



Features of system efficiency in centralized energy supply systems in the Russian Federation

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RUSSIA IS A WORLD LEADER IN HYDROCARBON RESERVES, PRODUCTION AND EXPORT OF ENERGY RESOURCES, HYDROPOWER AND NUCLEAR ENERGY

SELF-SUFFICIENCY IN PROVIDING NATURAL RESOURCES

10% world primary energy production **5%** world primary energy consumption **≈20%** volume of carbon energy trade

DEVELOPED ENERGY INFRASTRUCTURE

- Unified Energy Russian system
- Unified system gas supply
- Large-scale operation of small-scale energy facilities
- Main pipeline system for transportation of oil and petroleum products
- Trunk system and distribution heating networks
- Diversified fuel and energy complex. Environmentally friendly (low-carbon) fuel and energy balance.

11% global volume oil exports and petroleum products

25% global volume gas exports

16% global volume coal exports

38% of electricity generation comes from nuclear power, hydropower and other renewable energy sources

47% of electricity generation comes from natural gas

District heating in the Russian Federation

The annual Report on the state of thermal energy and district heating in the Russian Federation was developed based on official statistical data from Rosstat, industry reports from the Russian Ministry of Energy, as well as information from other federal executive bodies of the Russian Federation and other official documents.

The report is published in accordance with the order of the Government of the Russian Federation dated 15.11.2012 No. AD-P9-107pr.

Final heat consumption

V 2024 year 1,175.7 million Gcal

498.2 Industry

468.0 Population

Number of heat supply sources in the central heating system in 2024

74,4 thousand heating plants
3,079 units > 20 Gcal/h

374 cogeneration
units from 500 kW

Number of organizations

in 2023 18,8 thousand units

73%

State
and municipal

27%

Private and others

Length of heating networks in 2-pipe calculation

in 2024 167,19 thousand km

124.75

diameter less than 200
mm

42.4

diameter 200 mm or
more

ОТЧЕТ

о состоянии
теплоэнергетики
и централизованного
теплоснабжения
в Российской Федерации
в 2024 году

Москва, 2024

Federal Law 190-FZ "On Heat Supply" provides:

- ensuring energy efficiency of heat supply and consumption of thermal energy
- ensuring the priority use of combined generation of electrical and thermal energy for the organization of heat supply and etc.

Federal Law 261-FZ "On Energy Saving and on Improving Energy Efficiency..." provides:

- development and implementation of energy saving programmes
- energy resource accounting
- specifics of establishing prices (tariffs) and etc.



Strategic Direction for the Digital Transformation of the Construction and Housing and Communal Services Industries of the Russian Federation until 2030 (**Order of the Government of the Russian Federation No. 398-r dated March 2, 2026**)



The introduction of modern information and digital technologies based on the Internet of Things (IoT) and technologies incorporating artificial intelligence (AI), as well as digital products and services, to meet the needs of residents, raise the standards of safety and comfort of the living environment, and develop service models through the application of smart solutions.



