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Green Growth Strategies and Nuclear Power in the Russian Federation

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Green Growth Strategies and Nuclear Power in the Russian Federation

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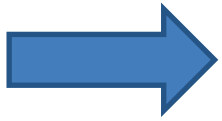
CONTENTS

I. GREEN GROWTH STRATEGIES IN THE WORLD AND SPECIFIC FEATURES OF RUSSIA

GREEN GROWTH STRATEGIES IN THE WORLD

Threats

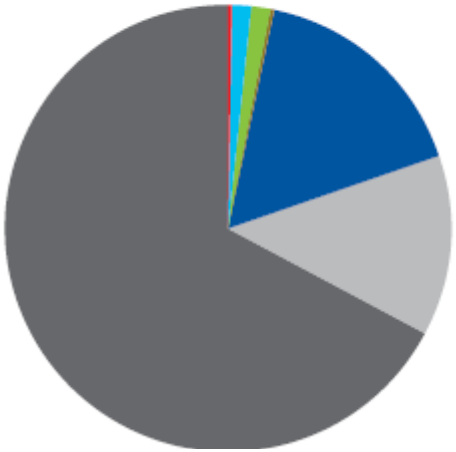
- **Environment pollution;**
- **global climate change;**
- **energy security of countries;**
- **dependence from the raw material resources**



DEVELOPMENT OF GREEN ENERGY TECHNOLOGIES

GREEN GROWTH STRATEGIES IN THE WORLD

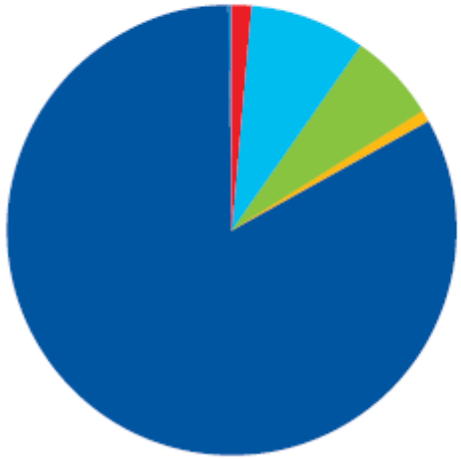
Structure of electricity production – 2010



- Geothermal **0.3%**
- Wind **1.6%**
- Biomass **1.2%**
- Non-renewable waste **0.2%**
- Solar **0.2%**
- Hydraulic **16.3%**
- Nuclear **13.0%**
- Fossil **67.2%**

