APEC, 2021



Source: EGEDA (2023)

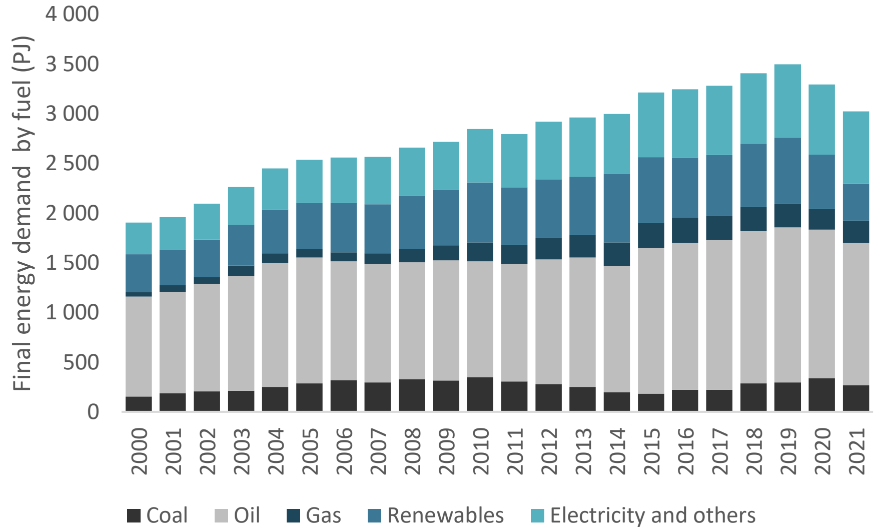
Final energy demand

Thailand experienced an 8% reduction in its final energy demand in 2021, totalling 3 000 PJ (Figure 6). Fossil fuels constituted more than 60% of this final energy demand. Over the past decade, Thailand witnessed a rise in the growth of oil and gas demand (1.5-2.0%), whereas the growth in coal demand decreased by approximately 2.5%.

The decline in oil demand can be attributed to restricted mobility, primarily during the second and third quarters of 2021, due to new waves of COVID variants. Conversely, gas demand experienced an upswing, driven by the resurgence of the export-oriented manufacturing industry amid the global economic recovery. However, the increase in gas demand was counterbalanced by reductions in the power and transport sectors, especially with a lower number of stations and a decrease in compressed natural gas (CNG) fleets.

Additionally, electricity demand increased by 2.2% due to higher manufacturing output for export-oriented goods. Furthermore, the shift to remote work and online education played a significant role in driving up demand for electricity and others.

Figure 6: Thailand final energy demand by fuel (PJ), 2000 to 2021



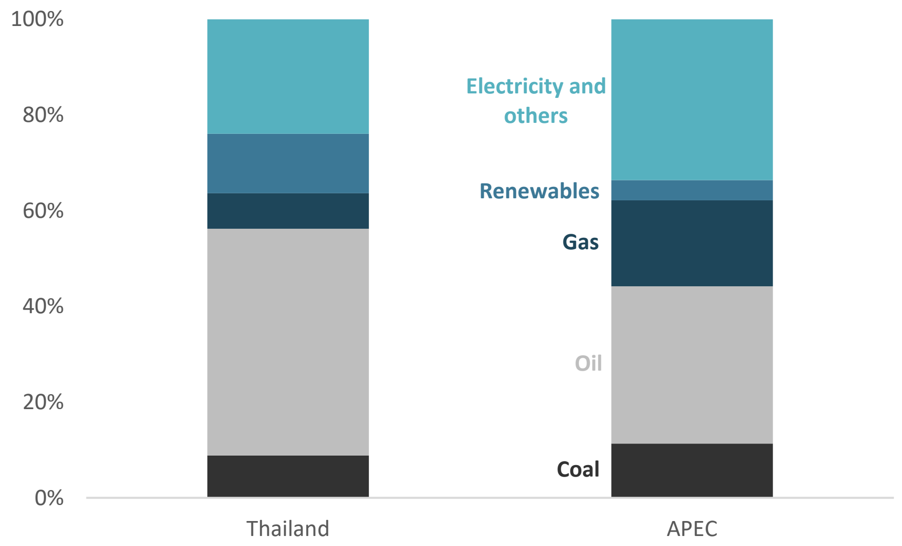
Source: EGEDA (2023)

Note: Does not include non-energy sector consumption of energy products.

The composition of Thailand's final energy demand differs from that of APEC in several aspects. The predominant share of oil demand, primarily driven by the transport sector, especially due to the influence of the tourism industry, accounted nearly 50%. Additionally, the share of renewables, particularly biomass sourced from the agricultural sector, reached 12% in 2021, surpassing APEC's figures significantly (Figure 7).

On the other hand, the demand shares of gas and electricity, along with other sources, fall below the corresponding shares in APEC. This discrepancy reflects a distinct final energy demand pattern in Thailand compared to the broader APEC region.

Figure 7: Final energy demand fuel share, Thailand and APEC, 2021



Source: EGEDA (2023)

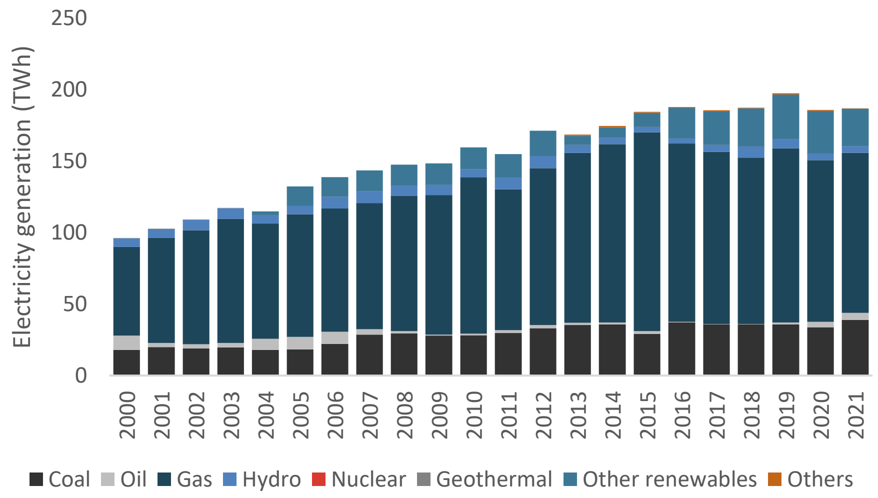
Transformation

Power sector

Power generating capacity stood at 50.9 GW as of end of December 2021 (EPPO, 2022). EGAT and independent power producers made up almost two-thirds of this capacity. The remainder comprised of small power producers, very small power producers, and imports (approximately 10%). Particularly, Thailand currently imports hydroelectricity from Lao PDR and has electricity exchange arrangements with Malaysia to enhanced overall grid stability during demand fluctuation.

Electricity generation saw a slight uptake (Figure 8), reaching 187 000 GWh in 2021, predominantly relying on natural gas (60%). The year-on-year percentage growth has plateaued since 2015. Comparing this trend alongside a continual rise in electricity demand suggests a decoupling of electricity demand from generation growth, aligning with the Thai Government's effort to improve energy efficiency and leverage technological advancements, particularly in the steel and automobile industry.

Figure 8: Thailand electricity generation by fuel, 2000 to 2021

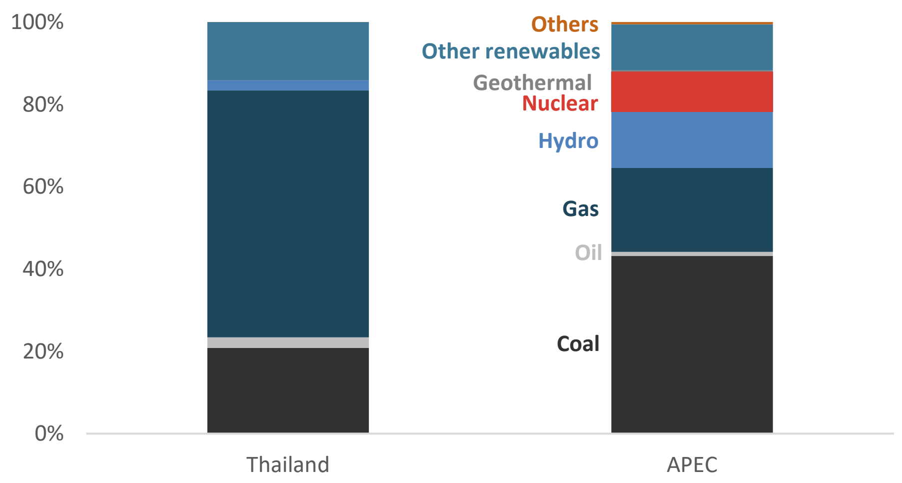


Source: EGEDA (2023)

Given Thailand's initial abundance of natural gas resources from the

Gulf of Thailand, and recognising the lower emissions associated with gas compared to coal and oil, the economy predominantly utilised gas for electricity generation. However, Thailand currently faces the challenge of a diminishing domestic gas supply, necessitating an increased reliance on LNG imports. Elevated LNG prices have the potential to escalate the costs of electricity generation. Additionally, heightened pipeline imports from Myanmar pose concerns regarding gas supply security. This concern materialised in 2015 when power plants had to switch to fuel oil and diesel, incurring higher costs during the suspension of pipeline gas due to maintenance (Reuters, 2015).

Figure 9: Electricity generation fuel share, Thailand and APEC, 2021



Source: EGEDA (2023)

The dominance of natural gas becomes evident when comparing it to the generation mix observed for APEC (Figure 9). Additionally, Thailand exhibits a relatively lower proportion of coal and hydroelectricity generation. Continuous growth in other renewables is expected to be driven by supportive policies, abundant renewables potential, especially solar and biomass, and the growing cost competitiveness of related technologies.

Refining

Thailand is among the few economies in APEC's Southeast Asia that have a self-sufficient policy in the production of petroleum products. The petroleum refining sector in Thailand comprises six major refineries and one small refinery for military use. In 2021, Thailand's refinery capacity stood at 1 245 thousand barrels per day (kb/d), compared to 840 kb/d in domestic petroleum product consumption. The Thai Oil refinery is expanding its refinery capacity by 125 kb/d, with a goal of shifting to higher value-added products, with expected commissioning in 2025 (IEA, 2023). Furthermore, the Thai refinery sector also serves as a major supplier of petroleum products to neighbouring economies. Crude oil intake by refineries was slightly under 1 000 kb/d in 2021, indicating an approximately 80% utilisation rate. Despite the lower import volume, substantial decline in domestic petroleum product consumption resulted in a heightened export volume to regional markets such as Myanmar, Cambodia, and Viet Nam. Thailand produced 1 015 thousand barrels of petroleum products per day, with diesel accounting for 45% of total production.

Energy Transition

Thailand has committed to energy transition as evidenced by the Long-term Low Greenhouse Gas Emission Development Strategy. This strategy outlines the economy's commitment to achieve carbon neutrality by 2050 and net zero greenhouse gas emissions by 2065. In 2021, the Thai Government introduced the promotion of electric vehicles (known as the 30@30 policy), which aims to achieve a minimum 30% production of low or zero-emission vehicles by 2030.

The objective is to position Thailand as a leading hub for electric vehicle production in the ASEAN region.

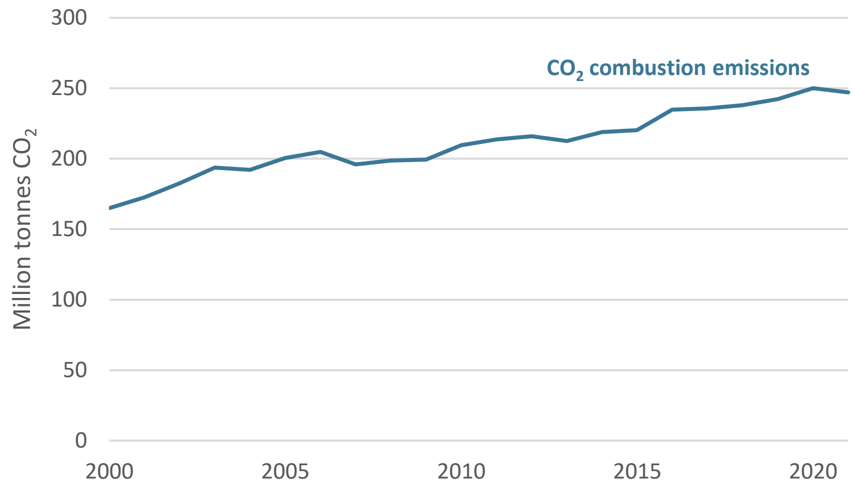
The Thailand Integrated Energy Blueprint (TIEB), introduced in 2015 and partially revised in 2018 with the target year of 2037, serves as a guiding framework for the long-term direction of the energy landscape and value chain. The Blueprint covers five key development areas: power, energy efficiency, alternative energy, gas and oil. Revisions to the targets are expected with the assumption of a new government in 2023.

Emissions

Under Thailand's 2nd Updated Nationally Determined Contribution (NDC) published in November 2022, Thailand aims to reduce relative GHG emissions of 30-40% by 2030, with the more ambitious reduction dependent on international support. Thailand expects to emit 555 million tonnes of carbon dioxide equivalent ($MtCO_2eq$) in the 2030 in the business-as-usual.

Over the past two decades, Thailand has witnessed a 2% annual increase in CO_2 combustion emissions, primarily attributed to the economy's dependence on fossil fuels for its development. The power sector has been the primary contributor to these emissions, accounting for 35% of the total. In 2021, there was a slight reduction in emissions to 247 million tonnes compared to the previous year, a trend associated with the economic repercussions of the COVID-19 pandemic. Moreover, the industry sector observed an increase in emissions during this year, while other sectors experienced a decline.

Figure 10: Thailand CO_2 combustion emissions (million tonnes), 2000 to 2021



Source: EGEDA (2023)

Energy security

Thailand's self-sufficiency, a ratio of domestic production to total primary energy supply, has shown a decline, reaching about 48% in 2021. Within the economy, 10%, 40%, and 70% of crude oil, coal, and gas supply, respectively, is produced domestically. Particularly, productions of domestic natural gas declined to 3 200 million standard cubic feet per day (mmscfd), marking a 2% decline from the previous year. This decline is notable when compared to the peak of gas production of 4 070 mmscfd in 2014, attributed in part to resource depletion and the hand-over of operations from Chevron to the local operator, PTT Exploration and Production (PTTEP), due to the expiration of the concession.

