Comprehensive Approach to Efficient Use of Natural Gas and Other Fuel and Energy Resources in Development of Projects of Power Deliveries to Regions

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1. Introduction

High energy inensity of the Russian economy and increased cost of fuel and energy resources have motivated the main goal of the state policy in the field of energy production and consumption. At the current stage, it consists in major increase of FER use efficience and consequential reduction of energy intensity of the gross domestic product (GDP), which is one of the conditions for steady development of the economy.
The main ways to achieve the objective is to reduce specific energy consumption and minimize energy losses, create and execute large-scale implementaion of energy-efficient technologies.

The energy sector is also targeted to conversion from raw-exports to the innovative development scenario, implementation of energy-saving technological potential, and reduction of the FEC share in GDP of the country (The Energy Strategy of Russia till Year 2030). A most important task consists in efficient use of natural gas, the purest fossil nonrenewable fuel and energy resource, which current share in the balance of primary energy resources exceeds 50% for the country in general.

JSC "Gazprom promgaz" is the leading center of JSC «Gazprom» in the field of regional energy-engineering, gas disribution systems and gas deliveries to regions. There the General Projects of Gas Supplies and Gasification of Regions, regional energy strategies, programs for development of power-engineering, energy-saving and improved efficiency of FER use in regions are worked out. The solutions for development of regional gas supply systems are coordinated with other industrial energy supply systems, the required volumes of gas supplies to gas-distribution networks – with the capacities of trunk gas-lines and the integrated gas supply system (IGSS).

At present, regional power-engineering is one of the main directions of JSC "Gazprom promgaz" operations, which development is addressed in elaboration of regional energy strategies, power-engineering development programs, comprehensive projects of power deliveries to regions, programs of improved efficiency of FER use in regions, heat and power deliveries projects.

2. Objectives

The report presents data concerning development of Comprehensive Projects of Power Deliveries to RF constituents, other regions and large cities, which main objectives include:

- satisfaction of the developing economy's demand for fuel and energy in the course of congruent innovative development of regional power, heat and gas supply systems;
- increased energy efficiency of fuel and energy resources' production, transportation and consumption;
- improved energy security of the region and reliable power supplies to consumers;
- abatement of the technological environmental impact of power engineering.

3. Methods

The methodological basis of the work is the systems power engineering studies that are developed in JSC «Gazprom promgaz» in the regional context (figure 1) to allow taking into account the specificity of the particular region's economy and power engineering, assess the technical and economic indices of the resource base and real opportunities of cost-efficient energy- and resource-saving.

The approach under development consists in comprehensive integrated analysis of regional energy supply (gas, power, heat supply etc.) systems, identification of the forecasted demand for heat, power, gas and other FER by establishing regional FEB and accounting, on this basis, the limitations for different FER and their substitutability. In the course of the forecasted FEB efforts, rational involvement of local fossil and renewable energy resources in the regional energy consumption is determined, the possibility of FER import from other regions or, vice versa, their export from that region is taken into account, improved energy security is elaborated.

Energy supplies to the region are regarded as conjunction of numerous subjects of regional energy markets including detailed analysis of the actual condition of energy supply systems and particular FER users and producers, regional problems and other local aspects.

A key component of the works is a comprehensive examination of energy saving and imporoved efficiency of use of gas and other FER along the whole chain of their production, transport and consumption and all stages of solution development and implementation – from Master Plans and Strategies to particular investment programs. Improved efficiency of FER use is treated as an essential factor of successful development of the regional economy and energy saving – as an additional energy source, an alternative to development of new fields, erection of new generating capacities and energy transport systems.

Taking into account the external energy connections with other regions, electric power system (EPS) and IGSS, as well as external conditions fixed in the Energy Strategy of Russia, Master Plans for development of energy sectors and other federal and regional documents allows developing the optimal energy supply patterns minimizing counter energy streams and total cost of energy saving.

