

Workshop on APEC Energy Resiliency Enhancement Project

Workshop Summary Report

APEC Energy Working Group

September 2024



**Asia-Pacific
Economic Cooperation**



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Economic Cooperation**

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Produced by

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Acronym

AI	Artificial Intelligence
APEC	The Asia-Pacific Economy Cooperation
APEREC	The Asia Pacific Energy Research Centre
ASEAN	Association of South East Asian Nations
AUD	Australian dollar
AZEC	Asia Zero Emission Community
BCM	Business Continuity Management
BCP	Business Continuity Planning
CAD	Canadian Dollar
CNE	The National Energy Commission
COP	Conference of Parties
COSTI	Committee on Science, Technology, and Innovation
COVID	Coronavirus Disease
DOE	Department of Energy, the Philippines
EGAT	Electricity Generating Authority of Thailand
EMM	APEC Energy Ministers Meeting
ENTEC	National Energy Technology Center, Thailand
ERTF	Energy Resiliency Task Force
EWG	The APEC Energy Working Group
IEA	International Energy Agency
IEEJ	The Institute of Energy Economics, Japan
ISO	International Organization for Standardization
IT	Information Technology
JICA	Japan International Cooperation Agency
MEN	The Ministry of Energy, Chile
METI	Ministry of Economy, Trade and Industry, JAPAN
BMKG	Badan Meteorologi, Klimatologi, dan Geofisika (Indonesian Agency for Meteorology, Climatology and Geophysics)
NDC	National Determined Contributions
NEC	National Energy Council
NGO	Non-Governmental Organization
O&M	Operation and Maintenance
PO	Project Overseer
SDG	Sustainable Development Goal
SEC	The superintendency
SENAPRED	Servicio Nacional de Prevención y Respuesta ante Desastres

SOP	Standard Operating Procedure
TAGP	Trans-ASEAN Gas Pipeline
TBBM	Oil Fuel integrated Terminal
TC	Technical Committees
TCTP	Third Country Training Program
UNFCCC	United Nations Framework Convention on Climate Change
US DOE	The United States Department of Energy

1. Executive Summary

The APEC Energy Working Group (EWG) conducted the Asia-Pacific Economy Cooperation (APEC) Workshop on Energy Resiliency Enhancement project from 9 to 10 November 2023. The workshop was held to disseminate the APEC Energy Resiliency Principle and the APEC Energy Resiliency Guidelines, share knowledge and experiences on energy resiliency among APEC member economies, and solicit input for the development of the APEC Energy Resiliency Sectoral Guidelines for Energy Infrastructure Companies.

1.1 Background and aims of the workshop

Stable and resilient energy supply is critical for maintaining socio-economic activities. Many APEC economies continue to be challenged by intensifying natural disasters which cause serious damage to energy infrastructure and economy. Energy supply systems also increasingly threatened by man-induced disasters such as cyber-attacks and terrorism. As a result, energy disruption risks have increased dramatically, and energy resiliency has been an emerging priority across APEC economies.

The energy ministers of member economies of the APEC affirmed the importance of energy resiliency to promoting energy security and achieving sustainable development in the 2015 APEC Energy Ministerial Meeting held in Cebu, the Philippines. The meeting resulted in the Cebu Declaration on East Asian Energy Security. Since then, the Energy Working Group (EWG) and the Energy Resiliency Task Force (ERTF) have facilitated discussions on energy resiliency among APEC member economies. As a result, EWG, led by Japan with the support of ERTF and APEC member economies, developed the APEC Energy Resiliency Principle, which was endorsed at the EWG59 meeting held in 2020. Following the Principle, which compiled voluntary norms and measures that stakeholders in each economy should consider and implement for improvements in energy resiliency, the APEC Energy Resiliency Guidelines were published in February 2023.

Energy resiliency can be enhanced in various ways, including diversifying energy sources, implementing contingency measures, and building smart systems harnessing cutting-edge technologies such as IT and AI. These solutions will help build a more resilient energy system, and thus more resilient businesses and cities. On the other hand, harnessing emerging technologies will bring new challenges for energy resiliency evaluation, including legal challenges, as well as difficulties in utilizing or processing data for business purposes, depending on the economy. These issues will need to be overcome through international cooperation and will be important issues to be considered in sectoral guidelines.

Against this backdrop, the workshop aims to raise social awareness of energy resiliency in APEC economies and local community with a focus on energy supply infrastructure. Through the discussions at the workshop, it will be sought to gain insight for developing the Energy Resiliency Sectoral Guidelines for Energy Supply Infrastructure to improve resiliency efforts in the sector and enhance participants knowledge and understanding of energy resiliency evaluation.

1.2 Summary Proceedings

1.2.1 Opening

Following opening remarks from **Dr Kazutomo IRIE, President of the Asia Pacific Energy Research Centre (APEREC)** and a welcome remark (video message) from **Mr Dan Ton, Program Manager of Smart Grid R&D, Office of Electricity, the United States. Department of Energy**, a total of four sessions were held with discussions between speakers and attendees. The outline of the discussion is as follows.

1.2.2 The first session on “the urgent need for evaluating energy resiliency”

Ms Rieko EDA, Director for Natural Resources and Energy Research International Affairs Division of Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry (METI), JAPAN introduced the APEC Energy Resiliency Task Force, Principles, and workshops on the Principles

(video message). The expert committee for quantitative assessment of energy resiliency in Japan (contents of the 2020 report), the efforts to formulate ISO on energy resiliency, and the position of this workshop were outlined.

Mr Brian Strong, Chief Resilience Officer and Director, City and County of San Francisco outlined California and San Francisco efforts for energy resiliency. The rapid expansion of solar and wind power across the State to reduce its dependence on fossil fuels, deal with aging power grids (consider energy storage in various places), secure sufficient storage batteries, and save energy (including demand response) are moving forward.

While utilities have been active in improving energy resiliency, more support is needed at the federal level.

During the Q&A session:

- Although underground construction is considered because power lines can cause wildfires, it is incredibly costly in cities where a lot underground and above ground infrastructure is in place.
- The issue is what kind of performance standards are appropriate for energy resiliency, and he hope that APEC and federal agencies will consider adopting them (City of San Francisco has its own standards for the provision of energy and water in the event of an earthquake).
- One of the challenges cited was the reluctance of private companies (e.g., telecommunications companies) to share confidential information about their vulnerabilities.

Mr Hiroki Kudo, Board Member, Director in Charge of Electric Power Industry Unit, The Institute of Energy Economics, Japan (IEEJ) explained the APEC Energy Resiliency Principle, APEC Energy Resiliency Guideline, and APEC Energy Resiliency Enhancement Project.

He also informed the outline and benefits of ISO 22366 (Security and resilience - Community resilience - Framework and principles for energy resilience) as a related activity and pointed out that how to harmonize between the APEC guidelines and international standards related energy resiliency enhancement is an important point, and that it includes supply chain networks as a benefit for users.

1.2.3 The second session “Situation and challenges for energy infrastructure resiliency in member economies (1)”

Experts from three APEC member economies (Australia; Canada; Japan) gave their presentation and discussed the status of resiliency in energy infrastructure in each economy.

Dr Kevin J. Foster, Chairman, Risk Engineering Society (Western Australia), introduced the status of Australia’s energy resiliency related efforts. Australia’s inter-state electricity grid is limited to the eastern States. South-Western Australia has a completely separate electricity grid and there are various other smaller isolated grids in remote regions of the economy. Renewable energy production is growing rapidly, especially solar and wind power. Electricity authorities are gradually developing a capability to electrically isolate roof top solar panels by remote control, especially when it is necessary to maintain stability and safety of the grid. In addition to natural disasters such as wildfires, cyclones, floods and droughts, other risks can come from supply chain failures, including coal mines or thermal power plants closing earlier than planned.

Delays in large-scale clean energy construction projects could also potentially result in grid reliability gaps from 2025.

He pointed out a chronic shortage of skilled technical tradespeople and engineers needed to design, build, operate and maintain energy infrastructure. Australia’s governance framework, critical infrastructure resiliency strategy, legislation and resiliency principles were outlined. Incentives are necessary for private

companies to invest in energy resiliency. Energy resiliency principles need to be globally standardised and harmonized and should be based on socio-technical systems thinking: for both societal and engineering resiliency, not just one or the other.

During the Q&A session:

- He pointed out that the economic incentives of connecting electricity and gas grids between Western and Eastern Australia and with other economies in the region are likely very weak.
- Australia is a major exporter of energy, and other economies depend on Australia for their supply chains. Therefore, he also pointed out that due to these trade obligations. It is not necessarily a simple matter to close coal mines or natural gas production facilities in the near future.

Dr Guy Félio, Independent Consultant, Senior Advisor, Infrastructure Resilience

introduced the status of Canada's energy resiliency related initiatives. Due to geographical circumstances and population distribution, trade and interconnectivity with the United States have a significant impact on Canada. Climate-related disasters have increased in recent years, with insured losses alone surpassing CAD billions annually in recent years (e.g., the May 2022 derecho cost more than CAD1.1 billion in insured losses). Non-insured losses are typically twice those amounts.

It is not always possible to solve all problems by making the equipment infrastructure itself more robust (e.g., damage caused by debris blown from a nearby construction site by a tornado). In light of the United States - Canada blackout in August 2003, interdependence between utilities is also a risk, and O&M risks should also be considered in the context of resiliency. It is possible to deal with physical infrastructure risks, but building bigger and stronger requires enormous costs, and the solution should be a combination of infrastructure and non-infrastructure solutions, not just technology.

In addition, it is necessary to consider the perspective of smart cities and domestic security as cyber risks. Canada has developed codes, standards, and laws related to resiliency, and there are many strategies and plans by energy companies. Revisions to codes and standards take time, so other methods and tools that can provide faster results should be considered. It is also important to ensure adequate capacity of experts in climate risk assessment and resiliency.

During the Q&A session:

- He pointed out the reduction of insurance premiums as an incentive for private companies and property owners to take resiliency measures.
- In addition, he said that opportunity losses are not included in the calculation of losses due to natural disasters, and that insured losses are only 30-50% of the total losses.

Mr Keisei Nozaki, Assistant Director, International Affairs Division, Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry (METI), JAPAN introduced the status of Japan's energy resiliency related initiatives (video message). There is an urgent need to develop and strengthen disaster-resilient power system infrastructure due to the two major issues of threatening the power supply, the occurrence of intensifying natural disasters and the use of renewable energy as the main power source. As a countermeasure, the Energy Supply Resilience Act was enacted.

1.2.4 The third session “Situation and challenges for energy infrastructure resiliency in member economies (2)”

Experts from three APEC member economies (Chile; Indonesia; Thailand) gave their presentation and discussed the status of resiliency in energy infrastructure in each economy.

Dr Claudio Huepe Minoletti, Former Energy Minister of Chile, Universidad Diego Portales introduced the status of Chile's energy resiliency related initiatives. More than 50% of the renewable energy generation capacity is located in the north of the economy. The risk from natural disasters is under the

jurisdiction of the MEN, CNE, and SEC and SENAPRED, while the risk of man-made attacks is under the jurisdiction of the Ministry of the Interior.

In the wake of the 2010 earthquake, energy resiliency efforts have changed significantly, with policy focusing not only on infrastructure security, but also on supply and operational security. Efforts have been made to integrate information into a single platform, and a lot of information has been collected, but how to handle various forms of information is an issue.

Legislative action has been taken to require all sectors to plan for disaster response, to map key infrastructure for monitoring, and develop plans for risk management. However, there is no systematic approach to resiliency and a comprehensive legal framework and regulation.

There is also a problem in Chile as private companies are the actors of the market and the government doesn't have all information.

Dr Ir Djoko Siswanto, Secretary General, Indonesia National Energy Council, Republic of Indonesia introduced the status of Indonesia's energy resiliency related initiatives. The IEA has conducted an emergency response review in Indonesia and has formulated energy rules and policies such as the Energy Law, National Energy Policy, National Energy Master Plan, Regional Energy Master Plan, and Energy Crisis and Energy Emergency Assessment and Response Procedures (Decree of NEC).

The Decree of NEC clearly stipulates the measures taken by the central government. Future measures to strengthen resiliency include expanding renewable energy, phasing out energy subsidies, expanding stockpiles, conducting drills to mitigate supply disruptions in cooperation with ASEAN economies as an emergency response, and improving oil refining capacity.

During the Q&A session:

- He cited cooperation and knowledge sharing between Indonesia and the Philippines and other economies in the region in response to a question about what the appropriate strategy for the private sector is to strengthen infrastructure for economies with market-driven energy sectors.

Dr Nuwong Chollacoop, Director, Low Carbon Energy Research Group, National Energy Technology Center (ENTEC) introduced the status of Thailand's energy resiliency related initiatives. In regard to energy resiliency is in the context of adaptation, energy resiliency assessments are conducted based on risk assessment methods. Although it is difficult to obtain the commitment of the private sector in resiliency measures, his team aims to strengthen information sharing and cooperation to increase engagement.

Resiliency assessments are applied to a variety of different renewable energy technologies. Introduced the ASEAN COSTI Priority for 2021, three workshops on energy resiliency, and the ASEAN Energy Resilience Assessment Guideline. The SOP (Standard Operating Procedure) presented in the guidance shows the procedure step by step to make private companies aware of the time and cost required (the guidance itself still needs revision).

Resiliency assessment in Malaysia and cooperation with Japan (Ministry of Economy, Trade and Industry (METI), The Institute of Energy Economics, Japan (IEEJ) and Japan International Cooperation Agency (JICA)) were introduced.

During the Q&A session:

- Thailand raised the National Determined Contributions (NDC) target towards carbon neutrality but pointed out that energy resiliency is not explicitly included in NDCs, NDCs are mitigation, and resiliency is in the context of adaptation.

1.2.5 Panel session “Panel discussion: What are implications to enhance energy resiliency in energy supply sector and role/contents of the standard in APEC”

All of the face-to-face speakers (6 in total) participated in the panel discussion. The moderator was Dr Félío (Canada). The moderator asked three questions, and each speaker answered them. The main contents were as follows.

Question 1: What are the main challenges of building energy resiliency in your economy or region?

Australia: Information-sharing networks are functioning well, but they were originally developed for security and have restricted distribution and access. Reliability considerations are also an issue, and more rational decision-making is needed to avoid future problems.

Chile: As an organizational issue, it seems to be clearly stated in the law, but it is unclear who will be responsible for implementation in actual operation. Preparing people and organizations to plan and execute resiliency behaviors. Financing to implement resiliency measures.

City of San Francisco: Strengthening appropriate cooperation (collaboration across sectors and institutions). Securing resources to leverage data. Cities face many different challenges, and climate change is important, but only one of them.

Indonesia: Lack of regulations and resources to implement them. Review of policies (towards 2060 carbon neutrality). Development of infrastructure and power grids. Fundraising assistance. Cooperation with other economies.

Thailand: Stakeholder involvement (private companies, NGOs, etc.). Develop policies and implementation guidelines. Development of simple adaptations.

Question 2: What do you need in your economy and region to strengthen energy resiliency?

Australia: Investment in innovation and technology (potentially hydrogen) and better management of transition periods are needed. Better information sharing arrangements for exchanging experiential knowledge

Chile: Resiliency debate needs to be broadened to a broader audience. Sharing experiences and good practices of learning by doing as a way to contribute.

City of San Francisco: We need “pressure and advocacy” on energy resiliency – use. APEC’s signals of the importance of energy resiliency. Linking energy resiliency to economic resiliency. Where we can contribute: the United States resources and, local voices on resiliency (city initiatives).

Indonesia: Funding is needed to plan and implement energy resiliency measures. Technology transfer and sharing are also necessary. Where you can contribute is by sharing your experience.

Thailand: Energy resiliency solutions need to be implemented. Where I can contribute is in resiliency training.

Question 3: Consider the APEC Energy Resiliency Principles and the APEC Energy Resiliency Guidelines, and what additional guidance and information is needed in your economy or region?

Australia: Practical guidance is needed, including case studies. Addressing skills shortages and promoting education and development. Explanation of the difference between risk management and resiliency management.

Chile: Simplified language to disseminate the guidelines. How will resiliency be monitored and evaluated, including how investment priorities will be chosen? The impact of decisions and policies on resiliency.

City of San Francisco: Guidance on justifying investment needs. Quantification of benefits for cost-benefit analysis. Showing what is valuable. Resiliency presents, such as a resiliency scorecard.

Indonesia: Lessons and examples from other economies and regions that have adopted and implemented the Energy Resiliency Guidelines. Relationship with net zero (how to link it). Calculating the cost of implementing resiliency measures and how to implement them (lessons learned from successful cases).

Thailand: Sector-specific guidance (e.g., public and private sectors). Since it targets various economies, specific content is included in addition to general content. Include case studies. Include easy-to-understand explanations like infographics.

1.2.6 Summary of moderator's observations from panel discussions

The implementation of energy resiliency regulations, policies and programs appears challenging due to a number of factors, more pronounced in some economies than others; they include:

- Institutional challenges
 - Lack of instruments (regulations, policies, codes, standards) for energy resiliency
 - Difficulty to implement energy resiliency measures, due to lack or gaps in:
 - Collaboration and engagement: within and between sectors (public and private)
 - Awareness of needs and benefits of energy resiliency, including impacts on other sectors of the economy and well-being of citizens
- Financing energy resiliency measures and initiatives
- Examples (case studies, lessons learned) of successful energy resiliency initiatives

The economies represented on the panel indicated particular needs to meet the above challenges, such as:

- Investments in innovation and technology
- Broadening the energy resiliency conversation and debate beyond central governments by engaging relevant stakeholders including the private sector (often responsible for the energy infrastructure) and civil society.
- Using APEC credibility and energy resiliency related work to support advocacy for energy resiliency
- Developing strong business cases for energy resiliency that include evaluating (monetized) economic and societal benefits.
- Examples or case studies of successful energy resiliency solutions, particularly related to implementation

The above economies can also contribute to the advancement of energy resiliency in other regions or economies. Example of the contributions include sharing:

- Experiences on energy resiliency initiatives including but not limited to the development and implementation of policies and regulations.
- Technologies to enhance energy resiliency
- Training and capacity development

Overall, the panelists indicated that the APEC Energy Resiliency Guidelines could be further developed and enhanced by:

- Providing practical guidance on implementation, including lessons learned and case studies (a standard template for case studies could be developed to collect data and information and publish as a compendium supplement to the current guidelines)
- Develop capacity building to train and raise awareness related to energy resiliency
- Tools to quantify the benefits of energy resiliency and build strong business cases that include the contributions of resilient energy systems to society and the economy.
- Communication material (tools) related to energy resiliency targeted at various stakeholders in simple language, including for example infographics

- Implementation guidance by sectors: public (policies, programs) and private (investment, infrastructure)

Finally, several representatives of the economies participating in the workshop indicated the importance of the Energy Resilience standard (ISO 22366) currently under development. Although projected to be released in October 2025, this standard is expected to be an important complement to the APEC guidelines.

1.3 Conclusion of the workshop and Next Steps

1.3.1 Key Findings

In the workshop, 6 experts from APEC economies and one city presented the current status of energy infrastructure and countermeasures against risks caused by disasters. In the panel discussion, they discussed future initiatives and challenges, and expressed expectations for related APEC activities in the future. Specifically, the following suggestions were presented.

- Risks from natural disasters to the energy infrastructure of each economy have become apparent, and the need to strengthen energy resiliency has been recognized. However, at present, these efforts are not sufficient, and it is necessary to continue to consider efforts to strengthen energy resiliency.
- In order to strengthen energy resiliency, it is necessary to develop relevant guidelines. In particular, best practices in other economies are likely to be used if they can be referenced.
- Sharing best practices for each economy is also a beneficial action for economies that are considering countermeasures in the future. The guidelines are considered to be the starting point for the consideration and implementation of such initiatives.
- In order to strengthen energy resiliency, it is also effective to use tools (indicators) that can assess risks to energy infrastructure.
- It is also expected that international standards such as ISO and APEC guidelines will be linked to promote activities aimed at strengthening energy infrastructure, including from an international perspective, in cooperation with each economy.

1.3.2 Next Actions to Consider suggested through the workshop discussion

Strengthening energy resiliency to disasters is recognized as an important issue for APEC economies. On the other hand, the workshop participants indicated that the response differs among each economy, such as the energy supply structure, the status of energy supply infrastructure, and the interrelationship with climate change countermeasures.

Against this backdrop, there was a strong expectation for action to share experiences, knowledge and best practices on energy resiliency-related initiatives in each economy. Therefore, it would be beneficial to continue to provide opportunities for sharing them through workshop. The following themes and discussions suggested through the workshop are considered to be as follows.

Focus on actual and best practices for energy resiliency enhancement efforts by energy infrastructure sector

- Discussion of implications for each economy through sharing of initiatives, experiences, and best practices for energy resiliency enhancement in individual energy infrastructure sectors (power supply, petroleum product and gas supply chains, etc.).
- Considering the establishment of guidelines and guidance for each individual energy infrastructure field through information and discussions gathered at the workshop and other sources.

Examination of the feasibility of formulating guidelines in other sectors identified by the APEC Energy Resiliency Principle (energy consumers, finance sectors)

- Sharing initiatives, experiences and best practices for energy resiliency enhancement among energy consumers and the financial sector.
- Discussion for the direction of future actions will be considered regarding the significance and expected effects of the establishment of guidelines in both sectors.

Sharing of the relationship between energy resiliency enhancement and other policies

In the workshop, the scope of energy policy is complex, including not only energy resiliency enhancement but also climate change countermeasures (mitigation, adaptation) and other policy issues, and it was shown that the actual situation and challenges vary depending on each economy.

- Discussing of what the implications are for each economy's situation: through discussion of the current status and challenges of energy resiliency efforts faced by each economy, what goals are set, how they relate to other policy issues (how to prioritize policies), and the challenges and best practices they face.
- Potential discussion issues: how resources are allocated, such as financial and human resources, allocation of funds to required investments, approaches that are expected to have synergies between different policy issues, and capacity enhancement through international cooperation.

Promoting Multi-Stakeholder Knowledge Sharing

The APEC Energy Resiliency Principle identify multi-stakeholder knowledge sharing as follows:

Stakeholders should take voluntary measures at all levels. Effective efforts are encouraged to be shared among stakeholders both within economies as well as globally.

- Consideration of the possibility of actions that can contribute not only to APEC economies but also to global efforts to strengthen APECs energy resiliency: Identification of disaster risks and management in the event of a disaster (Business Continuity Planning (BCP), Business Continuity Management (BCM)), consistency with climate change measures, etc.
- Candidates for participation in the discussion include such as policymakers, experts, and researchers who are involved in the related fields, for example, initiatives related to energy resiliency such as ASEAN, initiatives related to climate change measures such as AZEC (Asia Zero Emission Community), ISO/TC 292 (Security and Resilience) and ISO/TC 262 (risk management) and other standards related to the sustainable corporate activities.

2. Background

Energy, ranging from oil, coal, natural gas to electricity, provides the basis for many social and economic activities. A stable and affordable energy supply is essential to achieve sustainable development in all economies and regions. In this regard, energy resiliency – the ability to secure a stable energy supply by effectively dealing with disasters (both natural and human-induced disasters) – is essential to achieving energy security and sustainable development. The Asia-Pacific region has been faced with frequent natural disasters, causing severe damage to the energy infrastructure and economy. Thus, building energy systems which are resilient against disasters in the APEC region has emerged as a priority.

In this context, the Energy Ministers of Member Economies of the Asia-Pacific Economic Cooperation (APEC) affirmed the importance of energy resiliency to promoting energy security and achieving sustainable development in the 2015 APEC Energy Ministerial Meeting held in Cebu, the Philippines. The meeting, focused on the theme "Towards an Energy Resilient APEC Community," resulted in the Cebu

Declaration on East Asian Energy Security. Since then, the Energy Working Group (EWG) and Energy Resiliency Task Force (ERTF) have facilitated discussions on energy resiliency among APEC member economies. As a result, EWG, led by Japan, has developed the APEC Energy Resiliency Principle with the support of ERTF and APEC member economies. The principle, which was endorsed at the EWG59 meeting held in August 2020, compiled norms and measures that stakeholders in each economy should voluntarily pay attention to and implement in order to improve energy resiliency.

Following the Principle, which compiled voluntary norms and measures that stakeholders in each economy should consider and implement for improvements in energy resiliency, the APEC Energy Resiliency Guidelines were published in February 2023. In order to ensure the guidelines reflect the regional diversity and variety of energy resiliency challenges in the APEC region, a total of three virtual workshops were held for South America (host economy: Chile), Northeast Asia (host economy: Chinese Taipei), and Southeast Asia (host economy: Indonesia), to promote dissemination of the APEC Energy Resiliency Principle for capacity building and facilitate discussions on energy resiliency for the development of Energy Resiliency Guidelines in January and February 2022.

Following the previous APEC activities described above, at this time, the workshop aims to raise social awareness of energy resiliency in APEC economies and local community with a focus on energy supply infrastructure. The workshop is sought to gain insight for developing the sectoral energy resiliency guidelines for energy supply Infrastructure to improve resiliency efforts in the sector and to enhance participants knowledge and understanding of energy resiliency evaluation.

3. Workshop operation

- Title: APEC Workshop on Energy Resiliency Enhancement Project
- Date/Hours: 9 November 2023, 10:00 – 17:30
- Venue: San Francisco, the United States (Hotel Nikko San Francisco)
- The workshops featured presentations and discussions on:
 - Urgent need for evaluating energy resiliency
 - Situation and challenges for energy infrastructure resiliency in member economies
 - Lessons & learns from each economy's experiences and implications to future APEC activity for energy resiliency enhancement of energy supply sector
 - What are the key challenges to building energy resiliency in your economy/region?
 - What would be needed in each APEC economy/region to enhance energy resiliency?
 - What could each APEC economy/region contribute to building resiliency in other economies/regions?
 - Considering the APEC Energy Resiliency Principles and Guidelines, what additional guideline/guidance or information would be needed to advance energy resiliency in each APEC economy/region?