Renewable sources ~19% in electricity production including ~16% hydraulic

Structure of electricity production from renewable sources – 2010



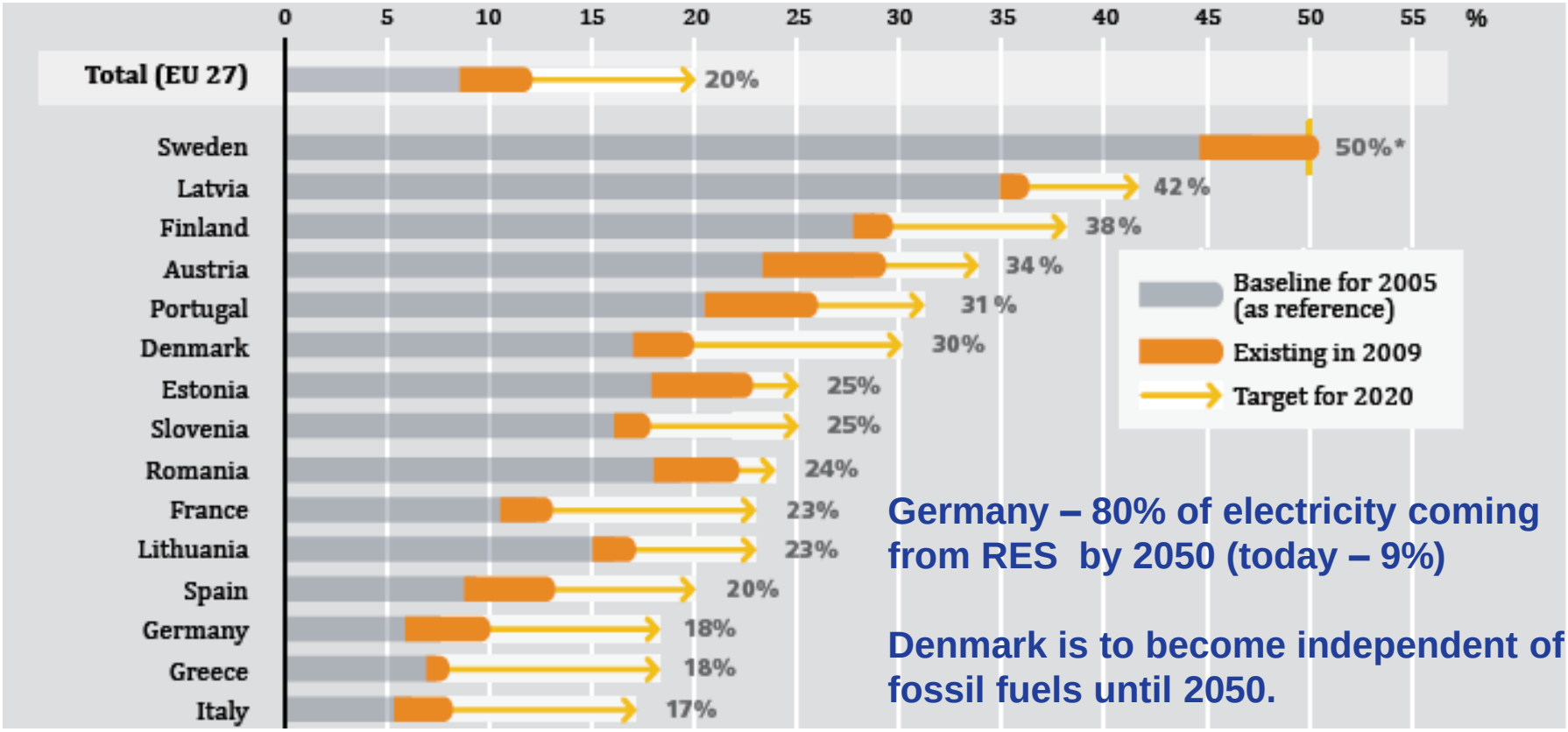
- Geothermal **1.6%**
- Wind **8.3%**
- Biomass **6.3%**
- Solar **0.8%**
- Hydraulic **82.9%**
- Marine energies **0.01%**

1. ***Hydraulic***
2. ***Wind***
3. ***Biomass***

Source: **Renewables 2011 Global Status Report**

Policies of countries regarding to RES

1. Policy of increasing the RES share in the energy balance for improving energy security and reducing release of GHG (developed countries)



EU shares of renewable of final energy, 2005 and 2009 and targets for 2020

Source: **Renewables 2011 Global Status Report**

Policies of countries regarding to the RES (3)

2 .Policy of RES share growth in countries with large-scale economies within the framework of diversification of the fuel-energy balance

USA, Canada, Australia, Japan

USA in 2010

Total capacity of wind power of 40,2 GW

Investments -over $25billion

TOP FIVE COUNTRIES – Existing capacity as of end-2010

	Renewables power capacity (not including hydro)	Renewables power capacity (including hydro)	Wind power	Biomass power	Geothermal power	Solar PV	Solar hot water/heat[2]
1	United States	China	China	United States	United States	Germany	China
2	China	United States	United States	Brazil	Philippines	Spain	Turkey
3	Germany	Canada	Germany	Germany	Indonesia	Japan	Germany
4	Spain	Brazil	Spain	China	Mexico	Italy	Japan
5	India	Germany/ India	India	Sweden	Italy	United States	Greece

Source: **Renewables 2011 Global Status Report**

Policies of countries regarding to RES

3 .Policy of RES share growth in developing countries which have not yet reached high industrialization level to assure full energy supply of their industry and population

China
India

Their energy strategy is based on the development of traditional energy technologies in their energy-generating strategy with particular attention to nuclear power development.

<u>China in 2010</u>
Total capacity of wind power of 44,7 GW
Solar hot water
Investment - $49 billion

<u>India in 2010</u>
3d place 13.2GW

Source: 1. Renewables 2011 Global Status Report
2. http://cdkn.org/2012/07/parliamentarians-bringing-renewable-energy-to-india/

Green growth strategy the Russian Federation (1)

«Russia is among of leading suppliers of energy resources to the global market. However, in APEC we plan to draw attention not only to issues related to energy trade. It is certainly an important issue today, but we should also think about tomorrow. Therefore, we will promote further constructive discussions of the entire range of energy security issues as well as green growth».

Dmitry Medvedev,
the former President of the RF

Dmitry Medvedev's article “Integrate to Grow, Innovate to Prosper”: http://www.apec2012.ru/news/20120128/462357588.html.