The general decision-making flow chart (figure 2) for development of regional fuel and energy saving systems comprises seven basic functional stages.

Stage 1 begins with the analysis and assessment of the RF constituent's economic condition, existing strategies and programs of its development, possible future directions of development. Considerable uncertainty of future conditions, a great number of factors make it expedient to apply the approach of scenarios, according to which social and economic development scenarios for the target period are created together with corresponding dynamics of macroeconomic measures (population size, industrial produce volumes, construction volumes, GRP structure and volume).

At stage 2 based on the analysis of energy supply and consumption systems' condition, possibilities of upgrading the functioning systems and using energy-efficient technologies and equipment in their development with regard to improved efficiency of end use of FER, the following is determined:

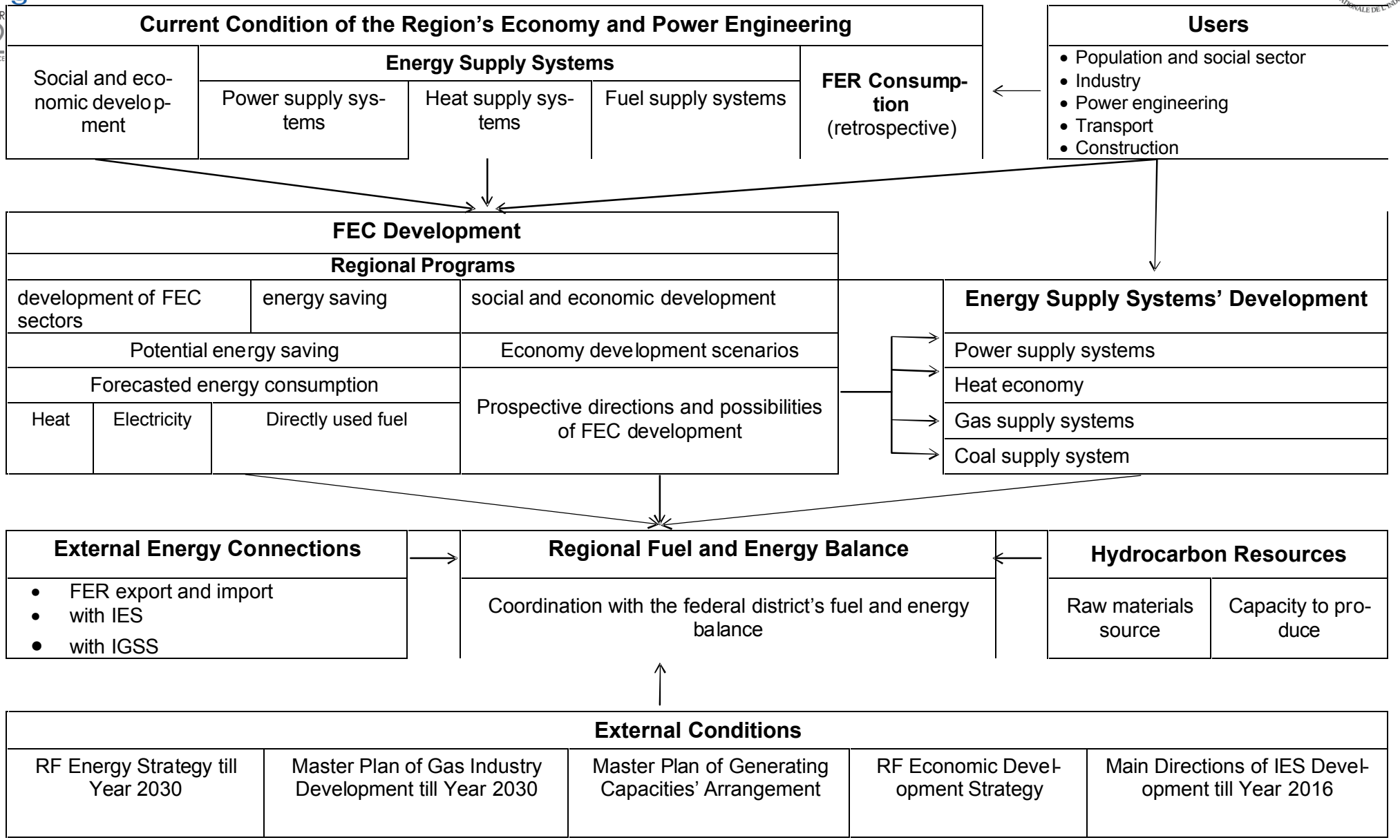

Figure 1 – Methodology of comprehensive solutions of power deliveries to RF regions

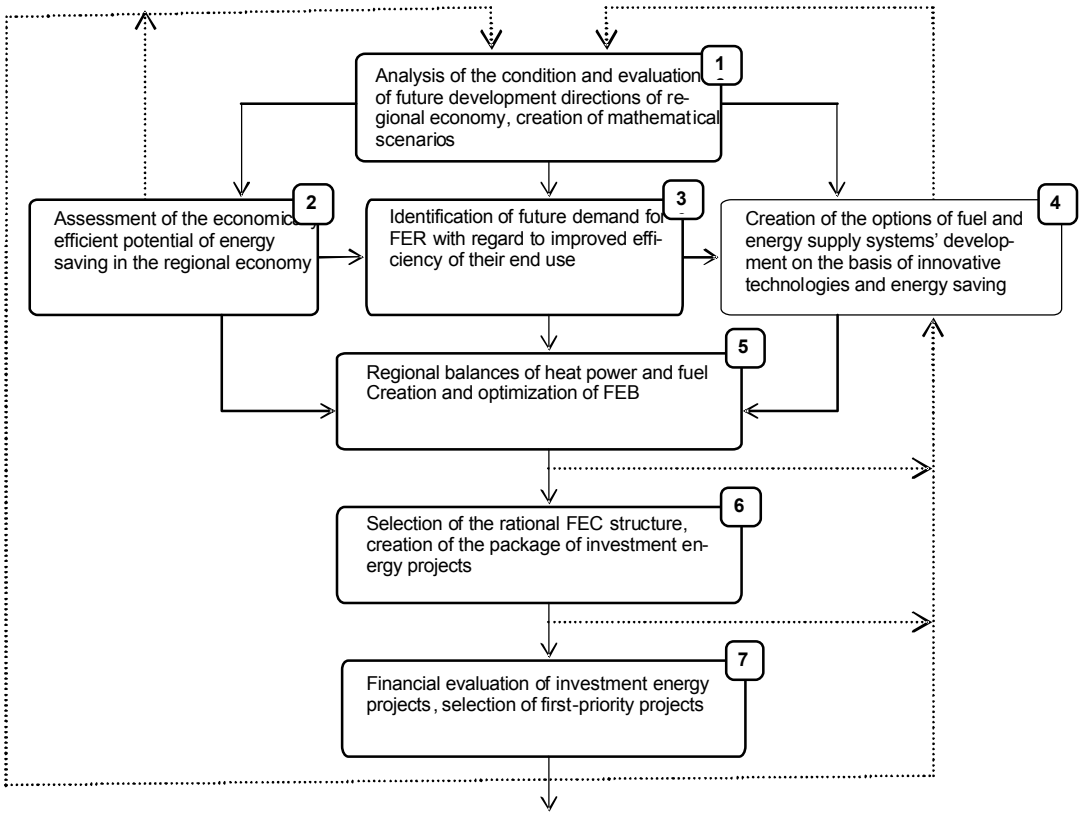

Figure 2 – General decision-making flow chart

- forecasted dynamics of specific fuel power and heat consumption for manufacture of various industrial products, fuel for generation of heat and electricity, heat for heating and hot water supply;
- economically efficient potential of energy saving in fuel and energy supply systems and regional economy sectors.