Please see the Appendix 2 for the workshop agenda, and the presentation slides are available in the Annex 3.

4. Participating Economies and Organizations

A total of 28 participants (including 6 invited speakers, 12 active participants and 3 speakers through video) were from 11 economies including: Australia; Canada; Chile; Indonesia; Japan; Malaysia; The Philippines; Chinese Taipei; Thailand; The United States; Viet Nam.

Table 1 List of Speakers and Participants

Economy	Organization	Name	Gender
Australia	Risk Engineering Society (Western Australia Chapter)	Dr Kevin J. Foster	M
Canada	Independent Consultant	Dr Guy Félio	M
Chile	Universidad Diego Portales, Chile (Former Minister of Energy of the Republic of Chile)	Mr Claudio Huepe Minoletti	M
Indonesia	Ministry of Energy & Mineral Resources	Dr/Ir Djoko Siswanto	M
	Ministry of Foreign Affairs	Ms Ruth Yohanna Lumbanraja	F
		Ms T. Elfani Prassanti	F
Japan	Asia Pacific Energy Research Centre	Dr Kazumoto Irie	M
		Mr Yoshiaki Imaizumi	M
		Ms Ikuno Yamaguchi	F
	Ministry of Economy, Trade and Industry	Ms Reiko Eda	F
		Mr Keisei Nozaki	M
	Institute of Energy Economics, Japan	Mr Hiroki Kudo	M
		Ms Tomoko Murakami	F
		Mr Goichi Komori	M
		Ms Kana Sato	F
Malaysia	Ministry of Natural Resources, Environment and Climate Change Malaysia	Mr Wan Aminuddin Wan Hitam	M
		Mr Faiz Farhan Mohd Sharif	M
The Philippines	Department of Energy	Ms Magnolia Baterina Olvido	F
		Mr William G. Quinto	F
Chinese Taipei	Energy Administration, Ministry of Economic Affairs	Ms Shu-Ya, Chiu	F
		Mr I-Wei, Ho	M
Thailand	National Science and Technology Development Agency	Dr Nuwong Chollacoop	M
	Ministry of Energy	Ms Patcharaporn Khajorn-in	F
		Mr Prasert Sinsersuksakul	M
The United States	City and County of San Francisco	Mr Brian Strong	M
	Program Manager of Smart Grid R&D, Office of Electricity	Mr Dan Ton	M
Viet Nam	Ministry of Industry and Trade	Mr Le Phan Dung	M

		Ms Hoang Thi Ngoc Thanh	F
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5. Workshop Sessions Summary

5.1 Opening Session

5.1.1 Opening Remarks from workshop organizer

Dr Kazutomo IRIE, President, the Asia Pacific Energy Research Centre (APERC)

Dr Kazutomo IRIE made his opening speech as this workshop organizer as follows:

- The energy ministers of the APEC member economies affirm the importance of energy resiliency in the 2015 APEC Energy Ministerial Meeting, held in Cebu, the Philippines. Since then, the Energy Working Group, EWG, and the Energy Resiliency Task Force, ERTF, have facilitated discussions on energy resiliency among APEC member economies.
- As a result, EWG, led by Japan, with the support of the ERTF and other APEC member economies, developed the APEC Energy Resiliency Principle, which was endorsed at the EWG 59th Meeting held in 2020. The principle compiles voluntary norms and the measures that stakeholders in each economy should consider and implement for improvement in energy resiliency.
- Following the principle, the APEC Energy Resiliency Guidelines were adopted in February 2023 this year. Energy resiliency can be enhanced in various ways, including diversifying energy source, implementing contingency measures, and building smart systems, harnessing cutting-edge technologies. These solutions will help build a more resilient energy system and thus more resilient businesses and cities.
- On the other hand, harnessing energy and emerging technologies will bring new challenges for energy resiliency evaluation, including legal challenges, as well as difficulties in utilizing or processing data for business purposes, depending on the economy. These issues will need to be overcome through international cooperation and with important issues to be considered in sectoral guidelines.
- Against this backdrop, this workshop aims to raise social awareness of energy resiliency in APEC economies and local communities with a focus on energy supply infrastructure. Through the discussion at the workshop, we seek to gain insight for developing sectoral energy resiliency guidelines for energy supply infrastructure to improve resiliency efforts in the sector.

5.1.2 Welcome Remarks from APEC/ERTF

Mr Dan Ton, Program Manager of Smart Grid R&D, Office of Electricity, the United States Department of Energy (DOE)

Mr Dan Ton made his welcome speech (video) as the Co-chair of APEC Energy Resiliency Task Force, ERTF as follows:

- Looking at the recent climate-related disasters, such as the devastating wildfire in the United States, states of Hawaii and Hurricane Otis in Acapulco, Mexico, which rapidly strengthened from a tropical storm to a Category 5 Hurricane in just 13 hours last month, we can see why the topic of energy resiliency is one of the highest importance to both the United States and APEC.
- The importance of energy resiliency to the United States can be seen in recent DOE programs supporting grid resiliency, including the new Grid Resilience and Innovation Partnership, GRIP Program, which was announced on 18 October 2023. The GRIP Program will provide USD3.5 million for investment in 58 projects across 44 states to strengthen electric grid resiliency and reliability across the United States.

- The Grid Project has been chosen across three broad categories: (1) Grid Resilience Utility and Industries Grants, (2) Smart Grid Grants, and (3) Grid Innovation Program. The lesson learned by the project will be relevant across all APEC economies. The importance of addressing energy resiliency for APEC can be seen in the development of the APEC Energy Resiliency Task Force, ERTF.
- The ERTF was established in 2015 upon the instructions of the APEC Energy Ministers during the 12th APEC Energy Ministers Meeting, EMM 12, held in Cebu, the Philippines, on 13 October 2015. Its objective is to implement the Energy Ministers instruction to promote energy resiliency in the APEC region anchored on four strategic priority subthemes identified in Cebu declaration.
- The outcome document of the EMM 12, which was (1) Climate Proof Energy Infrastructure, (2) Providing an Avenue for Cutting-Edge Energy Efficient Technologies, (3) Advocating Community-Based Clean Energy Use in Energy Poverty-Stricken Areas; and number four, Improving Energy-Related Trade and Investment in APEC.
- Energy resiliency, as defined in the Cebu Declaration, is the ability and quality of energy infrastructure and facilities to withstand extreme natural and manmade disasters and other climate change impacts, to recover and return to normal conditions in a timely and efficient manner, and to build back better.

5.2 Part 1: The urgent need for evaluating energy resiliency

5.2.1 Keynote Speech from Project Overseer (PO)

Ms Reiko EDA, Director for Natural Resources and Energy Research International Affairs Division, Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry (METI), JAPAN

Ms Reiko EDA made her keynote speech (video) as Project Overseer of the APEC Energy Resiliency Enhancement Project as follow:

- As with other disaster response, not only in Japan, but also in Asia-Pacific region, energy systems need to be made more resilient. APEC has been discussing energy resiliency over the past several years for sustainable growth and prosperity. Following the 2015 to 2025 APEC Connectivity Blueprint, it's an annex to the 2014 APEC Leaders Declaration, energy resiliency was the main theme of the 2015 Energy Ministerial Meeting.
- The importance of enhancing energy resiliency in promoting energy security and sustainable development was then shared and the Cebu Declaration was released as the outcome document.
- Based on the Cebu Declaration, the Energy Resiliency Task Force was newly established under the APEC Energy Working Group and since December 2015, the Task Force has been sharing initiatives and knowledge on energy resiliency and discussing the compilation of the APEC Energy Resiliency Principles. The APEC Energy Resiliency Principles have been discussed since December 2015.
- With regard to energy resiliency in response to natural disasters, it is important to note that the circumstances surrounding each economy are diverse and therefore efforts should also be diverse. Based on this premise, the principles identify relevant stakeholders and their roles to enhance energy resiliency, including government, energy suppliers, consumers, and financial institutions. As such, studies have been conducted from a variety of perspectives.
- Japan has been working on ISO, ISO Standardization of Energy Resilience. A new project team has been established to develop energy resiliency related standards and its development is underway. Japan is working on global standardization of business initiatives that contribute to energy resiliency.
- Japan conducted APEC Workshop on Energy Resiliency Principle Project from January to February 2022. Three virtual workshops were held to disseminate the APEC Energy Resiliency Principle. Then, they shared knowledge and experiences on energy resiliency among APEC member economies and solicit inputs for the development of the APEC Energy Resiliency Guidelines, which was published in February 2023.

5.2.2 Keynote Speech from local government

Mr Brian Strong, Chief Resilience Officer and Director, Office of Resilience and Capital Planning, Office of the City Administrator, City and County of San Francisco

Mr Brian Strong made his keynote speech regarding situation and challenges for energy resiliency enhancement in the City and County of San Francisco as follow:

- It has been thinking about resiliency really in San Francisco basically since 1906, when it had the great earthquake. It is 80% of the city burned down. The idea of coming back after disasters is something that people of San Francisco have had high in our mind for that entire period.
- It had some other recent earthquakes, one in 1989. Now, San Francisco is starting to really see some impacts of climate change, San Francisco has had to deal with less than many other parts of the world. When City of San Francisco think about resiliency, it is really thinking about a clean and healthy environment for people to live in, reducing asthma rates and those types of things.
- In the US in 1953, about 64% of the population was living in cities. Now, it is at 83%. The dramatic move from sort of rural areas to urban areas has happened in this economy and we know it's happening across the world too. The expectation is by 2050, 70% of the world's population will be living in cities. These cities and urban areas are where we are going to be seeing the energy consumption and it's where it needs to address a lot of these issues.
- 70% of the energy related CO₂ emissions are coming from cities today, it is talking about how to face some of these challenges, cities need to be at the fore.
- One of the things that City of San Francisco thinks about and trying to really institutionalize, as part of the principles, is ensuring that it is addressing shocks and stressors. Some of the shocks are going to be earthquakes, rainfall, heat, extreme heat events, flood events, those things that are really big shocks to the system. The City of San Francisco knows that the government is seeing those happen on a more regular basis with extreme rainfall or precipitation, those types of things. But the government want to guard against those, certainly, and try to become resilient to those shocks.
- Stressors are sort of these ongoing things that if we're not tackling them, then it means after the big shock, we're going to have that much more of a challenge to recover. Sometimes, the recovery is worse than the shock. It had seen the experience in New Orleans, the United States, Hurricane Katrina. In many ways, the recovery was more difficult than the actual event itself.
- How is it going to make sure that it is addressing some of those things around income and equality, lack of affordable housing, poverty, crime, unemployment, those are all related to this energy issue. That's part of the point is that it's not limited to one sector, to one area, but it is needed to make sure that communities and infrastructure. If infrastructure isn't maintained and it have a disaster, then it is much worse off than if it didn't have it maintained.
- San Francisco promoted passive air systems, fans, those types of things in many respects in the name of energy resiliency to reduce power needs. But now we've seen a change with climate. It has also seen a change with air quality coming from some of the extreme wildfires that are happening 200, 300 miles away, sometimes even in Oregon. The way the weather patterns work is that some of that smoke comes, and it sits right over San Francisco in the Bay area.
- Then, it is also talking about other issues here around sea level rise, which is very significant for a city like San Francisco, right on the bay, and the coastal flooding. San Francisco is beginning to see major rainstorms. It is expecting 35% more intense rain that's coming in the next 30 years by 2050.
- Those also require energy because San Francisco is doing to keep the water from coming into the city. But when it has the rain now, it got to get the water out of the city. San Francisco is a basin, so the only way San Francisco is really going to get the water out of the city is to pump it. San Francisco has to consider this issue of the importance of energy resiliency.
- One of the things that San Francisco did, actually this is after – it really started in 2010. In 2014, San Francisco did a major report by Lifelines Council, and this is where it is involving cities, counties, energy providers, communication providers, transportation, port, roads, Caltrans, or road people. The Council is bringing them together quarterly to talk about resiliency issues.

- San Francisco did an interdependency study back in 2014 and then, in 2020, San Francisco did this Restoration Performance Improvement Plan. Which is the idea of after an earthquake, and it was looking at major earthquakes or other events, how long would it take you, utility or communications firm, how long would it take you to get back up and running. San Francisco worked with a professor from the University of British Columbia who had sort of a methodology to look at some of the interdependencies. Electricity at the very forefront there, clicks every box.
- It is known if it doesn't have energy, if it doesn't have power, it is not able to be going to have water. Those seem to be the two really critical features of lifelines. Then, what it ends up having to depend on too is fuel, and how are it going to. It is building up fuel reserves and those types of things at the same time that it wants to get rid of using fossil fuels or reducing our reliance on it.
- Looking at California, it has a pretty complex energy grid with a broad mix. The diversity of energy sources is something that California is fortunate, there have been various policies that have helped to promote the use of renewable energy and different energy sources.
- Right now, it still is primarily relying on natural gas and nuclear and then geothermal, hydropower, solar and wind. The solar and wind, which has really picked up dramatically, is meeting the target which is 30% in 2022, but it knows it is going to need to do more.
- In California, the solar areas tend to be more in the eastern part of the state there is a lot of sun, there is a lot of land and area for it, but it got to move that energy into the cities, and you got to be able to store it and do those types of things. The hydro, so we do have a number of dams. San Francisco has a Hetch Hetchy, which is in Yosemite that serves water for San Francisco. San Francisco got those water rights 150-plus years ago, but that also serves as a major source for hydro energy for supply in San Francisco.
- The other thing is how is it managing demand. The California Independent Systems Operator managed the electricity flow, they are looking at how to ensure that it is not seeing blackouts and those types of things throughout the day. As the supply of solar and wind power generation increases, the issue of how to balance the supply and demand of electricity is emerging. In order to balance such supply and demand, batteries have been introduced as a regulating force, but the issue is how to expand the capacity of batteries in the future. The other difficult thing to tackle then is transmission. How is it going to transfer this electricity to the cities where the energy is needed? The transmission network is old, when it is talking about improving it, it is incredibly expensive, and it takes a lot of time.
- Renewable sources including solar, wind and geothermal are zero GHG emissions, but with natural gas it's high. On the other hand, if it sees for reliability of power supply, natural gas is excellent. There are some issues regarding future energy supply/demand in San Francisco, where does it need to put our resources, what are the challenges, and how can it make sure that it is getting green bars all the way down as much as it can.

[Question]

- San Francisco has any plan to improve efficiency of electricity for transmission instead of replacement. Because it was mentioned that replacement of transmission was not quite easy.

[Answer]

- Mr Strong informed recent outbreak of wildfires, there were concerns that power transmission lines were the cause of the wildfires, and that measures such as putting power transmission lines underground are considered.

[Question]

- How does San Francisco manage from this resiliency perspective, this dual necessity of densifying, but also identifying having to increase the supply of services, whether electric, water, wastewater, and so on, so just for that reason?

[Answer]

- Mr Strong pointed to the challenges that have become apparent due to the centralization of cities and introduced initiatives such as the process of infrastructure capital planning and operation by city authorities and the introduction of microgrids.

[Comment by participant]

- Ms Olvido informed the Metro Manila Earthquake Impact Reduction Study supported by Japan and follow-up activities including development of the National Energy Contingency Plan, tabletop exercise gathering all those stakeholders from the energy sector using the Contingency Plan. She recommended to communicate with not only power company but all type of organization which are responsible for lifeline by using a contingency plan.

[Question]

- Do San Francisco have a set of energy resiliency standards to make plan for replacement of transmission capacity considering sort of for drought or for extreme or for flooding?

[Answer]

- Mr Strong informed that San Francisco has established standards for energy and water supply and expectations around how that standard will change after an earthquake. He also informed that PG&E is relying on some of the international standards around resiliency, the standard developed by considering sort of what they would consider maximum earthquake or those types of things.
- He argued thinking appropriate standard is one of the challenges San Francisco has. And he argued need to sort of come together as a region and as a state for resiliency but identified difficulty to communicate with private company about it.

[Following comment]

- Regarding engaging the private stakeholders and them not sharing confidential, the Department of Energy in the Philippines issued a policy for them to submit their business continuity plans. Since the Department has this framework of adopting the National Energy Contingency Plan, the Department encourages them to update their Business Continuity Plan, considering the scenarios, the possible effects of the largest earthquake. Because some companies would not share this information, the Department had to craft non-disclosure agreement policies to facilitate the sharing of information, now, they will be comfortable sharing with the Department this vital information so that the Department can craft very specific or relevant action plans.

5.2.3 Introduction to APEC Energy Resiliency Principles/Energy Resiliency Guidelines

Mr. Hiroki Kudo, Board Member, Director, in charge of Electric Power Industry Unit, the Institute of Energy Economics, Japan (IEEJ)

Mr Hiroki Kudo explained the APEC Energy Resiliency Principle, APEC Energy Resiliency Guideline, and APEC Energy Resiliency Enhancement Project. He also informed the outline and benefits of ISO 22366 (Security and resilience - Community resilience - Framework and principles for energy resilience) as a related activity and pointed out that how to harmonize between the APEC guidelines and international standards related energy resiliency enhancement is an important point, and that it includes supply chain networks as a benefit for users.

- The APEC region has been continuously challenged with the natural disasters ranging from the earthquakes, tsunamis, hurricanes, and heavy snow. The different circumstances in each economy are based on some of the risk to make some of the impact of the energy supply and demand and in particular the energy supply infrastructure to consider how to act to the risks to some of the natural inclusion of the natural disaster.
- The APEC Energy Resiliency Principle recognized the delivery of the APEC member economies, energy infrastructure and respect all institutions in operation with the stakeholders. The principle

shows how enhancement of energy resiliency in each economy should be considered and what kind of action regarding to this, purpose for the enhancement of the energy resiliency in each economy. For example, communications by all of the stakeholders including government, energy supplier, consumer, and the financial institution shown to be important to avoid the impact of the natural disaster.

- Defining the energy resiliency is important. Some of the economies, and some of the organizations set some of the different type of the definition for energy resiliency. Making common definition for energy resiliency in the principle is the starting point for the discussion about the enhancement of energy resiliency in the APEC economies.
- After the publishment of the principle, the APEC considered the action towards enhancement of energy resiliency in each economy to prepare the APEC Energy Resiliency Guidelines. The guideline gives a more detailed explanation of the contents of the principle. It's a very interesting process to establish the guideline. This project prepared three workshops with inclusion of the APEC major economies, all of the invited APEC economies, and prepared some of the opinions and discussions and also some of the conclusion of how to implement the enhancement of the energy resiliency. This is a very important process to develop the guideline.
- The objective of this project is to follow up on the principle and the guideline. Particularly, this workshop, it is expected some sharing of the information and discuss and identify some of the implementation methods regarding energy resiliency enhancement in the energy supply sector in the APEC economies.
- In the principle, it has identified that the activity regarding energy resiliency enhancement project by the APEC should be considered to promote more relevant and activity within the APEC and globally. Development of the ISO 22366 which is international standard focusing on the energy resiliency enhancement is one of the relating global actions. ISO 22366 is an international standard aiming to be published in 2025 and is currently in the process of development. It is a very important point that how to harmonize the APEC activity and the international activity. It is the APEC-specific circumstances of each economy, APEC economies situation but also globally thinking about different types of discussions needed.

5.3 Part 2: Situation and challenges for energy infrastructure resiliency in member economies (1)

Moderator: **Ms Tomoko Murakami**, Senior Fellow, Electric Power Industry Unit, the Institute of Energy Economics, Japan (IEEJ)

5.3.1 Australian Case

Dr Kevin J. Foster, Chairman, Risk Engineering Society (Western Australia Chapter)

Dr Kevin J. Foster made his presentation regarding energy resiliency enhancement for the energy supply chain network in Australia.

- The first step in understanding how best to create resiliency in Australian energy supply chain networks is to understand the context of the problem. - In geographic area, Australia is only slightly smaller than the mainland of the United States, but it only has 8% population that the United States has. Approximately 40% of Australia's population of 27 million people live in two cities, Sydney and Melbourne. The relatively low population density in the rest of the economy provides some interesting challenges for Australia's energy resiliency, and opportunities for improvement.
- Australia's 'inter-state' electricity grid is limited to the Eastern States and even in those states some remote areas do not have access to the grid.
- A separate grid exists in South-West Australia. The gap between the grids is about 1,330km or 830 miles.

- There are some smaller grids in various remote areas of Australia, for example in the north-west of Australia there is a grid that services some of the mines, ports, natural gas production facilities and towns.
- The natural gas pipeline grids in Eastern and Western Australia are also separated.
- Australia exports far more energy than it consumes. In 2022, Australia exported 16,000 petajoules of energy but it only consumed 6,000 petajoules. Australia is a massive exporter of energy, 65% of the energy exported was in the form of black coal and 30% was natural gas.
- There are proposals to export renewable energy in the not-too-distant future. For example, there is a proposal to build an undersea power cable from Darwin to Singapore. There are also proposals to produce and export green hydrogen.
- In 2022, renewable energy production accounted for 32% of total electricity production in Australia and this is growing rapidly, especially solar and wind energy.
- It's worth noting that small-scale solar, for example, photovoltaic panels on rooftops, currently accounts for about 8% of electricity production in Australia.
- Importantly, 19% of Australia's electricity production was generated outside of the electricity sector. For example, many mines and some manufacturing facilities have their own private power stations. Also, many properties providing services in remote areas and large farms generate their own off-grid electricity.
- In Australia, for about the past 20 years, Trusted Information Sharing Networks have been well established to enable critical infrastructure owners and operators to share information about significant threats and vulnerabilities and collaborate on appropriate measures to mitigate risk and boost resiliency. There are 14 industry sectors that have been designated as critical, including electricity, gas and liquid fuels. Each of these sectors is supported in the trusted sharing network by an Australian Government agency - usually the agency that has portfolio responsibility for that sector.
- Cybersecurity threats are not necessarily understood by all stakeholders. Therefore, there is an effort in Australia to improve knowledge and information sharing along supply chains, especially those deemed to be critical infrastructure.
- While some energy supply or transmission organizations might implement good operational-technology security, at a community level cybersecurity might not be so well organized. For example, there has been some discussion about the vulnerability of rooftop solar systems to hacking, especially the inverters that convert DC power from solar panels into mains voltage power used for houses, buildings and export to the grid.
- Electricity authorities are gradually developing a capability to electrically isolate roof top solar panels by remote control, especially when it is necessary to maintain stability of the grid. The problem of course is that the electric energy available from roof top solar can vary rapidly with weather and lighting conditions. Other power sources might not always be available to respond quick enough to take up demand not met by variable solar energy supply. Therefore, sometimes with unstable conditions it is necessary for electricity authorities to turn the solar power supply off, and then turn on a more stable source of power. If a hacker develops the capability to remotely turn off large numbers of solar power system inverters or isolate photo-voltaic panels then there is scope for a hacker to disrupt power supply in a city or across a region.
- Bushfires are a threat to infrastructure. For example, when bushfires spread to a coal mine that supplies coal to a power station, electrical power availability might be severely disrupted. In an example described a coalmine which supplied a nearby thermal power station, caught fire in 2014 due to bush and grass fires in the area. The coal mine continued burning for four weeks and more than 7,000 fire fighters were deployed over 45 days before it was declared safe.
- Periods of prolonged very hot dry weather are especially hazardous if there are high fuel loads in bushland.
- North of the Tropic of Capricorn, severe tropical cyclones are not uncommon in the summer months. If a town is in the path of one of these cyclones the damage can be catastrophic. Modern buildings

and infrastructure in the high-risk areas should be built to be resilient to these intense winds, however flying debris can do a lot of damage. Older buildings are not always resilient enough, and occasionally the cyclones move south of the tropic to areas that are not in the high-risk areas, and the buildings in these more southerly areas are more vulnerable to damage due to a lower resiliency requirement in building construction standards. This increases the 'cascading' risk of damage to energy infrastructure exposed to flying debris.

- In some years, floods are a significant problem in some parts of Australia. It is a land of contrasts. We can have drought for years and then in other years very heavy rains bring floods. Coal mines are vulnerable to filling up with water during these wet times. In fact, any low-lying energy infrastructure in flooded areas is vulnerable.
- With rising seas, coastal erosion is a serious problem in many parts of Australia. Infrastructure along the coast such as power lines can become unusable.
- Droughts bring problems too. Bushfires and also sometimes insufficient water for cooling towers at inland thermal power stations.
- Other threats can come from supply chain failures, such as a coal mine closing earlier than planned, perhaps due to business decision-making that requires mitigating organizational risk or business risk. The risk to communities might not be considered as much as it should, perhaps because the 'owner' of the risk has not been defined clearly enough.
- Delays to the completion of large clean energy projects intended to replace unsustainable thermal power stations can also cause energy 'reliability gaps.' Some analysts believe this could happen in Australia from 2025.
- Australia implements a Federal strategic Critical Infrastructure Resilience governance framework. This includes Security of Critical Infrastructure legislation applicable to 14 infrastructure sectors. This legislation requires: transparency about who owns and operates critical infrastructure, including energy systems; the government to facilitate cooperation and collaboration between all levels of government, regulators, owners and operators of infrastructure to manage risks to those assets; and responsible entities to identify and manage risks to critical infrastructure assets. It imposes cyber security obligations to improve preparedness and response to cyber security incidents; requires reporting of cyber security incidents to a Federal government authority; and it provides a regime for government agencies to respond to serious cyber security incidents.
- Australia has tight energy market regulation at both the Federal and State levels, with the Federal government regulating inter-State markets, and State governments regulating intra-State isolated markets (for example in Western Australia).
- A Federal government agency known as Infrastructure Australia provides advice to government about infrastructure investments. Resiliency is an important consideration in the advice given. This agency has a particular interest in the need for infrastructure to contribute to making communities more resilient.
- They define resilient communities as those that "have the ability to resist, absorb, accommodate, recover, transform and thrive in a timely, effective manner in response to the effects of shocks and stresses to enable positive economic, social, environmental and governance outcomes."
- Every community, no matter how small or how remote, relies on the availability of energy. Energy resiliency principles promoted in standards and government policies need to be relevant to all communities that depend on reliable energy availability, no matter how big or small or where they are located. Private energy providers need incentives to achieve energy resiliency for communities reliant on energy services.
- Risk information sharing in energy supply chains probably needs to be better connected and more focused throughout the entire chain instead of just individual organizations in the supply chain.
- It is important that the development and completion of draft ISO 22366 Energy Resilience is very important and should continue to be supported. Solutions need to 'fit' resiliency and risk management problems. For example, an urban resiliency approach suitable for a large city like

Melbourne or Sydney is not necessarily suitable for a town that is off the main grid, or at the end of very long transmission line.

