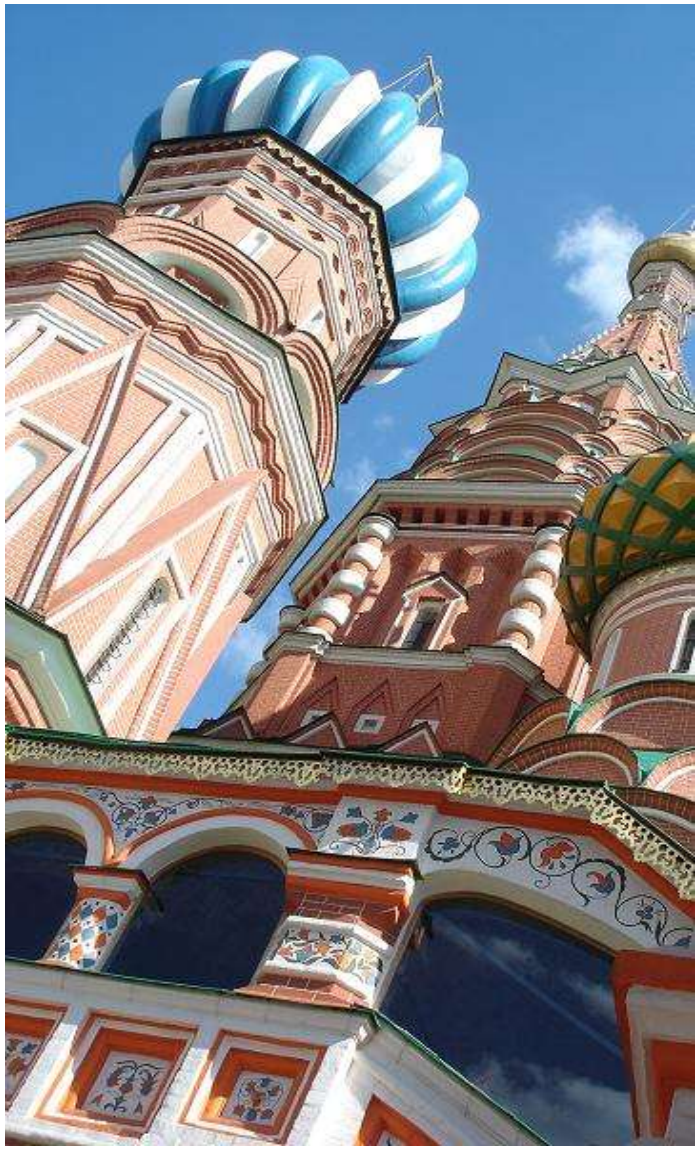

Strategy of the Russian energy sector development with its implication for the technologies

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Japan, February 2011

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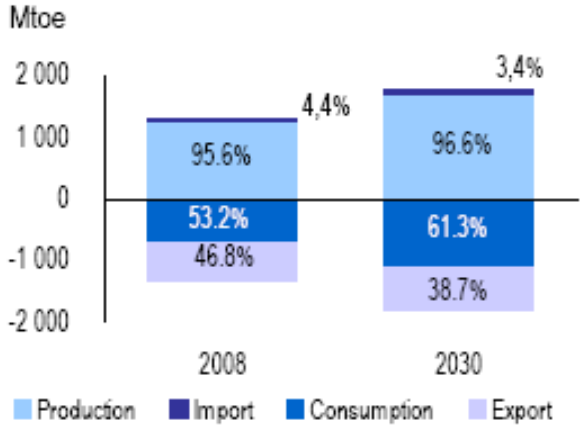
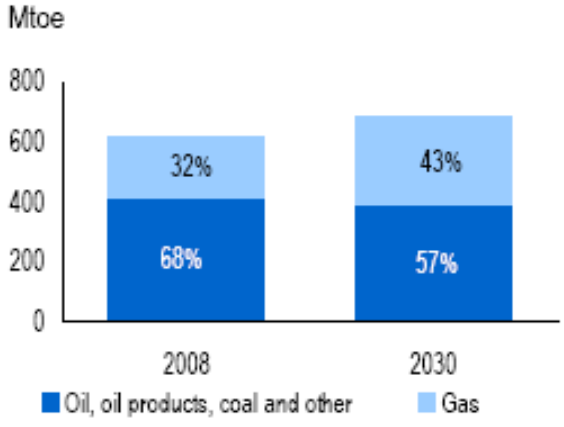
Energy Strategy 2030 in the system of Russian documents on the strategic development