LNG imports in 2021 was averaged at 829 mmscfd, an 11.5% increase from the previous year to compensate for a decline in domestic production. Crude oil imports declined 2.9% to 863 kb/d, with imports from the Middle East accounting for 49%. Coal imports increased slightly at 0.7% to 23 931 thousand tonnes.

APEC Energy Goals

There are two energy-related objectives that APEC member economies have agreed to meet as a collective: to improve energy intensity and double the share of modern renewables.

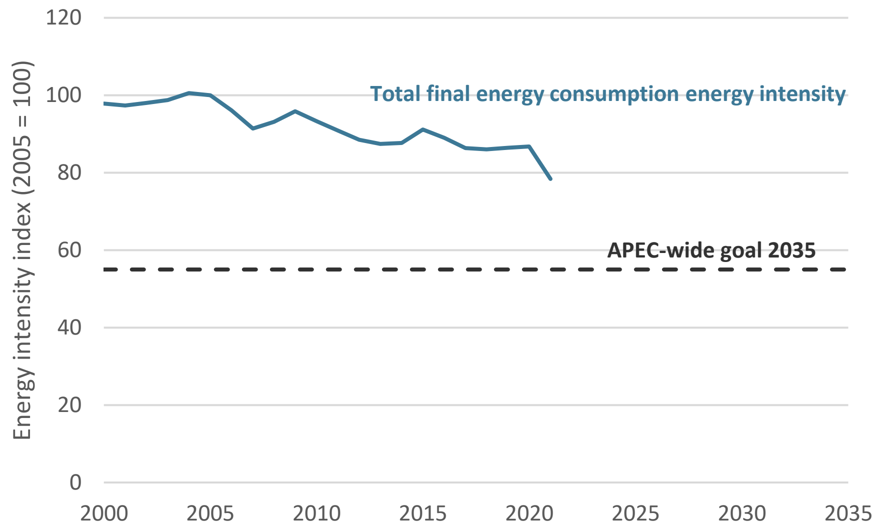
Energy intensity goal

In 2011, APEC member economies agreed to increase their ambition to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

APEC is on track to achieve this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

Despite a decrease in total final consumption by 8% in 2021 compared to 2020, the increase in GDP by 0.2% led to a lower energy intensity for Thailand. The economy achieved a 22% reduction in energy intensity, slightly below the 28% reduction accomplished by APEC.

Figure 11: Thailand total final energy consumption intensity index, 2000 to 2021 (2005 = 100)



Source: EGEDA (2022)

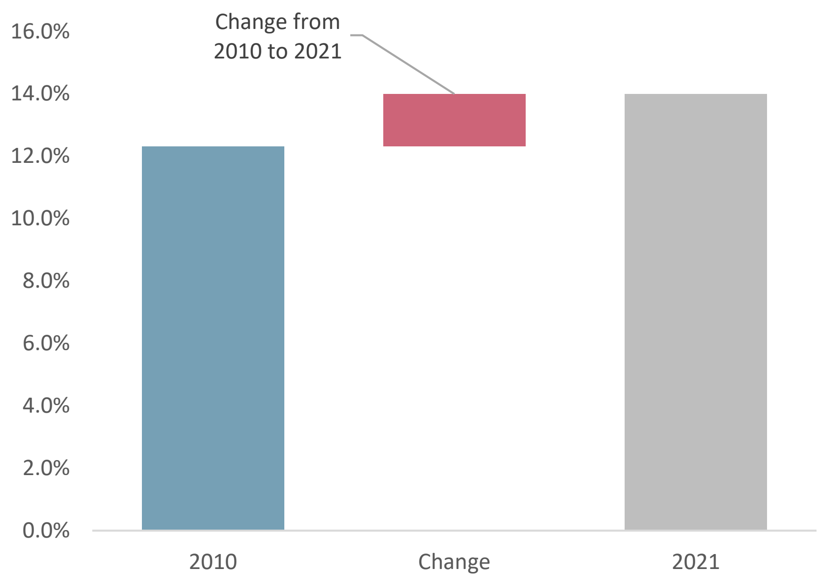
Doubling of renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period 2010 to 2030. There is no economy-level goal for individual member economies, but improvements by individual economies will contribute to the doubling goal.

Between 2010 and 2021, Thailand experienced a 1.4 percentage point increase in its share of modern renewable energy, reaching nearly 14%. Although Thailand experiences lower annual growth rates compared to APEC, the economy's modern renewable energy share surpassed that of APEC (10%). APEC aims to achieve a 12% share of modern renewable energy by 2030.

Thailand is currently adopting the Alternative Energy Development Plan (AEDP) 2018, with a goal of reaching a 30% share by 2037. The Long-Term Low Greenhouse Gas Emission Development Strategy (LT-LEDS) sets a target of at least 50% renewable energy in new power generation by 2050, with a specific focus on reaching a combined 65% from solar and wind sources in total electricity generation by 2060. The Thai Government is in the process of approving the Thailand National Energy Plan (NEP) 2023, the successor to the introduced TIEB in 2015. This new plan aims to support the targets outlined in LT-LEDS, anticipating a higher share of modern renewable energy in the near future.

Figure 12: Thailand modern renewable energy share, 2010 and 2021

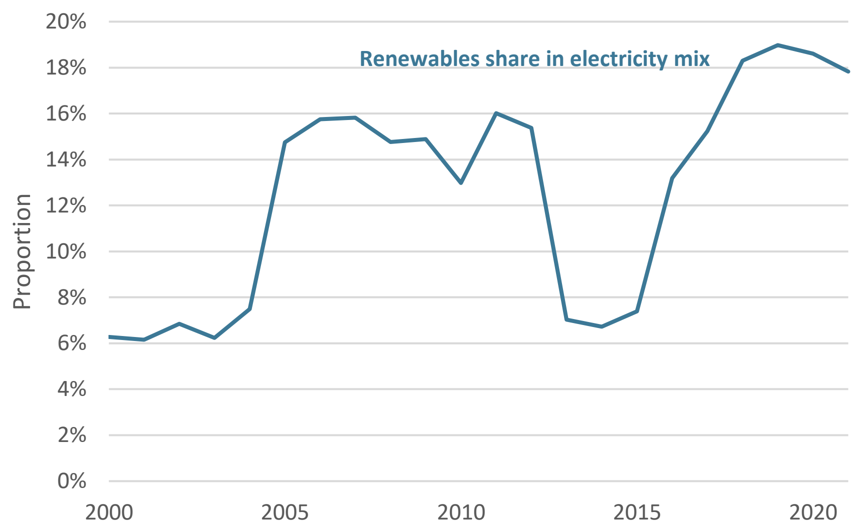


Source: EGEDA (2023)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

In 2021, the electricity generation amounted to 187 TWh, a slight increase from 186 TWh in 2020. Renewable energy sources contributed 33 TWh, constituting 18% of the total generation mix. The share of renewables in the mix declined by 2 percentage points compared to the preceding year, primarily attributed to reduced solid biomass generation and the impact of a two-year drought on hydro generation. Solid biomass accounted for half of the total renewable energy generation.

Figure 13: Thailand renewable generation share, 2000 to 2021



Source: EGEDA (2023)

Energy Policy

Energy policy	Details	Reference
2nd Updated NDC	30-40% GHG emissions reduction relative to a projected business-as-usual level by 2030 (555 $MtCO_2eq$). Additionally, Thailand aims to increase the target of renewable energy share in the new power generation to 50% within 2050.	UNFCCC
Long-Term Low Greenhouse Gas Emission Development Strategy (LT-LEDS) (Revised version)	Thailand aims to achieve carbon neutrality by 2050 and net zero GHG emissions by 2065. The strategy outlines long-term GHG mitigation actions in the energy, industrial processes and product use, agriculture, waste, as well as land use, land use change and forestry sectors.	ONEP
Thailand Integrated Energy Blueprint	Five energy development plans, including power, energy efficiency, alternative energy, oil and gas, with target year in 2037. The revision is expected to align with the revised LT-LEDS, following the assumption of the new government in 2023.	EPPO
Promotion of electric vehicles (known as the 30@30 policy)	A strategic commitment to accelerate the widespread use of EVs with tax and non-tax incentives. The initiative sets a goal that 30% of all vehicles manufactured in Thailand are electric by 2030.	ITA

Notable Energy Developments

Energy development	Details	Reference
Goals for clean energy and advanced energy system	Formulating an ambitious goal of renewable energy production, promoting solar and hydro-floating solar hybrid installation, and implementing CCUS and hydrogen technology.	NSTDA
Renewable energy project investment opportunity	Announcing a call for proposals for 5 000 MW renewable power generation capacity in solar, biogas, and wind power projects.	Watson Farley & Williams
Bio-Circular-Green Economy or BCG Model	Sustaining growth and improving environment by maximum the utilisation of local energy resources and converting waste into energy.	NSTDA

Useful links

Thailand's Energy Statistics – https://www.eppo.go.th/index.php/en/

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United States

Introduction

The United States is a geographically varied and resource-rich economy that both consumes and produces energy. The United States encompasses 50 states plus the District of Columbia, a federal district designated as the economy's capital. Of these 50 states, 48 are contiguous, positioned between Canada and Mexico, and the two others are Alaska (located north-west of Canada) and Hawaii (a cluster of islands in the Pacific Ocean). Additionally, the United States has five inhabited territories located in the Pacific and Atlantic Oceans.

The United States is historically one of the largest consumers of energy globally and, out of the APEC economies, the United States has the second highest global share of primary energy consumption at close to 16%. While the United States' primary energy consumption continues to be dominated by fossil fuels, in recent years, coal has decreased and renewables have increased. The economy's energy consumption is diverse, with applications in transportation, industry, residential and commercial sectors. The United States also has one of the highest levels of per capita final energy demand in APEC.

The US energy production continues to be greater than the US energy consumption, a trend that began in 2019. After a long break, the United States began exporting LNG in 2016 and was the top global exporter in 2023. Internationally, the United States' LNG export capacity and flexible destination clause policy has provided consumers in Asia and Europe the option to diversify their import sources. Domestically, environmentalists in the United States are expressing concerns about the gas industry's contributions to greenhouse gas (GHG) emissions. In addition to LNG exports, the United States exports crude oil, petroleum products, coal, and electricity, and exports renewable and nuclear energy equipment.

The United States has implemented initiatives to address climate change and promote a shift towards cleaner energy sources. It has participated in international collaborations aimed at reducing GHG emissions, and through federal and state regulations and subsidies, encouraged the increased use of solar and wind energy domestically. Regarding energy infrastructure, the United States has taken measures to modernise the grid to enhance resiliency and reliability. Additionally, incentives and subsidies have been introduced to promote the adoption of electric vehicles and reduce emissions in the transportation sector, and to invest in innovation and human capacity building for the clean energy sector.

Table 1: The United States macroeconomic data and energy reserves

Key data [a, b]		**Energy reserves** [c, d]	
Area (million km^2)	9.9	Oil (billion barrels)	44.4
Population (million)	332	Gas (trillion cubic feet)	625.4
GDP (2017 USD billion PPP)	21 129	Coal (million tonnes)	470 000
GDP per capita (2017 USD PPP)	63 636	Uranium (kilotonnes U < USD 130/kgU)	49

Source: EIA (2023); World Bank (2023); EI (2023); IAEA & NEA (2023)

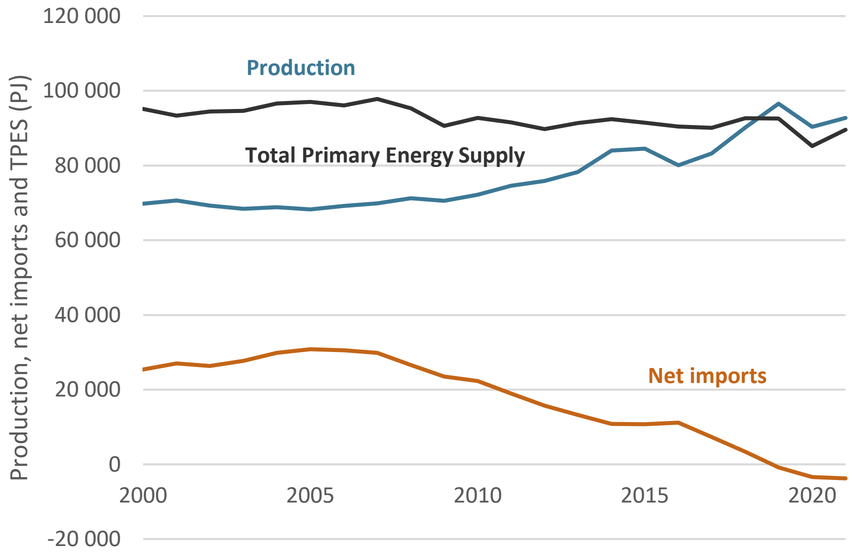
Note: Reserves are total proved reserves and reasonably assured recoverable resources for uranium.

Energy Supply and Consumption

Total primary energy supply

In the United States, total primary energy supply (TPES) has been on a slight decline since 2000.

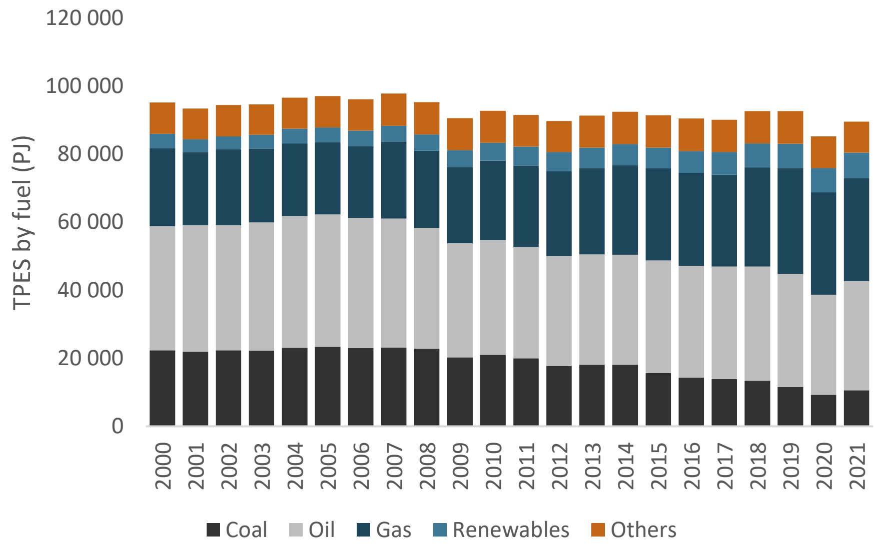
Figure 1: The United States energy supply, production, and net imports (PJ), 2000 to 2021



Source: EGEDA (2023)

In 2019, the US became a net energy exporter. The primary drivers of this transition from energy importer to exporter were the substantial growth in both the US oil and natural gas production. While there was a dip in production and TPES in 2020 due to the COVID-19 pandemic, both began to recover in 2021.