Investments in heat supply in the Russian Federation

Investments in heat supply

in 2024 320.0 billion rubles

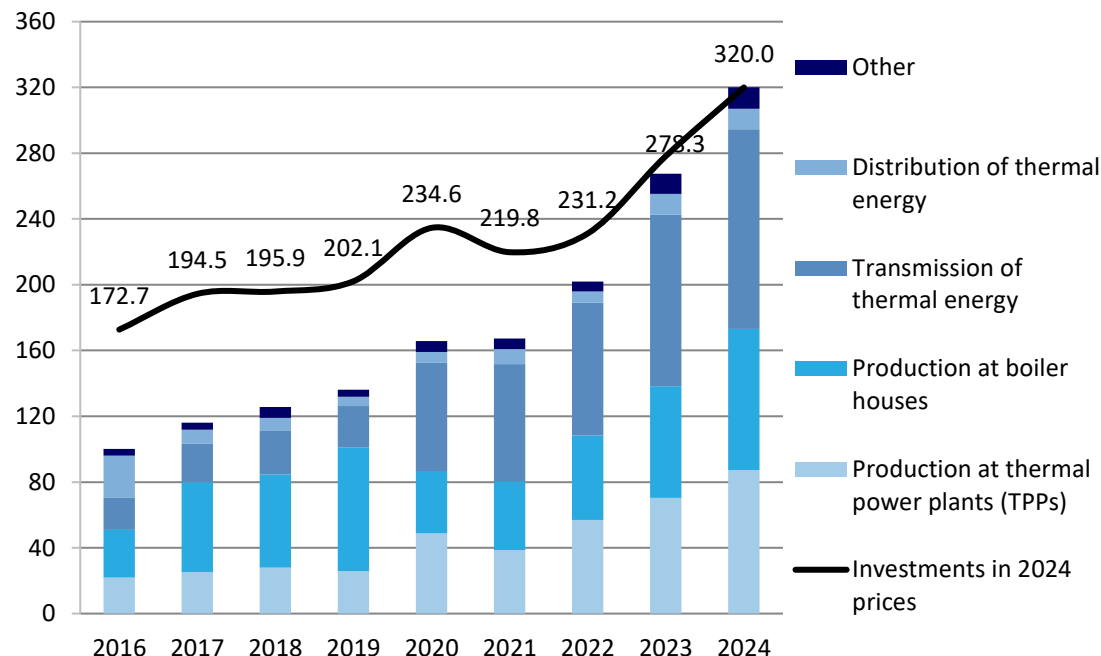
175.2
Production

121.4
Transport

At the end of 2024, **1,416 concession agreements** with investment obligations totaling 477.6 billion rubles were in effect in the heat supply sector.

Energy service contracts are also used for the reconstruction of heat-generating capacities, but is much less common due to financial and tariff risks.

Investments in fixed capital in centralized heat supply by type of activity, billion rubles.



Digital transformation of heat supply

- **Digitalization of heat supply schemes:** new requirements for schemes will be introduced from 2025
- **Unified monitoring system**
- **Reducing the administrative burden:** implementing data exchange standards and creating a single window for reporting by fuel and energy sector organizations

Heat supply schemes and energy saving programs

Heat supply schemes are the main document for the long-term development of the heat supply system of a municipality.

Energy saving programs include: optimization of heating systems, modernization of equipment, implementation of new technologies and reduction of fuel costs

Digital twins and electronic models

- automatic calculation of optimal modes
- predicting system behavior and warning about possible malfunctions
- real-time fuel and efficiency monitoring
- planning repairs based on the actual equipment service life

GOST R 57700.37-2021 "Computer Models and Simulation. Digital Twins of Products" lays the terminological foundation and distinguishes full-fledged digital twins from static models and visualizations.

Digital fuel and energy balance (FEB)

Fuel and energy balances **contain interconnected indicators quantitative conformity** extraction, transportation, supply of fuel and energy resources and their consumption, set **distribution fuel and energy resources** between systems **supply of** fuel and energy resources, **consumers** (groups consumers) of fuel and energy resources and determine **efficiency use fuel and energy resources**.

Digital Fuel and Energy Balance is a platform solution for generating actual and forecast fuel and energy balances with the ability to decompose them into regional and municipal management levels.

An example of energy conservation and construction of residential buildings using distributed energy and renewable energy sources

In the construction of **the SberCity** residential complex a number of innovative and energy-efficient solutions were used