Main priorities of the New Energy Strategy

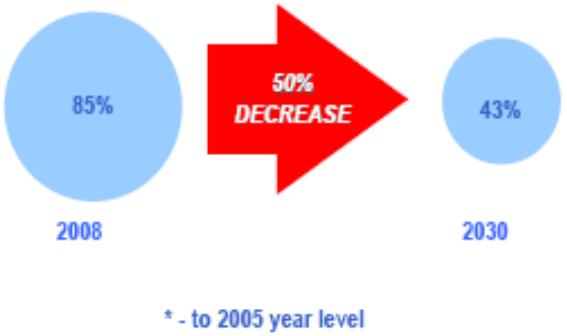
Primary Energy Resources



Energy Resources Export



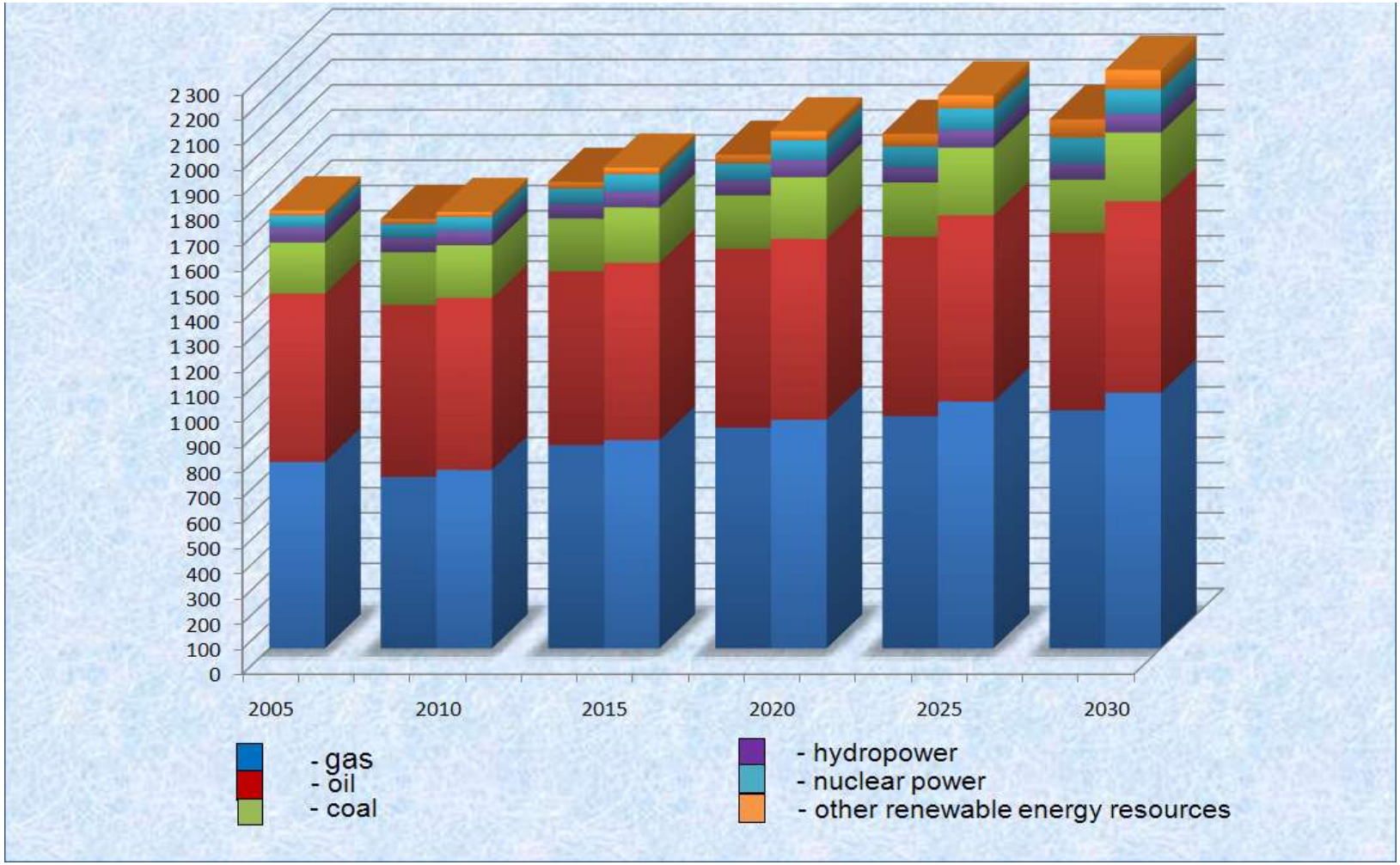
GDP Energy Intensity*



Total Final Consumption

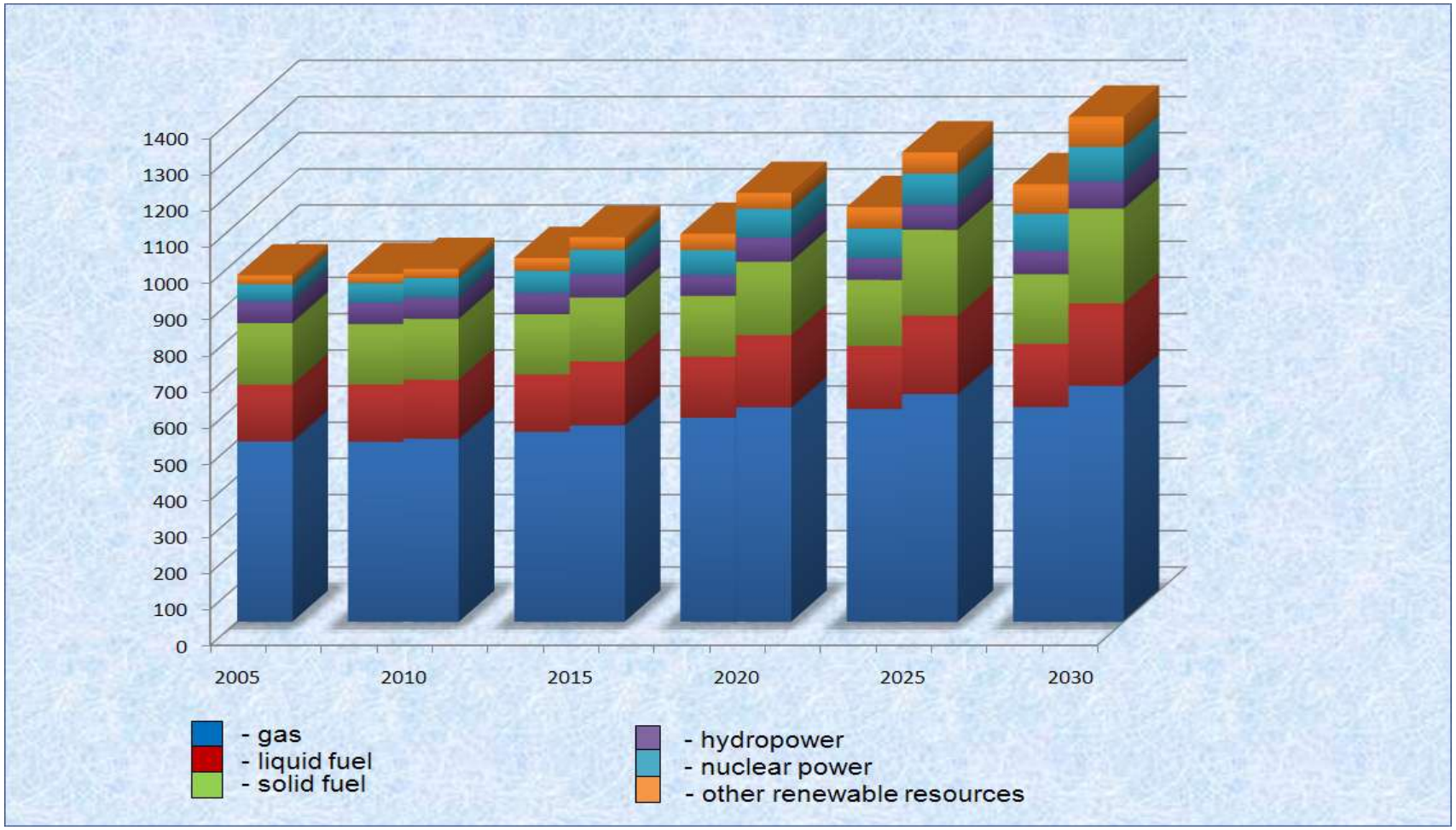
Source: Energy Strategy of Russia 2030

Primary energy production forecast, mln. tce



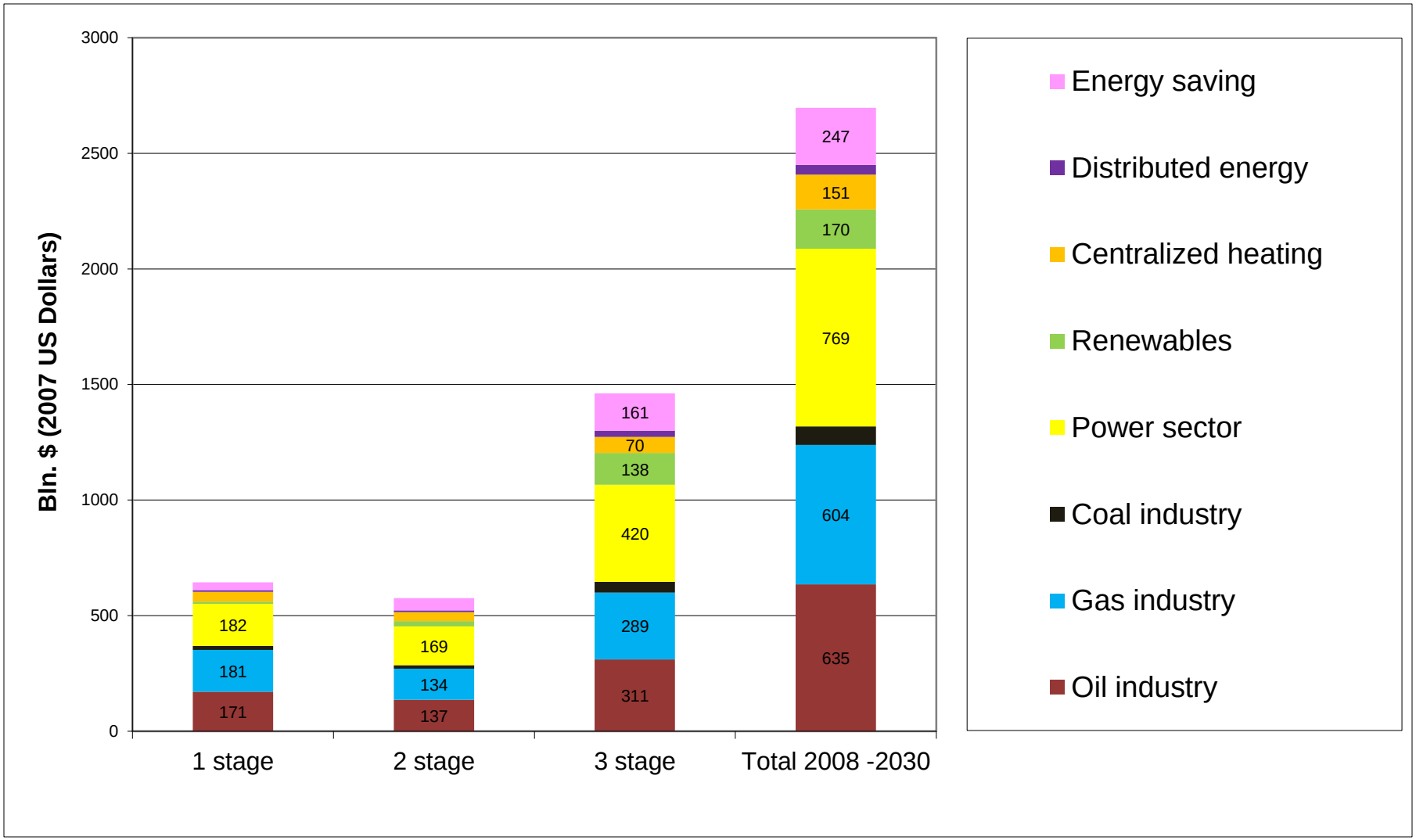
By 2030 Russian energy production should increase by 25-30% compared to 2005.

Primary energy consumption, mln. tce



The share of natural gas within overall energy consumption will fall from 52% to 47-49% in 2030; liquid fuel – from 16.3 to 14.5-16%. The share of solid fuel will remain at 15-16% and the share of non-fuel resources will grow from 13.8 to 18-21%.

Investment needs of the Russian energy sector-1



Investment needs of the Russian energy sector-2

- Capital investment in the development of the energy sector necessary to satisfy energy demand are 2,3-2,7 trillion US Dollars by 2030
- It means annually – about 3.6-3.7% of the GDP. They will fall from the current 4-5% to 3% of GDP by 2026-2030. However, worldwide the burden of the energy sector on the economy (1.5% of GDP) is 2.5 times less.
- The main investment sources are: own capital of the energy companies, their profits and loans. Development of nuclear, hydro will be financed by the state, as well as some particular projects in specific regions where energy companies need state support.
- Major investments are required for the traditional sectors:
  - 24-32% of the investment requirements are for the power sector
  - 22-26% for the oil sector
  - 21-24% for the gas industry
  - 3% for the coal industry

Major strategic initiatives of the Russian State in the energy sector

- Development and regional diversification of the energy transportation infrastructure
- Creation of the new oil and gas complexes in the Eastern part of the country
- Development of the oil and gas reserves in Arctic and Northern regions of the RF
- Development of the non-fossil energy
- Energy saving

Development and regional diversification of the energy transportation infrastructure-pipelines

OIL

BPS-2 – 50 mtpa – $4 bln.