Green growth strategy of the Russian Federation (2)

"Round tables" for discussions of various proposals on sustainable development of Russia.

Concerns about "green economy" development *:*

✓"green protectionism";

✓losses of job places in traditional production plants;

✓ does Russia have sufficient resources to assure the role of renewable energy sources to be equivalent to that of traditional energy sources today?

Position of the RF at the RIO+20 conference

The Russian Federation proposes to consider the notion “green” economy in the context of sustainable development on the broader basis without disjoining economical, environmental and social aspects of the development taking into account specific features of development of individual countries.

The Russian Federation proposes to create a platform for studying most effective practices of transition to the “green” economy, lessons learned and benefits, as well as relevant information exchange.

Source: Submissions of the RF to submissions to the outcome document of the ‘RIO+20’ Conference http://www.uncsd2012.org/content/documents/compilationdocument/MemberStates.pdf p. 376

Official point of view towards “green energy”

- is connected with alternative energy or RES:
  - small hydro,
  - geothermal,
  - solar,
  - tide,
  - wind
  - bio energy.
- Large hydro energy has not been included in the list of the RES
- Nuclear power officially doesn’t refer to “green energy” family

Non-Governmental public ecological organizations point of view towards "green energy"

From point of view of Non-governmental public organizations nuclear power and large hydro power can not be considered as alternatives to fossil fuel energy sources in solving problems of climate change.

In the program of World Wild Fund of the RF it is stated that in order to solve tasks of sustainable development, it is necessary to convert the country economy as soon as possible to low-carbon scenario including renewable-based economy.

Source: Position of the Russian branch of the World Wild Fund : http://www.wwf.ru/about/positions/atom/.

Opinion of representatives of business:

“For Russia «the green energy» isn't true "alternative" to full extent because RES can't replace traditional sources.

Russia doesn't intend to develop «green» energy (renewable) exclusively as the way of production electricity —

for the country is important synergy effect of renewable energy connected with recycling of a waste and other ecological aspects”.

T. Ivanov, the general director

of the Russian power agency considers.

Round table of RIA Novosti news Agency, devoted to development of renewed energy sources in the RF
http://www.bigpowernews.ru/interview/speech/document32065.phtml

II. STATUS AND PROSPECTS FOR DEVELOPMENT OF ALTERNATIVE ENERGY SOURCES (RES)

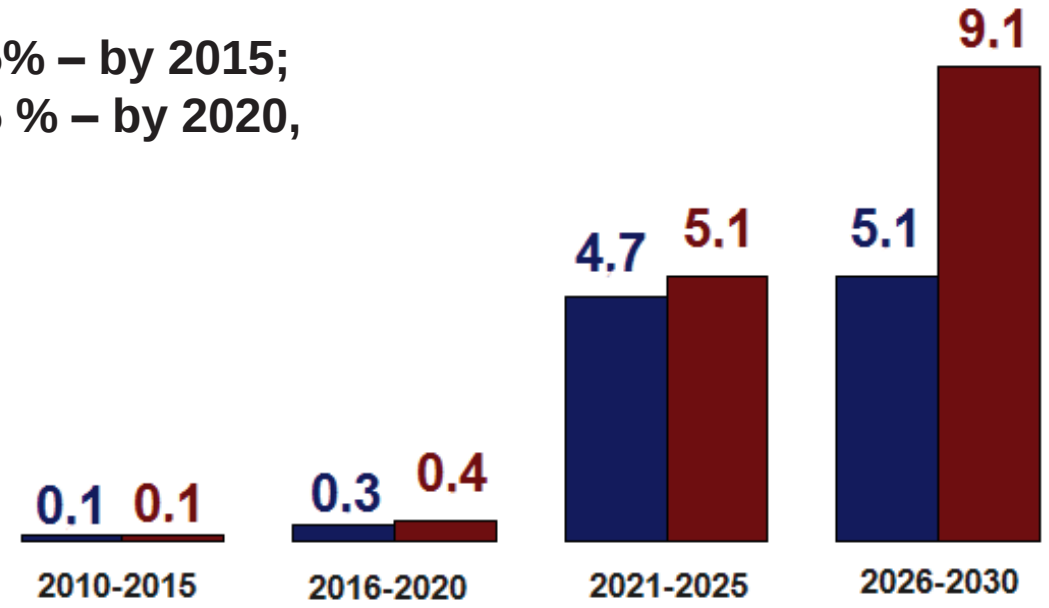
Status and prospects of RES in Russia

Share of RES in Russia today ~1%

Decree of the RF Government issued in January 2009*)

Program of deployment of renewable energy capacities (GW) in Russia

- **2.5% – by 2015;**
- **4.5 % – by 2020,**



Source: General arrangement of energy generating facilities up to 2030, information from website of the Agency for forecasting energy balances (ZAO «APBE»): http://www.e-apbe.ru/scheme/.