Stage 3 consists in forecasting the dynamics of the level and structure of heat power and directly used fuel consumption by regional economy sectors with regard to improved efficiency of FER use.

At stage 4 options are created for the development of heat and power sources, power and heat networks, gas and coal supply systems, based on innovative technologies and energy saving; the directions of the region's export and import policy are also determined.

Stage 5 includes development of regional balances of power and heat, boiler and furnace fuel, motor fuel, creation of possible options of the regional fuel and energy balance with its subsequent optimization. Thus, the rational structure of forecasted FEB by target time spans and volumes of forecasted demand for natural gas and other FER are determined by their uses coordinated with specific plans for development of economic and power engineering facilities, situation in the regional energy markets and possibilities of developing regional energy supply systems.

At stage 6, on the basis of comprehensive evaluation of the options of power deliveries to the regions, a rational structure of FEC is selected and a package of investment energy projects for the target time span.

Stage 7 is the financial evaluation and selection of priority projects for implementation.

The scientific and methodological base required for comprehensive solutions of developing power deliveries to RF regions includes concepts, methods, algorithms, software packages, information databases.

4. Results

The represented approach is widely used in practice in the development of regional energy strategies, power engineering development programs, programs of improved efficiency of FER use, comprehensive plans of power deliveries to regions, plans of heat and power deliveries to regions and large cities. The following has been developed on its basis:

- Master plans of gas deliveries and gasification of more than 70 RF constituents.
- Comprehensive power engineering development programs of the Astrakhan, Tomsk, Kaluga, Sverdlovsk Regions, the Republics of Komi, Mordovia and other RF constituents.
- The program of energy supply and fuel deliveries to the Komi Republic for years 2004–2010 and till year 2020.
- The energy strategies of the Astrakhan, Tomsk, Kaluga, Irkutsk Regions, the Krasnodar Territory till year 2020.
- The energy strategies of Moscow and the Altai Territory till year 2025.
- The master plan of power deliveries to Moscow.
- The program of energy saving in the Vologda Region for years 2011-2015 and for the future period till year 2020.

4.1. In the development of Master Plans of gas deliveries to and gasification of the regions of Russia (figure 3), the first stage involves comprehensive analysis of power deliveries and fuel supply to the region within the specified time span and the forecasted demand for gas balanced with the demand for other FER with regard to improved efficiency of FER use and energy saving is determined. The decisions on the development of regional gas supply systems are made with regard to development of other energy supply systems of the region to ensure FER saving, more rational structure of the regional fuel and energy balance, reduced total cost of power deliveries to the region.