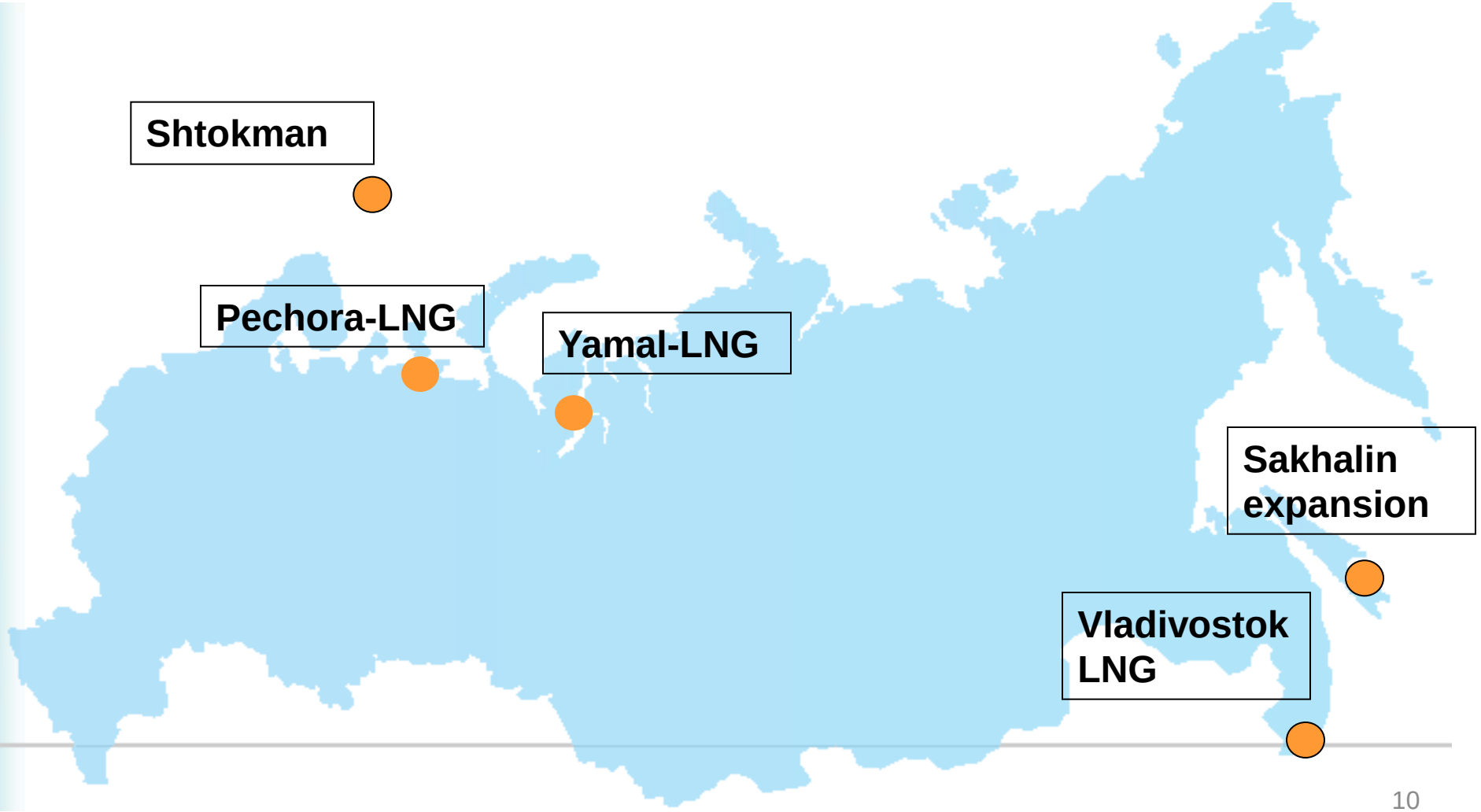
ESPO – 80 mtpa – $23,5 bln.

NATURAL GAS

Nord Stream – 55 bcma – €11 bln.

South Stream – 31 bcma – €25 bln.

Development and regional diversification of the energy transportation infrastructure-LNG



Shtokman

- Phase one - 23.7 bcm annual output planned, distribution between LNG and pipeline volumes is not defined yet
- In June 2008, construction of the first semi-submersible drilling platform started at the Vyborg Shipbuilding Plant
- Situation on the export market does not favor the project. Now waiting for results of the study with regards to shale gas and in conjunction with these findings the Shtokman Development Company will make its decision on LNG (it will also depend on gas price forecasts and the government`s willingness to provide support for the project).
- The final investment decision is planned on the pipeline gas for March 2011, and on LNG before the end of 2011, it will hinge upon oil and gas price forecasts and the government`s willingness to provide support for the project.
- On February 2010 the Shtokman partners decided to delay the startup of the project by three years, with the first pipeline gas expected in 2016 and first LNG production in 2017.

Yamal-LNG

Yuzhno-Tambeyskoye field on Yamal

Source: Novatek

- Project is designed to produce 15 mt of LNG per annum
- 18.06.10 Gazprom and Novatek signed a cooperation agreement. The Agreement determines the major parameters for interaction between Gazprom and Novatek in implementing the project for LNG facilities construction based on the Yuzhno-Tambeyskoye field, as well as the infrastructure creation and subsequent utilization on the Yamal Peninsula. The parties identified the Yuzhno-Tambeyskoye field as the basis for the pilot LNG project on Yamal.
- A long-term Agency Agreement was also signed today between Gazprom export and Yamal LNG stipulating for LNG exports from the Yuzhno-Tambeyskoye field.
- Novatek has established “Novatek Gas and power” in Geneva to start marketing of the future LNG
- The future supplies will be splited between North American market (10%), Asia Pacific market (10% - only 3 month per annum) and North Europe
- Many technological challenges, first of all on LNG transportation in the ice conditions.

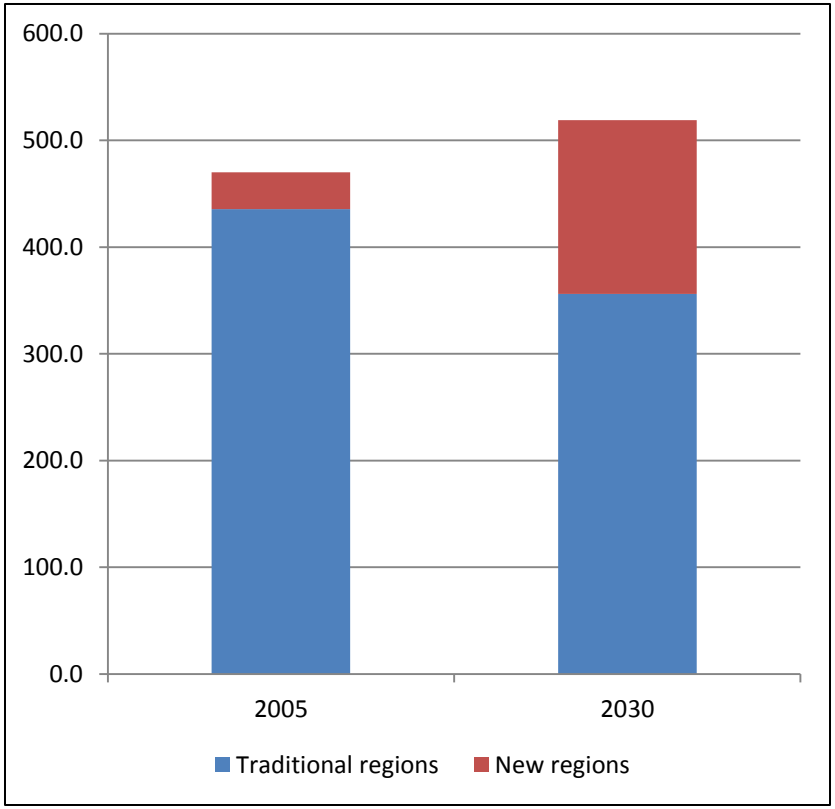
Creation of the new oil and gas complexes in the Eastern part of the country

Oil and gas exploration, production, transportation – investment needs about $90 bln.