- Energy Resiliency Principles need to be globally standardized and harmonized and should be based on sociotechnical systems thinking for both societal and engineering resiliency, not just one or the other. The principles need to be suitable for all contexts and all scales of systems, and all elements within the systems. All of the standardized principles need to be implemented to truly achieve systemic resiliency for energy supply chains and the communities they serve.
- In 2020, David Yu of Purdue University, Michael Schoon of Arizona State University, and their colleagues published a very interesting and detailed argument for General Principles of Resilience Engineering - from a socio-technical point of view for infrastructure dependent systems. Also, in 2022 the UN Office for Disaster Risk Reduction (UNDRR) published a set of principles for resilient infrastructure. Key contributors included Liz Varga of University College London and Helen Ng of UNDRR. These two sets of principles have a fairly common theme and both of them are essential reading for anyone considering energy resiliency improvements.

[Question]

- The grid system in Western Australia is quite isolated. Are there any possibilities to connect this with the main grid system in Eastern Australia?

[Answer]

Dr Kevin Foster thinks the economics of trying to connect Australia's east and west electricity grids or the gas grids is not viable. The only likely way inter-connection of the two main grids could become viable in the distant future would be for more towns and cities to be built between. However, those areas in between are grid and cannot sustain large populations, so interconnection of the Eastern (Inter-State) and Western Australian grids is highly improbable.

Dr Kevin Foster made additional comments: Australia exports much of the energy it produces, therefore it is really important to apply resiliency principles to the entire length of a supply chain which extends overseas. Other economies are reliant on the energy that we are exporting. We are very conscious of this, and it is one of the reasons why we have been a little slow in some areas to move away from coal and natural gas, we cannot just turn off the supply. However, we are working hard to transition to renewables and build resiliency.

5.3.2 Canadian Case

Dr Guy Félio, Senior Advisor in Asset Management and Infrastructure Resilience

Dr Guy Félio made his presentation regarding an overview of the energy sector in Canada.

- Dr. Guy Félio talked about the context and what is Canada's energy sector — some of the recent disruptions.
- The primary energy production in Canada, crude oil is 44%, and it has uranium, natural gas, and hydro, and so on.
- Regarding energy production, it gets polarized across three areas of Canada, British Columbia is mostly hydroelectric and natural gas. The oil and gas productions are predominantly in the provinces of Alberta and Saskatchewan. In Quebec, 90% energy production is hydroelectricity, that is where the economy has the cleanest production of energy. Ontario and New Brunswick are the producing areas of uranium, these three groups of provinces that are using different sources of energy with their own challenging.
- From an economic perspective, the energy as an economic contributor is about 10% of GDP. But what is important is to look at the energy trade, 91% of primary energy production is going to the United States (2021). So, it is important to consider the interconnectedness between these two economies. From an energy infrastructure perspective, pipelines and transport are important part of these trades.

- Canada has energy assets across the world; there are also different companies depending on the energy type. Canadian companies have assets in the United States, Latin America, Central America, Asia, Australia, and a number of economies. Canadian energy distributors and companies are all over the globe and, from a resiliency perspective, it is a factor to consider.
- In terms of the world production of electricity, Canada is 6th place and in terms of world exports is 1st place. That is huge for an economy that has greater geographical area than a number of economies. Canada is second place in the world in terms of area and population is only 40 million.
- In terms of the trends in energy demand, it has been going up because of the growing economy. However, the energy intensity, which is the use of energy per capita has been going down due to higher attention about the use of energy. But still, there is a growing energy demand, and it happens across all the sectors of the economy.
- In terms of power generation by energy source, 60% is hydropower. A small percentage is gas and oil, which is 12%. A smaller number is coal, and that is being reduced very quickly. The coal power plants are being shut down and, in most cases, they are being replaced by nuclear (15%); renewables are starting to grow more.
- In terms of disruptions to the energy supply, the sector is affected by all types of different hazards, and that are impacting power generation, transmission, distribution and use. In May 2022, a "derecho" occurred in Ontario and Quebec. A "derecho" is an intense windstorm that is several 100s of kilometers wide and travels very fast; this one traveled more than 1,000 kilometers in 12 hours, and wind speeds of more than 120 kilometers an hour were recorded at various locations in the path. It did about CAD1.1 billion worth of damages (only the insured losses). A lot of the damages to electricity distribution networks were not by failures of the poles, but by trees and large branches falling on the lines. This brought out the impacts of the importance of vegetation control because 90% or 95% of all the damages in Quebec were because of trees that fell on the lines.
- The other hazards of note were the six tornadoes in 2018 that caused more than CAD300 million worth of damages. One of the substations impacted was not damaged by the tornado, but by flying debris from a nearby construction site. There were a number of lessons from this and other wind-related events in the area, and the utility planned to install a composite pole to avoid cascading failures every five wooden poles as a resiliency enhancement measure.
- On June 28 2021, British Columbia Hydro broke its all-time summer peak demand record due to historic heat wave. British Columbia Hydro was calling on people to decrease their electricity demand, so that it did not have to resort to brownouts and restrictions. As a result, there were no outages because of the heat but the utility was at its limit of power generation. During the same year, British Columbia Hydro encountered 2 extreme weather events. In addition to the extreme heat events, British Columbia Hydro experienced a severe atmospheric river in November that caused flooding in many areas of the province. During the summer, the utility was worried about drying reservoirs and in November, it was worried about overflowing reservoirs. Eventually, British Columbia Hydro had to open the valves and had to flood some of the areas in the west of the province. This was a combination of two events within the same year.
- Regarding to hurricanes in the Atlantic Canada, it is not expected that hurricanes will be more frequent in the future, but they will be more intense. Also, in the North Atlantic, hurricanes are going to originate higher than where they originate today. Therefore, when they reach the coasts of New York, Maine, and Nova Scotia and other provinces, hurricanes are going to be stronger. Hurricane Fiona back in September 2022, CAD660 million of insured losses.
- One of the most important issues considering impact of climate change and cybersecurity are operations and maintenance risks. In August 2003, the largest blackout in the United States and Canada affected 50 million people. The area included Detroit, Ohio, Cleveland, Niagara, Toronto, all the way to the border with Quebec and north to almost the border with Manitoba. The cause of the blackout were inefficiencies in operations and procedures from one small utility. Considering the risk of energy resiliency, this shows that interdependencies, not only external to the utilities but within and between the utilities, become important.

- In terms of resiliency measures, there are codes and standards and related instruments; for example, the Canadian Energy Codes for buildings, or the new cybersecurity requirements and critical infrastructure codes. Infrastructure Canada has a document, which they call the "Climate Lens assessment". It is a guide that is used for projects funded by the federal government whereby the recipient needs to perform a climate-related assessment of the proposed project. The Climate Lens assessment has two components. One is the GHG emissions - the mitigation side of the equations, and the resiliency assessment – the adaptation side. Canada has a well-developed, publicly available data portal for climate projections. The portal¹ (climatedata.ca), has future climate projections for a number of parameters, and is continually growing with additional parameters relevant to the practitioner doing climate risk assessments. Major utilities including power company, gas company and oil company have developed strategies and plans related to adaptation and resiliency. These are typically public.
- Observations
 - The top three risks in Canada identifies by the Alliance Risk Barometer 2022² are business interruption, cyber incidents, and climate change. In the past, emphasis was on mitigation, but now, and for the last probably 5-6 years, that is being focused for adaptation. People and decision makers are realizing that they have to deal with the problems of today as well as planning for the future. In the past, emphasis was on mitigation, but now, and for the last probably 5-6 years, that is being focused for adaptation. From a municipal perspective, there might be bylaws that address resiliency, but in general there is a need for solid guidance documents that can be shared. There is also a need to build up the capacity of our professionals to deal with adaptation and resiliency. In Canada, there is still (albeit growing) a limited number of professionals that are doing climate risk assessments and resiliency studies.
 - In terms of cybersecurity, ransomware will be and continues to be a persistent threat. The National Cyber Threat Assessment for 2023-2024 indicates that although Canada is vulnerable to some state-sponsored cyber threats, it is unlikely to be at a scale that would shut down completely the services of some of our critical infrastructure. Finally, disruptive technologies bring new opportunities and new threats, for example. smart cities initiatives.

[Question]

- Are the financial and insurance industries doing something specific on that, like putting more standards for themselves on infrastructure beyond what is being worked on by government?

[Answer]

- Insurance companies are giving incentives - reductions in insurance premiums if the owner adds certain types of resiliency measures. For example, insurance companies said, "Look you've been exposed to this big wind event in 2022. If you were to install hurricane ties for the roof to the frame of the house, which probably will cost you about CAD200 or CAD300 to do it, we will give you a rebate to do that actually".

[Question]

- When it comes to the calculation of rebate, was the value of lost load also considered in the computation, or at least the opportunity losses for not having the electricity?

[Answer]

¹ <https://climatedata.ca/>

²

https://www.allianz.com/content/dam/onemarketing/azcom/Allianz_com/press/document/Allianz_Risk_Barometer_2022_FINAL.pdf

- No. There were no opportunity losses that were added to the calculations. The calculations are basically what comes from insurance claims, that gives you the insured losses. Munich Re and Swiss Re, the two reinsurance companies, have come up with a rule of thumb that insured losses are about 30% to 35% of the total losses that are incurred because a lot of the losses are not insured. That's where the total costs of the events come from.

[Question]

- In case of a big number of rebates, would it also consider the damage cost, opportunity loss, the recovery cost that you've been mentioning?

[Answer]

- No, because for example, those costs do not include all the emergency response costs and others related to the events. For example, if you consider Hurricane Fiona in Atlantic Canada or the wildfires that happened in Canada early this year, the cost of emergency response was huge, and they're not included in those.

[Comment to answer]

- Including the lost opportunity costs, the damage costs and the recovery costs will provide additional rationale and justification for investments in energy resiliency.

5.3.3 Japanese Case

Mr. Keisei Nozaki, Assistant Director, International Affairs Division, Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry, Japan

Mr Keisei Nozaki made his presentation regarding the status of legislative measures to improve power system resiliency in Japan from the perspective of the revision of the energy-related acts (video message).

- In recent years, a series of extreme natural disasters have threatened the power supply in Japan. Accordingly, it is becoming essential to establish a more disaster-resilient power system infrastructure. In order to support this, the "Act of Partial Revision of the Electricity Business Act and Other Acts for Establishing Resilient and Sustainable Electricity Supply Systems " that stipulates the revisions to the relevant energy-related Acts passed the Diet in June 2020 and equipped in April 2022. The Act covers partial revisions of the "Electricity Business Act" which stipulates the rules of the electricity business; the "Act on Special Measures Concerning Procurement of Electricity from Renewable Energy Sources by Electricity Utilities;" and the "Act on the Japan Oil, Gas and Metals National Corporation," the "JOGMEC Act."
- The background of the revisions made to the three Acts simultaneously is that Japan's power system infrastructure is facing the three challenges. Challenge one is natural disaster. In recent years, extreme natural disasters have impacted wider areas of Japan. Notable examples of disasters that damaged the power system infrastructure are the Hokkaido Eastern Iburi Earthquake, which caused a large-scale blackout across the entire Hokkaido area in 2018, Typhoons Numbers 15 and 19, which caused power supply interruptions for long periods in 2019. Considering that large-scale natural disasters may occur in the future, the immediate construction of a disaster-resilient power system infrastructure is necessary.
- Challenge two is making renewable energy a primary source of power. The "5th Strategic Energy Plan", which was approved in 2018 as a guideline for Japan's energy policy, set out a plan for making renewable energy a major power source. The "6th Strategic Energy Plan" in 2022 also continued same position, regarding the importance of renewable energy promotion. Renewable energy contributes to not only reducing CO2 emissions but also raising Japan's energy self-sufficiency ratio. It also enhanced distributed energy systems in which power production facilities are constructed

distant to each other while maintaining coordination. Distributed energy systems are disaster-resilient and therefore the introduction of renewable energy is considered necessary for building a resilient power supply structure. However, renewable energy in Japan is facing challenges such as high costs, power market integration, business discipline, grid constraints, and unstable generation.

- There are five specific challenges for promotion renewable energy.
 - **Cost reduction:** Under the Feed In Tariff (FIT) scheme, part of the cost incurred by utilities purchasing electricity generated by renewables is passed on to the general public in their electricity bills, which includes the renewable energy surcharge. Power generation using renewables remains so expensive that the burden on the general public may become greater than originally expected. Therefore, cost reduction is an urgent necessity.
 - **Power market integration:** The power system requires maintaining a balance of supply and demand at all times. Therefore, utilities are required to supply an adequate amount of electricity to the market in line with the supply and demand situation. On the other hand, the FIT scheme was formulated for the purpose of increasing power generation by renewables. Therefore, under the FIT scheme, utilities are required to purchase electricity generated by renewables at a fixed price regardless of the market situation. In order for renewable energy to become a major source of power, it needs to be integrated into the electricity market, and doing so requires fluctuating its output in line with the supply/demand situation as with other power sources.
 - **Business discipline:** Renewable energy power generation facilities, which are built in a variety of areas, need to ensure safety and harmonize with the local communities. For instance, proper disposal of generation equipment and facilities upon the expiry of the business must be ensured. Furthermore, risks to the facilities posed by natural disasters must be taken into account in advance.
 - **Grid constraints:** Due to the limited capacity of power grids, there are some cases where electricity generated by renewables cannot be supplied to the transmission lines. These difficulties are referred to as "grid constraints". In order to overcome the constraints, it is necessary to both reinforce the transmission lines and to use the existing lines more efficiently.
 - **Instability:** Renewables are natural sources of energy, and the amount of electricity generated by renewables is therefore unstable. If surplus electricity can be transmitted to other areas with electricity shortages, it will contribute to adjusting the supply to meet the demand. In order to realize electricity procurement involving multiple areas, inter-regional transmission lines need to be reinforced.
- There are six major policy measures to address these challenges in Japan.
 - **Strengthening cooperation in the event of disaster:** Power transmission and distribution companies are obligated to jointly formulate a disaster cooperation plan that includes matters related to mutual cooperation. In response to the request of the Minister of METI, power transmission and distribution companies will take measures such as obliging local governments and other entities to capture and provide information on individual electricity usage by smart meters installed in each household.
 - **Strengthening the power grid:** "Wide-area power agency" develop push type network development plans to prepare in advance to respond to requests for power grid expansion and power transmission. Transmission and distribution companies are now obligated to systematically upgrade their existing facilities from a long-term perspective. A new system of toll rates has been established, based on the European system as a reference. Under this system, METI approves a "revenue cap" for transmission and distribution companies at regular intervals after strictly examining the appropriateness and efficiency of the transmission and distribution business.
 - **Disaster-resilient distributed power systems:** The electricity distribution business license was created for new entrants into the electric power distribution business so that they can operate a distribution network that include distributed and small power sources within a specific area and function as an independent network in the event of an emergency. If new businesses enter the power distribution business through this license, they will be able to operate and manage their facility using advanced technologies such as IoT and AI, which may lead to cost reduction for their facilities.

- **Support for market-linked introduction:** In order to ensure their predictability of investment by renewable energy power generation companies, and to encourage market conscious behavior in addition to fixed price purchases, a new system, Feed-In Premium (FIP) system, was established to grant a certain premium to the market price.
- **Grid enhancement to utilize renewable energy potential:** Under the conventional cost-sharing approach, in principle, the cost of grid enhancement should be borne by the region on both sides of the interconnection line to be strengthened. But there was a concern that disparity in the burden related to grid reinforcement would arise among regions in the future due to the uneven regional distribution of renewable energy. Therefore, the portion of benefits brought by the wide area merit order is now borne in principle by the entire nation from the viewpoint of the beneficiary burden.
- **Proper disposal of renewable energy power generation facilities:** In order to address concerns that solar power generation is not properly disposed of, power generation companies will be obliged to accumulate external accumulation of cost for disposal.

5.4 Part 3: Situation and challenges for energy infrastructure resiliency in member economies (2)

Moderator: **Ms Tomoko Murakami**, Senior Fellow, Electric Power Industry Unit, the Institute of Energy Economics, Japan (IEEJ)

5.4.1 Chilean Case

Dr Claudio Huepe Minoletti, Former Energy Minister of Chile, Universidad Diego Portales

Dr Claudio Huepe Minoletti made his presentation regarding Situation and Challenges for Energy Infrastructure Resilience in Chile.

- Chile is a very long and thin economy, about 4,000 kilometers long, between 90 and 200 kilometers wide. That makes, in particular, the electricity system but in general, all energy infrastructure, very linear. And, it has a very concentrated population. About 40% or 45% of population is in one city, the capital city.
- About 70% of energy resources and 90% fossil fuels is imported. The southeast region produces a small amount of oil and gas, but its use is limited to that region, and the rest of the economy is 100% dependent on imports of fossil fuels. Chile has liberalized market (many private electricity companies in all segments, one public oil/gas company – not a monopoly but sole owner of refining capacity). Main energy infrastructures are:
 - One main interconnected electricity system - Sistema Eléctrico Nacional (SEN) around 3,000km long and 35,000km of transmission lines
 - Around 50% of renewable electricity capacity in SEN in the north region, 15% in the south region
 - Two LNG regasification plants (north and central region)
 - Two main refineries (central and south region)
 - One electricity interconnection, seven gas pipelines (north, central and south region) and one oil pipeline with Argentina
- Energy infrastructure resiliency institutions
 - Some specific issues considered in legislation
 - Transmission safety standards can be relaxed under natural catastrophes, must include resiliency analysis in transmission planning
 - Security regulation
 - In distribution can request management system to ensure operational continuity under various risks

- The Ministry of Energy (MEM) basically considers *seguridad* (safety and security) as an element of its policy. At the beginning, MEM's task was basically energy supply security, nowadays, it's become more involved with energy infrastructure security. It's not clearly defined in the law, so that, in a way, has allowed the MEM's task to shift over time.
- The National Energy Commission (CNE) can put into practice some technical regulation on different issues.
- The superintendency (SEC) can ask for contingency plan and do enforcement of some technical aspects.
- The coordinator can ask for recovery plans and recovery plans so that people can know what happens if there is blackouts or power flares or different events. This is oriented towards all of natural disasters and natural events.
- Ministry of the Interior in charge of human induced risks. Some electricity companies which are facing some vandalism and bombings of power towers.
- Servicio Nacional de Prevención y Respuesta ante Desastres (SENAPRED) is responsible for planning and coordinating resources to prevent and act on disasters advising local and domestic levels (operational institution for the domestic disaster prevention and response system).
- Earthquake Milestone (in 2010)
 - 27 February 27, 8.8 magnitude earthquake with epicenter in the central - south of Chile followed by a Tsunami
 - Blackout affected about 90% of population
 - About 25% recovery in same day, around 40% next day, but after 12 days still 20% below normal.
 - Refineries affected by power cut
 - No widespread fuel shortages
- Policy actions after the earthquake
 - Earthquake made policy focus on infrastructure security and not only supply security and operational safety
 - Efforts to integrate information on one platform
 - SEC requested information and plans to companies
 - MEN studied for actionable estimations of vulnerability
 - National Emergency Operations Committee and Regional Emergency Operations Committee were established as operational measures (Decree 38, 2011)
- Current situation
 - **Institutional framework:** After the earthquake in 2010, focusing point changed from disaster and emergency management to a more comprehensive disaster risk management approach. MEN created a unit in charge of energy risk management in 2018. In 2020, new disaster management law 21.364 enacted. Following the law, the domestic system of disaster was established for prevention and response, with committees at domestic and local level. The institutional framework focused on reducing vulnerability risks and preparedness and fast/efficient reaction by each actor.
 - **Monitoring:** As efforts to integrate information on one platform, MEN developed the map by using GIS technology for risk management. The contents of the map are main infrastructure including energy, policy stations, hospitals, or rural water infrastructure. And the maps include the information of main threats (earthquakes, volcanic activity, forest fires, hydrometeorological events, storm surges, tsunamis) by zones. This is real time monitoring system fed by several specialized public organizations.
 - **Development plan:** Law 21.634 mandates all sectors in the domestic plan to have specific plans for management of disaster risks for considering a recovery phase. Under this Law that,

- The energy sector decided on a domestic and regional plan led by MEN
- Basically, focused on natural events, but could be extended to human made events
- Plans must consider how sectoral events affect other sectors (like telecommunications, for example)
- Sectoral plans should be ready by mid-2024
- MEN is trying to understand emerging issues, the problem of governance, and there is a study (it is not finished) which is being done with the help of international aid. For example, “Strengthening the resiliency of infrastructure through improved governance”, and “analysis of Climate Crisis Resilient Infrastructure for the energy sector”. But there is not yet though, a systematic approach to resiliency in Chile.
- Main emerging issues (Climate change)
 - Both climate trends and extreme events are considered relevant new threats for energy infrastructure
 - Trends: drought, temperature, wind and rain patterns
 - Extreme events: storm surges, rainstorms, floods, fires, snow
 - Forest fires, storm surges and rainstorms are of particular concern
 - Storm surges have on average almost doubled in the past 20 years
 - Rainstorms over two weeks during June and August in 2023 affecting tens of thousands of people
 - Forest fires in January and February in 2017 with record heat in some areas burnt over 500 thousand hectares (some related to transmission lines)
- Main emerging issues (Cybersecurity)
 - No known successful cyber-attacks to energy infrastructure but significant increase in attacks over the past years including energy companies
 - Framework law being discussed in Congress
 - Considering the response to the Directives from Coordinator for electricity companies (2020), coordinated companies must carry out self-evaluations of measures, report annually (noncompliance will be reported to SEC)
 - CNE is preparing a technical standard
- Main emerging issues (Public order and Direct attacks)
 - The public order issue has been growing in the past years with the unfortunate advance of drug trafficking in the economy and on the role of drug rings. High-risk areas have doubled in the past few years, and they are posing not a domestic threat to infrastructure but a local threat to infrastructure because the state has little oversight of these areas.
 - Direct attack is that it had power lines and power towers blow up. It was the bombing of two towers in June 2023, three in September 2022, so it's an issue also that is coming under concern.
- Conclusions
 - Legal framework and regulation are not very comprehensive in terms of infrastructure safety/security
 - There is no clear institutional distinction of the various types of safety/security (operational, supply, infrastructure, usage)
 - There have been improvements in risk management, but risk management system (Law21.634) yet to be fully implemented so evaluation is still premature

- More formal evaluation of infrastructure risk would allow better allocation of resources for a more resilient system
- A comprehensive plan which includes emergency and contingency plans for all energy services and various threats is an objective that can be very relevant
- A life cycle analysis will be needed (prevention to response)
- Conditions are changing, infrastructure system is becoming more complex so more foresight and intelligence would be useful (there are efforts in this direction), and more complete standards are needed
- Emerging issues require a review of institutional framework, in particular human made vs natural threats

5.4.2 Indonesian case

Dr Ir Djoko Siswanto, Secretary General, Indonesia National Energy Council, Republic of Indonesia

Dr Ir Djoko Siswanto made his presentation regarding index of Indonesian energy resiliency and emergency response of Indonesia.

- Energy related information
 - Indonesia is an archipelagic economy, it has 17,000 islands, most of them are small islands. The population are almost 280 million.
 - Coal production is around 700 million tons per year, it is number two after Australia and 75% of coal is exported. Natural gas is exported as LNG, about 30% of production is exported. Also, we export natural gas via pipeline to Singapore from Sumatra Island and from Natuna Sea.
 - It is imported crude oil around 500,000 barrels a day for refineries and imported gasoline around 12 million kiloliters per year and also imported LPG almost 6 million kiloliters per year. 80% energy resources and energy products are imported, this is problem for Indonesia.
- Energy related policy
 - ASEAN has declared energy interconnectivity to strengthen the Trans-ASEAN Power Grid. There are 18 potential cross border interconnections with a cumulative capacity of 33 gigawatts in 2040. Indonesia-Malaysia Boarder Electricity Interconnection Agreement was signed at the Southeast Asia Energy Ministerial Meeting in August 2023. Indonesia imports some of the electricity from Malaysia, in north of the Kalimantan.
 - For securing long-term energy supply for the region, ASEAN will build the Trans-ASEAN Gas Pipeline, TAGP, as a physical energy infrastructure project to support new market opportunities, as well as to increase energy security amongst the ASEAN member states. Rapid increase in economic growth and population in the region has great potential challenges in terms of energy security and sustainability.
 - Indonesia already has regulations and policies related to the energy sector. For the regional efforts, there are the Energy Law No. 30/2007, the National Energy Policy by government regulation number 79, 2014, the National Energy Master Plan by presidential decree, regulation number 22, year 2017, Regional Energy Master Plan in provinces. We have 34 provinces in Indonesia, now 33 provinces have already regulations regarding master plan of the provinces.
 - Regulation of the energy types also already exist in Indonesia. There are Oil and Gas Law, Electricity Law, Mineral Law, Geothermal Law, and also BPH Migas Regulation No 19 / 2020 regarding the operational stock of the Indonesian, being drafted now regarding new renewable energy and also Presidential Decree regarding buffer stock of energy.
- Index of the energy resolution and improvement actions
 - According to government regulation number 79/2014, in definition, index of the energy resolution is the condition of guaranteed availability of energy, public access to energy, affordable price in the

long-term, while still paying attention to environmental protection. There are four variables as components of the index. One of them is availability, weighting value is around 32.5% and 26.3% is accessibility, 22.4% is affordability and 18.5% is acceptability.