Figure 2: The United States energy supply by fuel (PJ), 2000 to 2021

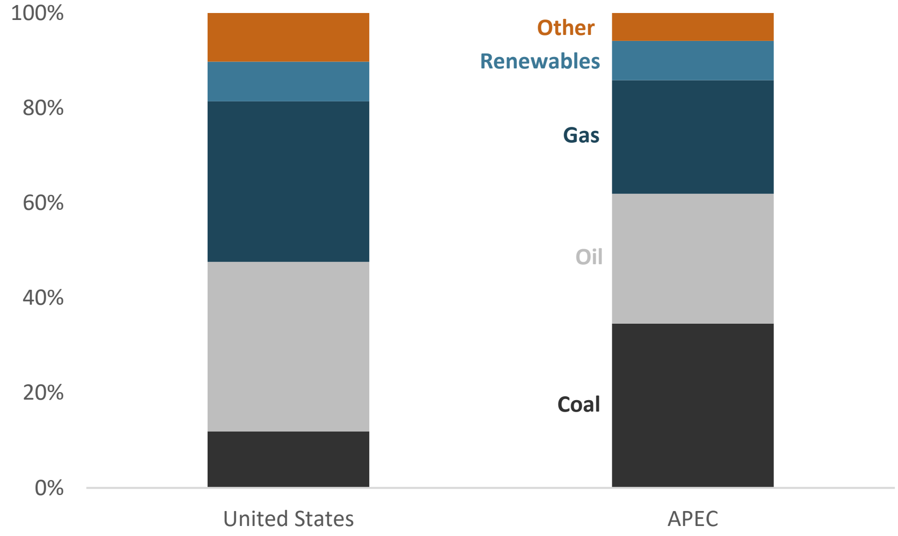


Source: EGEDA (2023)

During the first year of the pandemic in 2020, economic activities slowed, which led to an overall decrease in TPES. In 2021, as economic activities resumed, TPES started to slowly return to pre-pandemic levels. Between 2020 and 2021, quantities of all fuels increased, except for renewables. In 2021, 36% of TPES came from crude oil and petroleum products, 34% from natural gas, and 12% from coal. Renewables accounted for 8.4% of TPES, and other sources, including nuclear and non-energy use of fuels, accounted for 10%.

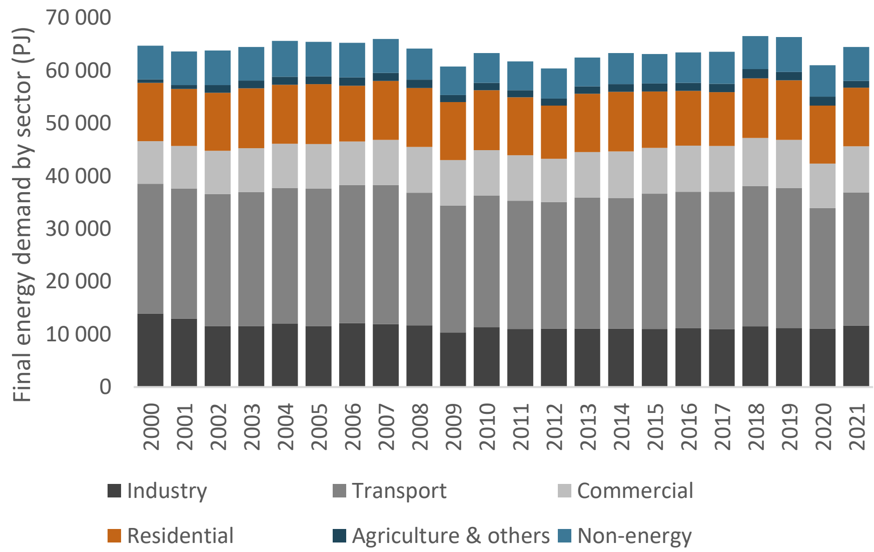
In comparison to 2021 average APEC TPES percentage shares, the US primary energy supply contains a nine-percentage point higher share of oil, and a 10-percentage point higher share of gas, but a 23-percentage point lower share of coal than the APEC average.

Figure 3: Energy supply mix – The United States and APEC, 2021



Source: EGEDA (2023)

Figure 4: The United States final consumption by sector (PJ), 2000 to 2021



Source: EGEDA (2023)

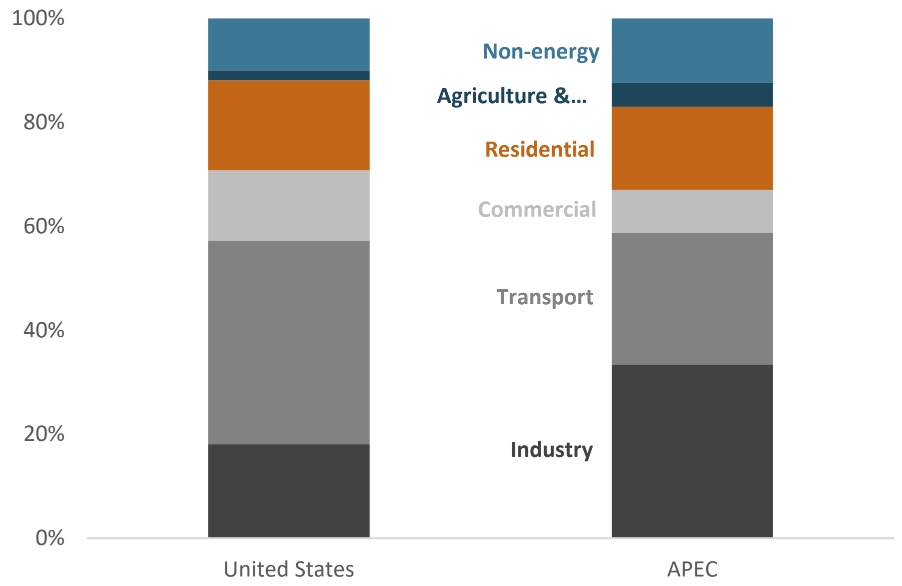
Total final consumption

The US total final consumption in 2021, including non-energy, was 64 465 PJ, an increase of 5.6% from 2020. From 2000 through 2021, the US total final consumption has maintained a generally consistent plateau (Figure 4), with variations associated with macro shocks, such as the Great Recession of 2007-2009 and COVID-19.

Similar to historic numbers, the transport sector continues to account for the largest share of total final consumption in the United States. In 2021, transportation's share of total final consumption was 39%, followed by industry (18%), residential (17%), commercial (14%), non-energy (10%) and agriculture (2.0%).

In comparison to APEC, the transport sector's 39% share of total final consumption in the United States is 14 percentage points higher than the APEC average. While other percentages are similar, the United States' commercial sector is 6 percentage points higher than the APEC average, and the US industrial sector's share of total final consumption is 16 percentage points lower than the APEC average.

Figure 5: Final consumption by sector, The United States and APEC, 2021

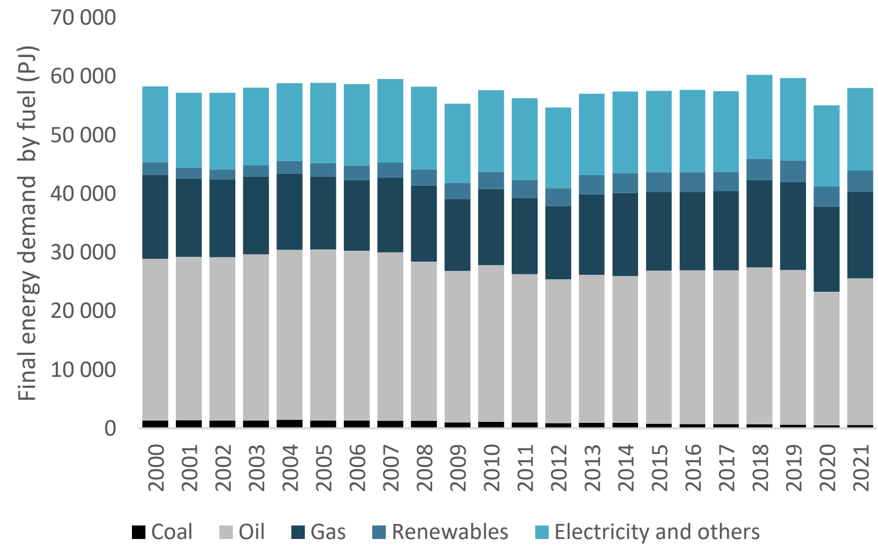


Source: EGEDA (2023)

Total final energy consumption

In 2021, the US total final energy consumption, which excludes the non-energy use of fuels, was 58 025 PJ, which is a 5.4% increase relative to 2020. This change is likely reflective of economic activity resumption after the first year of the pandemic.

Figure 6: The United States final energy consumption by fuel (PJ), 2000 to 2021



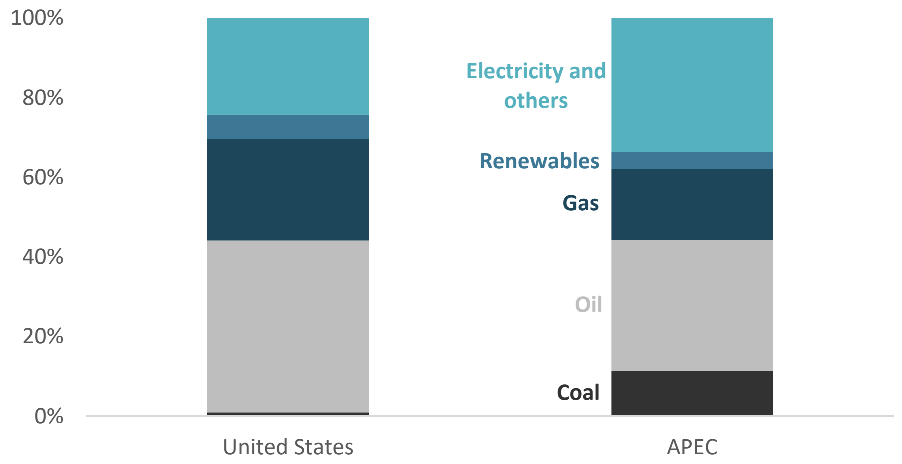
Source: EGEDA (2023)

Note: Does not include non-energy sector consumption of energy products.

Petroleum products remained the dominant energy source in the United States, accounting for 43% of total final energy consumption in 2021 (up from 41% in 2020). Natural gas and electricity were the two other main energy carriers, accounting for 26% and 24%, respectively.

Following the first year of the pandemic, petroleum products began to regain market share, slowly recovering to pre-pandemic levels. Since 2000, renewables rose 67%, likely due to an increased attention to climate change issues and emissions reduction.

Figure 7: Final energy demand fuel share, The United States and APEC, 2021



Source: EGEDA (2022)

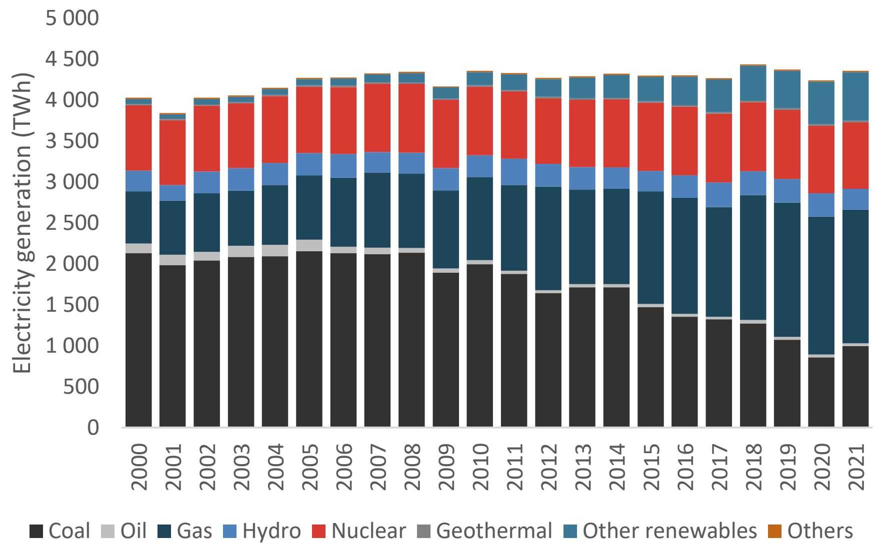
In comparison to the aggregate total final energy consumption of APEC, the United States relies much more on oil and gas and less on coal and electricity than the APEC average. The US share of oil and gas is 10 percentage points and 8 percentage points higher than the APEC average, respectively, and the US share of coal and electricity is 10 and 9 percentage points lower, respectively.

Transformation

Power sector

The United States generated 4 354 TWh of electricity in 2021, which is 2.7% more than what was generated in 2020.