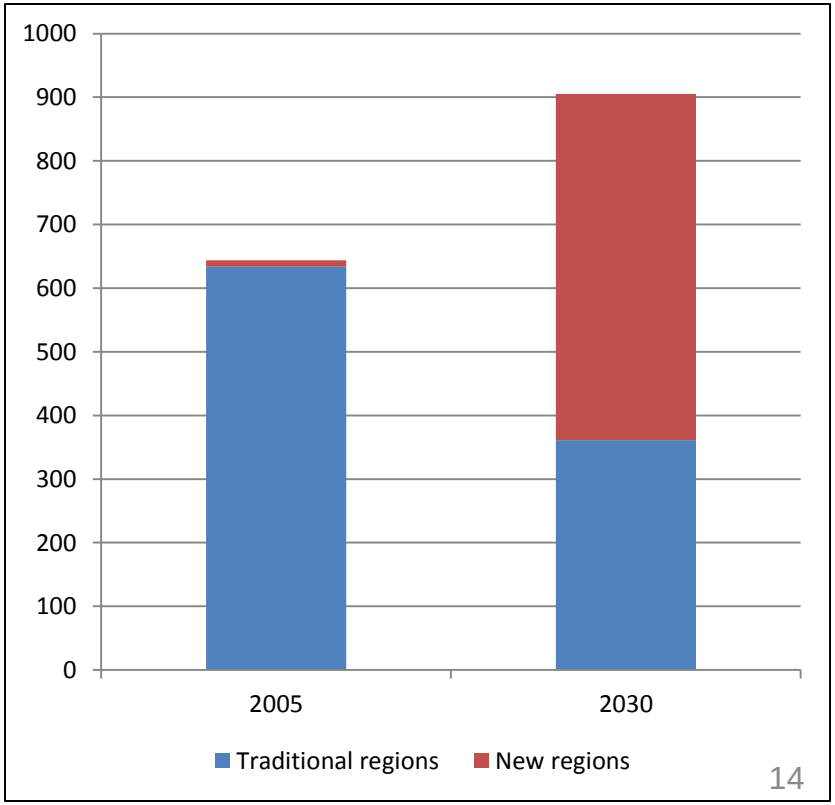
Development of the oil and gas reserves in Arctic and Northern regions of the RF

One of the priorities of the ES-2030 is “Providing efficient international cooperation on risky and challenging projects in Russia (including off-shore projects in Arctic)”. By 2030 the share of foreign direct investments in total investments in the Russian energy sector should be at least 12%.

Oil production by the region, mtpa



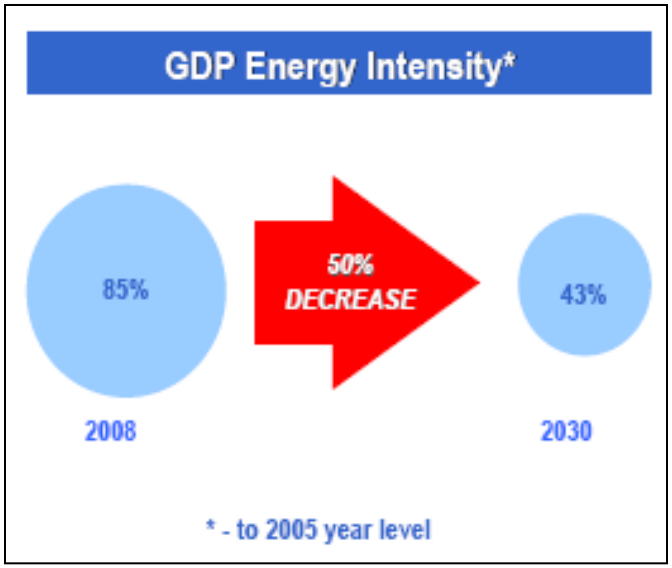
Gas production by the region, bcma

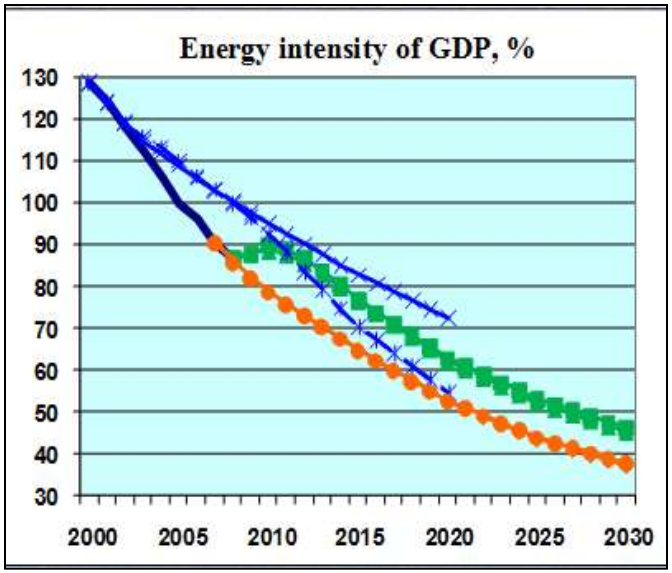


Non-fossil energy development

- Nuclear Programme carried out by Rosatom is extremely ambitious, aiming at increasing generating capacities by 43 GWh by 2030 (compared to 25 Gwh in 2009). Investment needs until 2030 are estimated at $100-140 bln.
- RusHydro planned capacity additions are more modest – 12 Gwh by 2030 (compared to installed 47 Gwh in 2009). Depending on the scenario of economic development (and thus electricity demand in the Eastern part of Russia, where the main hydro potential is located) investment needs are approximately $55 – 125 bln.
- The Russian renewable energy sector is still very small, and as such should not be overestimated. Some steps forward have been taken, especially in the field of wind power, and the Russian Ministry of Energy has begun preparing a draft regulation to increase tariffs on traditional electricity generation and invest the proceeds in alternative energy sources. The state hopes this measure will ensure that the share of alternative energy will grow from 0,5% of electricity production currently up to 4,5%. It remains to be seen however whether increasing electricity tariffs during an economic downturn will be politically feasible. There has been also increased interest in the potential of geothermal power, as well as bio-fuel produced from wood, which is a particularly appropriate technology for Russian conditions. It should be noted however that most of these projects are of a very small scale.

Energy saving



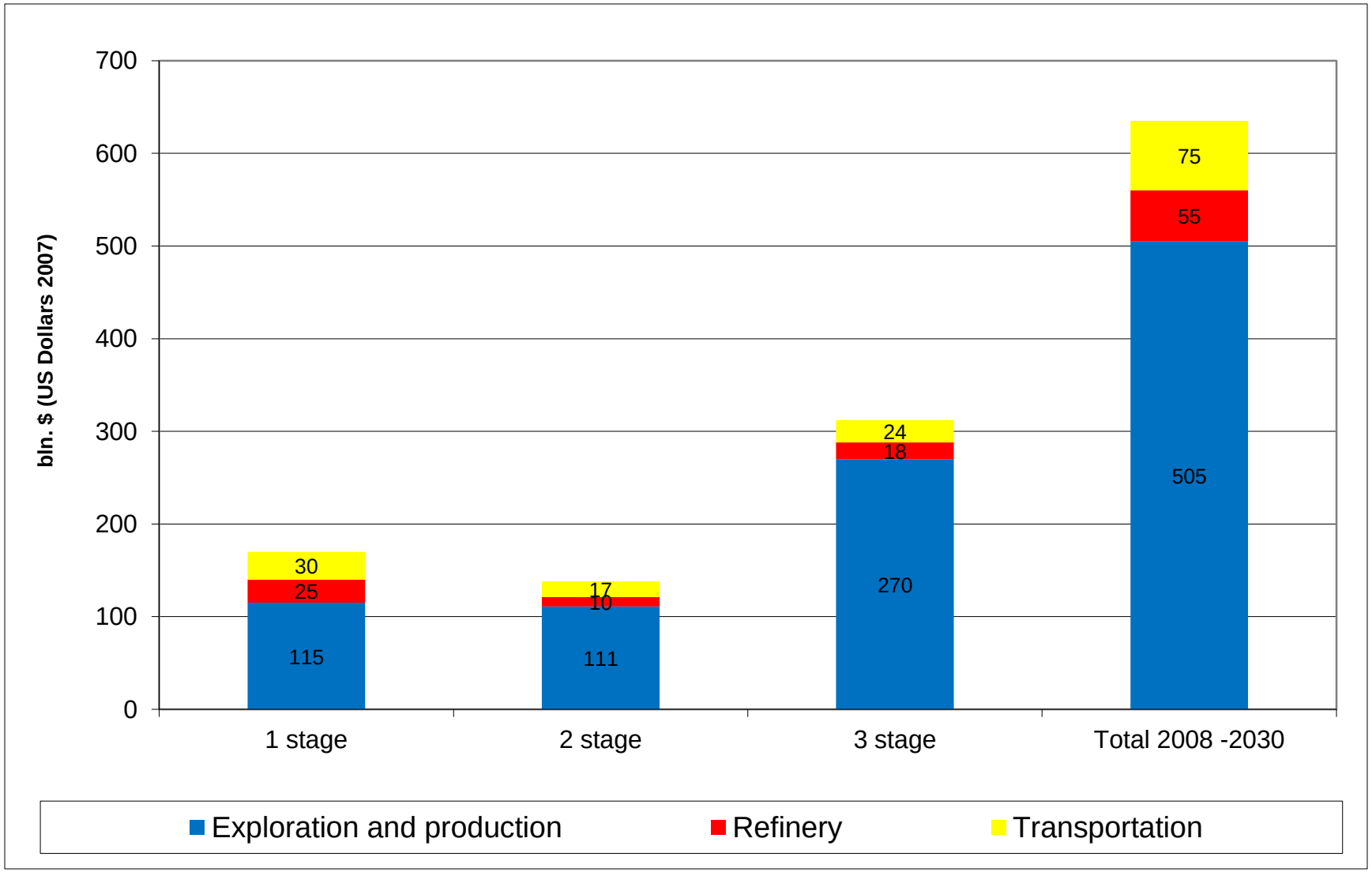


- There is an enormous energy saving potential in Russia – up to 45% of the current primary energy consumption, which could save 240 bcma of gas, 340 bln. kWh, 90 mtpa of coal and 45 mtpa of oil and oil products
- There are many declarations and legislative initiatives, but no working mechanisms
- In the low price environment there are no incentives to save energy
- The crisis will prompt an increase in GDP energy intensity for the next 2-3 years (in 2000-08 it went down by 32%).
- Total investments necessary in energy saving in order to achieve ES-2030 goal of 50% GDP energy intensity reduction are estimated at the level of $211-282 bln.