- Based on these four variables, it calculated the resiliency index of Indonesia (it is called "Resilience") is 6.64. It has not yet got high resiliency, because Indonesia still imports three energy commodities. Considering the level of the index, it still needs to promote more renewable energy and improve energy related infrastructure.
- Regarding improving accessibility, it develops electricity infrastructure, mainly transmission and distribution. Also, it develops infrastructure of the gas supply, regarding pipeline distribution, and also small-scale NG receiving terminals. Regarding fuel supply infrastructure improvement, gas stations, gas and oil infrastructure are developed in 500 local governments which has 34 provinces and 500 local governments. Also, it developed electric charging station and other infrastructure to support energy distribution.
- Regarding affordability, it still gives subsidy for the poor people, but it will reduce that from time to time. Currently, it gives subsidy for LPG for cooking and also for diesel in certain price.
- Regarding acceptability, in Indonesian energy mix, around 13.21% are using by new renewable energy, geothermal. Indonesia is number two economy after United States in geothermal capacity. To increase our energy resiliency, it needs to improve the capacity and reliability of the refinery. Also, it improves the level of the price of the energy products and also, it needs to build energy buffer stock and also, it has to increase renewable energy. Also, it has to reduce fossil energy imports until zero. Indonesia is trying best to increase domestic production of crude oil and natural gas.
- Countermeasures to mitigate impact by crisis
 - The crisis comes from operation and also comes from natural conditions. The tsunami in 2004, 230,000 people died and 500,000 lost their properties. For the mitigation of the disaster, there are 10 actions.
 - (1) Release of the energy buffer stock, unfortunately, it has stock volume for only daily usage operation. Government is targeting 30 days of our energy imports until 2035. (2) Additional energy imports. (3) International cooperation with neighboring economies. (4) Energy export restrictions. Now, it still exports coal and natural gas, when a disaster happens, it will have to stop exports. (5) Energy saving. (6) Energy demand restrain. (7) Alteration of the energy infrastructure. (8) Diversification of energy. (9) Utilization of excess power. (10) Other actions referring to next recommendation.
- Disaster potential and disaster mitigation concept
 - It has volcanic eruption and earthquakes almost every day. Fortunately, most earthquakes do not damage the infrastructure. It had disaster experience by Tsunami once. Floods, almost every year in rainy season in some area. It is identified disaster risk of Landslide, drought, and some tornadoes.
 - In Indonesia, there is disaster mitigation concepts from pre-disaster until post disaster and developed standard operational procedure (SOP) of emergency response readiness.
 - **Pre-disaster stage:** it has a map of disaster potential areas. Two agencies always report the information to the people and the institutions every day. It is called "BNPB, Badan Nasional Penanggulangan Bencana", operated by the National Agency for Disaster Management and the BMKG, the Agency of Meteorology, Climatology, and Geophysical.
 - **Preparedness stage:** Disaster Identification, Report to Rescue Team, Personnel, Network Assets, Movable assets.
 - **Emergency response stage:** Personnel Rescue, Deployment Rescue, and Asset Rescue
 - **Rehabilitation and reconstruction stage:** Emergency Assistant (posts, medicine, food, drinks, and clothing, kitchen), Medical Officer, Search and Locate Victims, Damage Inventory, Damage Evaluation, Recovery, and Reconstruction.

- **Evaluation and monitoring stage:** Post Rehabilitation and Reconstruction Evaluation, Post Disaster Monitoring, External Communication, Report to Supervision.
- Referring the map of disaster potential area, it identified the potential area to become disaster. At the very significant area, it has some of the equipment ready, including personnel, transport, cranes, electricity station for car, and then generator electricity in portable and also rubber speed boats. It makes exercise at least once a month for the team rescue, for readiness if there are any disasters.
- Fuel distribution is complicated, there are 121 fuel terminals and 23 LPG terminals, 99 fuel terminals, 18 integrated terminals of fuel and LPG. There are 7 refineries, 179 tankers, three tankers stay and 76 to stay of the tanker and 4,000 anti-truck type tanks. Fuels distribute by pipeline, train, and also aircrafts to each part of Indonesia in Papua Island. In other areas, it transports fuels by aircrafts.
- The Safety Stock Calculation Methodology has accommodated potential distortions from the demand side and logistics dynamics in each TBBM (Oil Fuel integrated Terminal), both Main TBBM and End TBBM. By monitoring fuel distribution field, it is possible to evaluate and change fuel distribution in case of any disasters.
- Pertamina's Operational Stock Reserves are modeled as integrated from the supply point to the distribution point. This system ensures the reliability of the supply chain (Refinery, Import, Shipping, Fuel Terminal). The stock level is monitoring day to day and keep safety stock of the fuel.
- Recommendation to increase index of energy resiliency in Indonesia
 - **New energy and renewable energy:** Currently, only 12.6% of our new energy is in the energy mix. Indonesian target is 20% in year 2025 and 31% in 2050 and 60% in 2060 in our net zero emission target.
 - **Price disparity:** Reducing subsidies gradually and implementing subsidies on target at the same time as applying fair economic selling prices.
 - **Improving refinery capacity by regulation**
 - **Consider energy response in cross-economy:** It is needed energy response in cross-economy like, ASEAN economies, Australia, and New Zealand to do exercise if one of our economies have any disasters.

[Question]

- What is the appropriate strategy for us to advise the private sector to improve their facilities, or to enhance their energy infrastructure?

[Answer]

- For example, the cooperation between Indonesia and the Philippines and also, among economies closer to our economy, at least sharing their experiences. I know that currently a lot of coal we export to the Philippines. Probably, we'll have the cooperation regarding Indonesia's success in diesel fuel because of success of our biofuel, we mix diesel with palm oil, 35% kind of diesel and because of that, we do not import anymore diesel. This is idea about the Philippines can — what you call it — between private company to produce also will result.

5.4.3 Thailand case

Dr Nuwong CHOLLACOOP, Director, Low Carbon Energy Research Group, National Energy Technology Center (ENTEC)

Dr Nuwong CHOLLACOOP made his presentation regarding Situation and Challenges for Energy Infrastructure Resiliency in Thailand.

- What drives Thailand is committed under UNFCCC, since COP 21 in Paris, Following the commitment, Thailand set up its domestic energy division, about 20%-25% reduction. Thailand has its mitigation plan and adaptation plan. But adaptation is not so quantitative yet at the moment. Thailand with other

member economies have pledged to be carbon neutral by the year 2050, which is very challenging than anything.

- In Thailand, for resiliency, it does not have a good word yet. Of course, in Thailand, it has heard of considering about the disaster preparedness. But resiliency is a bit different perspective. For two things, affordable clean energy (SDG 7) and climate change (SDG 13), can increase the affordability of the energy renewables and also that's linked to climate change.
- Energy resiliency assessment is similar to the risk assessment, people who are working on energy resiliency are also have a background in risk assessment, so they are trying to explore energy resiliency assessment based on knowledge of risk assessment. Of course, for risk assessment, it has to first identify the threat, and also looking into the impact assessment, like how impactful is the threat, how big it is and also, what its immediate impact is on the town or community.
- After threat identification and impact assessment, it identify the vulnerabilities. It looks at the assessment of risk and their change over time. When it highlights the change over time, typical risk may find before doing projects. When company want to build a dam, a bridge, a building, they do assessment before they do construction. Then, make sure that they minimize those risks that may occur with infrastructure. But of course, that can be cost.
- It is coming to identify the resilient measures through the assessment. What we are doing in Thailand is trying to bring the assessment. But it has felt that private sector does not want to give anything. It is quite difficult to get binding or get some commitment or action from the private sector when it is privatized, not under government sector. Then the government started engagement with state enterprise or trying to make a policy-wise so that can be bit by bit managed to get some of their cooperation and information.
- At the phase 1 energy resiliency assessment project, it looked at the infrastructure accessibilities and the vulnerabilities over time. It focused on fast recovery because it knows that those indirect benefits or indirect costs that have been burdened by the community or the city, or it has to take a detour, when it has some outdated infrastructure like road was broken down. It had to look at the recoverability, look at how it can ensure the continuous operation and enhance our quality over time. Then, it looked at the adaptive capability, focus on a nature-based solution, if existing,
- When it looks at survey the solar farms, the most often problem is the cost, the reduction in power generation by rodents or rats biting the expensive wires and just kills himself because of that. It can try to prevent those kinds of things with simple solution such as rodent repelling mechanisms. It could be showing the private sector that with those measures, it costs money but in the long term, it would give you more profitability. It still in Thailand have some challenges in trying to get the buy-in from the private sector, it maybe it can discuss among member states to consider what are other suggestions.
- In Thailand, this happened just before COVID-19, it did some assessment on all types of renewable energy generation systems. It looked at the on-grid solar, off-grid solar, large scale biomass power plants, and biogas, just looking into the different aspects to see whether its assessments can be applied to different types and different sizes of the renewable energy system.
- It has lesser damage from the potential of the identified threat and climate action. It maybe looks at what are the potential countermeasures, both in terms of the critical solution, problem management, and so what are some of the kinds of forecasts to see what the upcoming issues for the threat are. Then, it looks at the site selection, construction, operation, and it try to see that whether this can be of help, if a company want the site selection for the potential solar cell selection.
- Development and implement energy resiliency guidelines and international cooperation
 - The other activity regarding energy resiliency is hosting a series energy resiliency workshop. The first workshop was held in 2021. At that time, the idea of creating resiliency that was quite new for Thailand. The Philippines already had some resiliency work, a lot in this sector, and Thailand's participants learned that a lot. It was trying to get this information across to the people, especially from the SDG sector and also from the energy sector.
 - It is trying to look into the effort of expanding of energy resiliency related experiences and knowledges through ASEAN and APEC. It is trying to look into initiative in ASEAN, it looks at the

grassroots and then try to highlight how this energy resiliency assessment can help those underprivileged, or those sensitive groups to have sustainable energy supply, for example, in microgrid area, or in rural areas where the energy infrastructure cannot reach them.

- The ASEAN Energy Resilience Guidelines developed that has been endorsed by this COSTI (Committee on Science, Technology, and Innovation). Based on the guideline, it developed some of the standard processes and procedures trying to apply this to look into the investment in the energy resiliency structure. This guideline is not very thick and comprehensive, but making it simple first, try this one, and then it could be built it up. Because it is believed that any standard is never perfect and never up to date., it has to keep revising.
- It is considering do assessment by using the guideline for a floating solar because in Thailand, our state enterprise, EGAT, is having a lot of dams. It considers doing with EGAT because they are the state enterprise, it is easier to talk than the private companies.
- It had the workshop with IEEJ (the Institute of Energy Economics, Japan) in Bangkok that was the project by the earlier IEEJ, and this was very interesting because the project by IEEJ is a lot of the private sector involved and this is the pain point that in Thailand cannot get the buy-in from the private sector.
- By the support JICA (Japan International Cooperation Agency), it is going to hold the TCTP (Third Country Training Program) in ASEAN, it is going to invite some of expert from ASEAN to look into the cross-sectoral collaboration on energy resiliency for the efficiency of energy and for doing a test pilot.

[Question]

- Do you know Thailand's NDC target, and do you know what is the percentage of conditional and unconditional commitment? Do you have energy resiliency projects that can contribute to Thailand NDC target?

[Answer]

- For NDC, the old target was 20%-25%, where 20% was unconditional and another 5% was conditional. But with COP 26 where Thailand wants to reach our carbon neutrality, Thailand raised that 20%-25% to 30%-40%. Now, Thailand is in the process of revising the NDC for each sector. The unconditional is 30% and another 10% is conditional on international,
- Unfortunately, energy resiliency project not explicitly related in those NDCs yet. Because usually NDC are from the mitigation side. For adaptation side, it is quite challenging to identify what is the potential contribution in GHG target coming from these entities' adaptation activities.

5.5 Part 4: Lessons & Learns from each economy's experiences and Implications to future APEC activity for energy resiliency enhancement of energy supply sector

- Moderator: **Dr Guy Félio**

All of the face-to-face speakers (6 in total) participated in the panel discussion. The moderator asked three questions, and each speaker answered them. The main discussions are as follows.

Question 1: What are the main challenges of building energy resiliency in your economy or region?

- **Australia:**

- In Australia the trusted information sharing networks are working reasonably well. Because they originally started as a means of exchanging information about security threats and then over time, they have evolved into exchanging information about all hazards relating to infrastructure.
- Because they started in a security framework, they are quite secretive, so the information does not necessarily come out into the open domain. The problem there at a practical level is that while operators and owners and others might be sharing information, other people who are outside that will struggle. If you are a consultant, for example, and you've been engaged to advise some of these organizations, you may not get access to that information. And so, that needs to open up a little bit more. They just need to, I guess, expand who a trusted user of that information is. I think that's the next step there, to expand the networks, that would be really good.
- The other big issue that we have is this reliability gap that there is an expectation that the planning for where we are going has been a little bit of sort of muddling through sort of not really necessarily a rational approach to decision making.
- We had sort of a lot of political arguments about whether we should do. In the meantime, the homeowners started putting solar panels on roofs and the whole energy situation of Australia changed not because of the government policy, but because of the demands of homeowners and businessowners and things like that, which was really interesting and was really good.
- Now, the government is trying to play catchup. It does not really matter which political party it is, you end up playing catchup. They are doing that at the moment. We have this situation where we will. We have had a reasonably reliable power system and gas supply system as well, but we are expecting there to be problems from 2025 as coal mines close, thermal power stations go offline, and the new renewable energy systems, the large-scale facilities are not coming online quick enough, so that's going to be our biggest problem.

- **Chile:**

- The institutional issue is one of the key points on how we actually get the institutions to work. Sometimes it designs very interesting laws, and if you look at the law, it looks like it would work really well. But then when you put it in practice and when you go to the actual institutions, how they really work, it doesn't turn out to be exactly how it was supposed to be.
- There was one interesting point that was pinpointed here by a couple of presentations, the need to prepare the human resource, the people properly, have the adequate preparation but also the institutional design to make sure that whatever is defined in theory, it does come to work out in practice.
- Institutional design, institutional capacity is the basis. Because even if you do an excellent study, I have an excellent definition of resiliency. If you don't get the institutions working together, sharing the right information, being on time with sharing the information, complying with what they have to do properly and getting the finance is also another issue.
- Because resiliency is the kind of thing that few people are concerned about in normal situations many times governments don't want to put money until, of course, there is an event and then everyone says, why didn't we prepare for this.

- **City of San Francisco:**

- We do not have the right structures in place. Every day, we are learning more and more about these different events, these different disasters around different solutions.
- The learning is happening, the collaboration is not, and we are much too siloed, especially in this area but in other parts of the economy too, where it is still a constant. You have got the utility sector, the private sector, the government sector, the quasi-government sector, and it is really hard to move in the same direction and I think there's a sense of urgency that's coming not as strong as it should be, but that collaboration is what we are needed.
- The other thing is it is also about resources and maybe coming from the local government. It is not seeing the resources to develop the capacity, to be able to use the data, to be able to work with the

different sectors. We are struggling with trying to manage so many different issues that are facing urban cities right now. And quite frankly, climate is a top one, but it is not the top and it still seems like you can still hope. You can still hope that you're not going to get hit by a heat wave. You can still hope that you have some more time before the next extreme weather event. Unfortunately, without having the capacity and the funding to sort of do that work, we are really stuck, and we have to muddle along.

- **Indonesia:**

- In the Indonesian case, there are some keys to build the energy resiliency regarding the supply of energy. Number one is understanding the regulations regarding buffer stock of energy. Currently, we are creating the regulation. Hopefully, next month, it will be signed by the President. We need cooperation among our economies because we need a lot of money to build the energy buffer stock. Our target is 30 days until 2035, so we need at least IDR50 trillion, that is a lot.
- Number two is we have to revise the energy policy because in current policy, our supply demands planning until 2050, but every economy has a target in net-zero emission target. In our economy, our target is 2060, so we have to change our policy, we have to increase renewable energy until 60% in 2060.
- Number three is the infrastructure and transfer technology because technology very faster developed in some economies. On the other hand, Indonesia is very few in infrastructure development and so on. It is better if an advanced technology development is very fast to developing economy, including Indonesia. For example, technology of solar panel, in some economies, already 90% cost is down compared to 10 years ago.
- Then, we need to develop our infrastructure. We need electricity, transmission, and distribution infrastructure, and then also gas and fuel infrastructure. Indonesia still needs to develop many infrastructures regarding energy.
- Number four is financial supporting, so it is not easy to have phase out coal generation and also reduce gas and oil to renewable energy, so we need a lot of money to change, remove from fossil to renewable energy.
- The last one is the cooperation between some of our economies.

- **Thailand:**

- What is in Thailand and what I feel in ASEAN is the engagement from stakeholders. Stakeholders mean two things; one is of course government policy and second is from private sector.
- We learned from the Philippines that they are going to revise their National Energy Plan to include the energy resiliency chapter. That is something that we can learn on.
- What is more important that to get engagement from the private sector so that they know that they get benefit from this. Because if it is just a requirement, there will be like another requirement of government, or another data and we have to submit to another institution we have to deal with. Those kinds of things we learn when we work with the private sector.
- My key challenge is how to get engagement for building energy supply resiliency. From the government point of view, we have a guideline policy, and also from the private sector that they can see the potential benefits so that they keep the wheels moving without having to buy a lot of budgets to come and building up.
- Go back to see how we can amend the problem in Thailand, where we see the rats eating the wire, and if we can sectorize those wire, then you have a protection, then it does not damage the whole panel, maybe just only a few things in there. Something like this, I think is worth sharing and apply to other systems.

Question 2: What do you need in your economy and region to strengthen energy resiliency?

- **Australia:**

- The ISO 22366 project is really fundamentally important for all economies. The work that's being done on that would probably help to solve a lot of problems because it provides a framework for people to make decisions about resiliency and they can adapt it to suit their own particular economies.
- Within Australia, we probably need to invest more money in innovation to develop new technologies and make existing ones greener and more efficient. Australia does have a good reputation for development, but we need to spend a bit more money.
- Some of the innovations, the hydrogen industry has a huge potential globally and certainly in Australia to replace natural gas with hydrogen. There are certainly many projects in Australia heading in that direction. We are also doing a lot more in the hydro scheme. We could have some hydro schemes, we are making them bigger, but we are also investing a lot. We will be investing a lot in really small pump hydro schemes to help individual towns and communities. That is going to be useful.
- Especially the small pump hydro schemes could apply anywhere in the world, and they have been really good in a lot of places, and they are not expensive, they can be built on a farm. Basically, all you need is a hill and enough space to build a small dam at the top of the hill and a small dam at the bottom of the hill and an external power source to get the water up there in the first place. We need to manage the transition period from the fossil fuels to these other better solutions, cleaner solutions, a bit better than we are, but I think we will probably get there.

- **Chile:**

- One of the things we need is to bring these debates into a wider audience and to reach levels to which we do not reach. Within government, this exists, especially about central government, sometimes the local level is very much focused on very small specific issues that they are concerned, and they do not see the bigger picture.
- If there is something that we would need is more of this kind of exchanges but thinking specifically on different groups which need to be reached specifically, business, the financial sector, even the consumers, the role of the citizens has to be very much increased.
- In Chile, a lot of learning by doing, learning in practice, because we didn't really have time to think about many of these things and we had to see how to make them work. This experience is quite useful for the central government, even the monitoring system in Chile, which has been a big advance, and it has worked very well. That is the kind of things like the sort of best practices we can also share.

- **City of San Francisco:**

- The primary thing that we need is pressure. Pressure and advocacy. Having APEC signal the importance of energy resiliency is really important to other economies and recognizing that we are in economically difficult times in many parts of the world, including mine. But we really need to make it clear that this is an issue that needs to be solved within our economies, and it is an opportunity within the economies. That is where organizations like this could be especially powerful.
- The fact that we have so many different economies with different interests, different resources coming together to sound this need, makes it much easier, even for me within my own organization to be able to say this is what we are hearing internationally. But it also gives me the opportunity to go to my federal representatives and say why are we not with these people or why are we not helping these people? That pressure is incredibly important.
- Locally perspective, it is bringing local voices and cities into the conversation. For this work to be effective, we need to have examples at the local level. You need to have real people that are experiencing energy resiliency challenges and the people that are going to be feeling the impact in the future. We need to make sure that we have a way for those voices to be heard that can be sort

of channeled into the work that is going on here and into the principles.

- **Indonesia:**

- Last year, Indonesia was the Presidential House for G20, so many economies, I mean APEC economies, G20 economies promised that they will help Indonesia and support Indonesia with USD20 million to reduce the emission for renewable energy and also the transfer of technology. If any economy has developed a new technology, make it efficient and then high quality. I think we need technology and also investment in Indonesia.
- Indonesia still has a lot of production in coal. If any economy needs coal, we can export to the economy. And also, we still export the LNG, and we have many natural gas discoveries in Indonesia, like in Masela, in Basin Masela, and also getting oil and oil products.
- Indonesia is number two in producing geothermal resources after the United States, we can share our experience in geothermal development and production.

- **Thailand:**

- What do I need is to learn from others. I have a few ideas to go back and modify our assessment and also maybe try to bring it up to the ministry and other state enterprises who look after the infrastructure for energy and renewable energy production side.
- What I can offer is ASEAN wide training.

- **Moderator (Canada):**

- What I have heard through presentations is that we need to differentiate between the energy sources. There are fuels and there is electricity. Now, electricity can be generated by fuels that can be addressed, but there are differences of how you address resiliency to those two.
- I have heard a lot about the interconnected systems, the interdependencies within the system with others, and others could be other utilities, but it could be other regions, it could be other economies. I heard also about this interconnected supply chains and the business continuity issues that arise. You might have seen that in your economies due to COVID-19. Also, I heard a lot about governments, about legislation, about incentives, about the role of the private sector in all this space. I heard about lifecycle analysis, which in my mind links to asset management because at one point, somebody mentioned ISO 55000, but also the role on the use of standards, which is important. for example, ISO 22366.
- Also, I heard about energy resiliency assessments. That there were various levels of maturity within the economies that we represent as a whole in terms of being able to assess the threats, the vulnerabilities, resiliency measures, and they also vary with the sources of energy. I have also heard that these threats or vulnerabilities or resiliency measure may change with time, and it is not only because of climate change and so on, but there are other sources that may make, including the policy decisions at the central government levels that may change the priorities.
- I heard about the challenges posed by the lack of skilled people. It could be the trades, but it could be policy advisors that need to be trained in the areas of energy resiliency because they might not have the grasp of the tools, the technologies, the implications of this. We have heard also about main challenges from each economy.

- **Question 3: Consider the APEC Energy Resiliency Principles and the APEC Energy Resiliency Guidelines, and what additional guidance and information is needed in your economy or region?**

- **Australia:**

- Guidelines would be quite useful if they took some of the ideas and principles and thoughts that we've had and give really practical examples of how they might be implemented. If we had some real case studies or even potential case studies that we have not actually built yet. But we can say

this is how you might go about funding, designing, building a small pump storage system, for example.

- That kind of thing could be really useful at a really practical level. The principles are great for the policymakers and getting the general standards sorted, but for the guidelines it would be fantastic to make them really practical at a really practical level, that then helps to address the skill shortage problem too. Because those guidelines, if they are at a very practical level, they could then be introduced into an education system somewhere.
 - In the Australian context, we have trade colleges where we train people to become tradesmen. It is something that could be introduced into that education system and start addressing the skills shortage. We have got the principles at a high level and then we have got the guidelines focusing on what can we actually do and when do we do it, can we do it, can we start working on this straightaway.
 - Also, we could have some guidelines that are sort of focused on how to implement the principles that we might agree on. For example, I talked about the need for polycentric governance where you have got multiple organizations in a supply chain that are taking shared responsibility for managing the risk and enhancing resiliency. How would that really work in a practical sense? We could have a guideline explain that and how it would work without causing tension between people who might be organizations who might be contract to each other.
 - It is important to explain the difference in the guidelines between what is risk management and what is resiliency management and explain the relationship between them. Risk management is where you have a reasonable chance of assessing some future uncertain event which might have adverse consequences or might actually have beneficial consequences.
 - We need resiliency management when we are really not sure at all what is going to happen in the future. You need a model that conventional risk assessment just does not address and so that is where resiliency management is really important when you cannot come up with a really viable risk assessment for what might happen next year or the year after that. It needs another model to help deal with absorbing the risk and adapting to it or adapting to the situation when it comes.
- **Chile:**
 - In general, one of the interesting things about guidelines is they bring up a common language. We sort of agree on certain definitions, certain concepts, that is always useful. Personally, guidelines of resiliency evaluation would be something really valuable because this is the money issue. We have to put money into this resiliency. Private companies, the government and everyone has to put money in.
 - Where should we allocate these resources? How much should we put? The idea of having some sort of homogeneous, also, way of measuring and how do we go to multilateral banks, for example, that sometimes funds to finance this, we need to focus on this and that issue as priority and this costs so much, but we can probably save so much, it's something that I do not know if we can actually get to that level of detail. But if we could approach some sort of evaluation guidelines, it would be something that would make things much more concrete and sort of establish this common language.
 - For example, on the big discussion we are having on renewables and people from the renewable sector. They want to push forward with renewables as fast as they can and say we are happy with that. But what about security? No one is thinking about how much that is going to cost us and how we can value the necessary safety and security is going to have to be associated with those with that development. We have to do it, but how do we do it. It is a very valuable thing that could be done.
 - **City of San Francisco:**
 - We think about it in terms of money and financing and the need for those types of resources, a lot of it comes down to how do we justify the need for those monies. That means doing this benefit-cost analysis or those types of things, which is how do we and then it really comes to, how are we going to associate costs with some of these things that is related to resilient energy systems.