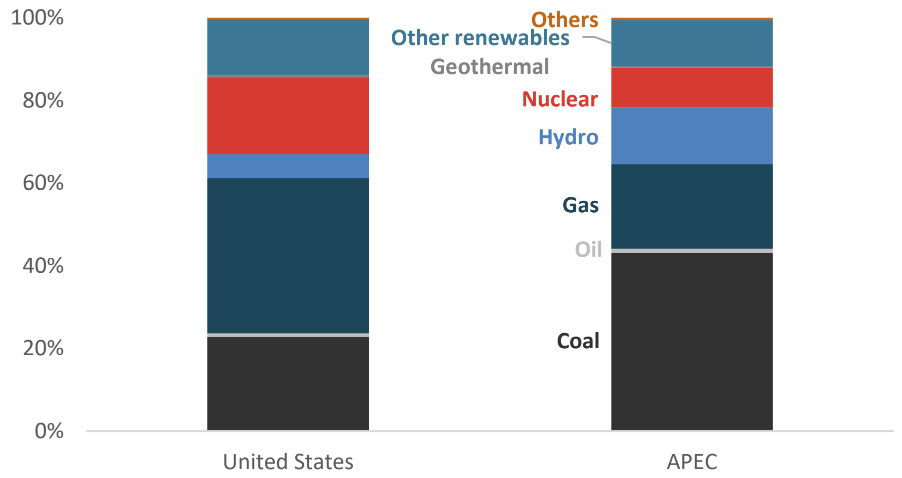
Figure 8: The United States electricity generation by fuel, 2000 to 2021



Source: EGEDA (2023)

The amount of generation has been relatively stable; however, the fuels used to generate power in the United States have changed considerably over the last two decades. From 2000 to 2006, more than 50% of the US electricity was generated in coal-fired plants, but this share steadily declined to 23% in 2021. Over the same period, the share of gas-fired generation increased from 16% in 2000 to 37% in 2021. The shares of other fuels and technologies remained relatively constant except for non-hydro renewables, the share of which grew from 2.5% in 2000 to 14% in 2021.

Figure 9: Electricity generation fuel share, The United States and APEC, 2021



Source: EGEDA (2023)

Electricity generation by fuel type varies between the United States and the APEC average. In 2021, coal was close to half in aggregate APEC, but only a bit over a fifth in the United States. Natural gas is the greatest contributor to electricity generation in the United States at almost 40%, but only represents a fifth in APEC. While oil represents similar amounts in both figures, on average APEC member economies rely more heavily on hydro than the United States, but the United States relies more heavily on nuclear than the APEC average.

Energy Transition

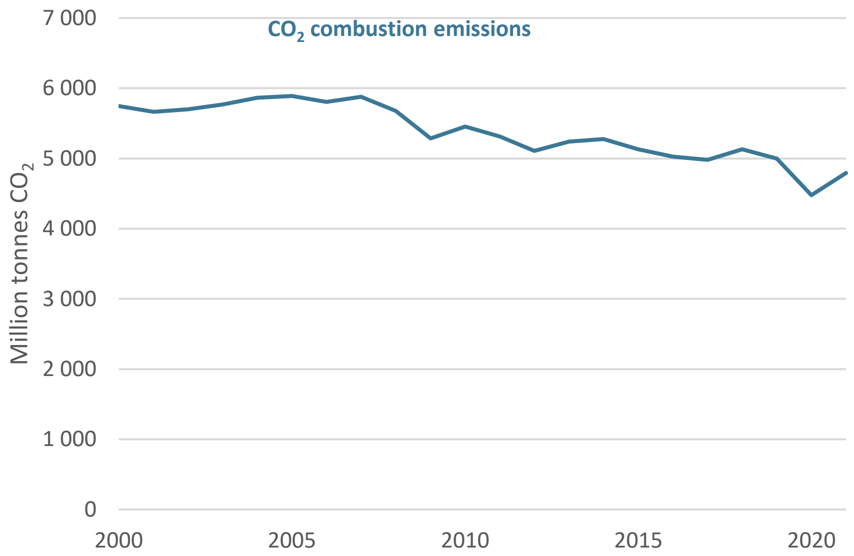
The current the US Administration is focusing on accelerating the energy transition in the United States towards a cleaner and more sustainable future through announced goals to address climate change and reduce greenhouse gas emissions, in line with global efforts to combat environmental challenges. Key initiatives included rejoining the Paris Agreement, which commits the United States to significant emissions reductions. The Administration also proposed increased investments in clean energy infrastructure, research, and development as part of broader economic recovery plans. Executive orders aimed at promoting electric vehicles, advancing renewable energy projects, and enhancing energy efficiency highlighted the commitment to reshaping the US energy system. Additionally, efforts were made to prioritise environmental justice, providing support to communities disproportionately affected by pollution, climate change, and job losses associated with the energy transition.

Emissions

The US CO_2 emissions exhibited fluctuations influenced by economic conditions, energy consumption patterns, and policy initiatives. In the early 2000s, emissions increased slowly, driven by economic growth but partially offset by switching from coal-fired to gas-fired electricity generation. Emissions then dropped during the 2007-2009 Great Recession. The post-recession recovery led to a continuation of the previous emissions trend. The deployment of technologies such as solar and wind power contributed to a decrease in the carbon intensity of the electricity sector. There has been a steady decrease in emissions, with a major drop in 2020 due to reduced activity during the pandemic. These trends reflect the ongoing transition toward a more sustainable and low-carbon energy landscape with reductions in carbon emissions due to increased renewable energy adoption, a decline in coal usage, and improved energy efficiency.

The expert group on energy data and analysis (EGEDA) falls under the umbrella of APEC's Energy Working Group (EWG). In addition to energy data compiled by EGEDA, CO_2 emissions from combustion activities in the energy sector are also recorded. These emissions are a subset of total greenhouse gas (GHG) emissions that are considered in the context of climate change, such as under the United Nations Framework Convention on Climate Change (UNFCCC).

Figure 10: The United States CO_2 combustion emissions (million tonnes), 2000 to 2021



Source: EGEDA (2023)

Energy security

The United States has implemented a multifaceted approach to enhance its energy security. Strategies include diversifying energy sources to mitigate over reliance on individual fuel types, promoting energy efficiency across various sectors, and maintaining a Strategic Petroleum Reserve as a safeguard against disruptions in oil supply. The United States has also encouraged the development of domestic energy resources, particularly through the expansion of shale gas and oil production, contributing to reduced reliance on imported fuels. Investment in renewable energy technologies, such as solar and wind power, is a key focus, supported by policies and incentives to accelerate their adoption. Modernising energy infrastructure, including the electricity grid and pipelines, is prioritised to improve overall reliability and resilience. The United States has also furthered international collaborations and resilience planning against potential disruptions, such as natural disasters and cyberthreats, to increase its energy security.

APEC Energy Goals

There are two energy-related objectives that APEC member economies have agreed to meet as a collective: to improve energy intensity and double the share of modern renewables.

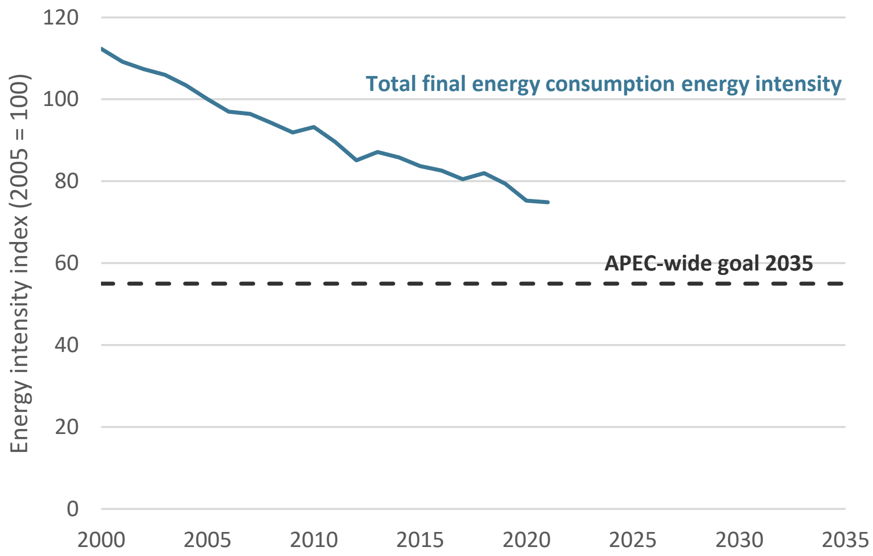
Energy intensity goal

In 2011, APEC member economies agreed to increase their ambition to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

APEC is on track to achieve this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

Over the past few decades, the United States has made strides in improving energy intensity, reflecting a more efficient use of energy in relation to economic activities. This trend is attributable to numerous factors, including advancements in energy-efficient technologies, increased emphasis on energy conservation measures, and shifts in the industrial and economic structure. Federal and state-level policies, along with voluntary initiatives by businesses, have played a role in promoting energy efficiency across sectors. As a result, the United States has managed to decouple economic growth from a proportional increase in energy consumption, contributing to a more sustainable and environmentally conscious energy landscape.

Figure 11: The United States total final energy consumption intensity index, 2000 to 2021 (2005 = 100)

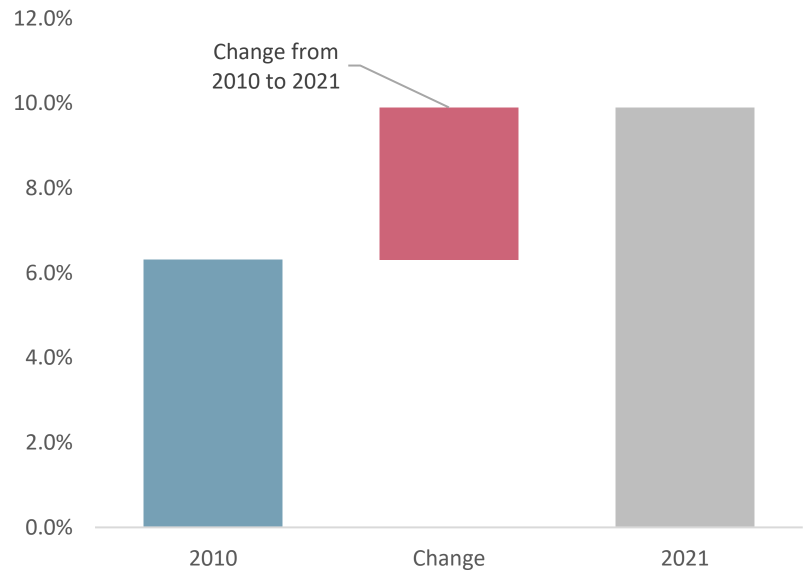


Source: EGEDA (2023)

Doubling of renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period 2010 to 2030. There is no economy-level goal for individual member economies, but improvements by individual economies will contribute to the doubling goal.

Figure 12: The United States modern renewable energy share, 2010 and 2021

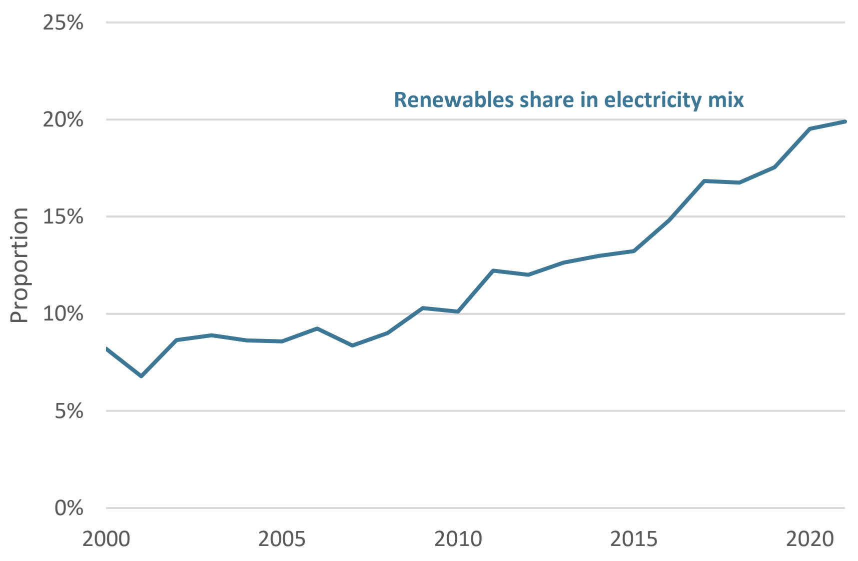


Source: EGEDA (2023)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Since 2010, the share of renewable energy in the United States has doubled from a share of 9.9% in 2010 to 19.9% in 2021. This change was fuelled by a combination of technological advancements, cost reductions, and renewable energy tax credits. Particularly, wind and solar power have seen substantial growth, marked by an increase in capacity installations and reduced reliance on fossil fuels in electricity generation. Both federal and state-level policies, alongside incentives such as tax credits, have been instrumental in promoting renewable energy development. Additionally, corporate commitments to sustainability objectives and heightened awareness of climate change have prompted investments in clean energy projects.