Current key technologies in Russia

- new efficient methods of mineral exploration, including exploration on the continental shelf
- technologies to process associated petroleum gas
- technologies to produce synthetic liquid fuels from natural gas, coal and biomass
- technologies to develop oil fields with low-permeability structures, high-viscosity oil, and oil bitumen
- technologies for extraction and industrial use of coal-bed methane
- advanced technologies and new types of electric equipment for transmission, distribution and consumption of electricity
- energy and transport units running on alternative fuels
- range of heat and power plants (mini heat and power plants) of modular type
- energy-saving and environmentally friendly lighting appliances of a new generation, using LED and mercury-free gas-discharge lamps
- technological bases for rapid diagnosis of electric equipment
- technological bases for heat supply systems of new generation ensuring a significant reduction in energy loss
- technological solutions for capture and burial of carbon dioxide using modern combustion technologies
- technologies and equipment using low-potential geothermal resources.

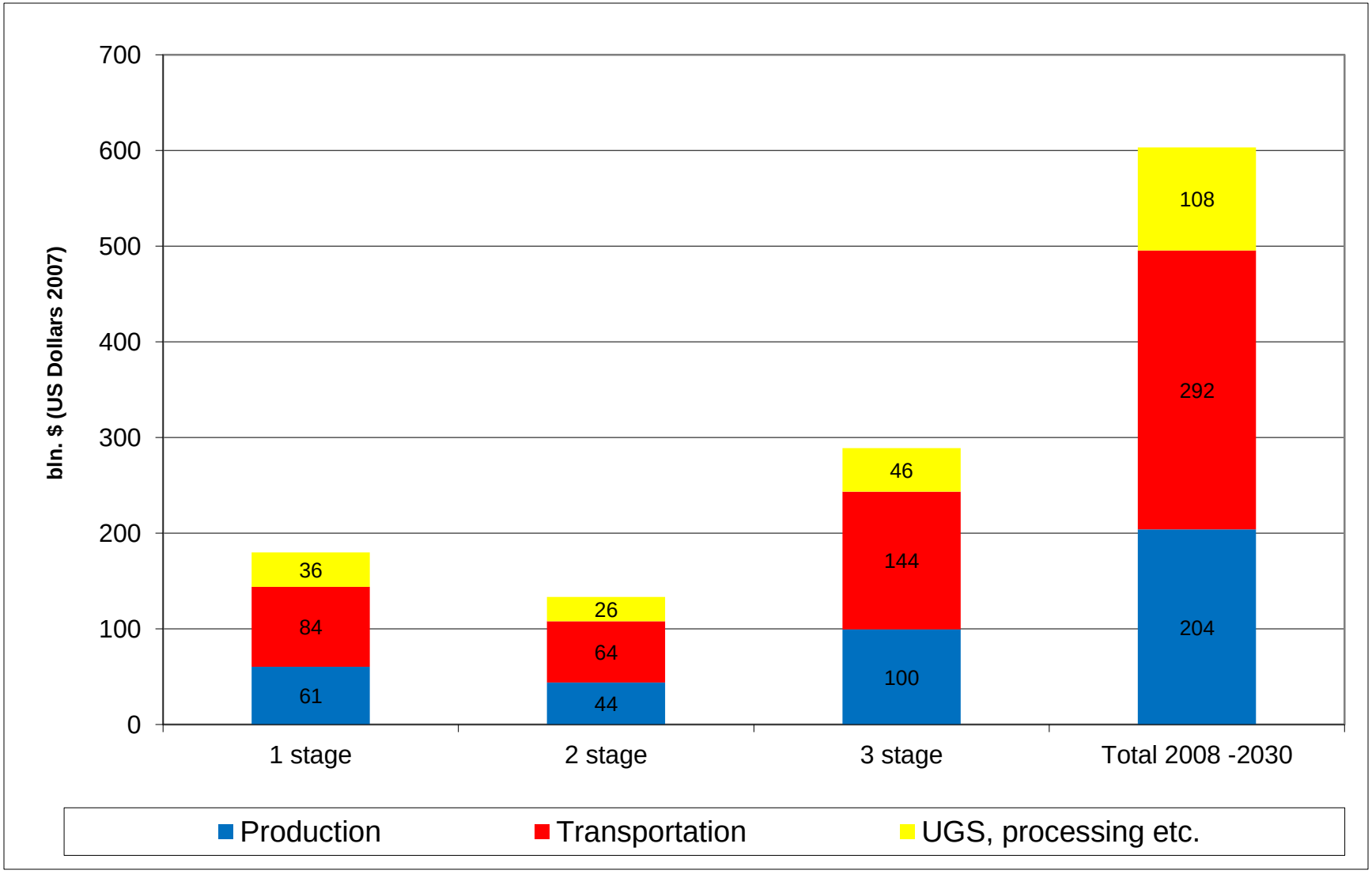
Oil sector investment needs



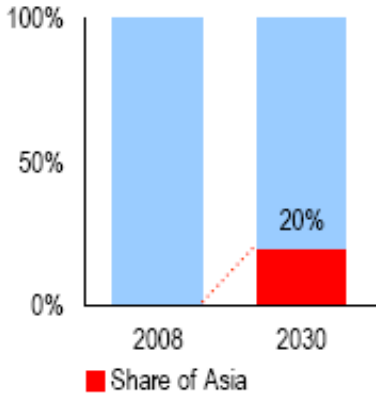
ES-2030 key technologies in the oil sector

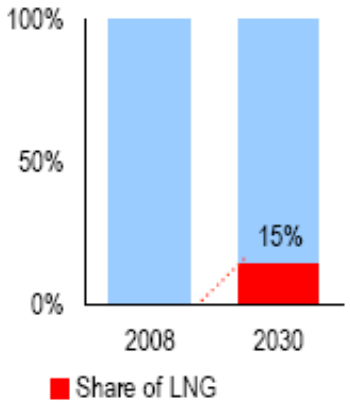
- technologies ensuring the reproduction of fuel and energy reserves (resources), improving reliability of forecasts for promising sites, radical decrease in timetable of search and exploration works on deposits in marine waters
- technologies improving oil recovery rate of oil fields being developed and brought into development, including fields with non-conventional hydrocarbons such as heavy (high-viscosity) oil and natural bitumen
- advanced oil recovery methods
- developing and wide-spread use of domestic software-hardware systems, equipment, and devices to simulate and manage geological and technical activities in the development of deposits
- provision of scientific and technological support to improve the quality of light oil products (including in line with international standards)
- technologies and equipment for small-tonnage production of synthetic liquid fuels in the field of associated petroleum gas production as well as in isolated natural gas fields