Prospects of RES devlopment

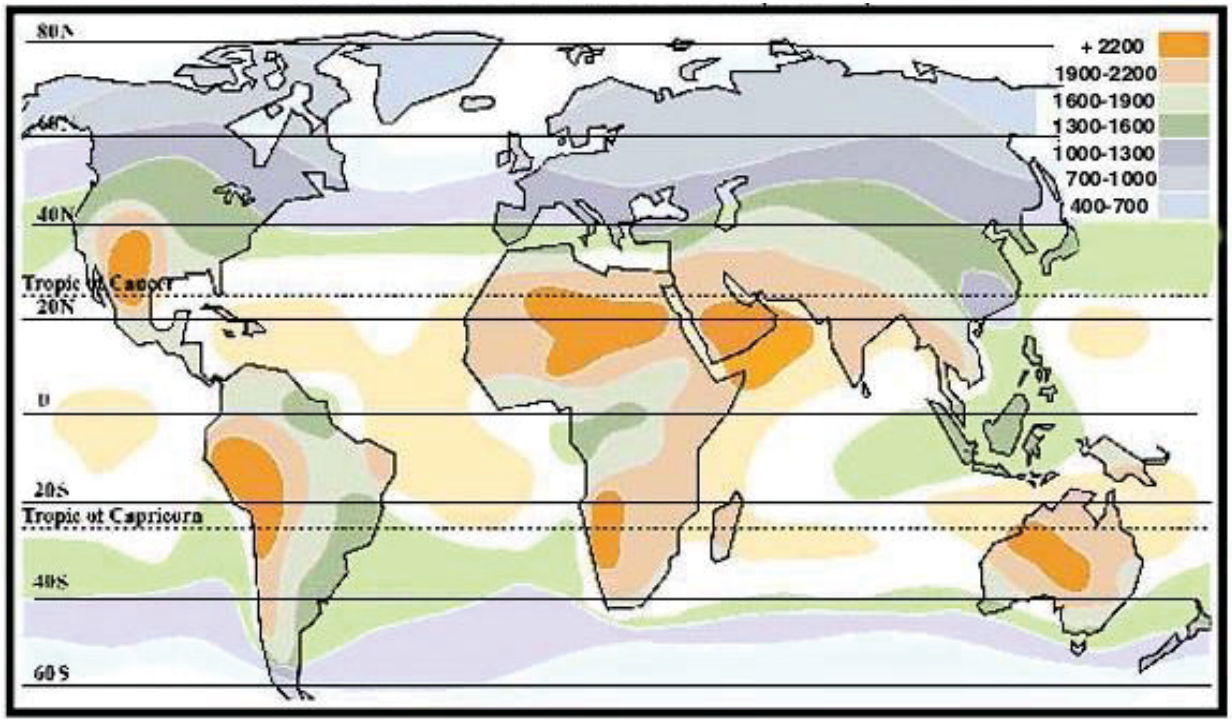
Planned target figures of capacity and electric energy production for various RES

Power plants (PP)	Units	2010	2015	2020
Hydro-electric PP < 25 MW	Billion kW·h	3.5	10.0	20.0
	MW	850	2430	4800
Wind PP	Billion kW·h	0.21	2.6	17.5
	MW	120	1500	7000
Geothermal PP	Billion kW·h	0.6	2.0	5.0
	MW	90	300	750
Biomass PP	Billion kW·h	13.5	22.0	34.9
	MW	2800	5000	7850
Tide PP	Billion kW·h	0.00	0.024	2.3
	MW	1.5	12	4500
Solar PP	Billion kW·h	0.00003	0.002	0.018
	MW	0.03	1.5	12.1
Other types of PP	Billion kW·h	0	0.08	0.5
	MW	0	20	250
RES share (without large-size hydro-electric power plants)	% of total electricity	1.5	2.5	4.5

Source: Working out national plan of renewable energy development in Russia, The European Union's Tacis Programme for the Russian Federation Europe Aid/116951/C/SV/R, 2009: http://esco-ecosys.narod.ru/2011_8/art188.pdf./.