Figure 13: The United States renewable generation share, 2000 to 2021



Source: EGEDA (2023)

Energy Policy

Energy policy	Details	Reference
COP28	At COP28, world leaders committed, for the first time to transition away from fossil fuels and strive to triple renewable energy globally by 2030.	Statement from President Joe Biden on Agreement Reached at COP28
G7 Clean Energy Economy Action Plan	As part of the G7, the United States is enhancing cooperation to address the climate crisis and accelerate the global clean energy transition to reach net zero emissions by 2050 at the latest, while also reaffirming unwavering commitment to the Paris Agreement. The plan includes initiatives, such as working as part of the Climate Club to achieve its goals, maximising the impact of incentives through filing gaps in investments, reducing emissions through trade policy, establishing resilient global supply chains, promoting clean energy technologies, promoting trade and investment in clean energy goods and services, and supporting global partners in their clean, just energy transitions.	G7 Clean Energy Economy Action Plan
Net Zero World	In August 2023, the US Department of Energy (DOE) hosted the first Net Zero World Ministerial. Net Zero World, launched at COP26 in Glasgow, is the DOE's flagship international initiative that includes 10 National Laboratories and nine the US government agencies. The programme provides world-class technical, financing, and policy assistance to help economies chart a pathway to advance clean energy use in buildings, industry, electric power and transportation to achieve transformative emissions reductions. As part of the programme, partners have access to: • Immediate and sustained access to expert technical, deployment, and investment analysis and expertise from the US government, including DOE's government laboratories. • Targeted support for in-economy technical institutions to build long-term, self-sustaining technical capacity, and • Deep collaboration to develop technical and investment plans and support implementation for technology project design and testing, infrastructure modernisation, enabling policies and measures, investment analysis and facilitation, capacity building and workforce development, and other critical actions needed to achieve near- and long-term energy system decarbonisation.	DOE Brings Partners Together for First-Ever Net Zero World Ministerial
International Climate Finance	The United States announced that the US climate finance for developing economies is expected to exceed USD 9.5 billion in 2023, on track to meet the President's pledge of over USD 11 billion in 2024, which includes a significant scaling up of adaptation finance through the President's Emergency Plan for Adaptation and Resilience (PREPARE).	SPEC John Kerry's Remarks to the Press at the Conclusion of the UN Climate Change

Energy policy	Details	Reference
		Conference (COP28)
Investment in Domestic Grid	In 2023, the DOE made the largest federal investment in the grid in history with more than USD 8 billion in grid investments. This included USD 3.5 billion to modernise and strengthen the grid through the Grid Resilience Innovation Partnership (GRIP) Program, USD 1.3 billion in transmission investments through the Transmission Facilitation Program that aims to add 3.5 GW of additional grid capacity and create more than 13 000 direct and indirect jobs, more than USD 750 million in formula grants to states, tribes, and territories to boost grid resilience, and USD 37 million in hydropower incentives.	US Department of Energy Top Clean Energy Accomplishments in 2023
Regional Clean Hydrogen Hubs	The Regional Clean Hydrogen Hubs Program (H2Hubs) includes up to USD 7 billion to establish six to 10 regional clean hydrogen hubs across America. The H2Hubs will form the foundation of a clean hydrogen network that will contribute to decarbonising multiple sectors of the economy, such as heavy industries (steel and cement production) and heavy-duty transportation.	Regional Clean Hydrogen Hubs
Electric Vehicles	In 2023, the United States surpassed 1 million in domestic electric vehicle sales. In addition, the United States announced USD 15.5 billion to support a transition to electric vehicles. In December 2023, Ohio and New York marked the first states in the economy to open electric vehicle (EV) charging stations funded through the National Electric Vehicle Infrastructure (NEVI) Formula Program. These new charging stations will fill gaps in charging, add capacity and boost the reliability of the economy's fast charging network. Other new charging station launches will follow in 2024, with stations already under construction in Maine, Pennsylvania and Vermont. In May, the DOE, through the Joint Office of Energy and Transportation, launched the National Charging Experience Consortium, a new effort led by the DOE's National Laboratories to rapidly develop solutions that ensure a reliable and frictionless charging experience for all Americans. The development and maintenance of a robust charging network will create jobs and stimulate economic growth in local communities, while public and private investments in EV charging infrastructure will catalyse technological innovation across multiple economic sectors.	US Department of Energy Top Clean Energy Accomplishments in 2023
Lowering Energy Costs	In October 2023, the DOE announced the launch of the Affordable Home Energy Shot, a new initiative focused on the research, development and demonstration of clean energy solutions to decarbonise and deliver energy and cost savings for affordable homes. This programme will reduce the cost of energy-efficient retrofits in affordable homes by 50% and decrease residents'	US Department of Energy Top Clean Energy Accomplishments in 2023

Energy policy	Details	Reference
	energy costs by at least 20% within a decade. The Weatherization Assistance Program (WAP) Retrofit and Readiness team deployed USD 3.17 billion in funding. The Energy Efficiency and Conservation Block Grant Program (EECBG) is designed to assist states, local governments, and tribes in implementing strategies to reduce energy use, to reduce fossil fuel emissions, and to improve energy efficiency. In 2023, the Program made USD 550 million available.	
Boosting Supply Chain and Domestic Manufacturing	In 2023, the DOE announced: USD 5.5 billion to boost domestic production of advanced batteries, battery materials, and electrified vehicles; more than USD 13 billion in Advanced Technology Vehicles Manufacturing Loan Program conditional commitments to support the advanced technology vehicles supply chain; USD 169 million to accelerate electric heat pump manufacturing at 15 sites across the economy; and more than USD 390 million to expand solar, wind and vehicle technology domestic manufacturing.	US Department of Energy Top Clean Energy Accomplishments in 2023
New Carbon Pollution Standards for Fossil Fuel-Fired Power Plants	In 2023, the US Environmental Protection Agency proposed new technology standards for power plants and the transportation sector, representing some of the largest source of GHG emissions in the United States. These new standards are intended to protect public health, reduce harmful pollutants, and deliver up to an estimated USD 85 billion in climate and public health benefits over the next two decades.	EPA Proposes New Carbon Pollution Standards for Fossil Fuel-Fired Power Plants to Tackle the Climate Crisis and Protect Public Health

Notable Energy Developments

Energy development	Details	Reference
Fusion Energy	The United States is expanding domestic and global efforts to leverage market forces, inclusive technological innovation, and investments to accelerate the next generation of clean energy technology breakthroughs, such as fusion energy. These technologies will help the United States meet its individual and collective carbon reduction goals, ensure energy security and resilience, and advance economic development. In March 2022, the United States announced a Bold Decadal Vision for Commercial Fusion Energy that recognised fusion energy's increasing technical readiness and strong market interest and	International Partnerships in a New Era of Fusion Energy Development

Energy development	Details	Reference
	included a direction to explore new international collaborations to accelerate the development of fusion energy.	
Largest Oil Producer in History	In 2023, the United States became the largest oil producer in history, reaching approximately 13.3 million barrels per day at the end of the year.	EIA – Petroleum & Other Liquids
Record LNG Exports	In December 2023, US exports of LNG reached a record of 8.6 million tonnes. Full year exports reached approximately 90 million tonnes, a 15% increase from the previous year.	Reuters - US was top LNG exporter in 2023 as hit record levels
First New Nuclear Reactor Since 2016	In July 2023, Georgia's Vogtle Unit 3 started operations, making it the first reactor in seven years to come online in the United States. The new 1 114-megawatt Unit 3 reactor joins two existing reactors at Plant Vogtle, which is jointly owned by Georgia Power and three other electric utility companies.	EIA - First new US nuclear reactor since 2016 is now in operation

Useful links

APEC Expert Group on Energy Data & Analysis (EGEDA) – https://www.egeda.ewg.apec.org/

Energy Institute Statistical Review of World Energy – https://www.energyinst.org/statistical-review

International Atomic Energy Agency (IAEA) – https://www.iaea.org/

OECD Nuclear Energy Agency (NEA) – https://www.oecd-nea.org/

The White House Statements and Releases – https://www.whitehouse.gov/briefing-room/statements-releases/

US Department of Energy – https://www.energy.gov/

US Department of State – https://www.state.gov/

US Energy Information Administration – https://www.eia.gov/

US Environmental Protection Agency – https://www.epa.gov/

World Bank Open Data – https://data.worldbank.org/

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The White House (2023), *Statement from President Joe Biden on Agreement Reached at COP28.* https://www.whitehouse.gov/briefing-room/statements-releases/2023/12/13/statement-from-president-joe-biden-on-agreement-reached-at-cop28/

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VIET NAM

Introduction

In 2023, the Government of Viet Nam issued a series of significant energy-related policies designed to help the economy reach its 2050 net zero target.

In May 2023, the Government of Viet Nam issued Decision No. 500/QD-TTg, approving a new National Power Development Plan (PDP8). PDP8 establishes a roadmap for the power sector through to 2030, with a vision towards 2050. This plan provides a detailed, explicit pathway towards decarbonization in the power sector to achieve the government's net zero emissions target announced at the COP26 Summit (PDP8, 2023).

In July 2023, the Government approved the National Energy Master Plan for 2021-2030, with a vision to 2050 (NEMP) via Decision No. 893/QD-TTg. The NEMP sets specific targets for energy sectors, including oil and gas, coal, and renewable energy (NEMP, 2023).

Also, in July 2023 the government approved the Master Plan on Exploration, Exploitation, Processing and Use of Minerals in 2021-2030, with a vision to 2050 via Decision No. 866/QD-TTg. The master plan sets out the overall objectives for mineral development as well as the objectives and requirements for exploration, exploitation and processing of specific minerals (Minerals Plan, 2023).

In April 2024, the implementation plan for PDP8 has been approved (PMVN, 2024). The implementation plan develops a roadmap to effectively organize the implementation of schemes/projects to meet the planned targets of PDP8, ensuring the power demand for socio-economic development in each period

In recent decades, Viet Nam has been one of the fastest-growing economies in Asia, with a gross domestic product (GDP) growth rate of 6.2% per annum on average from 2000 to 2021 (EGEDA, 2023). In 2022, the economy's population was 99.4 million, with an urban population share of 37.5% (GSO, 2023). In 2021, Viet Nam's GDP surpassed USD 1 000 billion (2017 USD purchasing power parity [PPP]), marking a 2.6% increase from 2020 (World Bank, 2023).

Viet Nam's GDP grew 8.02% in 2022, achieving the highest growth since 1997 as a result of the economic recovery (Reuters, 2023). Industry, construction, and service are significant sectors, accounting for approximately 95% of Viet Nam's GDP in 2022 (GSO, 2023).

Viet Nam's natural resources are diverse, including coal, oil, natural gas and renewables (Table 1).

Table 1: Viet Nam's macroeconomic data and energy reserves

Key data [a, b]		**Energy reserves** [c]	
Area (million km^2)	0.33	Oil (billion barrels)	4.4
Population (million)	99.4	Gas (trillion cubic feet)	23
GDP (2017 USD billion PPP)	1 035	Coal (million tonnes)	3 360
GDP per capita (2017 USD PPP)	10 628	Uranium (kilotonnes U < USD 130/kgU)	-

Source: [a] GSO (2023); [b] EGEDA (2023); [c] BP (2022)

According to the *Statistical Review of World Energy* report, the proven fossil energy reserves were 4.4 billion barrels of oil, 23 trillion cubic feet of gas and 3 360 million tonnes of coal as of 2019 (BP, 2022). Viet Nam has a high potential for renewable energy, including hydro, solar, wind and biomass. The renewable energy share in the total primary energy supply (TPES) was 20% in 2021, a 5% increase relative to the 2020 level (EGEDA, 2023), and it is expected to rise to 85% by 2050 (NEMP, 2023).

Over the last few years, Viet Nam's energy sector has shifted from fossil fuel-based energy to cleaner energy to pursue climate goals, particularly in power generation. Simultaneously, the Government of Viet Nam has prioritized energy security, resilience and affordability for economic growth amid the recent global energy crisis and volatile energy prices.

Energy Supply and Consumption

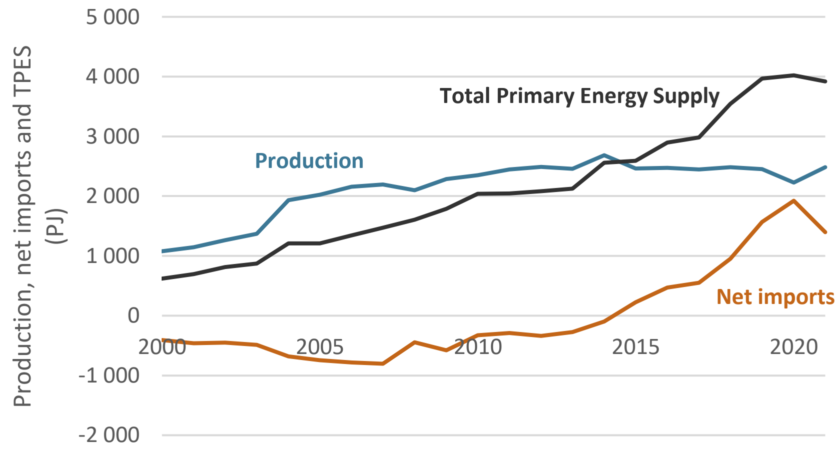
Total primary energy supply

With a high economic growth expected in the coming years, ensuring reliable and affordable energy supplies is one of the top priorities of Viet Nam's Government. Figure 1 illustrates that the TPES rose by a factor of 6.3 from 2000 to 2021, driven primarily by a high rate of economic growth. In 2021, TPES dropped by 2.5% to 3 920 petajoules (PJ) compared to the previous year (EGEDA, 2023).

Indigenous energy production has declined since reaching a peak in 2014 but rebounded in 2021. Indigenous energy production rose 11% in 2021 as a result of the partial recovery of the economy following the COVID-19 pandemic.

Viet Nam has abundant coal resources in the northern provinces, anthracite and semi-anthracite coal in Quang Ninh province, and sub-bituminous coal in the Red River Delta provinces (Thai Binh, Hai Duong, Hung Yen, Nam Dinh, Hai Phong and Ha Nam). Nevertheless, the domestic coal mining industry is constrained due to technical barriers such as complex geological conditions and deep coal seam formations. Therefore, coal has mainly been mined in the Quang Ninh coal basin. This coal basin produces over 40 million tonnes of coal annually, accounting for approximately 90% of domestic coal production.

Figure 1: Viet Nam's energy supply, production, and net imports (PJ), 2000 to 2021



Source: EGEDA (2023)

Meanwhile, due to technical and economic issues, sub-bituminous coal in the Red River Delta area has not been mined yet. According to the Development Strategy of the Coal Industry to 2030 with a vision to 2045, the government plans to start pilot exploitation in the Red River coal basin before 2040 and to proceed with industrial-scale mining before 2050, if the trial is successful (DSCI, 2024).

Crude oil and natural gas are mainly extracted offshore in the south of Viet Nam. However, economic crude oil reserves are expected to be depleted sometime before 2030. A significant recent natural gas development is the Ca Voi Xanh project in the central provinces (Quang Nam and Quang Ngai). Upstream and midstream components of this project belong to a joint venture project between the Exxon Mobil group and the Viet Nam National Oil and Gas Group, which expects to have the first gas stream by 2028 (Environmental Economics, 2023). Based on economic assumptions, the production will continue until the field reaches its economic limit in 2047 (Offshore Technology, 2023). It will supply gas-fired power generation and petrochemical plants in Viet Nam's central region, such as Mien Trung 1 and 2, and Dung Quat 1 and 3.