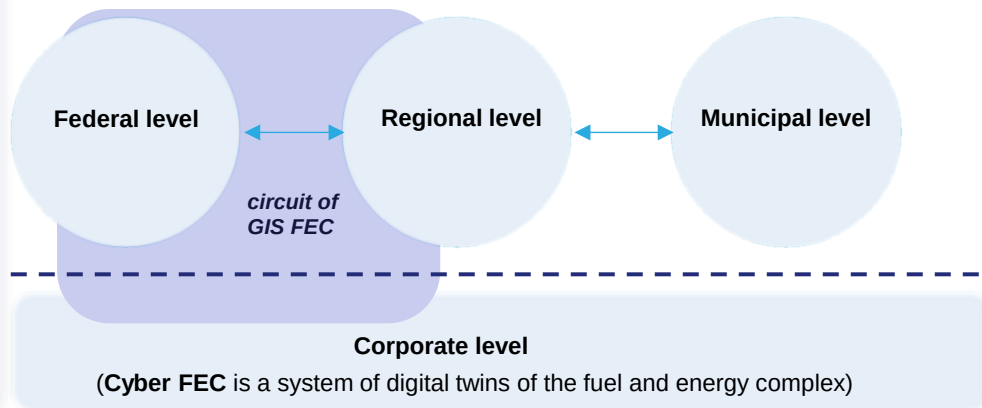
MicroGrid	Distributed generation system	Energy management
These include: • energy storage systems • photovoltaic modules • electric charging stations. Effects: • uninterruptible power supply for the building's critical infrastructure • reducing the risks of energy complex overload • Ensuring a balance of power and electricity consumption during peak hours	80 natural gas power plants on the upper floors of buildings are managed from a single center. The energy complex fosters environmental responsibility and allows for: • reduce natural gas consumption by 53% by 2030, • reduce heat losses in networks by 70%, • reduce CO2 emissions by 165 thousand tons	• Energy centers and the entire energy complex are controlled by AI from a single Energy Management Center • dynamic determination of heat, cold and electricity needs using energy modeling and regulation of heating equipment • For each building, a digital twin and a digital energy model have been created and are regularly updated.



DATA IS THE BASIS

- ✓ An up-to-date array of related data on the functioning and development forecast of the fuel and energy complex
- ✓ **Data sources: State Information System (GIS) and Information Systems of Federal Executive Authorities** (including the Ministry of Energy of Russia, Rosstat, the Ministry of Economic Development of Russia, the Federal Customs Service of Russia, the Federal Antimonopoly Service of Russia, the Federal Tax Service of Russia, etc.), **Information Systems of Fuel and Energy Complex Companies**

DIGITAL FUEL AND ENERGY BALANCE



USERS



Government
of Russia



Ministry of Energy
of Russia



Other
federal executive
authorities



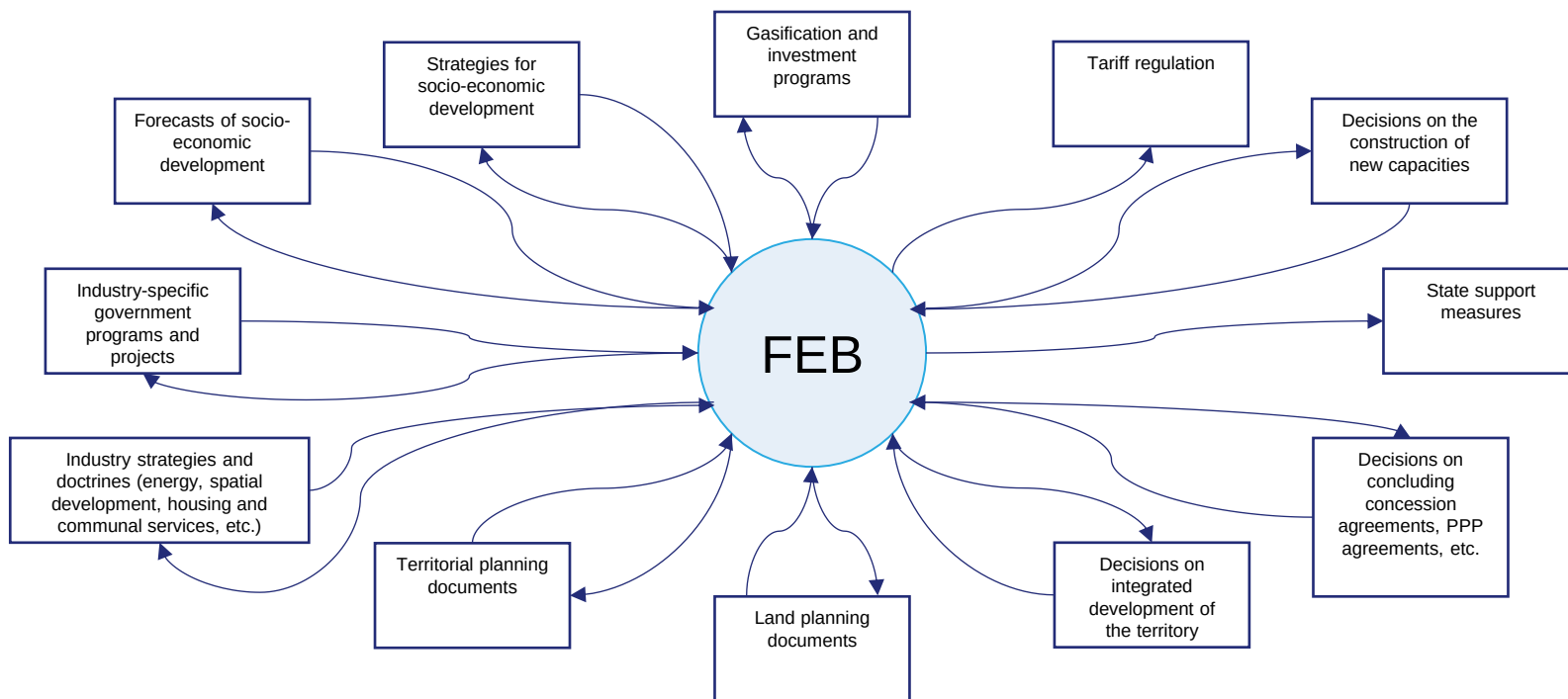
Subjects of the Russian
Federation and
municipalities