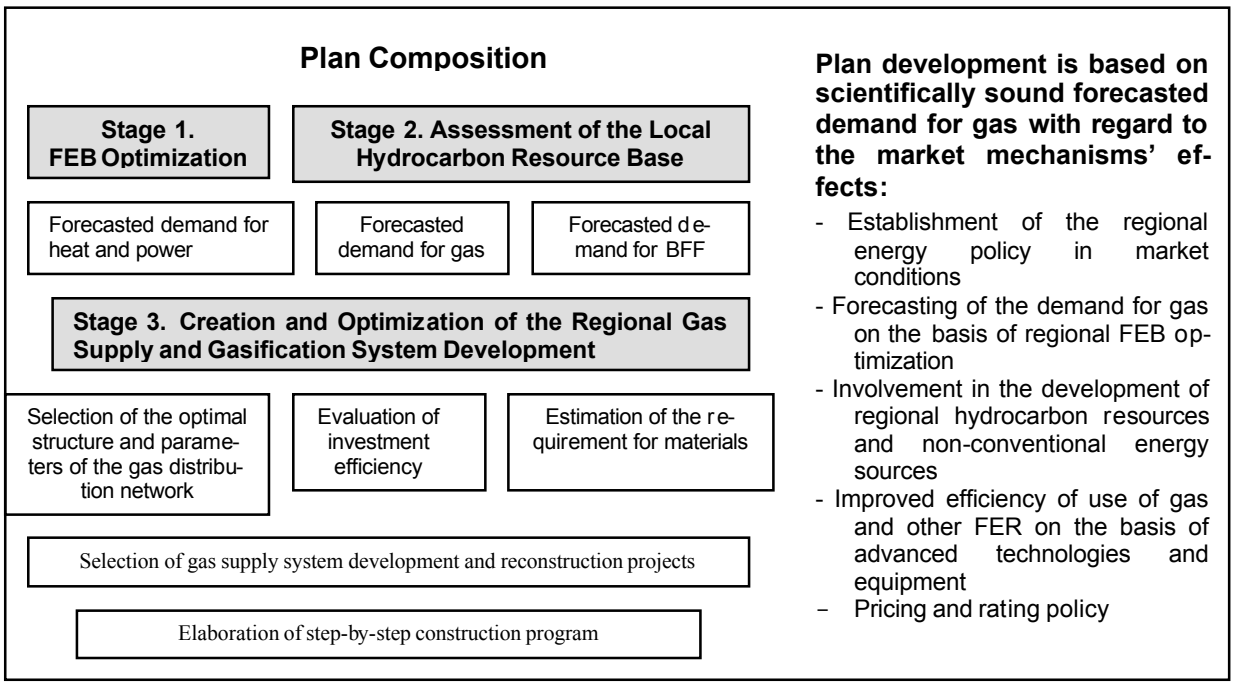

Figure 3 – Development of Master Plans of gas deliveries to and gasification of Russian regions

For instance, thanks to use of innovative technologies for generation of heat and electricity and cost-efficient energy-saving measures as well as involvement of local gas fields in the regional balance, the required volumes of future gas deliveries to the Krasnodar Territory

from northern fields have been reduced compared to the achieved figures in spite of total growth of fuel consumption.
In the present-day situation characterized by a great number of participants in the regional energy markets, frequently uncoordinated decisions on development and modernization of systems, commission of RF constituents to electrical power self-balance, elaboration of regional energy strategies and programs is an important mechanism of regulation and coordination of power supply systems' development.

4.2. Regional energy strategies determine the main directions of mutually agreed future development of regional FEC sectors. In each region, particular problems of energy economy development are resolved. The problems that are usually common for all regions are those of accounting and accommodating the interests of numerous subjects of relations in regional power engineering: power, heat and fuel suppliers, regional and local authorities, major fuel and energy users, investors, public organizations.
For instance, the main purpose of developing the Energy Strategy of the Tomsk Region consisted in finding a compromise between oil industry, nuclear industry, JSC «Vostokgazprom», power industry, housing and utilities (figure 4).

Objectives

- Accommodate interests of FER users and producers
- Ensure reliable power deliveries
- Coordinate energy saving programs
- Accumulate and distribute the money

Main Solutions

- GTTPP running on associated petroleum gas to the total capacity of 67MW
- Mini TPP to the total capacity of 131MW
- TTP-3 development on the basis of CCGT-450
- Production of 6-7bln. m^3 of gas
- Development of nuclear power – after 2020

Adopted by decree of the Head of Tomsk Region Administration of 09.07.2002, No.288-r

Figure 4 – The Energy Strategy of the Tomsk Region till Year 2020

Development of the Energy Strategy of the Astrakhan Region, where gas accounts for 90% of the fuel balance, was aimed mainly at improved efficiency of gas use in all sectors of the regional economy and higher reliability of power deliveries to users.

4.3. In the comprehensive development of the Moscow Energy Supply Master Plan till Year 2020 (figure 5), the first stage consisted in development of the Energy Strategy of the city defining the energy policy priorities, development directions of FEC sectors, requirements to elaboration and development of sectoral plans as Strategy implementation mechanisms (figure 6).