Gas sector investment needs



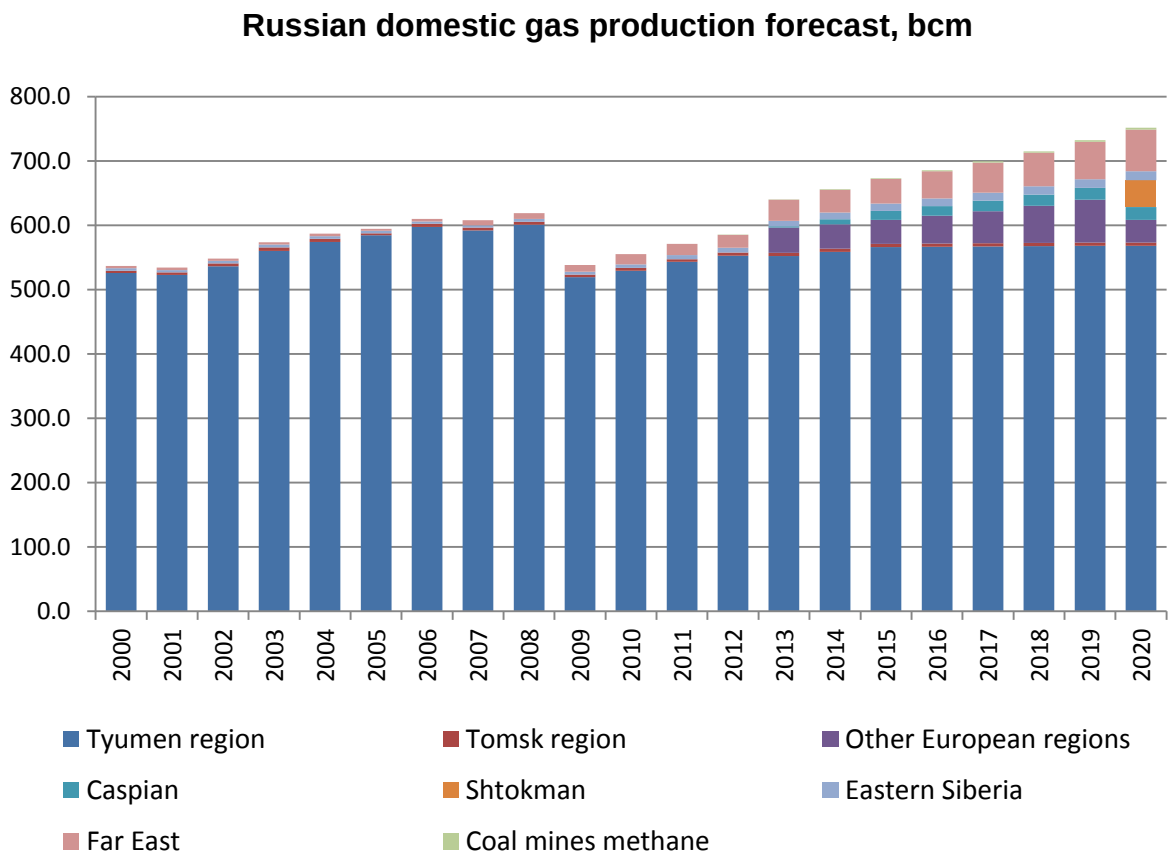
ES-2030 gas export strategy priorities





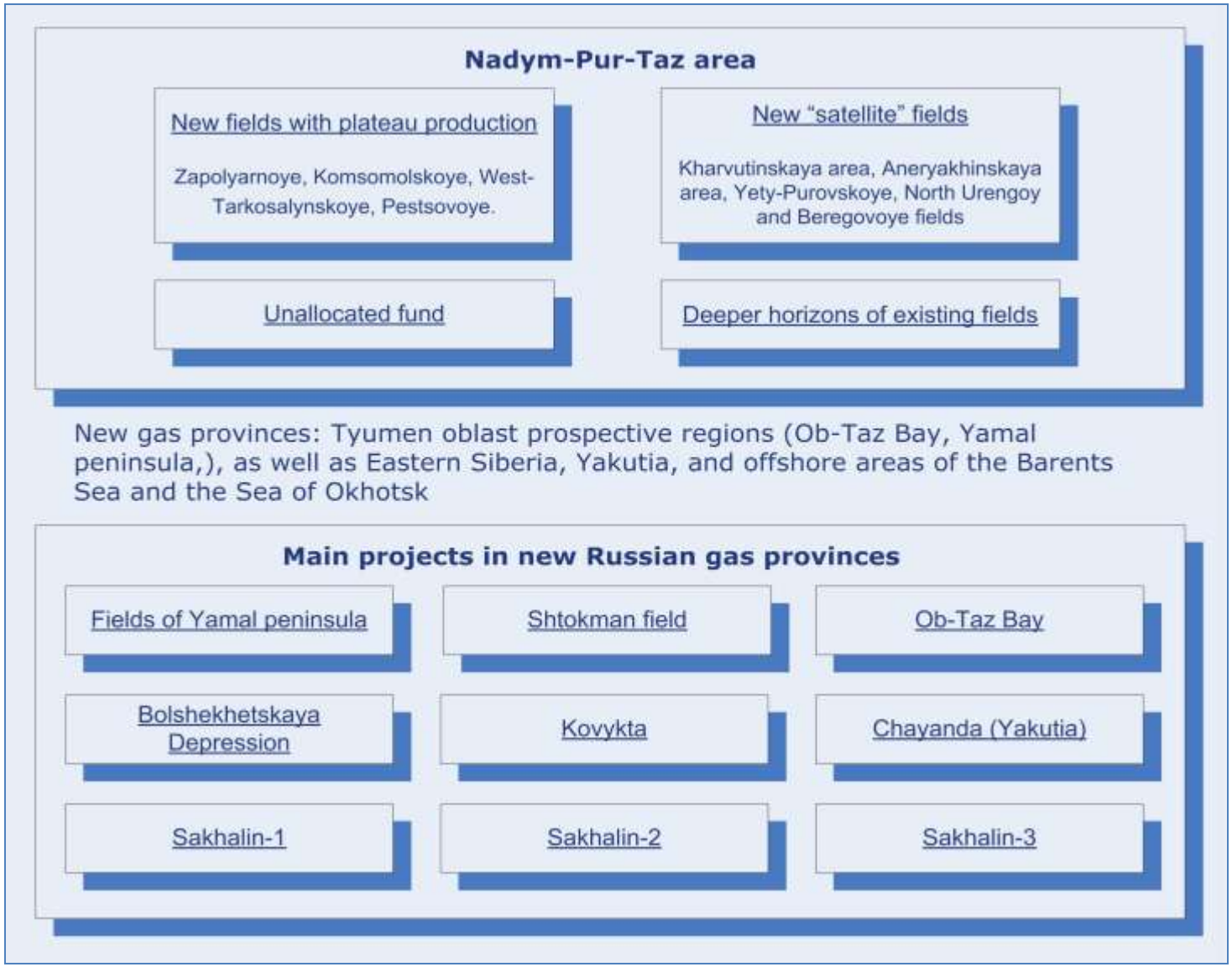
- The first ES-2030 priority is to maintain position in Europe while diversifying energy supplies and decreasing dependence on the European customers. Diversification of export markets, primarily – to the Asian market. The target is to increase the share of energy export to Asian markets up to 26-27% of total energy export (and up to 20% of gas exports by 2030).
  - Practically it means that once the agreement on gas price is reached – fast development of pipeline gas supplies to China will start (up to 70-85 bcm by 2030).
- Diversification of the product structure of exports (share of LNG in gas export reaching 15% by 2030).
  - Flexible development of LNG production in Atlantic basin (both domestically – Stokman - and abroad) to supply North American market and European market with an appropriate development of the downstream activities in the USA. Trading and arbitrage on Atlantic LNG.
  - Expanding LNG production in the Pacific basin with possible downstream development in Hong Kong, Taiwan and active participation in trading and arbitrage.

Long-term Russian gas production forecast by field



- In 2008-2020 Russian gas production is expected to increase by 13-19% and reach 750-795 bcm (compared to 665 bcm in 2008)
- Falling production on the “Big Three” will be replaced by new fields in Tyumen region, development of fields in Yamal, East Siberia and the Far East and the Shtokman field.
- In order to sustain and increase production, companies will have to move to more remote and challenging fields with significantly higher costs.

Major Russian gas upstream projects



Example: main technologies involved in Yamal development

Trunk Gas Pipeline Network Bovanenkovo-Ukhta

Unique combination of technical specifications:

- 115 Bnm³/ year production capacity
- 11.8 MPa (120 atm.) transportation pressure
- 1100 km length (2 routes), 1420 mm diameter

Baydaratskaya Bay subsea pipeline - 71 km

Cost to Gazprom of developing innovative solutions for the project – RUR 1.3 Bn

Rate of return - 1526% a year

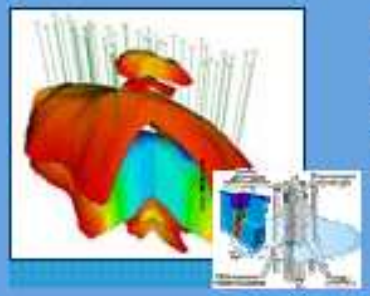
Creating Transportation Infrastructure on the Yamal peninsula

Obskaya - Bovanenkovo railway bridge crossing the Yuribei river

The world's longest bridge built north of the Arctic Circle

Cost effectiveness as a result of bridge construction – RUR 1.1 Bn

Field Development and Infrastructure Construction



Multi-zone structure development system. Use of wells with insulated pipes. Use of horizontal and multi-hole wells

Decreasing the spacing beween adjacent production wells from 40 m to12 m to cut infrastructure construction costs

High-Strength 1420 mm 11.8 MPa (120 Atm.) Rated Pipes

High-strength and cold-resistant pipes with high steel viscoplasticity. No risk of extended damage to the gas pipeline. There is no world practice of using K 65 strength (X80) grade pipes for gas pipelines with such characteristics. Concrete-encased pipes with external reinforced-plastic insulation for Baydaratskaya Bay