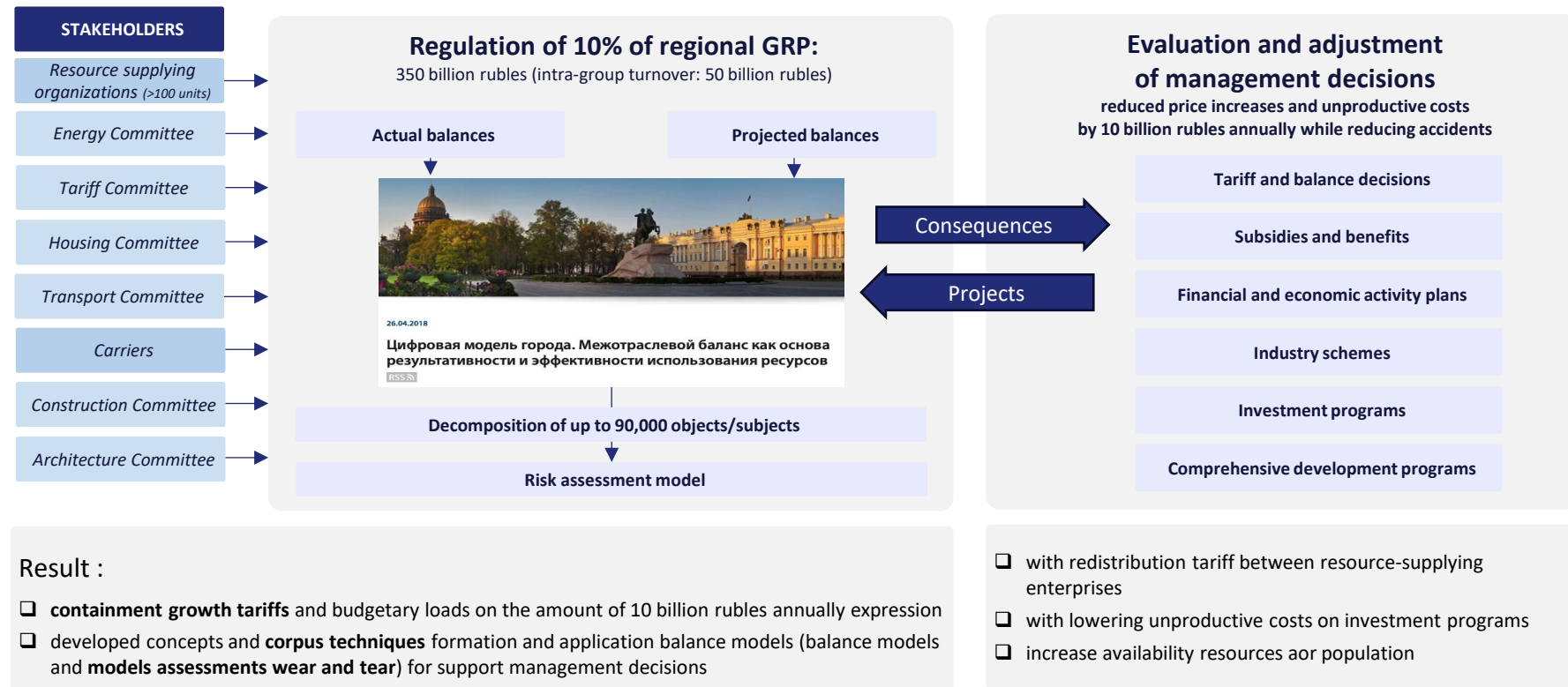


Fuel and energy
companies



Scientific and expert
community





1. Advanced calculations and verification

- A prototype of a digital platform for verifying the fuel and energy balance of Russian regions has been developed.
- A three-circuit structure of fuel cell has been introduced:
 - natural indicators (tons, cubic meters, Gcal, etc.);
 - energy equivalent (TJ, kW*h);
 - **valuation** (rubles)
- The energy balance is linked to the inter-industry balance (IIB) to assess the energy intensity of the economy, the factor causes and potential for its reduction

2. Thematic applied models

- A unified model has been developed for calculating the substitution of energy sources for natural gas by region, with an assessment of investment and tariff consequences.
- A model **for assessing the impact of** external economic shocks, including the ban on imports of petroleum products, on the economy and **inflation has been developed** (a tool for stress testing the economy through the TEB).

3. Groundwork for the restoration of interregional flows

- Work has begun to restore interregional fuel and energy flows, including the import/export of energy resources between regions. Such statistics are not officially kept, but they are critical for balancing the energy balance.

Ontological and analytical base

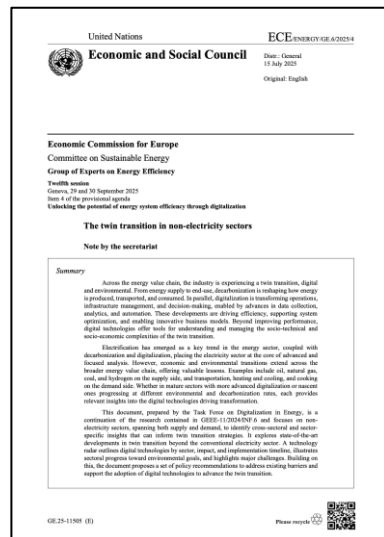
Modeling scenario conditions



International cooperation in the field of energy system efficiency



Group of Experts on Energy Efficiency of the United Nations Economic Commission for Europe



The twin transition
in non-electricity
sectors, 2025



Fostering interoperability and open-
source solutions to accelerate the
digital transformation of the energy
System, 2025



Governance policy of digitalization
in the energy sector, 2024

New documents 2026