- To talk about standards is really important and scorecards that I heard coming up, how can we tell that we are doing a good job and what we are saying we are going to do. But then it is also how can we quantify the benefits? How can we monetize and quantify the benefits? Because that is what is going to speak to the private sector, that is what is going to speak to some of the government ministries and those folks, which is that we can show the level of investment, the return on investment, and that, I think, is something that often is easily said, but is really hard to do.
- When we are thinking about these systems, what's the value of reducing energy poverty levels or what's the value to your economy by enabling people to say that they are only going to spend 10% of their monthly income on energy, right? How does that play out? Because we know that is going to play out in many ways. It is going to mean better education, and it is going to be better health impacts, more time with family or doing other things. Those are all, really important quality of life type issues that are difficult to quantify. But if we can start going in that direction, that starts to open up various doors and it enables us to be much more effective at being advocating.
- **Indonesia:**
 - Regarding the guideline, APEC should be one more to do something like survey or research, or what you call learning from one economy that we think the economy is very successful in implementing the policy, regulation, and then implementation of their program. Norway for example, the source of energy comes from renewable energy, right, for example like that.
 - APEC should be then connected with the net-zero emission program, now all of the economies are talking about clean energy, right? We have to make attempt regarding achieving the zero emission. Because at least now, every economy makes their own policy regulation program that is not easy to implement. Many economies said in year 2040, 2045, 2050, 2060, we have to achieve. Then, every economy makes it like that. But the implementation is not easy, right? There are so many problems when we implemented the guidelines program.
 - For example, we need a lot of money, technology, infrastructure, and so on. In many economies, we have to stop coal, fossil energy, but actually, they increase to use fossil energy. Some economies are very successful in developing nuclear energy. But in some economies, they are very strictly not allowed to develop nuclear power. Like Indonesia for example, the regulation already long time ago, but until now it is very difficult in society. How we learn from one economy that is very successful in developing nuclear. We have to learn from one economy that is very successful in developing policy regulation program and roadmap and guideline.
 - The guidelines should be connected to the net-zero emission.
- **Thailand:**
 - The guideline should be broad enough to be applied as we have a range of economies in APEC. What would be maybe useful? Maybe we can break it down to like a general broad scope and then have a specific one, for example, like solar or transmission line, those kinds of things, because those will be answering those economies who have the same pain point. Before going there, we need a general broad guideline concept for people to buy.
 - Through case study, we know that in APEC economies, we have a different readiness. The case study could be very well, like for those who have energy resiliency in policy already. Those are the steps that I think for the economy, like Thailand, we can learn because we have not yet built that into our policy, but we can learn to see what you need to get a political body's commitment to that one. Then, if that can be laid out, there are some sensitive issues for the economy but in the general, that could be something useful.
 - Some infographics or some online course, like online explanation you can put on YouTube, or you can put it on the APEC Energy Resiliency Task Force web site, then that can be shared as well as understood by those who are coming in and try to better understand how important it is. It could be a low hanging fruit solution to apply to any particular system in your economy.

- **Closing remark of the panel session by Moderator**

- In some cases, it is difficult to develop a case study. But that it is possible, based on the principles document and based on other work that this working group has been doing, to extract elements of what can become even if it is a hypothetical case study, the reader does not have to know that it is hypothetical. That is the beauty of an organization like this.
- For APEC in general is that the APEC Energy Working Group and this group here has credibility and brings together all these experts not only at this workshop, but the other activities that can help with selling "the concepts of energy resiliency" with decision-makers, with policymakers. Therefore, that is something to really take advantage of. The same way that when we are talking about standards, we are talking about ISO 23366 and the others, ISO has credibility and I think that APEC has credibility.

5.6 Closing Remarks

Dr Kazutomo IRIE, President of the Asia Pacific Energy Research Centre (APEREC)

- This workshop was informative and insightful on ways to enhance resiliency of energy supply infrastructure in APEC member economies, as we had hoped in planning this workshop. We hope the Sectoral Energy Resiliency guidelines for energy supply infrastructure will be developed in a timely manner.

Appendix 1 Workshop Analysis

Evaluation Survey

15 respondents from 18 attendees	Strongly Agree	Agree	Disagree	No response	Total
* The objectives of the workshop were clearly defined.	12	3	0	0	15
* The workshop achieved its intended objectives.	11	4	0	0	15
* The agenda items and topics covered were relevant.	11	4	0	0	15
* The content was well organized and easy to follow.	11	4	0	0	15
* Will you apply the project's content and knowledge gained at your workplace?	9	6	0	0	15
* The time allotted for the workshop was sufficient.	7	7	1	0	15
* The workshop included diverse viewpoints across economies and professions (government, private sector, academia).	9	6	0	0	15
* The workshop was effective in sharing successful expertise, best practices, and knowledge.	9	6	0	0	15
* The workshop was a good foundation for future international cooperation and discussion among APEC economies regarding energy resilience.	11	4	0	0	15
* The workshop was a good opportunity to provide you with new insights and awareness about energy resilience-related activities.	11	4	0	0	15
* The workshop improved your understanding of energy resilience.	10	5	0	0	15

Appendix 2 Workshop AGENDA

Agenda items	
10:00-10:20	<p>Workshop facilitator: Ms Kana Sato, Senior Researcher, JIME Center, the Institute of Energy Economics, Japan (IEEJ)</p> <p>Opening Remarks: Dr Kazutomo IRIE, President, the Asia Pacific Energy Research Centre (APERC)</p> <p>Welcome Remarks: Mr Dan Ton, Program Manager of Smart Grid R&D, Office of Electricity, the U.S. Department of Energy (DOE)</p>
Part 1: The urgent need for evaluating energy resiliency	
10:20-11:00	<p>Keynote Speech: Introduction of the APEC energy resiliency enhancement project” Ms Reiko EDA, Director for Natural Resources and Energy Research International Affairs Division, Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry (METI), JAPAN</p> <p>Mr Brian Strong: Chief Resilience Officer and Director, Office of Resilience and Capital Planning, Office of the City Administrator, City and County of San Francisco</p>
11:20-12:00	<p>Introduction to APEC Energy Resiliency Principles/Energy Resiliency Guidelines Mr. Hiroki Kudo, Board Member, Director, in charge of Electric Power Industry Unit, the Institute of Energy Economics, Japan (IEEJ)</p>
Part 2: Situation and challenges for energy infrastructure resiliency in member economies (1)	
13:10-14:40	<p>Moderator: Ms Tomoko Murakami, Senior Fellow, Electric Power Industry Unit, the Institute of Energy Economics, Japan (IEEJ)</p> <p>Australian Case Dr Kevin J. Foster, Chairman, Risk Engineering Society (Western Australia)</p> <p>Canadian case Dr Guy Félio, Independent Consultant, Senior Advisor – Infrastructure Resilience</p> <p>Japanese case Mr Keisei Nozaki, Assistant Director, International Affairs Division, Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry (METI), JAPAN</p>
Part 3: Situation and challenges for energy infrastructure resiliency in member economies (2)	
15:00-16:30	<p>Moderator: Ms Tomoko Murakami, Senior Fellow, Electric Power Industry Unit, the Institute of Energy Economics, Japan (IEEJ)</p> <p>Chilean case Dr Claudio Huepe Minoletti, Former Energy Minister of Chile, Universidad Diego Portales</p> <p>Indonesian case Dr Ir Djoko Siswanto, Secretary General, Indonesia National Energy Council, Republic of Indonesia</p> <p>Thailand case Dr Nuwong CHOLLACOOOP, Director, Low Carbon Energy Research Group, National Energy Technology Center (ENTEC)</p>
Part 4: Lessons & Learns from each economy’s experiences and Implications to future APEC activity for energy resiliency enhancement of energy supply sector	
16:30-17:20	<p>Panel discussion: What are implications to enhance energy resiliency in energy supply sector and role/contents of the standard in APEC.</p> <p>Moderator: Dr Guy Félio (Canada) Ask to invited speakers questions and discuss</p>
17:20-17:30	<p>Closing Remarks: Dr Kazutomo IRIE (APERC)</p>


Appendix 3 Workshop Presentations

Part 1: The urgent need for evaluating energy resiliency

Keynote Speech: Introduction of the APEC energy resiliency enhancement project”

Ms Reiko EDA

Director for Natural Resources and Energy Research International Affairs Division, Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry (METI), JAPAN



Introduction of the APEC Energy Resiliency Enhancement Project (EWG 09 2021A)

APEC Energy Resiliency Enhancement Project Workshop@San Francisco

Nov 9, 2023

Reiko EDA
Agency for Natural Resources and Energy
METI, Japan

Cebu Declaration

9. We welcome the new APEC Initiative for Enhancing the Quality of Electric Power Infrastructure taking into **consideration not only resilience to extreme weather events but also lifecycle costs, environmental impact, responsiveness to changing market circumstances and business continuity.**
17. **A priority goal in developing a resilient APEC community** will be to provide energy access to our people, including in remote communities. We note that clean energy technologies and traditional energy sources, including cleaner use of fossil fuels, are important in addressing energy access challenges. We recognize that significant potential exists to provide energy access to rural communities through the up-take of micro grids, energy storage and their integration with renewable energy resources.

Energy Resilience Task Force (ERTF) was established.

4

APEC Connectivity Blueprint for 2015-2025 (an annex to the 2014 APEC Leaders' Declaration)

17. We will **develop, maintain and renew quality infrastructure, including energy, ICT and transport infrastructure** and seek to increase the quality and sustainability of APEC transport networks; increase broadband internet access; **promote sustainable energy security; and build resiliency into the energy infrastructure.**

2

APEC Energy Resiliency Principle (Dec 2015)

APEC Energy Resiliency Principle	
I. Background and Purpose of the principle	Description of the background and purpose of the development
II. Definition of energy resiliency	
III. Respect for diversity among economies, holistic approaches and multi-stakeholder processes	Description of the "diversity principle" relating the contents of the Principle
IV. Relevant stakeholders and their roles to enhance energy resiliency	<ul style="list-style-type: none"> • Governments • Energy supply industries • Industrial and general energy consumers • Financial institutions
	Identification relevant stakeholders and description of their roles taking into action for enhancement of energy resiliency
V. Common approaches among different stakeholders towards energy resiliency	<ul style="list-style-type: none"> • Energy resiliency plans • Investment and financing to projects towards energy resiliency • Proper asset management • Emerging technologies adoption • Multi-stakeholder knowledge sharing
	Description of major common approaches for enhancement of energy resiliency
VI. Follow-up actions based on the principle in EWG-ERTF	

5

Cebu Declaration (2015 APEC Energy Ministerial Meeting)

2. Bearing in mind the 2014 Leaders' commitment made on the APEC Connectivity Blueprint for 2015-2025, we affirm the importance of **energy resiliency in promoting energy security and sustainable development and providing access to the people.** This includes in particular, **the ability and quality of energy infrastructure to withstand extreme natural and man-made disasters, to recover and return to normal conditions** in a timely and efficient manner and to build back better.
7. Consistent with the theme of an energy resilient APEC community we recognize the need to conduct **a vulnerability assessment of existing infrastructure and evaluate current infrastructure standards.** We encourage members to improve the robustness of their energy infrastructure and policy, through capacity building, sharing of information, and promoting best-practices as appropriate. Furthermore, we reaffirm that **resilience to potential energy supply disruptions can be strengthened through effective, well-targeted market and governance response mechanisms.** We also encourage Members to **promote energy supply diversity and energy efficiency and to reduce barriers to energy trade and investment in advancing resilience of the energy sector.**

3

Workshop on Energy Resiliency Principle (EWG 07 2020A)

[Key Activities]

1. Conducting 3 virtual workshops to disseminate importance of energy resiliency and to build the capacity of public and private sector in APEC economies for creating resilient energy supply system.
2. Developing APEC Energy Resiliency Guidelines based on the inputs gathered through workshops.

[Outputs]

1. APEC Energy Resiliency Guidelines
2. Project Summary Report



8

APEC Energy Resiliency Enhancement Project
(EWG 09 2021A)

[Objective]

Based on the follow-up actions stipulated in the Principles, this project aims to enhance the ability to secure stable energy supply by effectively dealing with disasters through the following three activities;

[Key Activities]

- (1) Conducting research work including identifying, collecting, and assessing indicators to evaluate energy resiliency in APEC economies,
- (2) Developing an APEC Energy Resilience Sectoral Guideline for Energy Infrastructure Companies
- (3) Holding a workshop for capacity building on energy resiliency through dissemination of the Principle.

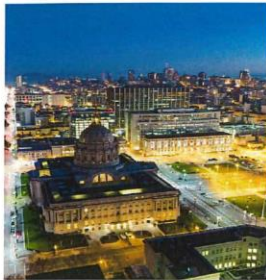
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Thank you for your attention.



Mr Brian Strong

Chief Resilience Officer and Director, Office of Resilience and Capital Planning, Office of the City Administrator, City and County of San Francisco



ENERGY RESILIENCE IN SAN FRANCISCO

APEC Energy Resilience Workshop
 Brian Strong, Chief Resilience Officer
 City and County of San Francisco
 November 9, 2023

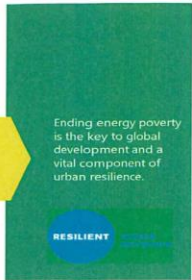


ENERGY RESILIENCE

Far too many people live without access to modern, affordable, reliable, and abundant power. Lack of power blocks their path to prosperity.



By investing in energy resilience cities can enable a climate-focused energy transition, bolster their local economies, create green jobs and improve quality of life for their most vulnerable urban residents.



Office of Resilience and Capital Planning
 A PLACE WHERE PEOPLE ARE RESILIENT AND THRIVE



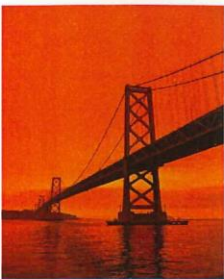
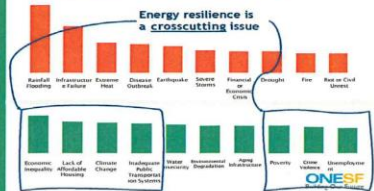
Source: Future Next City, Next Equitable City, Voice the Theory, Architecture, RWJF, SF Environment, SF State



Cities face a common reality multiple shocks and stresses at the same time

Our network cities are actively responding, building knowledge through experience and harnessing their power to effect change.

Most common shocks and stresses



Energy Resilience Overview

- > Critical to Citywide Resilience
 - o Cities are on the Forefront
 - o Climate Change is Making it Worse
 - o Key to Disaster Recovery
- > Complex Energy Framework
 - o Government & Regulatory Environment
 - o Managing Demand
 - o Energy Grid, Sources & Transmission
- > Opportunities & Challenges
 - o Clean Transition and Energy Mix
 - o Managing Demand
 - o Alternatives Comparison
 - o Funding



Energy Resilience

	CHANGES IN THE GLOBAL CLIMATE INCREASE THE SEVERITY OF LOCAL HAZARDS		
	INCREASING TEMPERATURES	RIISING SEA LEVELS	CHANGING PRECIPITATION PATTERNS
Extreme Heat	●		
Drought	●		●
Wildfire & Wildland-Urban-Interface Fire	●		
Poor Air Quality	●		
Coastal Flooding		●	
Stormwater Flooding		●	●
Soil Liquefaction in an Earthquake		●	





Energy Resilience

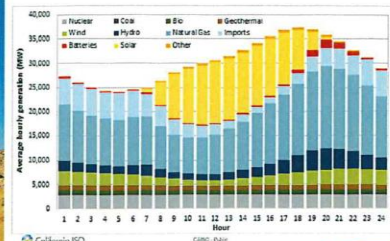
Lifelines Restoration Performance Project

- How would we like lifelines to perform in an earthquake?
- How would lifelines perform if an earthquake happened today?
- What actions are needed to close the gap?

Report available at: onesanfrancisco.org/lifelines-program



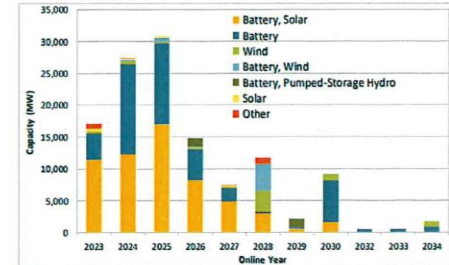
Energy Framework Diverse Sources – Managing Demand



Energy Resilience -- Lifeline Interdependencies



Energy Framework New Capacity



Energy Framework

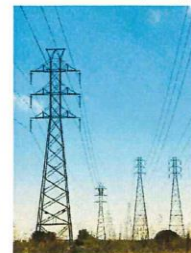
California's Electric Grid

- California has one of the most advanced electric grids in the world
- The energy mix on the grid consists principally of natural gas, nuclear, geothermal, hydropower, solar and wind
- Solar and wind met 30% of California's power needs in 2022



Source: CAISO

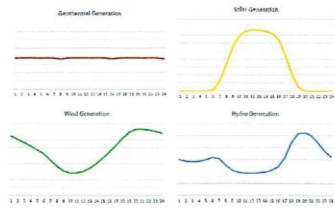
Energy Framework Transmission Capacity



Energy Opportunities

Clean Transition and Reliability Challenges

- Decarbonization means more renewables and less fossil fuels
- In addition, electrification means more demand for electricity overall
- Fossil fuels can produce electricity 24/7, many renewables do not
- Renewables also depends on location - need transmission!
- Transmission projects are expensive and take time to develop



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CleanPowerSF ONESF Building Our Future

Energy Opportunities

Comparison of Energy Alternatives -- Resilience

	Solar	On-shore wind	Off-shore wind	Hydro	Geothermal	Natural Gas
GHG emissions	None	None	None	None	Minimal	High
Cost	\$\$\$	\$\$\$	\$\$\$\$	\$\$\$	\$\$\$	\$\$\$
Availability	Good	Good	✓✓	Limited	✓✓	✓✓✓
Reliability	Requires sunshine, limited on cloudy days	Seasonal, locational	Seasonal, locational	Depends on water-year	Excellent	Excellent
New transmission need	Medium	Medium	Very High	N/A (minimal new hydro expected)	Very High	Low

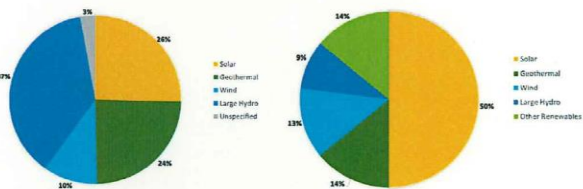
None Neutral Challenge

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CleanPowerSF ONESF Building Our Future

Energy Opportunities

CleanPowerSF Energy Mix (2022, 2035)



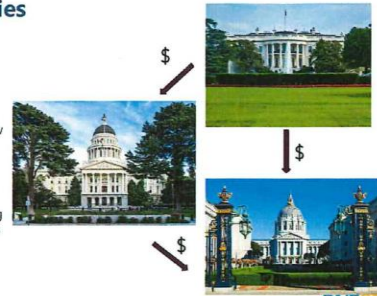
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CleanPowerSF ONESF Building Our Future

Energy Opportunities

Funding

- Expediting development of transmission and generation
- Federal Inflation Reduction Act and Bipartisan Infrastructure Law provides significant funding
- State budgets offer significant funds to procure electricity to ensure reliability
- State and CAISO are enhancing transmission planning processes



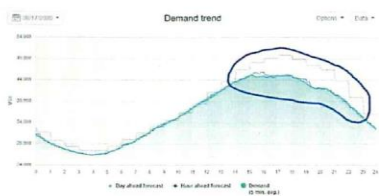
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CleanPowerSF ONESF Building Our Future

Energy Opportunities

Reducing Demand

- Reducing demand in strained times can be a critical tool to achieve reliability
- Several things are being done to enhance demand-side reliability:
 - 1) Demand flexibility
 - 2) Energy efficiency
 - 3) Demand Response



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CleanPowerSF ONESF Building Our Future

Questions?

Sources

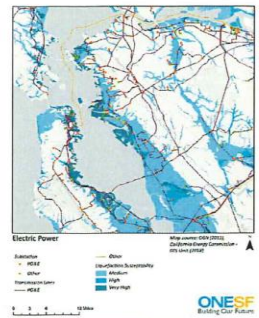
- San Francisco Office of Resilience and Capital Planning: <https://onesanfrancisco.org/>
- San Francisco Public Utilities Commission: <https://sfpuc.org/>
- Resilient Cities Network / Urban Power Campaign: <https://resilientcitiesnetwork.org/energy-resilience/>
- Hetch Hetchy Power System: <https://sfpuc.org/HetchyPower>
- CleanPowerSF: <https://www.cleanpowersf.org/>
- CleanPowerSF's Integrated Resource Plan: <https://www.cleanpowersf.org/resourceplan>
- CAISO (CA Independent Systems Operator) supply and demand forecasts: www.caiso.com/TodaysOutlook

RESILIENT CleanPowerSF



SF Lifelines Council Restoration Performance Project

- Electric Power Key Findings**
- ▷ Dependency on power rated as significant by all sectors, except AWSS
 - ▷ Most sectors have a central control center that relies on communications and electricity
 - ▷ Communications and electricity are functionally coupled. Few cell sites have back up generators.
- Electric Power Key Actions**
- ▷ PG&E needs to better understand reliance of other lifelines on power and the implications if they lose power to improve restoration prioritization.
 - ▷ Municipal and private owners with critical electricity needs should have resilient onsite back up, e.g. solar + storage.
 - ▷ Study implications of building electrification effort on electricity reliance.



San Francisco is an Electricity Generator and Buyer



Hetch Hetchy POWER CleanPowerSF ONESF Building Our Future

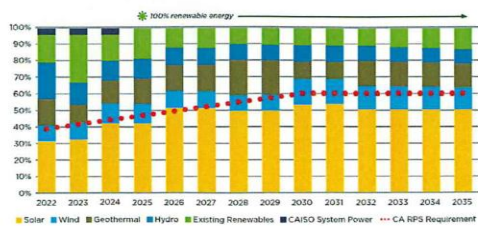
RESILIENT CITIES NETWORK CITIES SOLVE, CITIES DELIVER

- Is R-Cities' global campaign that showcases solutions to**
- Increase visibility of the role of cities and the Chief Resilience Officers in advancing urban resilience every day, building a safe and equitable world for all.
 - Inspire cities across and beyond the network with urban resilience solutions.
 - Leverage the collective experience of cities to fundraise and build partnerships.



Energy Opportunities

CleanPowerSF Energy Roadmap, 2022-2035

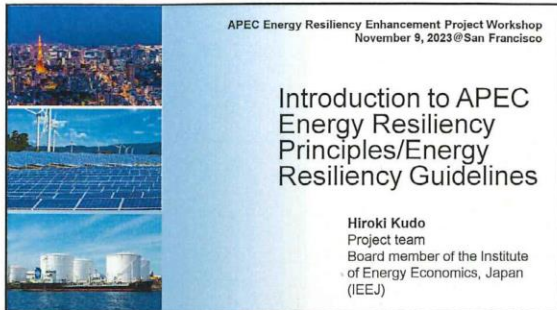


Part 2: Situation and challenges for energy infrastructure resiliency in member economies (1)

Introduction to APEC Energy Resiliency Principles/Energy Resiliency Guidelines

Mr. Hiroki Kudo

Board Member, Director, in charge of Electric Power Industry Unit, the Institute of Energy Economics, Japan (IEEJ)

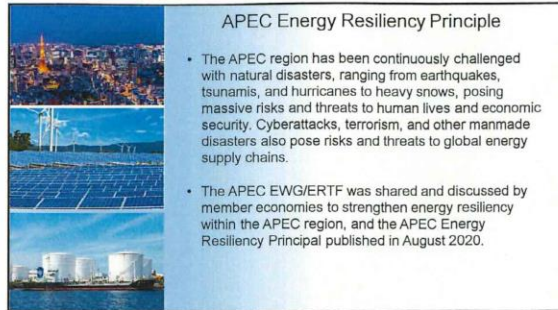


APEC Energy Resiliency Enhancement Project Workshop
November 9, 2023 @ San Francisco

Introduction to APEC Energy Resiliency Principles/Energy Resiliency Guidelines

Hiroki Kudo
Project team
Board member of the Institute of Energy Economics, Japan (IEEJ)

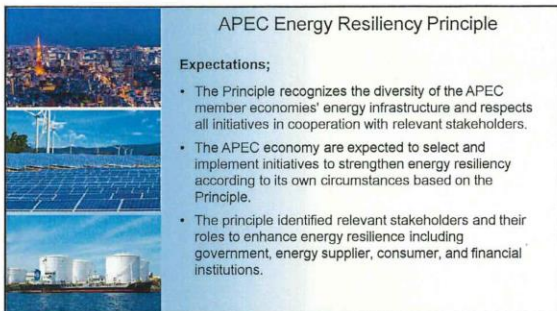
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APEC Energy Resiliency Principle

- The APEC region has been continuously challenged with natural disasters, ranging from earthquakes, tsunamis, and hurricanes to heavy snows, posing massive risks and threats to human lives and economic security. Cyberattacks, terrorism, and other manmade disasters also pose risks and threats to global energy supply chains.
- The APEC EWG/ERTF was shared and discussed by member economies to strengthen energy resiliency within the APEC region, and the APEC Energy Resiliency Principle published in August 2020.