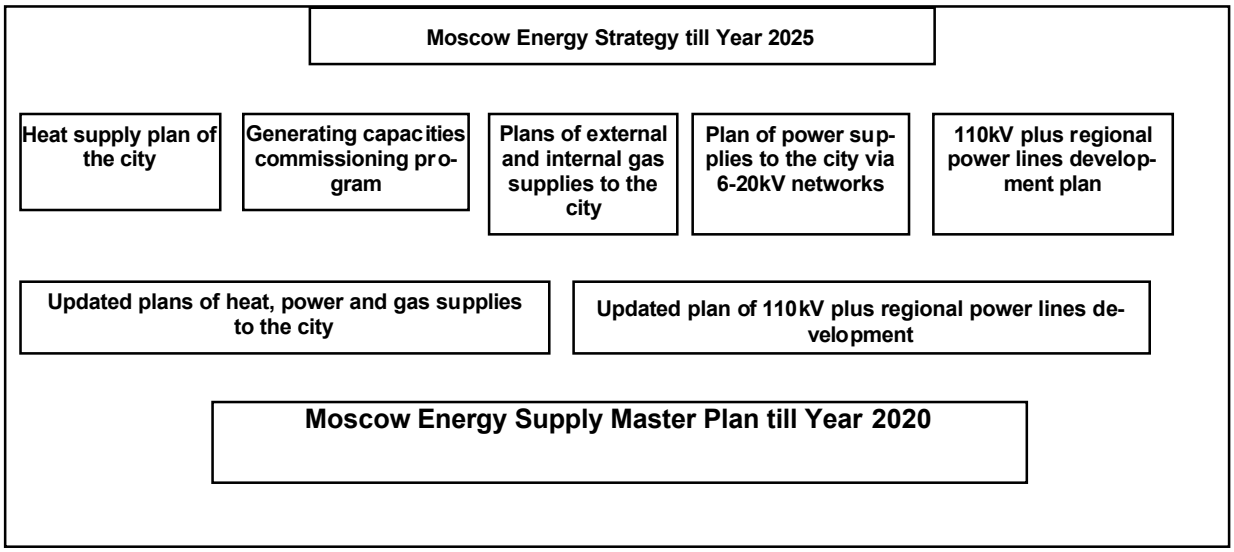

Figure 5 – Development of the Moscow Energy Supply Master Plan

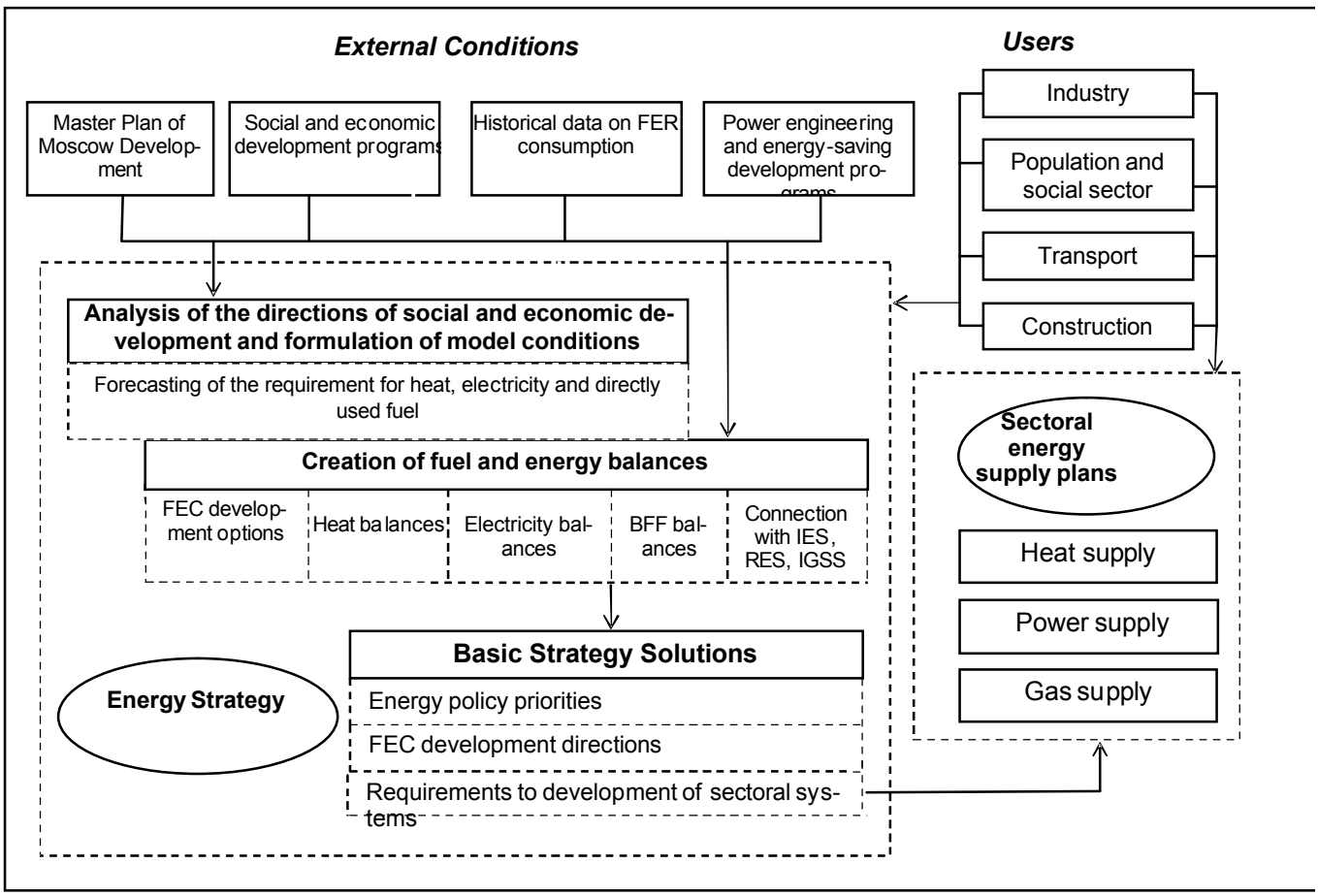

Figure 6 – Development of the Moscow Energy Strategy

The Strategy determined TTP heat and power co-generation on the basis of modern technologies as the strategic direction of FEC development, the technical policy's priorities being refurbishment and development of the functioning power plants using dual-purpose CCGT units and creation of CCGT TTP on the basis of district boiler houses .

Within the Energy Strategy frameworks, on the basis of integrated information environment, the heat supply plan of the city including the generation capacities commissioning program, the plans of power supply of the city using 110-750kV and 6-20kV networks, the plans of external and internal gas deliveries to the city have been developed. The efforts resulted in coordination of the development of heat and power generating capacities, heat sources and heat networks, power generating capacities and 110-750kV, 110-750kV, and 6-20kV power lines, gas deliveries to the city with trunk gas transport system.

The Moscow Energy Supply Master Plan till Year 2020 gives the updated volumes of energy and gas consumption by the city within the target time span and consistent solutions towards development of fuel and energy supply systems. Coordinated FEC development will ensure the required dynamics of the social and economic development of the city.

The proposals on the city's FEC development contained in the Energy Strategy are aimed at:

- maximal reduction of TPP condensing power generation and excessive power generation within the city;
- reduction of counter flows of natural gas and power between Moscow and the Moscow Region;
- ensuring reliable and stable gas deliveries in the context of single-fuel balance of the city;
- improved efficiency of FER use and reduced specific energy intensity of GRP.

Subject to active energy-saving policy, by 2020 heat and gas consumption in the city will remain stable at the current level (2010-2011), specific fuel consumption by power generation will decrease by на 36-40 g eq. f./kW. By 2020 GRP energy intensity of Moscow will be reduced by 46-53% vs. 2007 (figure 7).