- Aligning Data Centers and Large Loads Growth with Grid Resilience
- Financing Digital Transformation in the Energy Sector. Energy Transition Finance
- Digitalisation, Social Sustainability and Equitable Energy for All

Features of System Efficiency in Centralized Energy Supply Systems in the Russian Federation

1. **Centralized** energy supply systems (electricity and heat supply) dominate, with particular attention paid to the development of cogeneration and energy supply to isolated territories.
2. **The classical tools** for ensuring the efficiency and reliability for heat supply systems (heat supply schemes and energy saving programs) are being complemented by information models, digital twins, and AI-based control systems.
3. **The directions** for digitalization of housing and communal services, including the heat and power sector, have been directly determined by the Government of the Russian Federation.
4. **Special attention** is given to the formation of digital fuel and energy balances at the municipal, regional, and national levels.
5. **Digital fuel and energy balances** can serve as an element of system efficiency and as a foundation for developing development strategies and forecasts, making decisions on the implementation of investment projects and tariff decisions.

Suggestions for APEC



Suggestions for APEC

1. **Continue studying** the experience of APEC economics in the field of **system efficiency in centralized energy supply systems**
 2. **To form a description of cases** with best practices for improving **the system efficiency of centralized power supply systems**
 3. **Develop interaction with** expert groups on energy efficiency issues of other international organizations.
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Thanks for your attention !

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