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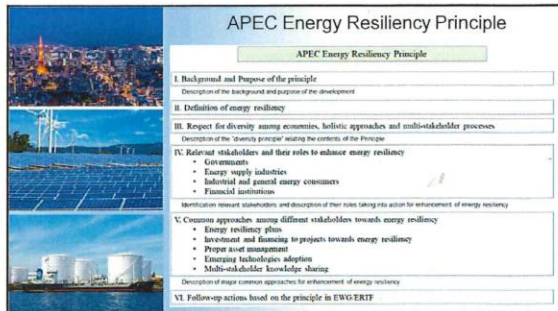


APEC Energy Resiliency Principle

Expectations;

- The Principle recognizes the diversity of the APEC member economies' energy infrastructure and respects all initiatives in cooperation with relevant stakeholders.
- The APEC economy are expected to select and implement initiatives to strengthen energy resiliency according to its own circumstances based on the Principle.
- The principle identified relevant stakeholders and their roles to enhance energy resilience including government, energy supplier, consumer, and financial institutions.

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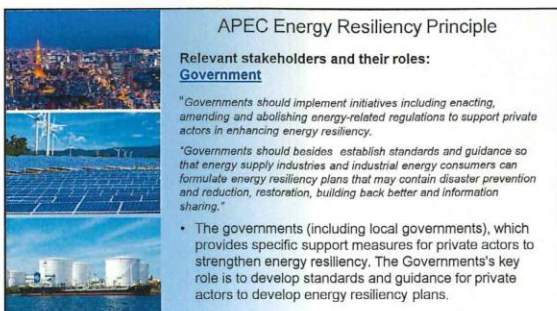


APEC Energy Resiliency Principle

APEC Energy Resiliency Principle

- I. Background and Purpose of the principle**
Description of the background and purpose of the development
- II. Definition of energy resiliency**
- III. Respect for diversity among economies, holistic approaches and multi-stakeholder processes**
Description of the "various principle" within the context of the Principle
- IV. Relevant stakeholders and their roles to enhance energy resiliency**
 - Government
 - Energy supply industries
 - Industrial and general energy consumers
 - Financial institutions
- V. Common approaches among different stakeholders towards energy resiliency**
 - Energy resiliency plan
 - Investment and financing to projects towards energy resiliency
 - Proper asset management
 - Emerging technologies adoption
 - Multi-stakeholder knowledge sharing
- VI. Follow-up actions based on the principle in EWG/ERTF**

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APEC Energy Resiliency Principle

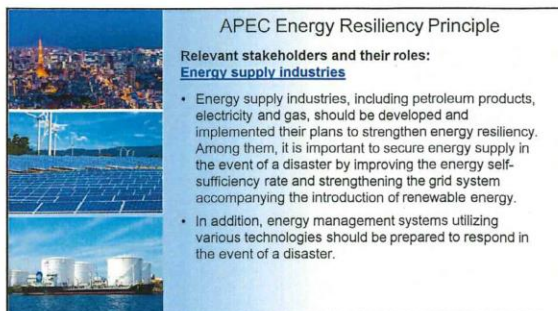
Relevant stakeholders and their roles:
Government

"Governments should implement initiatives including enacting, amending and abolishing energy-related regulations to support private actors in enhancing energy resiliency."

"Governments should besides establish standards and guidance so that energy supply industries and industrial energy consumers can formulate energy resiliency plans that may contain disaster prevention and reduction, restoration, building back better and information sharing."

- The governments (including local governments), which provides specific support measures for private actors to strengthen energy resiliency. The Governments's key role is to develop standards and guidance for private actors to develop energy resiliency plans.

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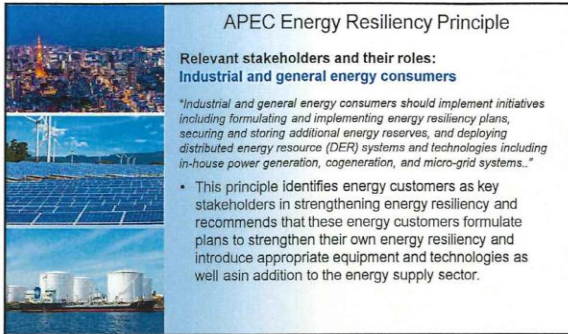


APEC Energy Resiliency Principle

Relevant stakeholders and their roles:
Energy supply industries

- Energy supply industries, including petroleum products, electricity and gas, should be developed and implemented their plans to strengthen energy resiliency. Among them, it is important to secure energy supply in the event of a disaster by improving the energy self-sufficiency rate and strengthening the grid system accompanying the introduction of renewable energy.
- In addition, energy management systems utilizing various technologies should be prepared to respond in the event of a disaster.

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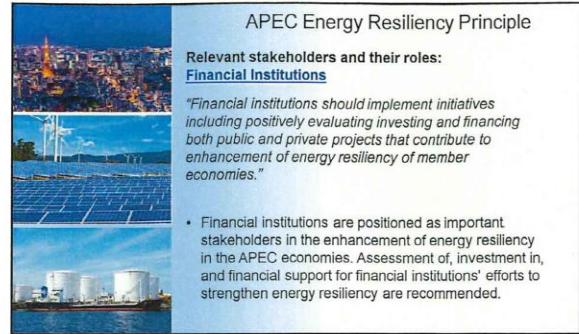
APEC Energy Resiliency Principle

Relevant stakeholders and their roles:
Industrial and general energy consumers

"Industrial and general energy consumers should implement initiatives including formulating and implementing energy resiliency plans, securing and storing additional energy reserves, and deploying distributed energy resource (DER) systems and technologies including in-house power generation, cogeneration, and micro-grid systems..."

- This principle identifies energy customers as key stakeholders in strengthening energy resiliency and recommends that these energy customers formulate plans to strengthen their own energy resiliency and introduce appropriate equipment and technologies as well as in addition to the energy supply sector.

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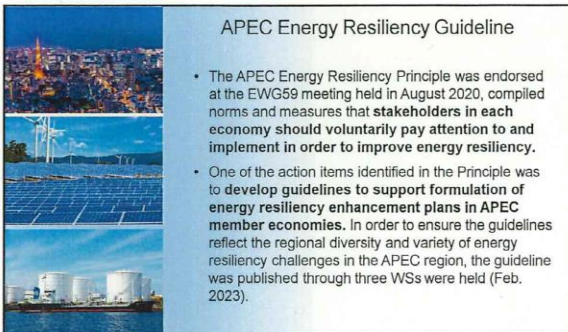
APEC Energy Resiliency Principle

Relevant stakeholders and their roles:
Financial Institutions

"Financial institutions should implement initiatives including positively evaluating investing and financing both public and private projects that contribute to enhancement of energy resiliency of member economies."

- Financial institutions are positioned as important stakeholders in the enhancement of energy resiliency in the APEC economies. Assessment of, investment in, and financial support for financial institutions' efforts to strengthen energy resiliency are recommended.

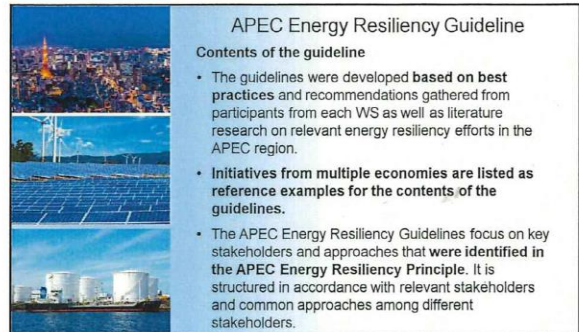
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APEC Energy Resiliency Guideline

- The APEC Energy Resiliency Principle was endorsed at the EWG59 meeting held in August 2020, compiled norms and measures that **stakeholders in each economy should voluntarily pay attention to and implement in order to improve energy resiliency.**
- One of the action items identified in the Principle was to **develop guidelines to support formulation of energy resiliency enhancement plans in APEC member economies.** In order to ensure the guidelines reflect the regional diversity and variety of energy resiliency challenges in the APEC region, the guideline was published through three WSs were held (Feb. 2023).

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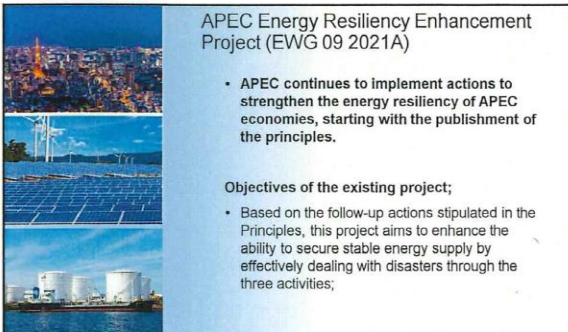


APEC Energy Resiliency Guideline

Contents of the guideline

- The guidelines were developed **based on best practices** and recommendations gathered from participants from each WS as well as literature research on relevant energy resiliency efforts in the APEC region.
- Initiatives from multiple economies are listed as reference examples for the contents of the guidelines.**
- The APEC Energy Resiliency Guidelines focus on key stakeholders and approaches that **were identified in the APEC Energy Resiliency Principle.** It is structured in accordance with relevant stakeholders and common approaches among different stakeholders.

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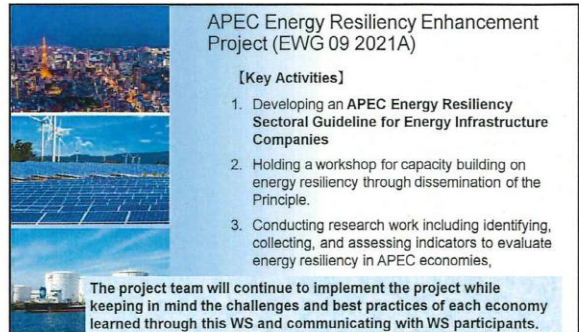
APEC Energy Resiliency Enhancement Project (EWG 09 2021A)

- APEC continues to implement actions to strengthen the energy resiliency of APEC economies, starting with the publication of the principles.**

Objectives of the existing project;

- Based on the follow-up actions stipulated in the Principles, this project aims to enhance the ability to secure stable energy supply by effectively dealing with disasters through the three activities;

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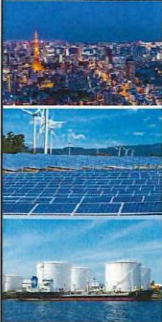
APEC Energy Resiliency Enhancement Project (EWG 09 2021A)

[Key Activities]

- Developing an **APEC Energy Resiliency Sectoral Guideline for Energy Infrastructure Companies**
- Holding a workshop for capacity building on energy resiliency through dissemination of the Principle.
- Conducting research work including identifying, collecting, and assessing indicators to evaluate energy resiliency in APEC economies,


The project team will continue to implement the project while keeping in mind the challenges and best practices of each economy learned through this WS and communicating with WS participants.

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Activity relative to APEC Energy Resiliency Principle

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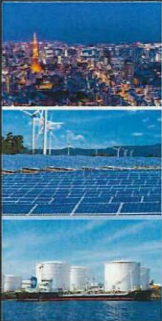


APEC Energy Resiliency Principle

Promote more relevant activities within APEC and globally;

- Promote the development of related guidelines and guidance including sector specific contents .
- Development of International standards (e.g., ISO) relating energy resilience enhancement

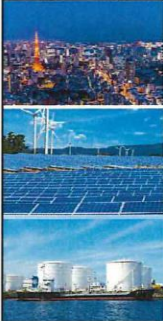
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ISO 22366; Security and resilience – Energy resilience – Framework and principles

- International standard development approval: September 2022 under ISO/TC292 (Security and Resilience)
- Proposer/secretariate: JISC/Japan
- Registered experts: 16 economies
- Development status: CD (committee draft)
 - Create WD referred on the APEC's principle and develop content as ISO
- Target publication date: 11 Oct 2025

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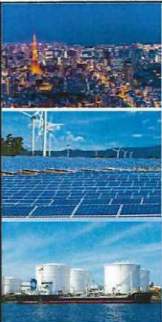


ISO 22366; Security and resilience – Energy resilience – Framework and principles

User's benefits:

- **Central/local governments** should support private stakeholders and communities in enhancing energy resilience and formulation of energy resilience plans that may contain disaster prevention
- **Energy consumers** should implement initiatives including formulating and implementing energy resilience plans
- **Residential sector** can also obtain various benefits from implementation of energy resilience enhancement

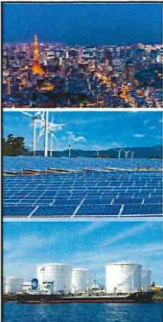
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ISO 22366; Security and resilience – Energy resilience – Framework and principles

- **Financial institutions** should implement initiatives including positively evaluating, investing and financing both public and private projects that contribute to enhancement of energy resilience.
- **Energy supply Chain Networks:** All stakeholders and contributors to an energy supply chain network should use a common set of resilience principles and standardised decision framework for enhancing energy resilience for the benefit of society

17



Thank you very much for your attention.

Reference;

- APEC Energy Resiliency Principle http://mddb.apec.org/Documents/2020/EWG/EWG59/20_ewg59_023.pdf
- APEC Energy Resiliency Guideline <https://www.apec.org/publications/2023/02/apec-energy-resiliency-guidelines#:~:text=In%20line%20with%20the%20APEC,snows%2C%20cyberattacks%2C%20terrorism%2C%20piracy>
- Workshop on Energy Resiliency Principle: Project Summary Report <https://www.apec.org/publications/2023/02/workshop-on-energy-resiliency-principle-project-summary-report>
- ISO 22366 <https://www.iso.org/standard/83384.html?browse=tc>

18

Australian Case

Dr Kevin J. Foster


Chairman, Risk Engineering Society (Western Australia)

1

Energy Resiliency Capability in Australia

Kevin Foster
PhD (Risk) FIEAust CPEng APECEng
Chairman, Risk Engineering Society (Western Australia)

Member Standards Australia MB-025 Security & Resilience
Member ISO/CD 22372 Infrastructure Resilience
Member ISO/CD 22366 Energy Resilience



Kevin Foster PhD FIEAust CPEng APECEng
09 November 2019


1

2

CONTEXT MATTERS

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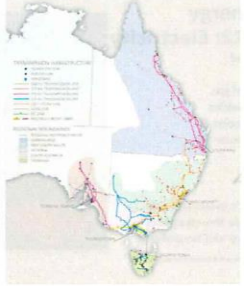


Maps from thetruesize.com

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Inter-State Electricity Market Interconnected System



Kevin Foster PhD FIEAust CPEng APECEng
09 November 2019

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Map from thetruesize.com

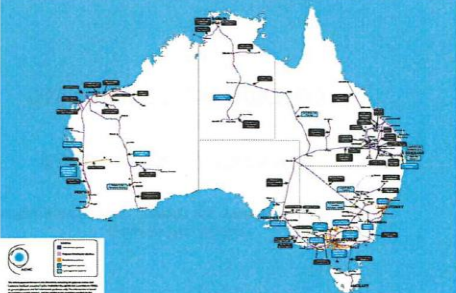
Inter-State Electricity Interconnected System

South-West Electricity Interconnected System

The gap between the two main grids is about 1350km (830 miles).

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Map from Australian Energy Market Commission

6


Australian Energy Statistics 2022

Australia exported 16,000 PJ of energy

- 65% was black coal
- 30% was natural gas

Energy consumed in Australia 6,000 PJ

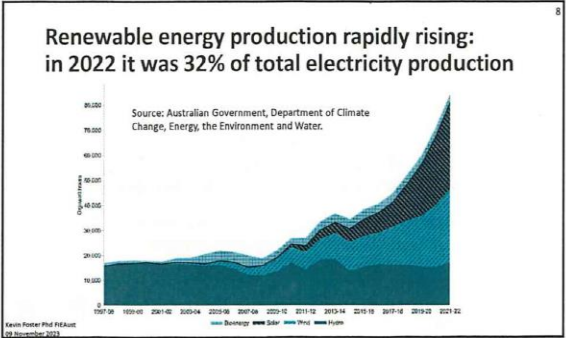
- 36.5% Oil
- 27.5% Coal
- 27.1% Natural Gas
- 8.9% Renewables



Source: Australian Government, Department of Climate Change, Energy, the Environment and Water.

Kevin Foster PhD FEAust CEng NER APSC Eng
09 November 2023

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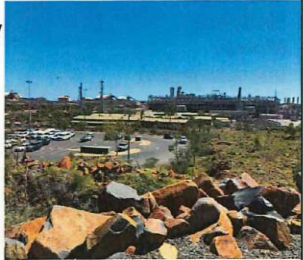
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Australian Energy Statistics 2022: Electricity

Electricity generated:

- 47% from coal
- 19% from natural gas
- 32% from renewables
 - small scale solar 8%
 - large scale solar 6%
 - Wind 11%
 - Hydro 6.4%

- 19% of Australia's electricity was generated outside the electricity sector by industry and households




Source: Australian Government, Department of Climate Change, Energy, the Environment and Water.

9

Lithium statistics 2022

- Australia supplied 53% of the global lithium demand including
- 79% of the world's hard rock lithium.



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COLLABORATIVE LEARNING and MANAGE CONNECTIVITY

Collectively understand the threats, hazards and risks in the energy supply chain

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Trusted information sharing network (TISN)

- One TISN for each of 14 critical industry sectors.

Banking and Finance	Communications	Data	Education and research	Electricity
Food and Grocery	Gas	Health	Liquid Fuels	Mining
Transport	Space	Water services		

- TISN sectors enable critical infrastructure owners and operators to share information on threats and vulnerabilities and collaborate on appropriate measures to mitigate risk and boost resiliency.
- Each sector group is supported by an Australian Government agency - usually the agency that has portfolio responsibility for that sector.

Kevin Foster PhD FEAust CEng NER APSC Eng
09 November 2023

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Physical security threats: reasonably well understood

- Terrorism
- Theft
- Vandalism
- Generally, sharing of information about threats and counter-measures is good



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09 November 2023

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Security: Cyber threats not always understood by all stakeholders

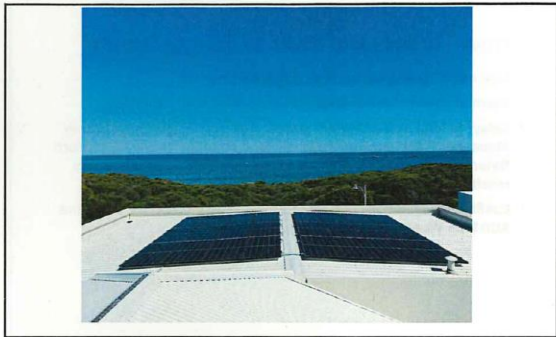
Unsecured 'operational technology' connected to the internet could be vulnerable

- For example: hackers might have the capability to turn off, or change settings in inverters for roof-top solar across a whole city or region: the energy supply to that area could be seriously disrupted!

Reliance on solar 'a risk to Australia's security'
Australian Cyber Security Magazine, 14 August 2023.


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09 November 2023

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Bushfires and grass fires

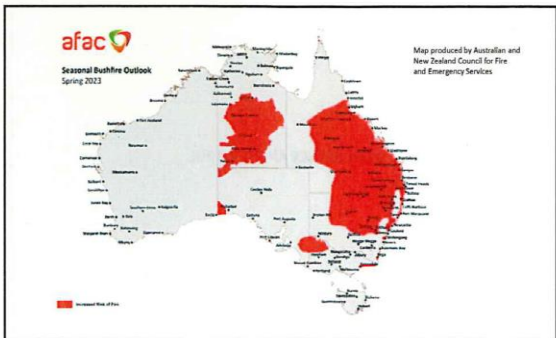


Hazelwood Mine fire, February 2014

- Loss of Infrastructure; or
- Loss of access to Infrastructure
- Disruption to the supply chain


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Severe Tropical Cyclones



Always been a threat north of the Tropic of Capricorn. However, towns south of the Tropic are occasionally vulnerable.

Photo from Western Power, Western Australia

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Floods 19




Photo of Yallourn from the Age Newspaper

- Any low lying energy infrastructure is vulnerable to floods
- E.g. a coal mine

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Coastal Erosion 20


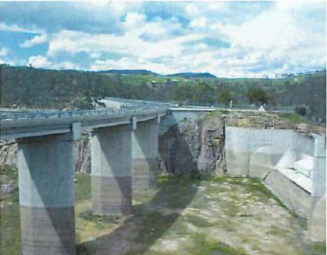


Photo from Canberra Times

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Thermal Power Station cooling water dams can run out of water – after a long drought 21



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Other Threats and Risks to Energy Supply

- Coal mines closing earlier than originally planned.
- Thermal power stations taken off-line earlier than expected.
- Delays to large-scale 'cleaner' energy projects, including the Snowy Mountains 2 GW pumped hydro scheme and the 750 MW Kurri Kurri Natural Gas/green hydrogen power station could cause an energy reliability gap from 2025.
- Conflicting regulations can delay large energy projects including the AUD16bn Woodside Scarborough gas project.

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Skills Shortage 23

Australia in worst skills shortage in 60 years

The West Australian Newspaper 5 October 2023

Not enough engineers and skilled technical workers.

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GOVERNANCE AND CONTROL

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Current Australian Governance Framework for Critical Infrastructure Resilience

- Critical Infrastructure Resilience Strategy and Plan
- Security of Critical Infrastructure Act 2018 (Cth) (as amended in 2022)
- Trusted Information Sharing Network

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Security of Critical Infrastructure Act 2018 (Cth) (as amended in 2022)

The **object of this Act** is to provide a framework for managing risks relating to critical infrastructure, including by:

- improving the transparency of the ownership and operational control** of critical infrastructure in Australia in order to better understand those risks; and
- facilitating cooperation and collaboration** between all levels of government, and regulators, owners and operators of critical infrastructure, in order to identify and manage those risks; and
- requiring responsible entities for critical infrastructure assets to identify and manage risks** relating to those assets; and
- imposing enhanced cyber security obligations** on relevant entities for systems of ... significance in order to improve their preparedness for, and ability to respond to, cyber security incidents; and
- providing a regime for the Commonwealth [of Australia] to **respond to serious cyber security incidents**.

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Energy Market Regulation

- Governance arrangements through federal and state legislation to manage energy markets.

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Resilience Principles Used by Infrastructure Australia – to facilitate government decisions about infrastructure investments

Resilience principles
Infrastructure Australia's approach to resilience

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Infrastructure Australia: Definition of Resiliency

"Resilient communities have the ability to resist, absorb, accommodate, recover, transform and thrive in a timely, effective manner in response to the effects of shocks and stresses to enable positive economic, social, environmental and governance outcomes."

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Infrastructure Australia resilience principles for assessing investment value of proposed infrastructure projects (summary)



- **Resist:** Robust, fail safe and safe-to-fail
- **Absorb:** Prepared and ready to respond
- **Accommodate:** Spare capacity, variety and sufficient reserves
- **Recover:** Restoration and response
- **Transform:** Future focussed, foresight and reflective
- **Thrive:** Integrated, flexible, innovative and inclusive
- **Effective:** Production of desired or intended result, place-based planning and engagement
- **Timely:** Accountability, transparency and promptness

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Energy Resiliency Capability in Australia: What Should Happen Next?



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What should happen next?

- Resilient energy supply chains should not be limited to Government prioritised energy infrastructure. Every community, no matter how small or how remote, relies on the availability of energy. Federal and State/Territory Policies need to improve energy resiliency for all communities.
- Private energy providers need incentives to achieve energy resiliency for communities reliant on energy services.
- Risk information sharing arrangements in energy supply chains need to be more comprehensive, better connected and more transparent where practicable.

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What should happen next?

- The development and completion of draft international standard ISO 22366 Energy Resilience is important and should continue to be supported.
- The design of institutional arrangements needs to fit the scale or nature of the energy resiliency problem: Federal and State problems are not necessarily the same as local community problems.
- Energy resiliency principles need to be globally standardised and harmonised, and in my view should be based on socio-technical systems thinking.
- The principles need to be suitable for all contexts and all scales of systems, and all elements of systems.

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Examples of broad-based resiliency principles

Resilience engineering principles proposed by Yu, Schoon, Hawes et al. 2020	UNDRR infrastructure resilience principles. 2022
P1 Recognise that system context matters Dynamically-changing social, ecological and technological contexts	Environmentally integrated. Work in a way integrated with the natural environment
P2 Foster social capital in the socio-technical system Includes group-shared assets: trust and collaboration that promote self-organising responses	Socially engaged. Develop active engagement & participation across society
P3 Maintain diversity Both redundancy and functional diversity in physical systems are important	Proactively protected. Plan, design, build & operate for current & future hazards
P4 Manage connectivity Exchange of knowledge and resources in collaborative networks are crucial	Continuously learning. Develop & update understanding & insight
P5 Encourage collaborative learning by doing Implemented throughout the entire energy supply chain and user networks	Shared responsibility. Share information and expertise for coordinated benefits
P6 Embrace polycentric governance and control Decisions by risk owners at various locations and times in the energy network	Adaptively transforming. Adapt and transform to changing needs
P7 Address the problem of fit Structure of a collaborative decision network must align with the energy infrastructure system	
P8 Manage for complexity <ul style="list-style-type: none"> a. Consider multiple scales and levels and their linkages. b. Understand robustness-vulnerability trade-offs. c. Pay attention to interdependencies or coupling of multiple infrastructure networks. 	