Use of Permafrost Soil Vapour-Liquid Thermal Stabilisation Systems

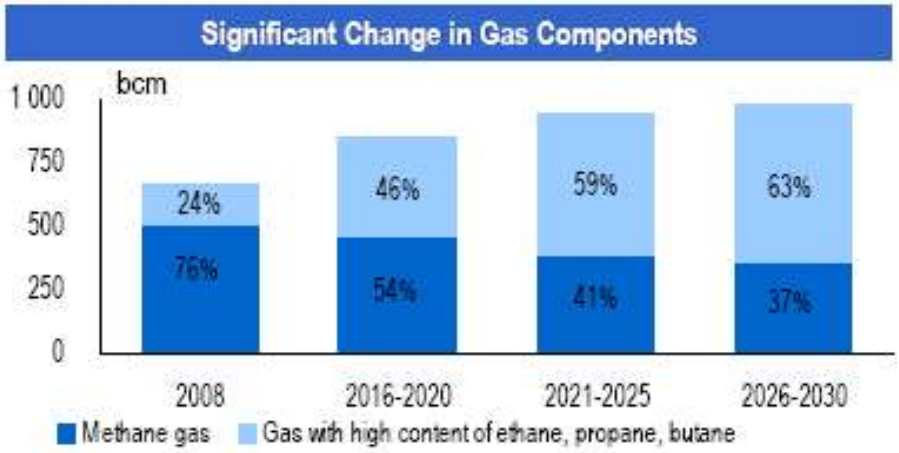
Decrease in steel intensity of the foundations by up to 50-60% and costs by 50%. Two to three-fold reduction of construction duration

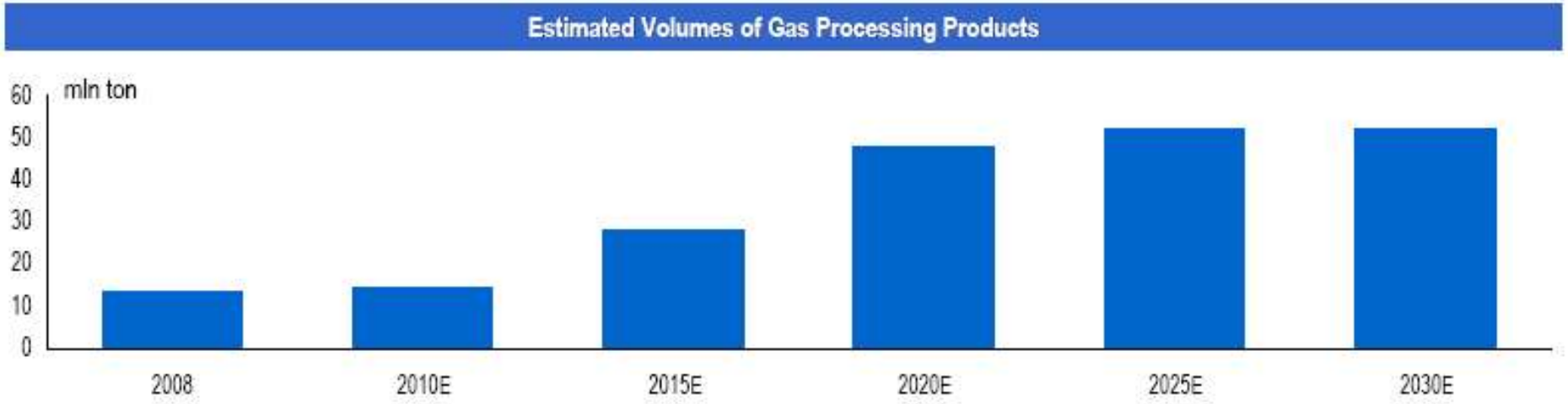
Ability to control thermal conditions of permafrost soil bases

New Technologies for Welding High-Strength Thick-Walled Pipes with Strength Grades up to K85 (X80)

Strength and cold-resistance of welds exceeds parameters of international peers. International standards are at the foundation of the technology. The expected cost effectiveness as a result of construction of one pipeline MG Bovanenkovo–Ukhta exceeds RUR 500 MM

Expansion of gas chemicals production





1. Excluding Salavatnefteorgsintez

ES-2030 key technologies in the gas sector

- technologies for drilling and extracting hydrocarbons on the continental shelf of the Arctic seas
- domestic equipment, technologies and materials to increase the reliability of wells, drilling-in, including in low-pressure natural gas deposits
- economic utilization of unconventional natural gas reserves
- domestic equipment, technologies and materials to construct and operate trunk pipeline systems with advanced characteristics as well as distribution networks of polymeric materials;
- designing and developing equipment for “raw” products treatment, extraction of high efficiency components (ethane, helium), engine fuel and hydrogen production, including for installation at the gas fields

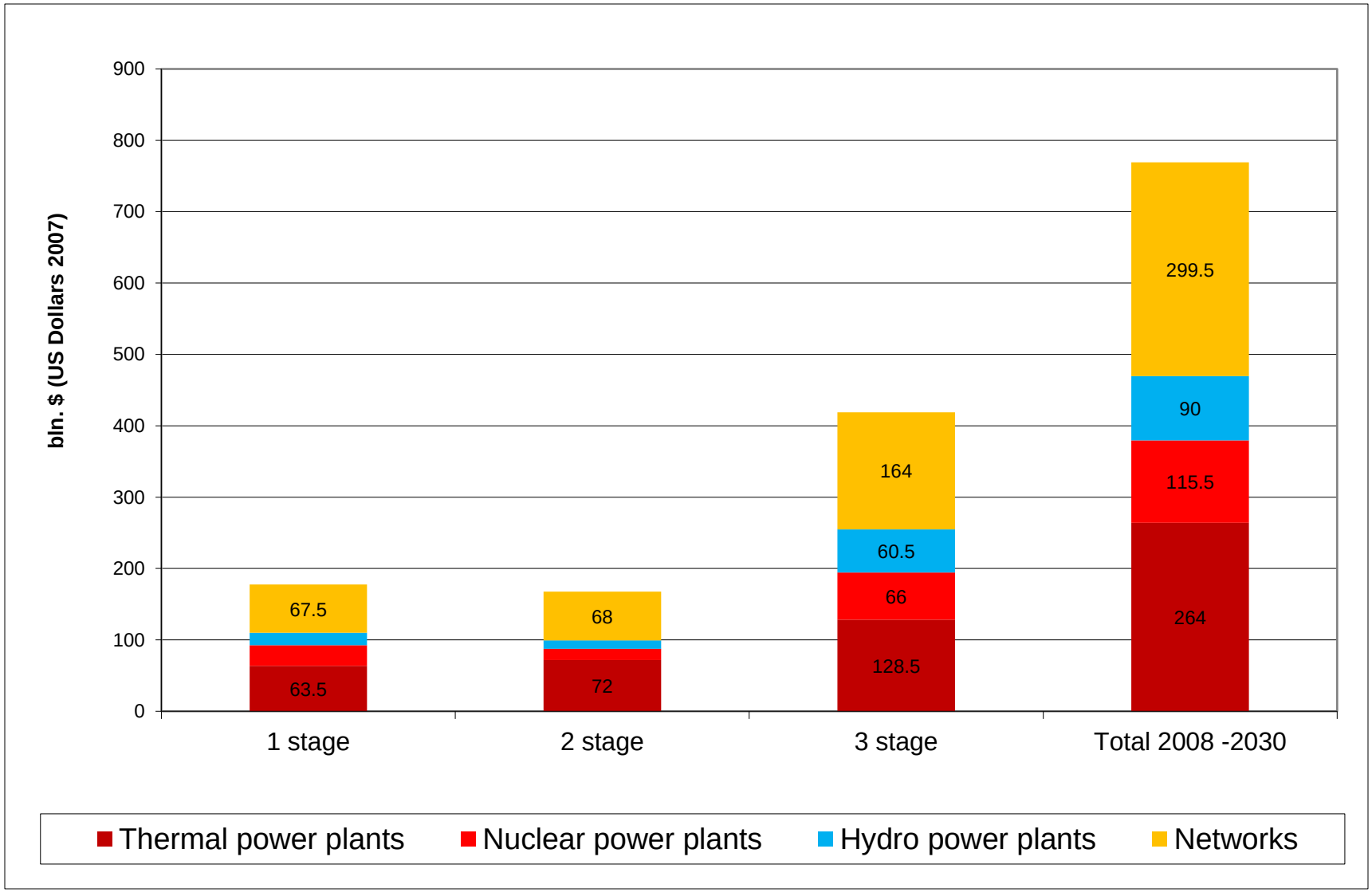
ES-2030 key technologies in the coal industry