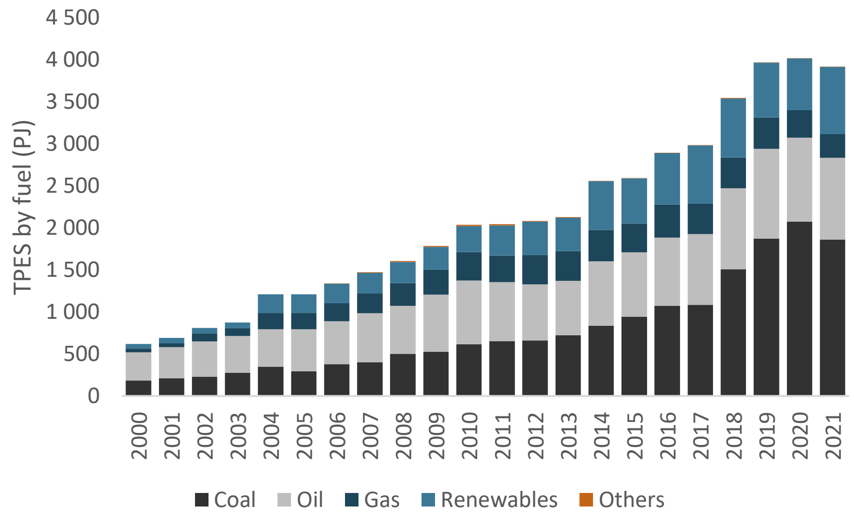
Hydropower is the most important renewable energy source, accounting for approximately 31% of its electricity generation mix in 2021. Viet Nam aims to leverage hydro and other renewable sources to partially replace fossil energy through electrification to reach its net zero target by 2050.

While Viet Nam was a net energy exporter for several decades, it has been a net energy importer since 2015 due to the substantial growth in energy demand and declining indigenous production. Energy imports have grown dramatically in recent years, except 2021, and are expected to continue to rise in the coming decades. In 2021, net imports dropped by approximately 27% due to record-high energy prices.

Viet Nam's TPES provided by fuel has continuously increased since 2000 to meet the high energy demand for rapid economic growth except in the year 2021 (Figure 2). TPES reduced slightly in 2021 due to the COVID-19 pandemic. Coal supply dropped approximately 10% from 2 077 PJ in 2020 to 1 864 PJ in 2021. Oil and gas supply also declined by 2.6% and 14.2%, respectively, in 2021 compared to the previous year.

The renewables supply increased rapidly by over 30%, from 614 PJ in 2020 to 802 PJ in 2021 (EGEDA, 2023). The surge in renewable energy supply resulted from renewable energy-promoting policies such as the feed-in tariff (FiT) mechanism (Watson Farley, 2019). However, Viet Nam has faced several challenges that hindered the switch to renewable energy, such as insufficient smart grid technologies, limited electricity storage systems, and constrained power transmission capacity. Consequently, most solar installations were required to reduce their electricity output due to the limited capacity of the grid system in the last few years.

Figure 2: Viet Nam's energy supply by fuel (PJ), 2000 to 2021

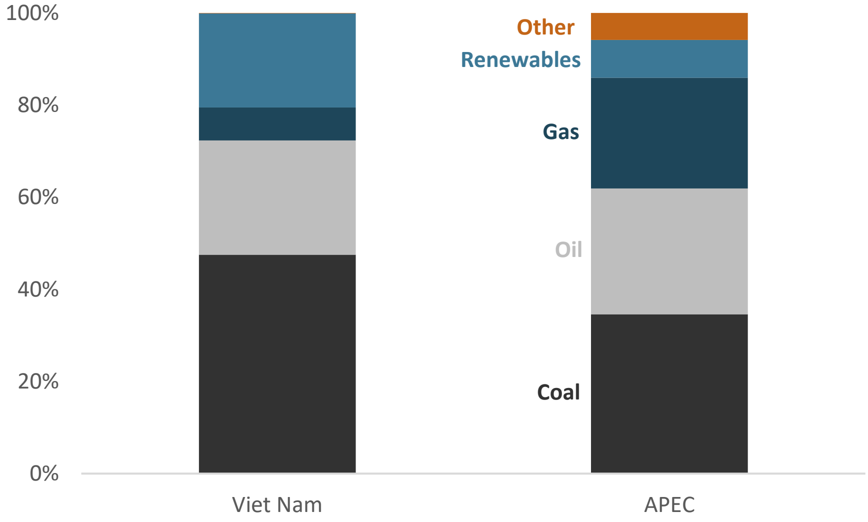


Source: EGEDA (2023)

Coal-fired power plants and energy-intensive industries (steel making, aluminium smelting, cement manufacturing and fertilizer production) have contributed significantly to coal supply growth in recent years.

Figure 3 shows the energy supply mix for Viet Nam and the APEC region in 2021. Coal has indeed dominated the Viet Nam energy supply mix, accounting for nearly half of it (47.5%). This share is much more prominent than coal's share in the APEC region (34.6%). Oil's share in Viet Nam's energy supply mix was approximately 25%, 2.5% lower than the APEC region's oil share. Furthermore, Viet Nam's gas share accounted for only 7.2% of the energy supply mix, much lower than the APEC gas share (24%). The renewables share accounted for 20.5% of Viet Nam's energy supply mix, almost double the APEC region's renewables share (8.2%).

Figure 3: Energy supply mix – Viet Nam and APEC, 2021



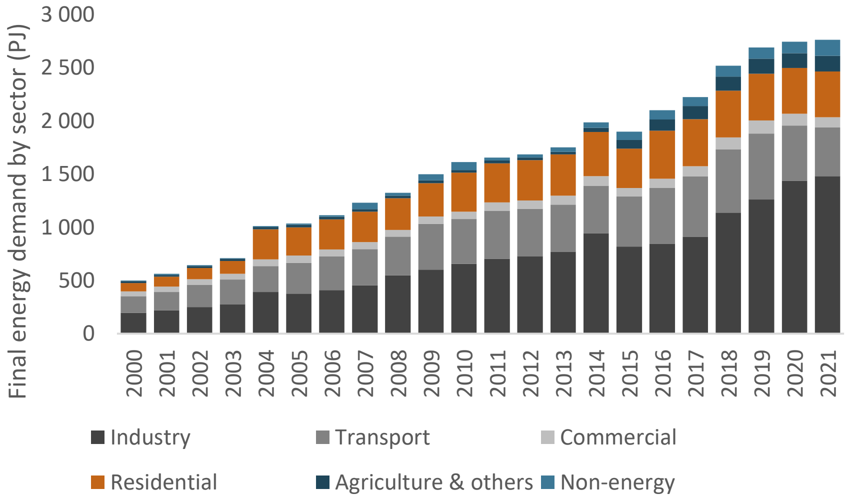
Source: EGEDA (2023)

Total final consumption

Viet Nam's total final consumption (energy plus non-energy use of fuels) rose 5.5-fold between 2000 and 2021 (Figure 4). This large increase resulted from significant growth in GDP and population. The total final consumption in 2021 was 2 765 PJ, a rise of 5.1% compared to the previous year.

The industrial sector was the dominant end-use sector, accounting for 53.6% of all end-use energy consumption (including non-energy) in 2021. The transport sector was the next largest, with a share of 16.5%. The commercial and residential sectors accounted for 3.5% and 15.6%, respectively. The agriculture, forestry, fishery and others only accounted for 5.3%.

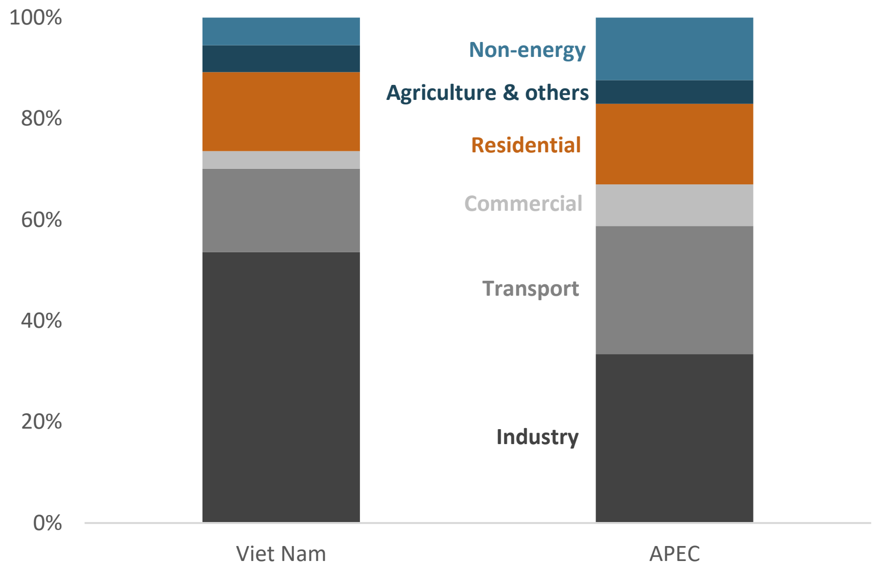
Figure 4: Viet Nam's final consumption by sector (PJ), 2000 to 2021



Source: EGEDA (2023)

The final consumption by sector of Viet Nam and APEC in 2021 is depicted in Figure 5. Energy consumption for Viet Nam's industry accounted for over half of the total final energy consumption (53.6%), much higher than APEC's average (33.4%). Government policy to accelerate industrialization and modernization drives Viet Nam's extensive energy use in the industrial sector (Politburo, 2018). In contrast, Viet Nam's transport sector share is lower than that of the APEC region.

Figure 5: Final consumption by sector, Viet Nam and APEC, 2021

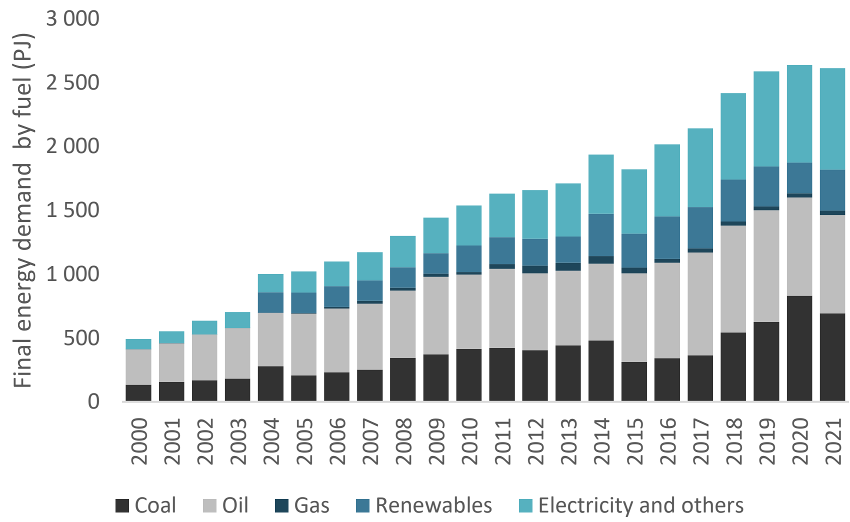


Source: EGEDA (2023)

Final energy demand

Regarding final energy demand by fuel, the share of fossil fuels accounted for around 57% of Viet Nam's final energy demand in 2021 (Figure 6). Among fossil fuels, oil was consumed the most, accounting for approximately 30% of the final energy demand, followed by coal (26.4%). Electricity and others accounted for 30%, while gas accounted for only 1.3% of the final energy demand. Renewables' share was approximately 12.2% of Viet Nam's final energy demand.

Figure 6: Viet Nam's final energy demand by fuel (PJ), 2000 to 2021

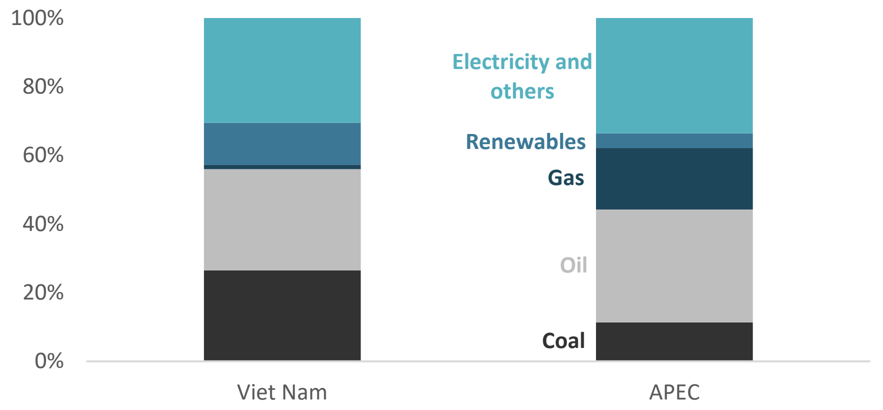


Source: EGEDA (2023)

Note: Does not include non-energy sector consumption of energy products.

While the coal share in Viet Nam's final energy demand was more than double that of APEC's coal share, its final demand share for oil was slightly lower than the APEC region's in 2021 (Figure 7). Gas demand accounted for only 1.3% of Viet Nam's final energy demand, much lower than its share of 18% for the entire APEC region. Viet Nam's renewables share was almost triple that of the APEC region in 2021, while the share of electricity and others showed only a minor difference between Viet Nam and APEC overall.

Figure 7: Final energy demand fuel share, Viet Nam and APEC, 2021



Source: EGEDA (2023)

Transformation

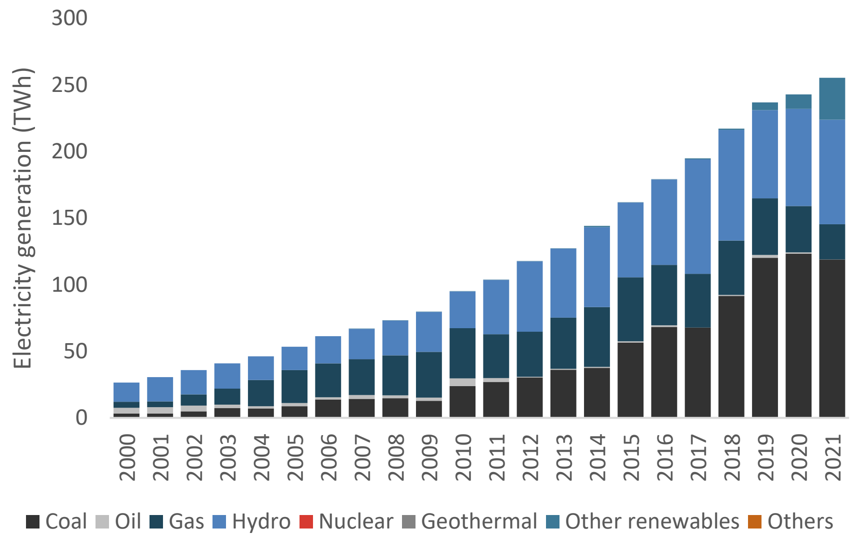
Power sector

Figure 8 shows the electricity generation by fuel in Viet Nam between 2000 and 2021. The economy has experienced rapid growth in electricity demand with a growth rate of 11.4% annually from 2010 to 2021 (EGEDA, 2023). Although the electricity grid is interconnected across the entirety of Viet Nam's geography, the different generation technologies tend to be congregated together. For instance, coal-fired power plants are mainly located in the north, while gas-fired power plants, solar and wind farms are mostly located in the south.