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References

- Yu, D.J., Schoon, M., Hawes, J.K., et al. 2020, Toward General Principles for Resilience Engineering, in Risk Analysis: An International Journal, Vol. 40, Number 8. pp. 1509-1537.
- United Nations Office for Disaster Risk Reduction. 2022. Principles for Resilient Infrastructure.

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Thank you

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 Chairman, Risk Engineering Society (Western Australia)




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Are we prepared?

Canada's Energy Sector Resilience – An Overview

Presented at the APEC Energy Resiliency Enhancement Project Workshop
 San Francisco (CA), November 9, 2023

By: Guy Félio

Context

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Acknowledgements

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- Infrastructure Canada
- Hydro One (Ontario)
- Hydro Quebec
- Manitoba Hydro

Thank you!

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Context – Canada's energy sector

PRIMARY ENERGY PRODUCTION, INCLUDING URANIUM

2020

Source	Percentage
Crude Oil	44%
Natural Gas	28%
Hydro	6%
Coal	4%
Other Renewables	4%
Natural Gas Liquids (NGLs)	4%
Uranium	10%

PRIMARY ENERGY PRODUCTION BY REGION AND SOURCE (2020)

Source: Energy FactBook 2023-2024, Natural Resources Canada

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Topics covered

- Context
 - Canada's energy sector
 - Recent disruptions
 - Climate-related
 - Cybersecurity
- Risks
 - Climate and Cyber
 - Projections
- Resilience measures

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Context – Canada's energy sector

ECONOMIC CONTRIBUTIONS

NOMINAL GROSS DOMESTIC PRODUCT (GDP)
 ENERGY'S NOMINAL GDP CONTRIBUTION FOR CANADA

Category	Percentage	Value
Canada's GDP	9.3%	\$226 billion
Energy Direct	2.7%	(\$180 billion)
Petroleum	0.7%	
Electricity	1.7%	
Energy Indirect	0.9%	(\$47 billion)

ENERGY TRADE (2021)

Energy exports

\$154.3 billion representing 33% of total Canadian goods exports

Oil and gas domestic exports totaled \$140 billion of which 96% were to the U.S.

exported energy products to 142 economies. The US accounts for 91% of energy exports by value (\$133 billion).

Energy imports

\$42.6 billion representing 1.4% of total Canadian goods imports

Imported energy products from 114 economies. The US accounts for 73% of energy imports by value (\$31 billion).

CANADA'S ENERGY INFRASTRUCTURE

Has energy infrastructure investments of more than \$200 billion in 2021

Category	Percentage
Fuel Energy and Pipelines	31%
Electricity	28%
Other	12%
Renewables	14%
Other	15%

Source: Energy FactBook 2023-2024, Natural Resources Canada

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Context – Canada's energy sector

CANADIAN ENERGY ASSETS
The total value of Canadian energy assets (ESA) went down in 2020 to \$695 billion, a slight decrease of 2.5% from \$712 billion in 2019. In 2023, domestic CEA totaled \$480 billion, down 4.0% from 2019, while CEA abroad totaled \$218 billion, up from \$213 billion.

CANADIAN ENERGY ASSETS BY REGION, 2020

Region	Value (\$B)
USA	314.2
Canada	312.8
Latin America	51.2
Europe	51.2
Asia	51.2
Africa	51.2
Australia	51.2
Other	51.2

Total Canadian energy assets: \$695B
Total Canadian energy assets abroad: \$218B

ELECTRICITY REVENUE RANKING
World production – 26,422 TWh (2019)

Country	Percentage
1 China	29%
2 The United States	10%
3 India	6%
4 Russia	4%
5 Japan	4%
6 Canada	2%

World exports – 74 TWh (2019)

Country	Percentage
1 Canada	9%
2 Germany	9%
3 France	9%
4 Sweden	5%
5 Switzerland	4%
6 Canada	2%

Source: Energy Research Centre of Canada, Natural Resources Canada

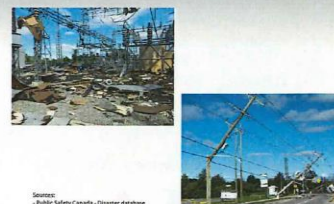
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Context – Climate-related disruptions

Example: September 21, 2018 – National Capital Region – Tornadoes

6 tornadoes touched down in and near the National Capital Region. The strongest was an EF-3 that touched down near the City of Ottawa's rural neighbourhoods.

Estimated total loss: CAD \$ 334 Million



Source:
- Public Safety Canada - Disaster database
- CBC
- Hydro One
- Hydro Ottawa
- https://www.cbc.ca/1.4812011/distribution-system-climate-risk-and-resilience-assessment-hydro-ottawa/

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Context – Canada's energy sector

TRENDS IN ENERGY USE AND INTENSITY BY SECTOR, 2000-2019

Sector	Energy use	Energy intensity
RESIDENTIAL	+11%	-24%
COMMERCIAL	+22%	-4%
TRANSPORTATION (air/mar/road)	+19%	-17%
FREIGHT	+24%	+1%
INDUSTRIAL (chemicals, metal, pulp, etc.)	+15%	-4%
INDUSTRY (agriculture, food processing, etc.)	-11%	-22%

CANADIAN SUPPLY GENERATION IN CANADA – 636 TWh

GENERATION BY SOURCE, 2020

Source	Percentage
OTHER RENEWABLES	7.8%
WIND	60.2%
NUCLEAR	14.6%
COAL	5.7%
GAS/OIL/OTHERS	11.8%


Source: Energy Research Centre of Canada, Natural Resources Canada

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Context – Climate-related disruptions

Example: BC Hydro – 2021 record-breaking year for demand and extreme weather

On June 26, 2021 BC Hydro broke its all-time summer peak demand record at 8,583 megawatts – breaking the previous record by 600 megawatts – the equivalent of turning on 605,000 portable air conditioners.




Source: BC Hydro


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Context – Climate-related disruptions

Example: May 21, 2022 Derecho



Insurance Industry Loss Estimates: > CAD \$ 1.1 Billion (Insured losses)
Source: CatIQ and Insurance Bureau of Canada

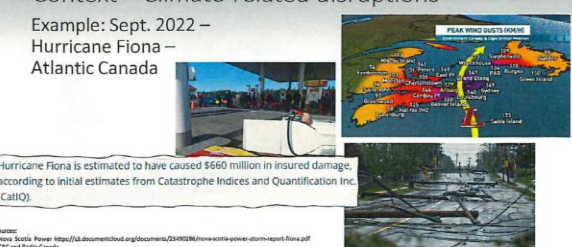


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Context – Climate-related disruptions

Example: Sept. 2022 – Hurricane Fiona – Atlantic Canada

Hurricane Fiona is estimated to have caused \$660 million in insured damage, according to initial estimates from Catastrophe Indices and Quantification Inc. (CatiQ).



Source:
- News: South Coast Power: https://18.documentcloud.org/documents/23480286/news-south-coast-power-dam-report-fiona.pdf
- CBC and Radio Canada
- Insurance Bureau of Canada

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Context – Cyber-risks

Recent example:
Suncor Energy /
Petro-Canada (June
2023)

CYBERSECURITY DIVE
**Suncor Energy continues probe of
cyber incident disrupting gas station
payments**
By Andrew O'Connell
6/27/2023 10:33 AM

SUNCOR News Release
FOR IMMEDIATE RELEASE
Update on Suncor Energy response to cybersecurity incident
Calgary, Alberta (July 6, 2023) – As previously announced on June 25, 2023, Suncor (TSX: SU) (NYSE: SUI) experienced a cybersecurity incident. We immediately activated our business continuity plans, engaged leading IT and cybersecurity experts and notified relevant authorities. Based on our investigations to date, we determined that our IT network was accessed by an unauthorized party on or about June 21, 2023.

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Critical functions and risks

Critical functions to the economy and their vulnerability to hazards

1. Transport cargo and passengers by air and land (rail, roads)
2. Provide information technology products and services
3. Public health and wellness
4. Produce and distribute energy products (electricity, natural gas, fuel)
5. Provide public safety and security (includes law enforcement)

Top risks

1. Coastal, fluvial and overland (ponding) floods
2. Supply Chain Failure
3. IT failures

Importance of interdependencies and risk controls



Source: Guy Fillo unpublished research study (2023)

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Context – Operations and Maintenance Risks

August 2003 US and Canada Blackout

August 14 and 15, 2003 - The northeastern US and southern Canada suffered the worst power blackout in history. Areas affected extended from New York, Massachusetts, and New Jersey west to Michigan, and from Ohio north to Toronto and Ottawa, Ontario. Approximately 50 million customers were impacted.



The causes for the blackout are attributed to deficiencies in operations and procedures in the state of Ohio. Specifically, there was a lack of adequate vegetation, or tree, management, poor communications between various utilities in the area, compounded by lack of training and tools for local operators to effectively deal with the emergency.

Due to these degraded conditions in Ohio, a series of large power swings ranging between 2,000 and 4,000 megawatts pulsed through New York and Ontario and into Michigan, overloading the system.

Source: - Final Report on the August 14, 2003 Blackout in the United States and Canada Causes and Recommendations, US-Canada Power Outage Task Force (2004)
Independent Electricity System Operator (IESO) – looking back at the 2003 blackout

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Climate change impacts and challenges in different regions across Canada



Source: Canada's National Adaptation Strategy (2023)

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Risks



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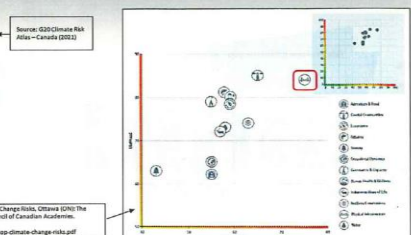
Canada's Top Climate-related Risks

CLIMATE CHANGE TODAY

HYDROPOWER
Changes in temperatures and rainfall may impact water levels in Canada, which can have a direct impact on the ability of hydroelectric power generation.

STORMS
Severe storms, hurricanes and floods have caused major power outages and substantial damage to infrastructure in the United States. The 2005 Super Storm in the US, the 2013 Canada Ice Storm in 2013 and the 2013 Flash Flood in Ontario.

VULNERABILITY
The energy infrastructure in Canada is aging and a large proportion will need replacement or retrofit by 2035. Much of the infrastructure is highly vulnerable to climate change as well as degraded based on historical weather-related outages.



Source: Council of Canadian Academies. 2023. Canada's Top Climate Change Risks, Ottawa (ON): The Queen's Fund on Climate Change Risks and Adaptation Research, Council of Canadian Academies.
<https://cca-reports.ca/wp-content/uploads/2023/01/Report-Canada-top-climate-change-risks.pdf>

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Canada's Top Climate Change Risks



Source: Council of Canadian Academies, 2018. Canada's Top Climate Change Risks. Ottawa (ON): The Expert Panel on Climate Change Risks and Adaptation Potential, Council of Canadian Academies.
<https://cca-reports.ca/wp-content/uploads/2018/07/Report-Canada-top-climate-change-risks.pdf>

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Cyber-risks

Smart Cities and National Security

Smart Cities:

"Environments where digital technologies are used to enhance the quality and efficiency of municipal services. A 'smart' city collects and analyses data interactions with, and usage of, public infrastructure in order to improve service delivery and user experience. This data is collected through connected sensors and individual devices which are part of centralized networks that manage service delivery."

WHAT ARE THE NATIONAL SECURITY CONCERNS?

Smart cities represent the next generation of critical infrastructure, underpinning nearly all aspects of daily life. This integrated centrality means that smart cities will be attractive targets of hostile state actors and criminals for espionage and sabotage/disruption.

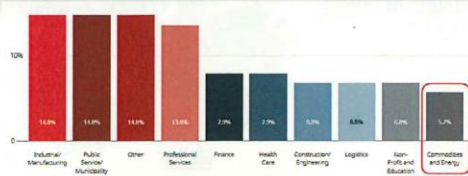
Source: Canadian Security Intelligence Service

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Cybersecurity Incidents – by Industry (2021)



Source: - Status Cybersecurity - Canadian Cybersecurity Trends Study 2021

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Resilience Measures

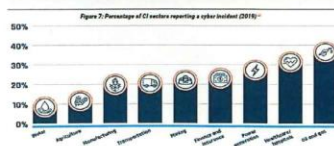


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Cyber-risks



Source: Canadian Centre for Cyber Security

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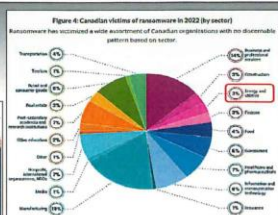


Figure 4: Canadian victims of ransomware in 2022 (by sector)
 Ransomware has accounted a wide assortment of Canadian organizations with top distributed patterns based on sector.

State of Play (some examples)

Codes, Standards and Related Instruments (CSRI) - options include:

- Codes
- Note: Canadian energy Code for buildings focused on energy efficiency
- Legislation, e.g.:
 - Bill C-26: New Cybersecurity Requirements in Critical Infrastructure (2022)
- Standards:
 - Canadian Standards Association (CSA), Bureau des normes du Québec (BNQ)
 - ISO

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State of Play (some examples)

Codes, Standards and Related Instruments (CSRI)
- options include:

- Industry specific practices, e.g.:
 - Canadian Electricity Association: Climate Change and Extreme Weather – A Guide to Adaptation Planning for Electricity Companies in Canada (2020)



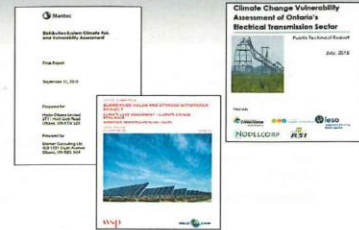
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Climate risk assessments of energy assets and systems

- Example: using the PIEVC Protocol assessment tool (Public Infrastructure Engineering Vulnerability Committee) developed in 2007
- See: <https://pievc.ca/>



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Examples of Federal Government Initiatives

- Updating Codes for climate change
 - National Building Code
 - Canadian Electric Code
 - National Fire Code
 - National Energy Code for Buildings
- Standards Council of Canada
- Infrastructure Canada – Climate Resilience assessment for infrastructure
- Climate services: ClimateData.ca
- Canada's National Adaptation Strategy (2023)



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Observations



Source: Allianz Risk Reconnector 2022: Top concerns around the world

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Examples of Energy Utilities strategies and plans



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Observations – Climate Risks and Resilience

- Past emphasis on mitigation (GHG emissions reduction) now being matched by adaptation (risk assessment and resilience)
- Updating codes and standards to account for climate changes is underway ... but a long process – other instruments may result in faster outputs
- Build-up of climate risks and resilience specialists

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Observations – Cyber Risks

- **Ransomware is a persistent threat to Canadian organizations**
- **Critical infrastructure is increasingly at risk from cyber threat activity**
 - However, state-sponsored cyber threat actors will very likely refrain from intentionally disrupting or destroying Canadian critical infrastructure in the absence of direct hostilities.
- **State-sponsored cyber threat activity is impacting Canadians.** State-sponsored cyber programs pose the greatest strategic cyber threats to Canada
- **Disruptive technologies bring new opportunities and new threats.**

Source: Canada - National Cyber Threat Assessment 2023-2024

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Thank You !

Questions ?

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Part 3: Situation and challenges for energy infrastructure resiliency in member economies (2)

Chilean case

Dr Claudio Huepe Minoletti

Former Energy Minister of Chile, Universidad Diego Portales

Situation and Challenges for Energy Infrastructure Resiliency in Member Economies: The Case of Chile
 APEC Energy Resiliency Enhancement Project Workshop

Claudio Huepe Minoletti
 udp Universidad Diego Portales (Chile)

1

CONTENT

- ❖ Background
- ❖ Current Situation
- ❖ Future Perspectives
- ❖ Concluding Remarks

2

CONTENT

- ❖ Background
- ❖ Current Situation
- ❖ Future Perspectives
- ❖ Concluding Remarks

3


Relevant Aspects of Chile's Energy Sector

- ❑ Chile: 4000 km long and 90 – 200 km wide, population (~19M) concentrated in center, mining activities in the north.
- ❑ Heavily dependent on imported energy (~70%) and imported fossil fuels (~90%).
- ❑ Member of OECD, but not IEA (law states 25 days of average sales but hard to enforce)
- ❑ Liberalized market (many private electricity companies in all segments, one public oil/gas company – not a monopoly but sole owner of refining capacity)
- ❑ Regulation focused on service quality not defining procedures

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Main Energy Infrastructure

- ❑ One main interconnected electricity system - Sistema Eléctrico Nacional (SEN) around 3.000 km and 35.000 km of transmission lines
- ❑ Around 50% of renewable electricity capacity in SEN in the north 15% in the south of the system
- ❑ Two LNG regasification plants (north and centre)
- ❑ Two main refineries (centre and south); one in far south
- ❑ One electricity interconnection, seven gas pipelines (north, centre and south) and one oil pipeline with Argentina



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Main Institutions for Energy Sector

- ❑ Ministerio de Energía (MEN): Policy and Planning
- ❑ Comisión Nacional de Energía (CNE): Regulator
- ❑ Superintendencia de Electricidad y Combustibles (SEC): enforcement and some technical standards (oversees service quality and safety/security of operation and use)
- ❑ Coordinador Eléctrico Nacional: Independent System Operator (some operational standards)

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Energy Infrastructure Resilience Institutions (1)

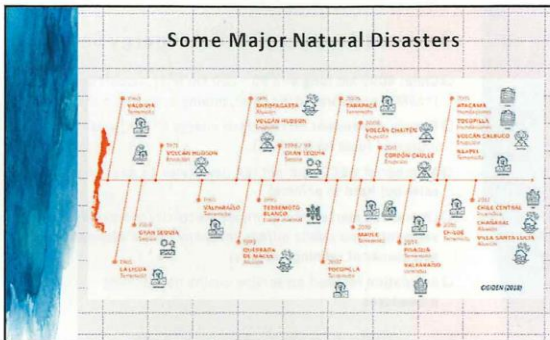
- Some specific issues considered in legislation
 - Transmission safety standards can be relaxed under natural catastrophes, must include resiliency analysis in transmission planning
 - In distribution can request management system to ensure operational continuity under various risks
- MEN: "seguridad" (safety and security) is an element of policy (but no precise definition);
- CNE: technical regulation
- SEC
 - In electricity distribution can request contingency plans
 - enforces and oversees technical aspects of operations focused mostly on risk management

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Energy Infrastructure Resilience Institutions (2)

- Coordinador: recovery plans and some standards
- Ministry of the Interior in charge of human induced risks (protection by Armed Forces of critical infrastructure)
- Servicio Nacional de Prevención y Respuesta ante Desastres (SENAPRED): planning and coordinating resources to prevent and act on disasters advising local and domestic levels (operational institution for the domestic disaster prevention and response system)

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CONTENT

- ❖ Background
- ❖ Current Situation
- ❖ Future Perspectives
- ❖ Concluding Remarks

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2010: Earthquake Milestone

- February 27: 8.8 magnitude Earthquake with epicentre in the centre-south of Chile followed by a Tsunami
- Blackout affected about 90% of population
- About 25% recovery in same day, around 40% next day, but after 12 days still 20% below normal.
- Refineries affected by power cuts
- No widespread fuel shortages

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Policy Actions After Earthquake

- Earthquake made policy focus on infrastructure security and not only supply security and operational safety
- Efforts to integrate information on one platform
- SEC: requested information and plans to companies
- MEN: studies for actionable estimations of vulnerability
- Operational measures (Decree 38, 2011)
 - National Emergency Operations Committee
 - Regional Emergency Operations Committee

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First actions (1)

- Study in 2010: Diagnosis on Reduction of Disaster Risk (UNISDR), Hyogo Framework for Action
- Coordination mechanism launched in 2012 (Plataforma Nacional para la Reducción de Riesgos de Desastres, which included MEN)
- Integrated information system (Sistema Integrado de Información para Emergencias, SIIE) –integrating available public information (launched in 2011)
 - Several sources with varied methodology and different levels of detail
 - Partial information on earthquakes, volcanic activity, tsunamis, landslides, floods, extreme w
 - Need to complete and integrate information was recognized

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First Actions (2)

- SEC Oficio Circular 10.013 (Official Letter 10.013) of October 2010: requested companies affected by earthquake to propose plans for supply normalization and damage mitigation under similar events
 - Integrity evaluation: through inspections
 - Normalization plan
 - Risk analysis: focused on earthquakes - conditions of plants, population density, surrounding services
 - Prevention and mitigation plan: defined aspects to be considered
- Information collection and review took two years
- A lot of information gathered but under various methodologies, difficult to handle

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First Actions (3)

- MEN study in 2012 tried to approach resiliency through a structured collection of information
- Starting in the North Electrical System (in 2012 SEN was two systems) collected geographically referenced information through surveys on main assets types, preparation and protection to various threats
- A multicriteria vulnerability index was developed
- The index had problems due to information limitations and lack of relevant benchmarks

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Advances in Electricity Sector (1)

- 2007: Concept of “integrity” is defined by SEC: capacity of an installation to fulfill its function in an effective and safe form complying with all legal requirements
- 2010: Safety plans were requested (OC 10.013 set the stages of this process)
- Initial standards were set for asset management: 2012 - PAS 55 , 2014 -ISO 55000

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Advances in Electricity Sector (2)

- MEN Regulation on Safety and Security of electricity facilities (Decree DS 109, 2017): all electricity facilities connected to a system must have an Integrity Management System (Sistema de Gestión de Integridad de Instalaciones Eléctricas, SGIIE)
- SEC: technical standards for DS 109, (Pliego técnico normativo RPTD 17, 2020) deadline for implementation - march 2024

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Current Situation: Institutional Framework

- After the 2010 earthquake focus changed from disaster and emergency management to a more comprehensive disaster risk management approach: evolution in process
- 2018 MEN created formally a Unit in charge of Energy Risk Management
- New disaster management Law 21.364 (2020)
 - Establishes a domestic system of disaster “prevention and response”
 - Establishes an administration (“committees” at domestic and local levels)
- Focus on reducing risks (vulnerability), preparedness and fast/efficient reaction by each actor

18

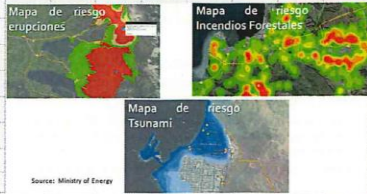
Current Situation: Monitoring (1)

- ❑ Ministry of Energy has a GIS for Risk Management (Sistema de Información Geográfica para la Gestión de Riesgos, SIGGRE)
- ❑ Map of main infrastructure (energy, but also others like police stations, hospitals, or rural water infrastructure)
- ❑ Includes maps of main threats by zones: earthquakes, volcanic activity, forest fires, hydrometeorological events, storm surges, tsunamis,
- ❑ Real-time monitoring system fed by several specialized public organizations

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Current Situation: Monitoring (2)

- ❑ Used by MEN, CNE, Coordinador, Utilities
- ❑ Allows the MEN Unit to inform all relevant actors and helps coordination in working groups



Source: Ministry of Energy

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Current Situation: Monitoring (3)



Source: Ministry of Energy

21

Current Situation: Plans

- ❑ Law 21.634 mandates all sectors in the domestic plan to have specific plans for management of disaster risks (considers a recovery phase)
 - The energy sector decided on a domestic and regional plan.
 - Basically focused on natural events, but could be extended to human made events.
 - Plans must consider how sectoral events affect other sectors (like telecommunications, for example)
 - Sectoral plans should be ready by mid 2024
- ❑ Coordinador: Service recovery plan (currently being updated)

22

Current Developments

- ❑ Search for better understanding - studies
 - "Strengthening the resiliency of Infrastructure through improved governance" - Coalition for Disaster Resilient Infrastructure (CDRI) & United Nations Office for Disaster Risk Reduction (UNDRR)
 - Analysis of Climate Crisis Resilient Infrastructure for the Energy Sector - Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) & MEN
- ❑ No systematic approach to resiliency

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CONTENT

- ❖ Background
- ❖ Current Situation
- ❖ Future Perspectives
- ❖ Concluding Remarks

24

Emerging Issues

- Main issues
 - Climate change
 - Cybercrime
 - Public Order
 - Direct Attacks
- Institutional difficulties to face some of these issues because of allocation of responsibilities

25

Climate Change

- Both climate trends and extreme events are considered relevant "new" threats for energy infrastructure
 - Trends: drought, temperature, wind and rain patterns
 - Extreme events: storm surges, rain storms, floods, fires, snow
- Forest fires, storm surges and rainstorms are of particular concern
 - Storm surges have on average almost doubled in the past 20 years
 - Rainstorms over two weeks during June and August 2023 affecting tens of thousands of people
 - Forest fires in January and February 2017 with record heat in some areas burnt over 500 thousand hectares (some related to transmission lines)
- Attention to better infrastructure design

26

Cibersecurity

- No known successful cyber attacks to energy infrastructure but significant increase in attacks over the past years including energy companies
- Framework law being discussed in Congress.
- Directives from Coordinador to electricity companies (2020): coordinated companies must carry out self evaluations of measures, report annually; non compliance will be reported to SEC
- CNE is preparing a technical standard

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Public Order

- Territorial control by criminal groups: "high risk areas" have doubled in the last decade
- Illegal settlements: occupation of areas under transmission or disturbing formal installations
- Cable theft: relevant issue since 2017, increase over 300% in past two years (over 60 per day)

28

Direct Attacks

- Attacks on infrastructure had been unknown since arrival of democracy
- Recent events on high voltage transmission (bombing of two towers in June 2023 and three towers in September 2022)

29

CONTENT

- ❖ **Background**
- ❖ **Current Situation**
- ❖ **Future Perspectives**
- ❖ **Concluding Remarks**

30

- ❑ Legal framework and regulation are not very comprehensive in terms of infrastructure safety/security
- ❑ There is no clear institutional distinction of the various types of safety/security (operational, supply, infrastructure, use)
- ❑ There have been improvements in risk management, but risk management system (Law 21.634) yet to be fully implemented so evaluation is still premature
- ❑ More formal evaluation of infrastructure risk could allow better allocation of resources for a more resilient system

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- ❑ A comprehensive plan which includes emergency and contingency plans for all energy services and various threats, could be a contribution
- ❑ A life-cycle analysis will be needed (prevention to response)
- ❑ Conditions are changing, infrastructure system is becoming more complex so more foresight and intelligence could be useful (there are efforts in this direction) and more complete standards are needed
- ❑ Emerging issues require a review of institutional framework - in particular human made vs natural threats

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SECRETARIAT GENERAL OF NATIONAL ENERGY COUNCIL

Energy Emergency Response of Indonesia's

APEC Energy Resiliency Enhancement Project's Symposium
 San Francisco, Novth 2023

Dr. Djoko Siswanto
 Secretary General of National Energy Council,
 The Republic of Indonesia

1

OUTLINE

- Overview
- National Energy Regulation
- Disaster Mitigation in Energy
- Recommendation

2

OVERVIEW

To strengthen energy security, ASEAN has declared energy interconnectivity to strengthen The Trans-ASEAN power grid. There are 18 potential cross-border interconnections with a cumulative capacity of 33 GW in 2040. One of the Indonesia-Malaysia border electricity interconnection agreements was signed at the Southeast Asia Energy Ministers' meeting in August 2023.