- improving the quality of exploration including introduction of the latest methods of three-dimensional modeling
- work safety, accident prevention and liquidation (including automation of industrial processes in coal extraction, developing new technologies and equipment for effective coal-bed degasification, developing equipment and protection means from methane and coal dust explosion)
- technologies improving the quality of coal production (including wide-spread use of techniques and technologies providing for improvement in the quality of coal produced, developing and applying efficient coal preparation technologies, designing equipment to produce, transport and store standardized coal fuel)
- radical technical renewal of coal production (including equipping open-pit mines with highly-productive mining transport techniques of continuous and cyclical action, including for coal-bed selective mining; developing underground coal mining technologies with prior utilization of scouring mechanized complexes and excavating equipment of new technical level, as well as short bottom-hole technology with continuous miners and self-propelled means of transportation for coal);
- developing production of liquid and gas products from high coal processing, integrated use of related resources and coal conversion waste

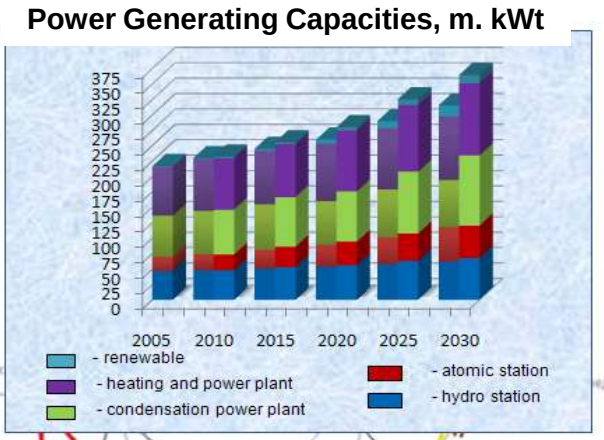
Current situation in the power sector

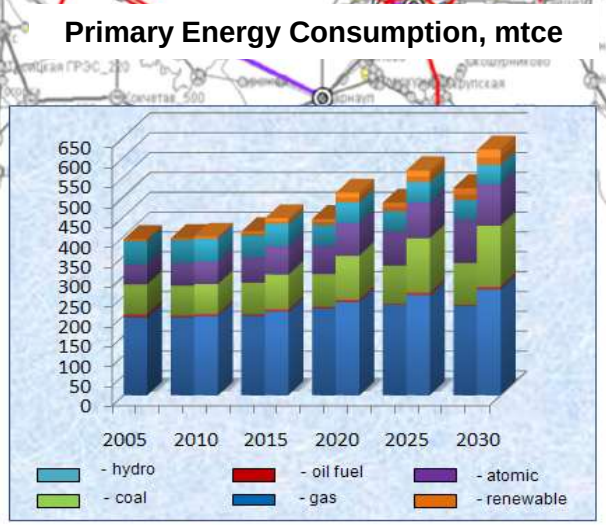
- RAO UES reform is completed while electricity market reform is in process with some crucial elements still lacking (wholesale and retail capacity markets, institutional conditions for the work of retail electricity companies, development of the system allowing consumers to choose suppliers).
- Privatization process is now replaced by the process of asset concentration under the state control (through INTERRAO), including not only networks, but also generating assets, which were supposed to be private.
- Transition to the free market pricing is expected by 2011, but the state is looking for additional mechanisms of price control. Cross-subsidization still exists between different groups of electricity consumers and between electricity and heat.
- Generating companies (OGKs and TGKs) have signed Agreements for Capacity Supply during privatization in 2006-2007, where capacity additions were calculated according to extremely optimistic electricity demand forecast. Further corrections are necessary
- High dependency on gas supply
- Insufficient network development which leads to problems with capacity output and with technological connection of consumers to the network

Power sector investment needs



Growth of generating capacity of power plants in 1,5-1,7 times, trebling of electricity networks





Electricity generation will remain the nucleus of the energy sector. By 2030, its capacity will increase 1.45-1.7 times. The total share of hydro and nuclear power plants and renewable sources will grow from 32.6% to 37-43%. The share of gas within primary energy consumption will see a reduction from 49.8% to 43%.

ES-2030 key technologies in the power sector-1

- gas turbines with a capacity of 300–350 MW and on their basis highly efficient condensation combined cycle gas turbine units with a capacity of 500–1000 MW and a performance index exceeding 60%
- standard modular combined cycle co-generation units with a capacity of 100 and 170 MW and a performance index amounting to 53–55% for heat and power plants
- environmentally friendly coal condensation units on ultra supercritical steam conditions with a performance index of 43–46% and a capacity of 660–800 MW
- environmentally friendly combined cycle units on solid fuel gasification with a performance index of 50–52% and a capacity of 200–600 MW, as well as a combine cycle unit on coal synthesis gas
- technologies using gas and solid fuel for combined production of electricity and synthetic liquid fuel
- developing highly integrated intellectual backbone transmission and distribution networks of new generation (Smart Grids) in the Russia's Unified energy system
- ultra-high voltage alternating and direct current electric transit lines the Siberia – Urals – European part of Russia
- electrical conductors on the basis of new composite materials providing for increase in the current-carrying capacity, reduction in the construction costs of transmission lines, as well as in distribution losses
- high-temperature superconductor materials as well as devices made on their basis
- utilization of low-temperature superconducting inductive electric accumulators in electrical networks

ES-2030 key technologies in the power sector-2

- all types of technologies of distributed generation
- power electronics along with devices based on it, especially various types of network controlling devices (flexible alternating current transmission systems (FACTS))
- highly integrated information and management complex of operational dispatch management working in real time mode with expert decision-making systems
- highly reliable backbone communication lines between various levels of dispatch management as well as duplicate digital channels for information exchange between objects and control centers
- centralized systems of emergency control covering all levels of the Russia's Unified energy system;
- automated electricity demand controlling systems
- highly-efficient and environmentally friendly hydroelectric equipment for tidal power plants as well as facilities for their construction with the use of floating blocks;
- establishing on the basis of computer diagnosis systems for hydraulic facilities a centralized safety system to monitor force-feed hydraulic facilities at hydroelectric power plants, as well as cascades of hydroelectric power plants
- a hybrid combine cycle power unit
- technologies for hydrogen production (including liquid hydrogen) from water with use of electricity from nuclear, thermal power plants and renewable energy
- hydrogen systems for energy accumulation and load pattern irregularity compensation with an electricity recuperation rate of at least 50% for nuclear and coal-fired power plants, as well as power plants using renewable energy

ES-2030 key technologies in the nuclear fuel cycle and nuclear energy industry

- modernization and renewal of production capacities at nuclear power plants with thermal neutron reactors
- designing experimental and commercial nuclear power plants with fast neutron reactors
- designing a new generation of water-moderated power reactors with supercritical steam parameters and adjustable neutron spectrum
- researching the issues of operation and closing of fuel cycle, developing technologies and setting up fuel cycle closing enterprises providing for fuel supply to nuclear power plants considering the integral and annual consumption of natural uranium, volume of separating works, fuel reproduction parameters, specific fuel tension rate in fast neutron reactors, as well as safety issues
- developing innovative technologies in waste processing and nuclear cycle closing aiming to approximation to the radiation-equivalent radioactive waste burial
- developing technologies of thermonuclear fusion on the basis of domestic innovations and fruitful international cooperation, including construction of an experimental thermonuclear reactor (ITER) and a demonstration power plant with a capacity of 1 GW

ES-2030 key technologies in heat supply

- modular technological equipment for new construction and transition of current heating sources to co-generation
- technological equipment and automated heat consumption control and management systems
- designing efficient combined-cycle technologies with steam injection and their prior utilization in heat supply
- technologies of condensation heat utilization of water vapors in combustion gases
- technologies of combined low-temperature heat supply with quantitative and quantitative-qualitative heat load control and decentralization of peak heat capacities
- technological equipment and designing standard technical solutions for utilization of heat pumps in heating systems in large cities and urban formations
- interconnected complex of technological subsystems in • the unified system of centralised heat supply and centralised cold supply of major social and industrial consumers of heat and cold
- telecommunication systems of centralized technological management of major heat supply systems using highly reliable executing mechanisms and technologies of geoinformation systems
- improving technologies of industrial production of heat pipelines with pre-applied anticorrosion cover, heat and hydro insulation and remote diagnostics, regulating and locking devices with automatic gear, as well as of assembling heat supply networks with the abovementioned units
- developing and introducing adaptive regulating circuits and intellectual regulating systems, structures and equipment for heating and hot water supply systems

ES-2030 key technologies in renewable energy and distributed generation

- technologies of renewable energy utilization, as well as multi-functional energy complexes for autonomous energy supply to consumers in regions not connected to centralized energy supply networks
- efficient technologies of network electricity and heat supply on the basis of renewable energy;
- technologies of combined use of renewable energy, as well as technologies for compensation of variations in power output of wind and tide generating units
- developing and introducing technologies of modern materials application in manufacturing equipment and components for generating facilities on the basis of renewable energy in order to reduce their construction costs and raise operating efficiency
- expanding production and use of new types of fuel derived from various types of biomass

Conclusions: the major technologies demanded in Russia

- Energy saving technologies in all spheres of energy production, transformation and consumption
- Exploration and production of oil and gas in difficult geological and climate conditions
- Technologies of efficient electricity production and transmission, smart grids
- LNG production and transportation (very limited)
- Oil and gas processing