Solar energy in Russia (1)

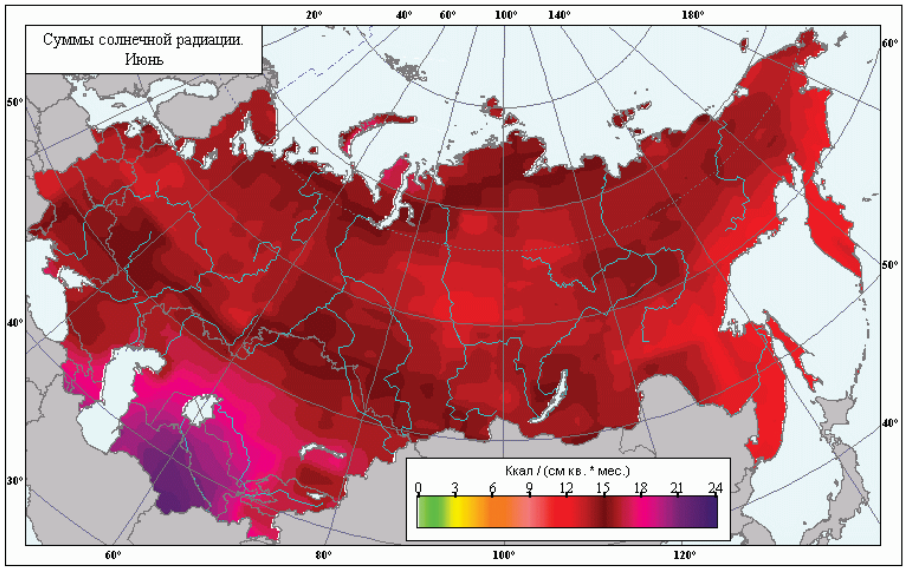
Map of solar radiation at the Earth surface



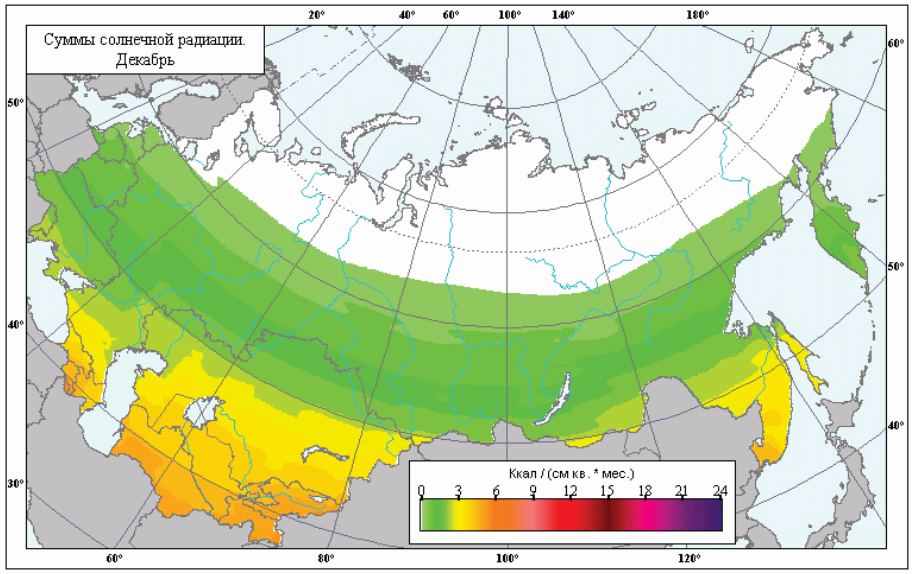
Russia is located between 41° and 82° of northern latitude and solar radiation levels on its territory vary significantly. The major part of the Russian territory is beyond the area of maximum solar radiation on the Earth surface

Solar energy in Russia (3)

Solar radiation in Russia in June



Solar radiation in Russia in December



Non-uniformity of solar radiation during a year is another factor determining economical efficiency of solar energy use.

For instance, in the territories located above the Arctic Circle polar night covers most of winter period.

In central Russia and in Moscow solar radiation received in the summer time is higher by a factor of five as compared to that received in the winter

Source: Agro-ecological Atlas of Russia and bordering countries: http://www.agroatlas.ru/ru/content/climatic_maps/Ir/Ir_12/

Solar energy in Russia (2)

Distribution of solar radiation over the RF

There is a potential to use solar energy in Russia, in particular, in Krasnodar and Stavropol Regions, as well as Eastern areas of Yakutia and Magadan region.