To securing long term Energy Supply for the region, ASEAN will build The Trans-ASEAN Gas Pipeline (TAGP) as a physical energy infrastructure project to support new market opportunities, as well as to increase energy security amongst the ASEAN Member States. Rapid increase in economic growth and population in the region has created potential challenges in terms of energy security and sustainability.

International Energy Agency (IEA) has an emergency response to anticipate conditions of energy supply shortages that could be caused by natural disasters. In addition to the oil stock release, the country should do other alternatives, like demand restraint, fuel switching or surge production. IEA already conducted Emergency Response Review in Indonesia.

Indonesia already has regulations and policies related to energy sector and their derivatives down to the regional level, there are Energy Law (Law No. 30/2007), National Energy Policy (GR No. 79/2014), National Energy Master Plan (Presidential Decree No. 22/2017), Regional Energy Master Plan in each province, Procedures for Determining and Handling Energy Crisis and/or Energy Emergency (Presidential Decree No. 41/2016 and Minister Decree No. 12/2022).

Regulation of energy types also already exists in Indonesia, there are Oil & Gas Law (Law No. 21/2001), Electricity Law (Law No. 30/2009), Mineral & Coal Law (Law No. 3/2020), Geothermal Law (Law No. 21/2014) and is currently being drafted regarding new and renewable energy law.

3

ENERGY RESILIENCY IN GOVERNMENT REGULATION NO 79/2014

INDONESIA'S ENERGY RESILIENCY

condition of guaranteed availability of energy, public access to energy at affordable prices in the long term while still paying attention to environmental protection.

Energy Resiliency of Indonesia in 2021 is 6,61th

Energy Resiliency on numbers

ASPECTS & INDICATORS

- A. AVAILABILITY**
 - 1. Final Energy Reserves & Productivity
 - 2. Energy Import
 - 3. Domestic Energy
- B. ACCESSIBILITY**
 - 1. Domestic Energy Supply
 - 2. Electricity Supply & Service
 - 3. Fuel Supply & Service
 - 4. Supply and Service of Natural Gas and LPG
- C. AFFORDABILITY**
 - 1. Energy Price (Wholesale)
 - 2. Rate of Energy Expenditures to Income
 - 3. Energy Intensity
- D. ACCEPTABILITY**
 - 1. NRE's Percentage on Energy Mix
 - 2. Energy Intensity
 - 3. Carbon Emission

ISSUES

- The capacity and reliability of the refinery are not sufficient to meet domestic fuel and LPG demand
- High disparities on oil, gas, and coal prices have impacts on household and potential disruption of energy services
- Energy Stock (Crude Oil) is not available yet
- The NRE portion in the energy mix is still low.
- Energy Imports (petroleum, fuel, and LPG) are still high
- Crude oil production decreased, while consumption of fuel increases

4

DETERMINATION OF ENERGY CRISIS AND/OR ENERGY EMERGENCY

Presidential Decree Number 41 of 2016 concerning Procedures for Determining and Handling Energy Crisis and/or Energy Emergency

DEFINITION

Energy Crisis: an energy shortage condition
 Energy Emergency: a condition in which the supply of energy is disturbed due to disconnection of energy facilities and infrastructures

TYPE OF ENERGY BEING REGULATED

Final Energy for the Public needs:

- FUEL
- Natural Gas
- LPG
- Electricity

CONSIDERATIONS FOR DETERMINING ENERGY CRISIS AND ENERGY EMERGENCY

Operational Conditions

- Energy Crisis consider maximum operational capacity of Fuel, LPG, Electricity System and minimum demand for Natural Gas needs
- Energy Emergency consider level of difficulty and length of recovery time

Economy's Conditions

- Disruption of government functions
- Disruption of people's social life and/or
- Disruption of economic activities

DETERMINATION SCHEME

IDENTIFICATION AND MONITORING
 NEC, MCDL, BPN, Governor and/or business Entity

Crisis and/or Emergency Preparedness Mechanism

Potential to suffer UNUS/UNEMERGENCY conditions

Implementation and formalization of NEC Member Meeting Recommendation by MCDL in Daily Decision of NEC

UNUS/UNEMERGENCY based on Operational Conditions
 UNUS/UNEMERGENCY based on Economy's Conditions

MINISTERIAL DECREE (UNUS with Emergency's determination based on operational conditions and consideration)

PRESIDENTIAL DECREE (UNUS with Emergency's determination based on economy's conditions and consideration)

Implementation of Countermeasures by the Government, Regional Government, Business Entities, Community

5

COUNTERMEASURES

Presidential Decree Number 41 of 2016

The Central Government is obliged to carry out countermeasures based on the countermeasures stipulated in the Decree of NEC.

MINISTER AUTHORITY
 In Implementing Countermeasures

- coordinate with ministries/institutions, governors, business entities, and other related parties;
- obtain data and information from agencies, business entities and other related parties;
- prepare a work plan to overcome the Energy Crisis and/or Energy Emergency;
- instruct the Business Entity to take certain steps in accordance with its business field;
- supervise the implementation of countermeasures;
- take other actions in accordance with the President's Instructions.

Other actions referring to NEC recommendations

Utilization of Excess Zone

Disconnection of Energy

Acceleration of Energy Infrastructure

Demand Restraint

Release of Energy Buffer Stocks

Additional Energy Impacts

International Cooperation

Energy Export Restrictions

Energy Savings

The Central and Regional Governments are obliged to provide facilities at least in terms of permits, procurement of goods and services, and land acquisition for the implementation of countermeasures.

6

NATURAL DISASTER

In Indonesia

Geographically, Indonesia is an archipelagic country located at the confluence of four tectonic plates (Asian continental plate, Australian continental plate, Indian Ocean plate and the Pacific Ocean plate). In the southern and eastern parts of Indonesia there is a volcanic arc that extends from the Islands of Sumatra - Java - Nusa Tenggara - Sulawesi, the sides of which are old volcanic mountains and lowlands, some of which are dominated by swamps. (NDMA)

This condition has potential to disasters such as

7

DISASTER MITIGATION CONCEPT

In electricity

EMERGENCY ANTICIPATION AND RESPONSE

- Electrical Sector**
 - Recovering electrical systems affected by disasters
 - Prepare personnels who will be assigned
 - Prepare material requirements
 - Organizing technical electricity restoration training for employees
- Logistics & Equipment**
 - Providing facilities, services, materials and equipment
 - Carry out reception, storage, distribution and transportation of logistical assistance and equipment
 - Carry out public kitchen support for Disaster Rescue Team
 - Facilitate health services and medicines
- Operational**
 - Mobilization of personnel and equipment
 - Mapping disaster-affected areas and recommend operational patterns to the Disaster Rescue Team Leader
 - Establish a field command post
 - Report all developments in the disaster management process to the command center

8

STANDARD OPERATIONAL PROCEDURE (SOP) OF EMERGENCY RESPONSE READINESS

Preparedness Stage

- Disaster Identification
- Report to Rescue Team
- Personnel, Network Assets, Movable assets / not

Emergency Response Stage

- Personnel Rescue
- Document Rescue
- Asset Rescue

Rehabilitation & Reconstruction Stage

- Emergency Assistance (Posts, Medicine, Food & clothes, Cooking, kitchen etc.)
- Medical officer
- Search & Locate victims
- Damage Inventory
- Damage Evaluation
- Recovery
- Reconstruction

Pre-disaster Stage

- Map of Disaster Potential Areas
- Natural Disaster Early Warning
- Socialization

Evaluation & Monitoring Stage

- Post rehabilitation & Reconstruction evaluation
- Post-disaster monitoring
- External Communication
- Report to Supervisor/GM

9

MAP OF EARTHQUAKE AND TSUNAMI POTENTIAL AREAS, BANTEN PROVINCE

LENGTH OF BEACH AFFECTED

- Kab. Tangerang: 75,38 Km
- Kab. Lampung Selatan: 66,25 Km
- Kab. Pangajene dan Kab. Selayar: 171,15 Km

TOTAL LENGTH AFFECTED: 312,78 KM

10

PERSONNEL AND EQUIPMENT READINESS BANTEN DISTRIBUTION UNIT

1.369 PERSONNEL

12 PRIORITY STANDBY LOCATION

EQUIPMENT & SUPPORT

58 POST & SUBPOST PLN UID BANTEN LOCATION

UNIT	PERSONNEL	EQUIPMENT	SUPPORT	POST	SUBPOST	PLN	UID	BANTEN	LOCATION
BANTEN SELATAN	20	300	70	1	-	-	1	4	16
BANTEN UTARA	24	262	60	-	-	1	8	-	1
CEROK	1	77	7	1	2	-	2	1	7
CIRUPA	2	112	11	-	1	-	1	5	4
SERPONG	2	141	33	1	4	-	1	5	4
TALUK NUSA	2	149	12	1	1	-	1	3	3
UPID	5	298	34	1	3	-	-	-	4
UID BANTEN	-	-	-	-	-	-	1	-	1
TOTAL	56	1220	197	5	15	3	28	6	40

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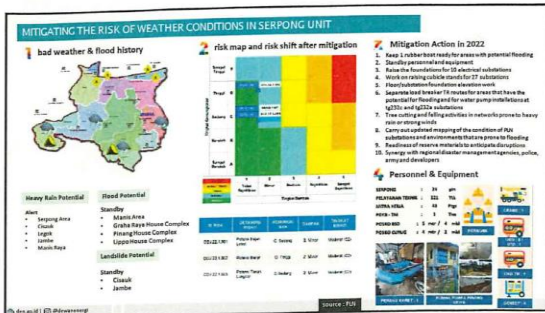
PREVENTIVE EFFORTS FOR ELECTRICAL SECURITY

1. DISASTER PREPAREDNESS TEAM

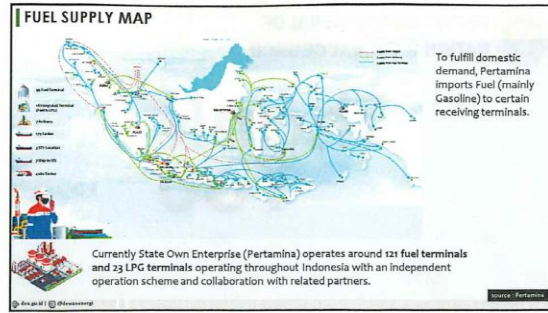
2. MOBILE BACKUP EQUIPMENT

1239 flood alert personnel & 89 flood alert equipment

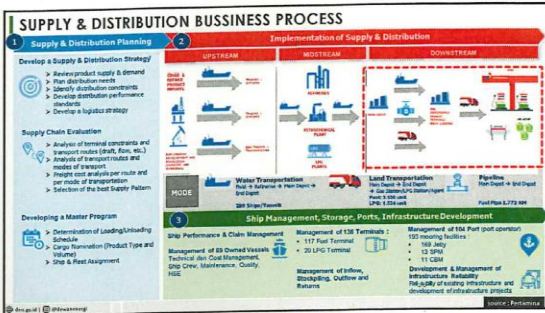
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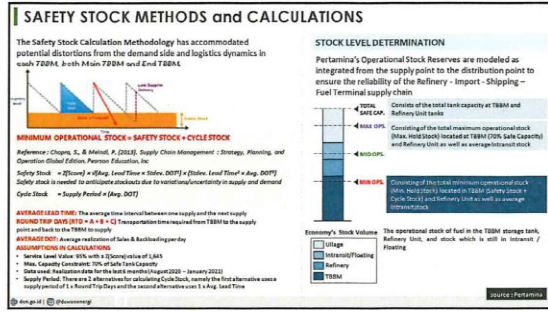
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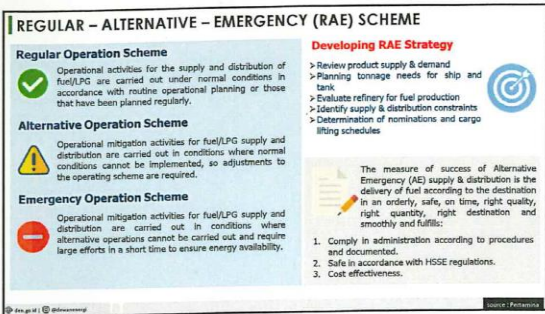
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SECRETARIAT GENERAL OF
NATIONAL ENERGY COUNCIL

**Thank
You**



Thailand case

Dr Nuwong CHOLLACOOP

Director, Low Carbon Energy Research Group, National Energy Technology Center (ENTEC)

EWG 09 2021A
APEC Energy Resiliency Enhancement Project Symposium
Situation and Challenges for Energy Infrastructure Resiliency in Thailand
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1

SDGs | Six Transformations to Achieve SDGs
Sustainable Development Goals
Leave no one behind
Transformation 1: Education, gender and inequality
Transformation 2: Health, well-being and longevity
Transformation 3: Energy decarbonation and sustainable industry
Transformation 4: Circular and decoupling
Transformation 5: Sustainable cities and communities
Transformation 6: Digital revolution for sustainable development

2

COP26 | Global Efforts towards Net Zero Emission & Climate Adaptation
2021 COP26
2016 COP21
2015 Paris Agreement
Net zero and 1.5 degrees
Carbon emissions by 2050
1.5C
Protect ecosystems and habitats
Mobilize finance
Collaboration

3

Energy Resiliency
Addressing SDGs and Enhancing Climate Adaptability
Adapt, Energy Resiliency, Absorb, Recover
7 Affordable and Clean Energy
13 Climate Action
Resilience to address climate change
Mitigating climate change impacts on renewables
Seeking balance

4

Energy Resiliency Assessment
Threat identification -> Impact assessment -> Identification of vulnerabilities -> Assessment of risks and their changes over time -> Identification of resiliency measures

5

Highlights of Energy Resiliency Assessment
Change of risks over time -> fast recovery
Recoverability -> continuous operation & enhanced power quality
Future-focused nature -> enhanced adaptive capacity
Based on experience of stakeholders, complimented by expertise of assessors
Less frequent and shortened down time -> better profitability

6

Energy Resiliency Assessment | Phase I

ON-GRID SOLAR
700 kW Solar Power Plant @CMRU, Chiang Mai

OFF-GRID SOLAR
100 kW Microgrid @Ban Pha Dan, Lamphun

State-owned power plant

Commercial power plant

Rural microgrid

Community plant
4.9 MW Biomass Power Plant @Ban Khao Noi, Phitsanulok
Biogas Plants + 60 kVA Generator @Ban Kham Khaen, Khon Kaen

7

Qualitative Analysis | Climate Adaptability of Solar Power Plants

energies

Approach

Thematic Analysis

Literature

Interview

Triangulation

Observation

Points of Consideration on Climate Adaptation of Solar Power Plants in Thailand: How Climate Change Affects Site Selection, Construction and Operation

8

Climate Adaptation | Solar Power Plant Site Selection

Site selection

Construction & Operation

Damages

Countermeasures

Climate adaptability of solar Power plants also depends on the site selection.

9

Promoting Energy Resilience in ASEAN

Energy Resilience as ASEAN COSTI Priority for 2021

AGENDA ITEM 6. COSTI DIRECTION 2021-2025

6.1 COSTI 2021 ANNUAL PRIORITIES

6.1.4 To implement at least 2 projects addressing the Sustainable Development Goals

- (1) EU-ASEAN Dialogue on Green Technology & Innovation Mapping (Philippines) [10 min]
- (2) Energy Resilience (Thailand) [10 min]
- (3) ASEAN Water Quality Index (Indonesia, Malaysia, Philippines) (tbc) [10 min]

10

Energy Resilience Workshops

1st Workshop

2nd Workshop

3rd Workshop

- 1st Workshop (June 17, 2021)**
 - 23 participants from 5 economies
 - Enhance understanding linkage between energy resiliency and sustainability/climate change
 - Discuss the ways to use energy resiliency to build capacity of energy systems toward climate change adaptation
- 2nd Workshop (September 21, 2021)**
 - 35 participants from 6 economies
 - Increasing awareness and engage national and regional stakeholders
 - Promoting application of energy resiliency in ASEAN energy systems
- 3rd Workshop (May 9, 2022)**
 - 56 participants from 11 economies
 - Leverage efforts of ASEAN and APBC in promoting energy resiliency
 - Promote grassroots activities in order to apply energy resiliency in actual energy systems.

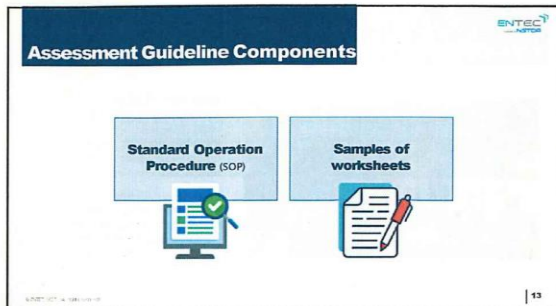
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ASEAN Energy Resilience Assessment Guideline

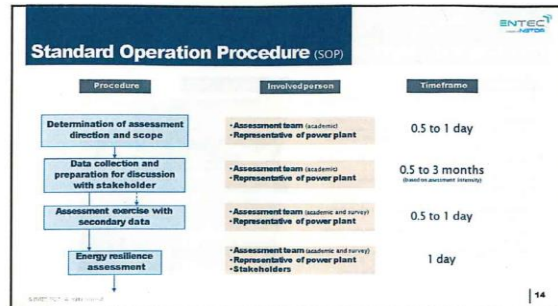
ASEAN Energy Resilience Assessment Guideline

- Endorsed by SCSEI and approved by COSTI at COSTI-82 on October 19, 2022.
- Consists of SOP for energy resilience assessment and materials needed for the assessment.
- Can help induce investment in resilience enhancement of clean energy infrastructure

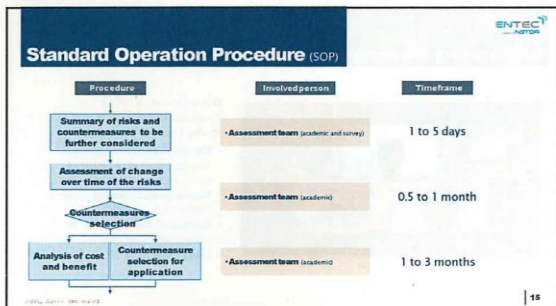
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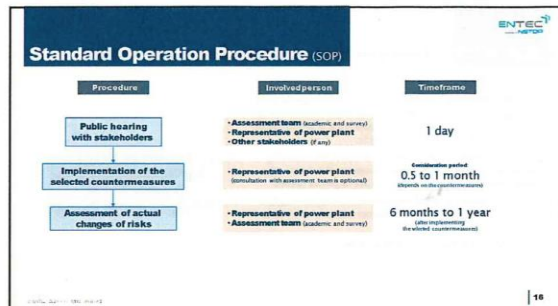
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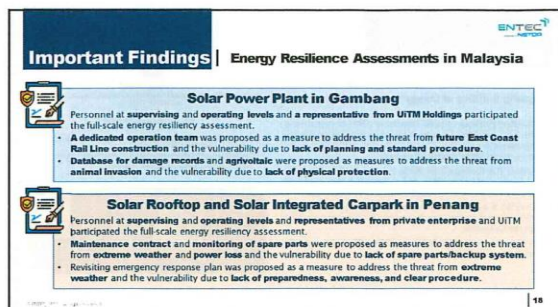
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Meeting with METI and IEEJ | Summary


Meeting Summary

- 14 Sectors in Green Growth Strategy are potential sectors that contribute to carbon neutrality.
- Addressing climate change are not only solving environmental issues, but also opportunities for industries to evolve, where Japan is turning from government-driven approach to private sector-driven approach.
- Solar, wind and hydrogen have potentials in future long-term applications.
- Green Transformation and Clean Energy Strategy serve as general directions for Basic Energy Plan and Green Growth Strategy.
- The Philippines employs energy resiliency as a chapter of national plan to address climate change.
- A matrix of energy resiliency of IEEJ employs multipurpose framework covering various sectors.
- Energy resilience assessment of ENTEC is a bottom-up approach and can be used to motivate users to incorporate the concept.
- Energy resiliency could help address cybersecurity risks.

Meeting with METI



Meeting with METI, APERC and IEEJ



19

ERIA-IEEJ Workshop



Date: April 24, 2024
Venue: Amoma Grand Bangkok Hotel, Bangkok
Participants: ERIA, IEEJ, ENTEC, Government agencies and private sector in Thailand

- Discussion on **energy resilience index of IEEJ**
- Sharing of **energy resilience assessment** from ENTEC
- Active discussion session

20

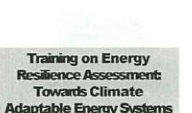
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JICA TCTP | Training on Energy Resilience Assessment in ASEAN

- Conduct training to build capacity of AMs in performing energy resilience assessment based on the ASEAN Energy Resilience Assessment Guideline through a JICA-supported project and other upcoming projects.
- Reflect the findings from AMs to account for diversity of local context in AMs and to broaden the scope of the Guideline to cover multiple types of power plants.
- Develop a case for pilot assessment to further engage AMs in performing energy resilience assessment based on the Guideline.
- Encourage cross-sectoral collaboration on energy resilience with SOME


Training on Energy Resilience Assessment: Towards Climate Adaptable Energy Systems



21

21

Preparatory Meeting with JICA and TICA



Date: October 6, 2023
Participants: JICA, TICA, ENTEC
Mode: Online

- Partial financial support for the capacity building event confirmed.
- Scope, period, timing roughly confirmed.
- Record of discussion to be signed on November 9, 2023.
- Long-term plan discussed.

22

22

2024 COSTI Priority


Capacity Building of Energy Resilience Assessment

- Conduct training to build capacity of AMs in performing energy resilience assessment based on the ASEAN Energy Resilience Assessment Guideline through a JICA-supported project and other upcoming projects.
- Reflect the findings from AMs to account for diversity of local context in AMs and to broaden the scope of the Guideline to cover multiple types of power plants.
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SUMMARY REPORT
THE 4TH MEETING OF THE ASEAN COMMITTEE ON SCIENCE, TECHNOLOGY AND INNOVATION (ACSTI-AS)
 20-21 June 2023, Manila Declaration

8.3.5 Will implement the ASEAN Energy Resilience Assessment Guideline: Capacity Building on Energy Resilience Assessment

72. The Meeting endorsed the request and the proposed deliverable: Studies by Thailand, which is the implementation of capacity building on Energy Resilience Assessment by annual Priorities 2024. Further details activities appear in [ENRRI-24](#)



23

23

Thank You

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24

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Appendix 4 Site Visit

The Workshop participants (four Speakers, 12 Active Participants, three APERC staff and three IEEJ staff) visit Stanford University Central Energy Facility (CEF) as a self-guided tour on 10 November 2023.

The CEF is one of the integral parts of the “Stanford Energy System Innovations Project”. The CEF has an equipment which transforms vapor into hot water and recovers heat, In addition to a substation in order to provide a whole area of Stanford University’s campus with high-efficient heat energy. The CEF reduces 80% of greenhouse gas emissions and 20% of water consumption.

The high voltage substation has a capacity of 100mVA, which is equivalent to two-folds of electricity demand in the university campus. The high voltage substation reduces 60kV power supplied by Pacific Gas and Electric Company (PG&E) through grid transmission network into 12kV power, and supplies to the university campus. More than 100 emergency power generations supply power for lighting, elevators, safety devices, and so forth.

Hot water and cold-water distribution equipment supplies hot water and cold water depending on season and temperature 20-mile-long pipeline. The CEF recycles water and reuses waste heat. The CEF supplies 90% of heat demand of the university campus.