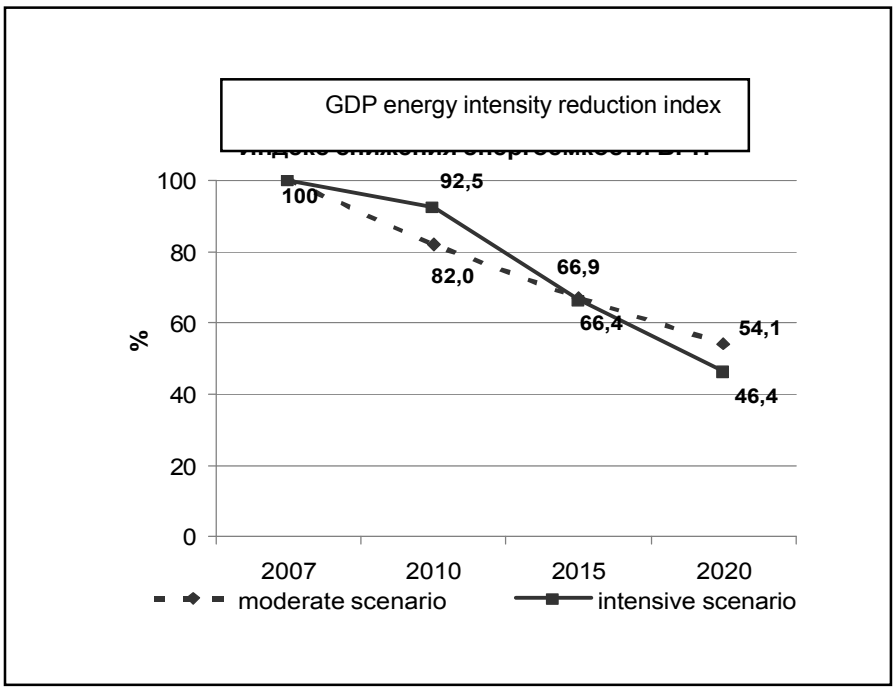

Figure 7 – Reduction of the city GRP energy intensity

Basic Energy-Saving Measures
FER consumption
– Implementation of the Program of Energy-Saving in Energy Resources Consumption
– Construction of new buildings with more stringent requirements to insulation
Heat transport and distribution
– Reduction of heat losses in heat networks
– Automation of heating units
Heat and power generation
– Organization of joint work of TPP with boiler houses including switching of DHU summer users to TPP
– Construction of GTO and CCGT Units

4.4. The measures envisaged in long-term target-oriented program «Energy-Saving in the Vologda Region in 2011-2015 and for the Future Period till Year 2020» provide improved efficiency of FER use in the Region and result in saving in 2011 -2015 of 4.8bln. cub. m of natural gas, 7.9bln. kW-hr of electricity, and 13mln. Gcal of heat. During 2016 -2020 the saving will amount to 13.3 bln. cub. m of natural gas, 21.7bln. kW-hr of electricity, and 37mln. Gcal of heat.

As a result, with 1.5-1.9-fold GRP growth since 2011 till 2020, the demand for energy resources will increase 1.08 – 1.13 times and specific energy intensity of GRP will decrease by 27- 40%.

5. Conclusions

Solving of the regions' energy-saving tasks with the help of this approach allows identifying the reasoned demand for gas and other types of FER according to real capabilities of each region's economy and power-engineering development, including specific measures of utilizing the energy-saving economic potential and directions towards increased efficiency of FER usage.

This enables an appraisal of the directions of rational use of natural gas and other energy resources and reduced energy intensity of GRP. A wide implementation of the suggested approach will drastically facilitate achievement of the objective of the state energy consumption policy of reducing GDP energy intensity by 40% in 2020 vs. 2007 and the targeted reduction of FEC share in the economy from 30.7% in 2006 till 18% in 2030 as per the Russian Energy Strategy.