In 2021, Viet Nam generated 255 terawatt hours (TWh) of electricity, an increase of 5.1% from the previous year. Fossil fuel-based power generation (coal, oil and gas) accounted for nearly 57% of the total generation mix, followed by hydro (30.8%). Renewable generation and others constituted 12.3% of the total generation mix (EGEDA, 2023).

Viet Nam's power sector is increasingly reliant on coal. Approximately 47% of the electricity production was generated from coal in 2021, representing an increase of nearly 19% per annum over 2010-2021 (EGEDA, 2023).

Figure 8: Viet Nam's electricity generation by fuel, 2000 to 2021



Source: EGEDA (2023)

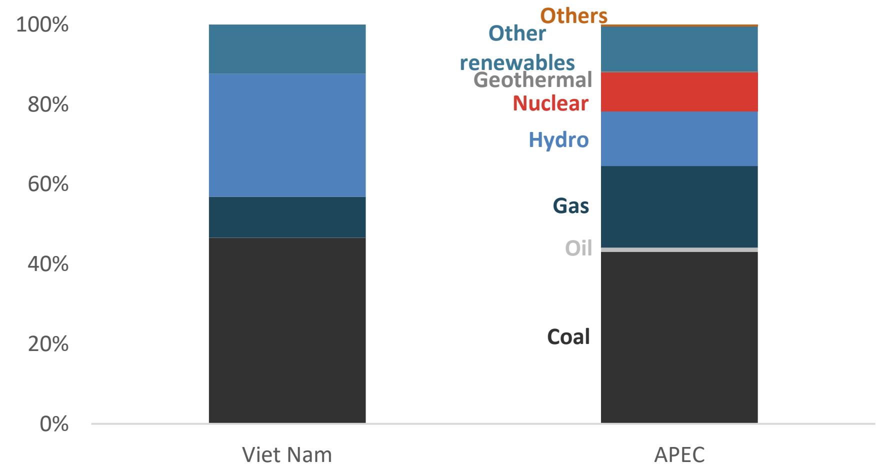
Hydropower plants are close to full utilization, contributing 30.8% of the total electricity production in 2021. Other renewables, including small hydropower, biomass, solar and wind power, accounted for 12.3% of the total generation mix.

Before 2018, only a small amount of solar and wind capacity was installed in Viet Nam. Thanks to the FiT mechanism, solar installed capacity increased substantially from 8 MW in 2017 to almost 16 600 MW in 2020 (EVN, 2021). Up to the end of 2021, total solar and wind capacities reached 20 600 MW, accounting for 27% of the total installed generation capacity.

The Vietnamese Government issued a new PDP8 in May 2023, considering the 2050 net zero carbon emission target. According to the PDP8, Viet Nam plans to gradually phase down coal power generation and ramp up renewable, biomass, hydropower generation and energy storage.

Viet Nam's electricity share from coal in 2021 was 3.5% higher than that of the APEC region (Figure 9). However, Viet Nam's share of gas in electricity generation was much smaller than that of APEC.

Figure 9: Electricity generation fuel share, Viet Nam and APEC, 2021



Source: EGEDA (2023)

Hydropower accounted for the second-largest share of Viet Nam's electricity generation mix in 2021. Its share was approximately 31%, more than double that of APEC's hydropower share. Electricity generation from other renewables in Viet Nam was similar to its share in the APEC region.

Refining

Currently, Viet Nam has two refineries, namely Dung Quat and Nghi Son, with a total capacity of 16.5 million tonnes per annum (Mtpa), meeting 70% of its demand for petroleum products.

Dung Quat was the first refinery, commissioned in 2009 with a capacity of 6.5 Mtpa, and is operated by PetroVietnam, a subsidiary of the government-owned Viet Nam Oil and Gas Group. The second one is the Nghi Son refinery plant with a capacity of 10 Mtpa, commissioned in 2018 and operated by Idemitsu Kosan (Japan).

Viet Nam plans to expand and construct new refineries to meet rising refined product demand over the coming decades. According to the National Energy Master Plan, Viet Nam plans to expand its refining capacity to 33.1 Mtpa in 2030.

Energy Transition

The government has updated and issued many new policies since COP26. These policies are: the National Climate Change Strategy to 2050 (2022); the Ministry of Foreign Affairs' Climate Diplomacy Action Plan aiming to implement Viet Nam's commitments at COP26 in the period 2022-2025 (2022); the Action Plan of the Construction Sector in Climate Change Response for the period 2022-2030, with a vision to 2050 in order to implement Viet Nam's commitments at COP26 (2022); the Action Plan of the Ministry of Industry and Trade to implement Viet Nam's commitments at COP26 (2022); the Scheme on Tasks and Solutions to Implement the Results of COP26 (2021); the Action Program on Green Energy Transition and Reduction of Carbon and Methane Emissions of the Transportation Sector (2022); and the Methane Emission Reduction Action Plan to 2030 (2022); National Power Development Plan for 2021-2030, with a vision to

2050 (2023); the Energy Master Plan for the 2021-2030 period, with a vision to 2050 (2023); the Plan for Exploration, Exploitation, Processing and Use of Minerals in 2021-2030, with a vision to 2050 (2023).

All these new policies focus on potential solutions and measures for transitioning to cleaner energy while maintaining energy security, reliability and affordability, particularly in the high GHG emissions sectors.

Emissions

As a developing economy that has just started a process of industrialization and modernization that will last a few decades, CO_2 emissions from energy-related sectors have increased six-fold over the last 20 years, reaching 273 million tonnes in 2020 from 45 million tonnes in 2000, mainly from the power, industry and transport sectors. The power sector is the major contributor to the total CO_2 emissions, accounting for over half of total energy-related CO_2 emissions. The industrial sector is the second-largest CO_2 emitter, followed by the transport sector. Although various policies related to CO_2 emissions reduction have been implemented recently, CO_2 emissions have continued to rise rapidly due to economic and population growth. Furthermore, being highly reliant on fossil fuels in the power and industrial sectors hinders the progress toward net zero emissions.

In recent years, Viet Nam has implemented measures to reduce GHG in various sectors, especially the energy and industry.

In the energy sector, enhancing renewable energy, saving and energy efficiency, and reducing transmission loss are major measures for GHG emission reduction, contributing to a reduction of 68 $MtCO_2eq$ in 2020 compared to the baseline year of 2014.

In the industrial sector, replacing clinker in cement composition and applying advanced technology in the chemical and steel industries are the key drivers to reducing carbon emissions in these sub-sectors. In 2020, a reduction of 4.06 $MtCO_2eq$ was achieved in the mining, construction, and chemical industries (NDC, 2022).

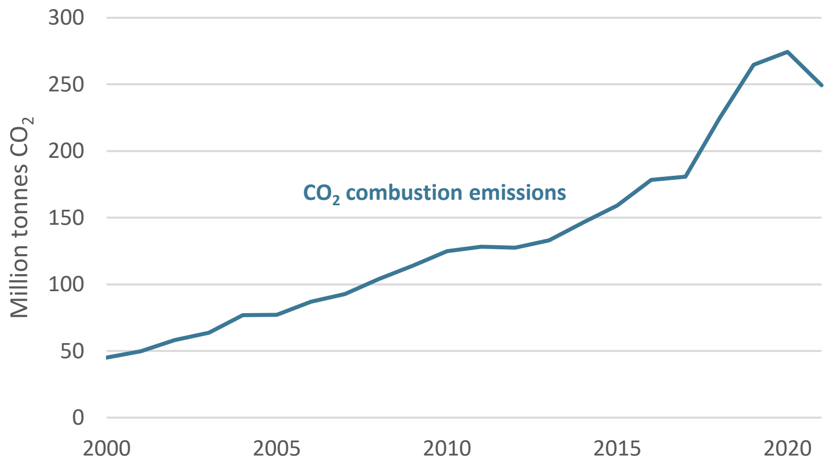
Viet Nam first submitted its Intended Nationally Determined Contribution (INDC) in 2015 and signed and approved the Paris Agreement in 2016. After the Paris Agreement came into force in November 2016, the INDC became a Nationally Determined Contribution (NDC). Viet Nam updated its NDC in 2020 and 2022. In the 2022 version, Viet Nam committed to reducing greenhouse gas emissions by 15.8% below 2005 levels by 2030 with domestic resources. This is a significant increase in ambition compared to the previous commitment in 2020. With financial support from international organizations, the GHG emission reduction target will increase from 15.8% to 43.5%.

In December 2022, Viet Nam and its international partners announced a USD 16 billion package through the Just Energy Transition Partnership (JETP) programme, designed to accelerate the reduction of carbon emissions and increase the uptake of renewable energy.

In December 2023, a Resource Mobilisation Plan (RMP) of the JETP initiative for Viet Nam was finally announced to the world at COP28 in Dubai.

Using the budget package from JETP and domestic resources, Viet Nam aims to reduce CO_2 emissions from the power sector, reduce the number of existing coal-fired power plants, and develop more renewable generation capacity associated with the transmission grid and a more effective energy infrastructure.

Figure 10: Viet Nam's CO_2 combustion emissions (million tonnes), 2000 to 2021



Source: EGEDA (2023)

Energy security

Viet Nam became a net energy importer in 2015, and import dependency is expected to rise further in the next decade, accounting for 53-60% of total primary fuels in 2030. Currently, Viet Nam is importing coal, crude oil, petroleum products and Liquefied Natural Gas (LNG). Therefore, energy security is one of the top priorities of the Viet Nam Government.

Due to high fuel prices and dependence on imported energy, the Viet Nam Government planned to dramatically reduce new LNG-fired and coal-fired power capacities in the final version of the PDP8, issued in May 2023. This action showed that the Viet Nam Government is working to ensure energy security to avoid global supply chain disruption due to geopolitical and extreme weather issues.

Energy import dependency is affected by global energy prices. By reducing the amount of imported energy, Viet Nam's energy system will face less risk due to price volatility. Therefore, diversification of domestic energy sources would also avoid the risk of global supply disruption.

According to the new PDP8, renewables (excluding hydropower and storage) are expected to be a major focus and will account for almost 29% of Viet Nam's total installed capacity by 2030 and over 63% by 2050 from 19% in 2021. The installed capacity of offshore wind power is expected to rise tremendously to 6 GW by 2030 and 91.5 GW by 2050 from almost zero in 2021. Viet Nam will maximize the technical capacity of offshore wind power to produce electricity and new energy. PDP8 calls for the use renewables to generate new energy (hydro, green ammonia), which will become a ‘new economic sector’ for Viet Nam for both domestic and export demand (PDP8, 2023).

Nevertheless, renewable generation sources are variable. They need other generation sources to assist during no wind and sunlight hours. These sources include hydropower, battery storage and thermal power (coal-fired and natural gas-fired power plants). As mentioned above, accelerating domestic coal and natural gas production is significant during the transitional period to clean energy to avoid energy supply disruptions in Viet Nam.

In October 2023, Petrovietnam and its partners signed and started implementing the Block B-O Mon gas-to-power value chain project after more than 20 years of negotiations with the attendance of the Prime Minister.
Accordingly, a nearly USD 12 billion project in southwest Viet Nam will provide power plants with about 5.06 bcm of gas annually to produce up to 3 800 MW of electricity. Its component projects will also help upgrade infrastructure, generate thousands of jobs, and promote economic restructuring in many localities.

APEC Energy Goals

There are two energy-related objectives that APEC member economies have agreed to meet as a collective: to improve energy intensity and double the share of modern renewables.

Energy intensity goal

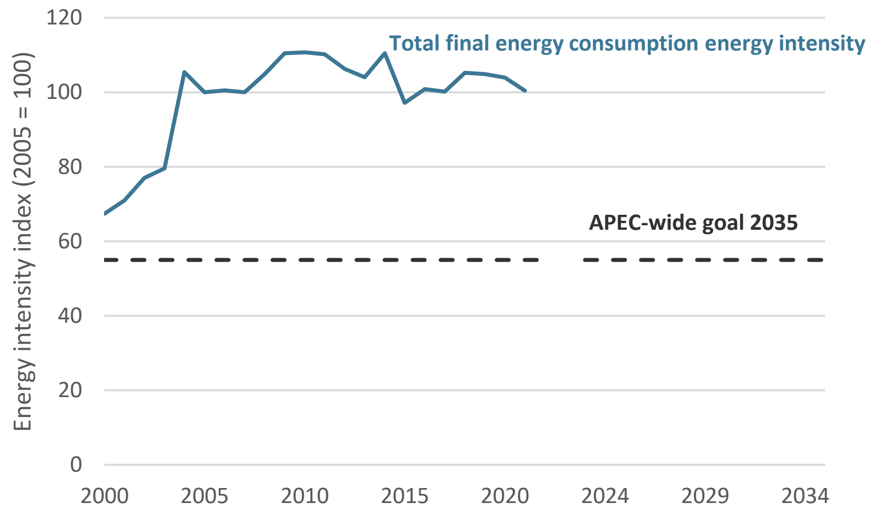
In 2011, APEC member economies agreed to increase their target to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

APEC is on track to achieve this energy intensity improvement. The goal does not impose individual economic targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

Viet Nam deployed the National Energy Efficiency Program and the Law on Energy Efficiency and Conservation in 2006 and 2010, respectively (NAVN, 2010; PMVN, 2006). However, its final energy consumption intensity is still high compared to other economies.

Viet Nam's total final energy consumption intensity improved by approximately 1% over 2010-2021 due to a higher annual growth rate in GDP than energy consumption (Figure 11). In this period, Viet Nam's GDP annual growth rate was 5.9%, while it was a 4.9% growth rate in total final energy consumption in the same period.

Figure 11: Viet Nam's total final energy consumption intensity index, 2000 to 2021 (2005 = 100)



Source: EGEDA (2023)

Viet Nam has approved the Viet Nam National Program on Energy Efficiency and Conservation for the Period 2019-2030, aiming to save 8-10% of economy-wide energy consumption and ensure electricity loss is below 6% (PMVN, 2019). The Program will partly contribute to APEC's aspirational target of reducing energy intensity.

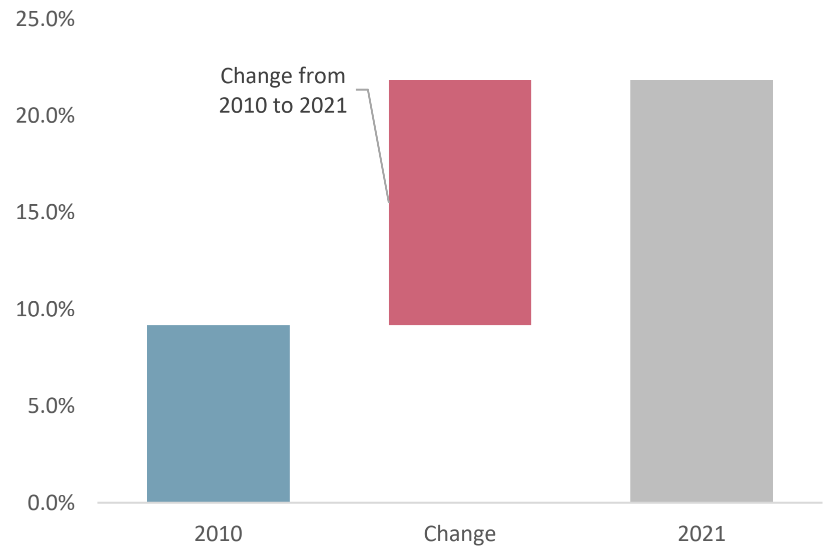
Doubling of renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix from 2010 to 2030. There is no economy-level goal for individual member economies, but improvements by individual economies will contribute to the doubling goal.

Viet Nam is starting from a higher renewable base than the APEC region, as its renewable share in 2010 was 9.2% (Figure 12), while APEC's was 6%. In 2021, the proportional share reached approximately 22%, 2.3 times greater than in 2010.

According to the NEMP, renewable energy is expected to account for 15% to 20% of the TPES by 2030 and 80% to 85% by 2050. This growth will contribute to APEC meeting its goal of doubling its renewables share by 2030.

Figure 12: Viet Nam modern renewable energy share, 2010 and 2021



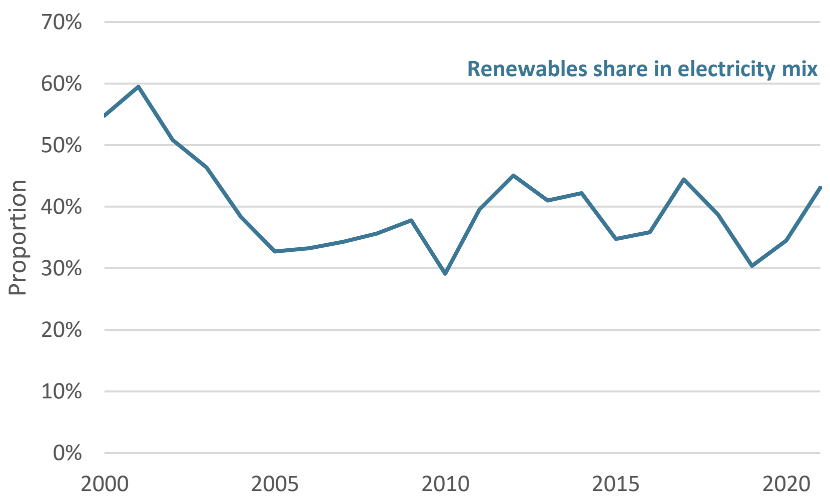
Source: EGEDA (2023)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

With a net zero emission target in 2050, Viet Nam aims to boost the uptake of renewable energy in the PDP8. Having a high potential for renewables, Viet Nam has the potential resources to achieve more than 90% penetration of domestic solar and wind power and pumped storage hydropower in its electricity mix, but the cost of such a plan is unclear. The momentum for ramping up renewable energy uptake could be built on the economy's early success in solar and onshore wind power development, making it a Southeast Asian leader.

Viet Nam has 475 GW of offshore wind power technical potential within 200 km of the coastal line, equal to about eight times Viet Nam's total installed power capacity as of 2020. According to the World Bank, by substituting coal power with 25 GW of offshore wind power by 2035, Viet Nam could reduce CO_2 emissions by about 200 million tonnes, approximately one-third of the total emissions in energy sectors under the business-as-usual scenario (East Asia Forum, 2021).

Figure 13: Viet Nam's renewable generation share, 2000 to 2021



Source: EGEDA (2023)

In Viet Nam, the proportion of electricity output from renewables has declined substantially from 55% in 2000 to 43% in 2021 (Figure 13).

The reduction was due to the small amount of undeveloped, large-scale hydropower generation potential remaining in Viet Nam and the growth in electricity demand exceeding the rate at which solar/wind and requited transmission lines were built.

Although solar and wind generation has been accelerating in recent years, it has not, to date, been growing at rapidly as electricity demand.

Energy Policy

Energy policy	Details	Reference
Politburo's Resolution No. 55 on Viet Nam's National Energy Development Strategy to 2030, with a vision to 2045	The resolution provides for the prioritization of fast and sustainable energy development while fostering favourable conditions for all economic sectors, particularly the private sector, to participate in energy development.	Communist Party of Viet Nam
Nationally Determined Contribution (2022 version)	Viet Nam will reduce GHG emissions by 15.8% compared to BAU by 2030 with domestic resources. However, this 15.8% contribution could be increased to 43.5% if international support is received through bilateral and multilateral cooperation.	United Nations Framework Convention on Climate Change
Law on Economical and Efficient Use of Energy	This law provides economical and efficient use of energy; policies and measures to promote economical and efficient use of energy; and the rights, obligations and responsibilities of organizations, households and individuals in economical and efficient use of energy.	Viet Nam Government Portal
The 2022 Petroleum Law	The 2022 Petroleum Law aims to guarantee a more convenient and flexible legal framework for promotion of the development of the oil and gas industry in conformity with international practices as well as the economy's realities. Taking effect from 1 July 2023, the 69-article Law provides for basic oil and gas investigation and oil and gas activities within the mainland, islands and seas of Viet Nam. It applies to Vietnamese and foreign agencies, organizations and individuals involved in basic oil and gas investigation and oil and gas activities.	Viet Nam Law
Electricity Law	This law prescribes the electricity development planning and investment, electricity saving, electricity markets, rights and obligations of organizations and individuals conducting electricity activities and using electricity, protection of electric equipment and facilities, electricity works and electric safety.	Viet Nam Government Portal
Law on Environmental Protection	This law provides statutory provisions on environmental protection activities, measures and resources used for the purpose of environmental protection, rights, powers, duties, and obligations of regulatory bodies, agencies, organizations, households, and individuals who are tasked with the environmental protection task.	Ministry of Natural Resources Environment
National Program on Economical and Efficient Use of Energy for the Period 2019-2030	To promote the economical and efficient use of energy by means of state management duties and solutions, technical assistance, scientific and technological research, product development, market transformation, human resource training and development.	Viet Nam Government Portal
National Climate Change Strategy to 2050	The strategy sets the overall targets to minimize the effects or damage caused by climate change, reaching net zero emissions by 2050.	Viet Nam Plus

Energy policy	Details	Reference
National Green Growth Strategy for the period 2021-2030, with a vision by 2050	The strategy focuses on the efforts to restructure the economy in conjunction with renewing the growth model; reducing the greenhouse gas emissions intensity, strive towards a green and carbon neutrality economy.	FAO
Viet Nam's Action Plan on Methane Emissions Reduction by 2030	The action plan targets methane emissions in cultivation, animal husbandry, solid waste management, wastewater treatment, oil and gas exploitation, coal mining and fossil fuel consumption. Total methane emission volume should not exceed 96.4 million tonnes of CO_2 equivalent in 2025, down 13.34% from 2020.	Viet Nam Plus
National Power Development Plan for 2021-2030, with a vision to 2050	On 15 May 2023, the Government of Viet Nam issued a decision 500/QD-TTg, approving a new National Power Development Plan (PDP8) for 2021-2030, with a vision to 2050. The overall goal of PDP8 is to ensure domestic energy security and meet the requirements of socio-economic development, industrialization, and the modernization of the economy. + Commercial electricity: about 335 TWh by 2025; about 505.2 TWh by 2030; about 1 114 – 1 254 TWh by 2050. + Electricity production and import: about 378.3 TWh by 2025; about 567 TWh by 2030; about 1 224 – 1 378 TWh by 2050. + Renewable generation reaches about 30.9%-39.2% by 2030 and up to 67.5%-71.5% by 2050.	Viet Nam Electricity
National Energy Master Plan for the 2021-2030 period, with a vision to 2050	In July 2023, the government approved the National Energy Master Plan (NEMP) for the 2021-2030 period, with a vision to 2050 via Decision No. 893/ QD-TTg. The NEMP sets out specific targets in the energy sector, including oil and gas, coal, electricity, and renewable energy. The NEMP estimates that Viet Nam’s total final energy demand is expected to hit 107 Mtoe by 2030 and 165 to 184 Mtoe by 2050. Viet Nam intends to ensure its energy supply is in excess of these estimates, aiming to have a total primary energy supply equivalent to 155 Mtoe by 2030 and 294 to 311 Mtoe by 2050	Government News
Master Plan on Exploration, Exploitation, Processing and Use of Minerals in 2021-2030, with a vision to 2050	The government has approved the Master Plan on Exploration, Exploitation, Processing and Use of Minerals in 2021-2030, with a vision to 2050 via Decision No. 866/QD-TTg. The plan sets out the overall objectives for mineral development as well as the objectives and requirements for exploration, exploitation and processing for specific minerals (such as bauxite, titanium, rare earth, gold, copper, nickel, tin, wolfram, antimony, lead, zinc, etc.).	Viet Nam Plus
The Development Strategy of the Coal Industry to 2030 with a vision to 2045	Coal output is expected to be between 45 and 50 million tonnes by 2030, and between 38 and 40 million tonnes in 2031-2045. Under the strategy, the industry will focus on exploration for upgrading existing coal resources along with new coal mines. A goal set by the strategy is to start pilot exploitation in the Red River coal basin before 2040 so as to proceed with industrial-scale mining before 2050 if the trial is successful.	Viet Nam News

Energy policy	Details	Reference
Viet Nam National Energy Developments Strategy to 2030, Vision to 2045”	On 1 March 2024, the Prime Minister issued Decision No. 215/QĐ-TTg approving the National Energy Development Strategy of Viet Nam until 2030, with a vision to 2045. This decision is to implement the Politburo of the Communist Party of Viet Nam’s Resolution No. 55- NQ/TW dated 11 February 2020 on orientation of the National Energy Development Strategy of Viet Nam to 2030, with a vision to 2045.	VNEEP

Notable Energy Developments

Energy development	Details	Reference
Viet Nam announces resource mobilization plan to implement JETP in Dubai	In December 2023, a Resource Mobilisation Plan for Viet Nam, a key tenet of the JETP initiative, was finally announced to the world at COP28 in Dubai. Using the budget package from JETP and domestic resources, Viet Nam aims to reduce CO_2 emissions from the power sector, reduce the number of existing coal-fired power plants, and develop more renewable generation capacity associated with the transmission grid, and a more effective energy infrastructure.	Government News
Viet Nam's renewable generation output exceeds the thermal power output	In 2022, total domestic plus imported renewable electricity was 268.4 billion kWh, of which hydropower output increased by 20.8% compared to 2021 due to good water in the lakes and the mobilization of power generation in accordance with inter-lake regulation. The increased renewable energy enabled EVN to reduce the purchase of coal-fired power, which had become by expensive due to high coal prices. In 2022, electricity output from renewable energy plants (including hydropower plants) exceeded thermal power.	Viet Nam Energy
Work starts on Viet Nam’s first green hydrogen plant on March 2023	Tra Vinh Green Hydrogen Company, a member of The Green Solutions Group, has started construction of Viet Nam's first and largest green hydrogen factory in the Mekong Delta province of Tra Vinh’s Duyen Hai district, with total investment of USD 341 million. Covering an area of 21 ha, the project is expected to become operational after two years, initially producing 24 000 tonnes of green hydrogen a year using electricity produce by wind turbines.	Vietnam Plus

Energy development	Details	Reference
Viet Nam launches first LNG terminal	Viet Nam began commercial operation of its first LNG terminal on 29 October 2023. The terminal has the capacity to store one million tons of LNG – equivalent to about 180 000 cubic metres of gas. The LNG terminal is located at Cai Mep Industrial Park in Tan Phuoc ward, Phu My township, southern Ba Ria-Vung Tau province. Construction on the USD 286 million project began in October 2019 on a surface area of about five hectares. It will supply LNG for domestic consumers, including Nhon Trach 3 and Nhon Trach 4 gas-fired power plants and other industrial plants.	Government News
Approving the Plan to implement the National Electricity Development Plan for the period 2021 - 2030, with a vision to 2050.	On 4 April 2024, the Government of Viet Nam approved the Plan to implement the National Electricity Development Plan for the period 2021 - 2030, with a vision to 2050. The Plan implements a strong energy transition from fossil fuels to new energy sources and renewable energy to reduce environmental pollution and greenhouse gas emissions, contributing towards the committed targets under the Nationally Determined Contributions and the 2050 net-zero target of Viet Nam.	Viet Nam Electricity

Useful links

Government of Viet Nam – http://chinhphu.vn/portal/page/portal/chinhphu/trangchu

Ministry of Industry and Trade – http://www.moit.gov.vn/

National Energy Efficiency Program (VNEEP) – http://vneec.gov.vn/

Electricity Regulatory Authority of Viet Nam (ERAV) – http://www.erav.vn/

National Load Dispatch Centre (NLDC) – https://www.nldc.evn.vn/

Viet Nam Electricity (EVN) – http://www.evn.com.vn

Energy Savings – https://tietkiemnangluong.evn.com.vn/

Viet Nam Energy – http://nangluongvietnam.vn

Viet Nam Oil and Gas Group (PVN) – http://www.pvn.com.vn

Viet Nam National Petroleum Group (Petrolimex) – https://petrolimex.com.vn/

Viet Nam National Coal and Mineral Industries Holding Corporation Ltd (Vinacomin) – http://www.vinacomin.vn/

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