Source: Prospects of Russian regions in the development of solar energy sources. Website: Association of solar energy in Russia: http://pvrussia.ru/?p=871#more-871

Wind energy in Russia

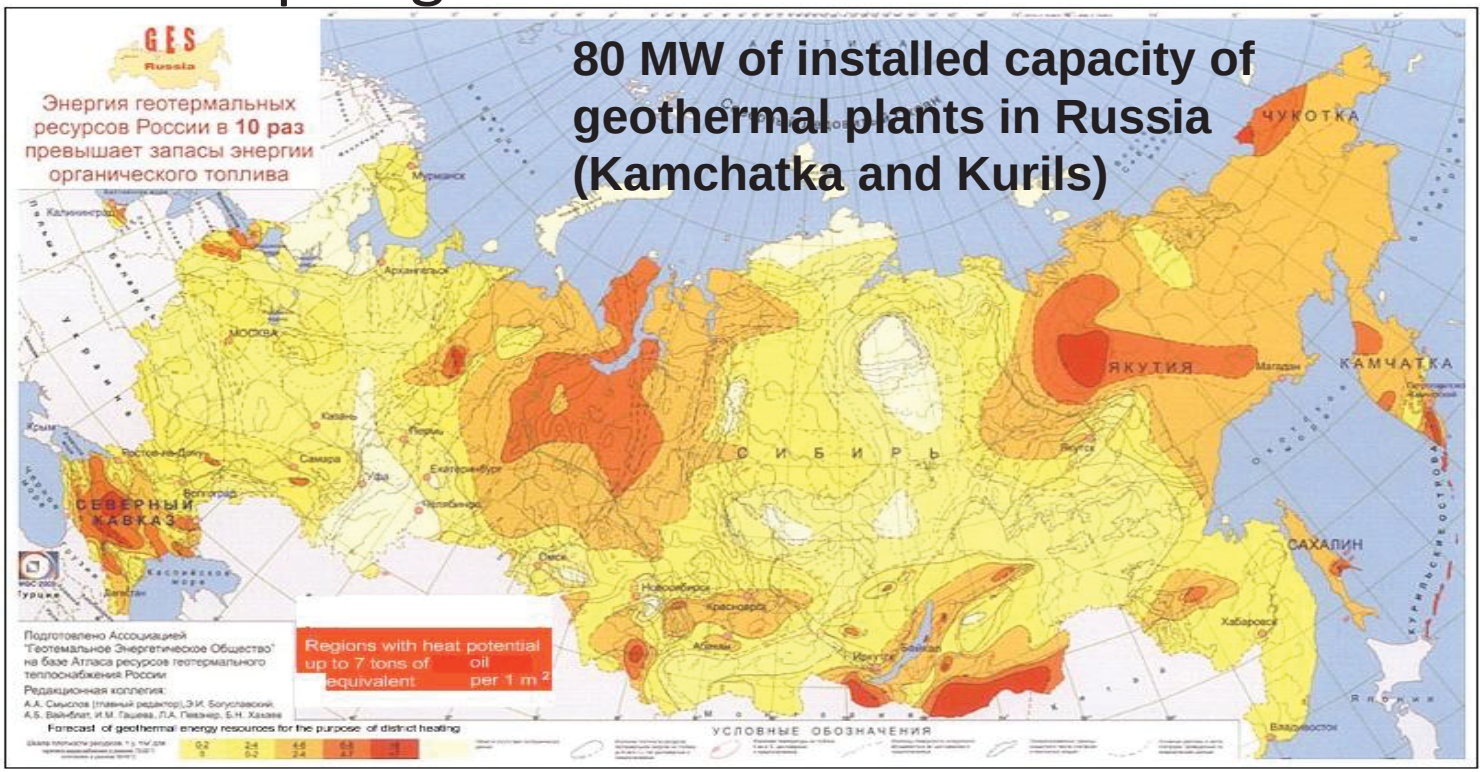
Distribution of wind velocities over the territory of Russia

Distribution of winds in Russia is quite non-uniform because of hugeness of its territory, variety of climatic, relief, and terrain features. On the major part of the Russian territory average monthly wind velocity is within 3-4 m/s, while on the coast of the Arctic and Pacific oceans it is within 7-8 m/s

Source: Wind in Russia: http://www.src-vertical.com/wind_geography/wind_russia/

Geothermal power in Russia

Map of geothermal sources in Russia

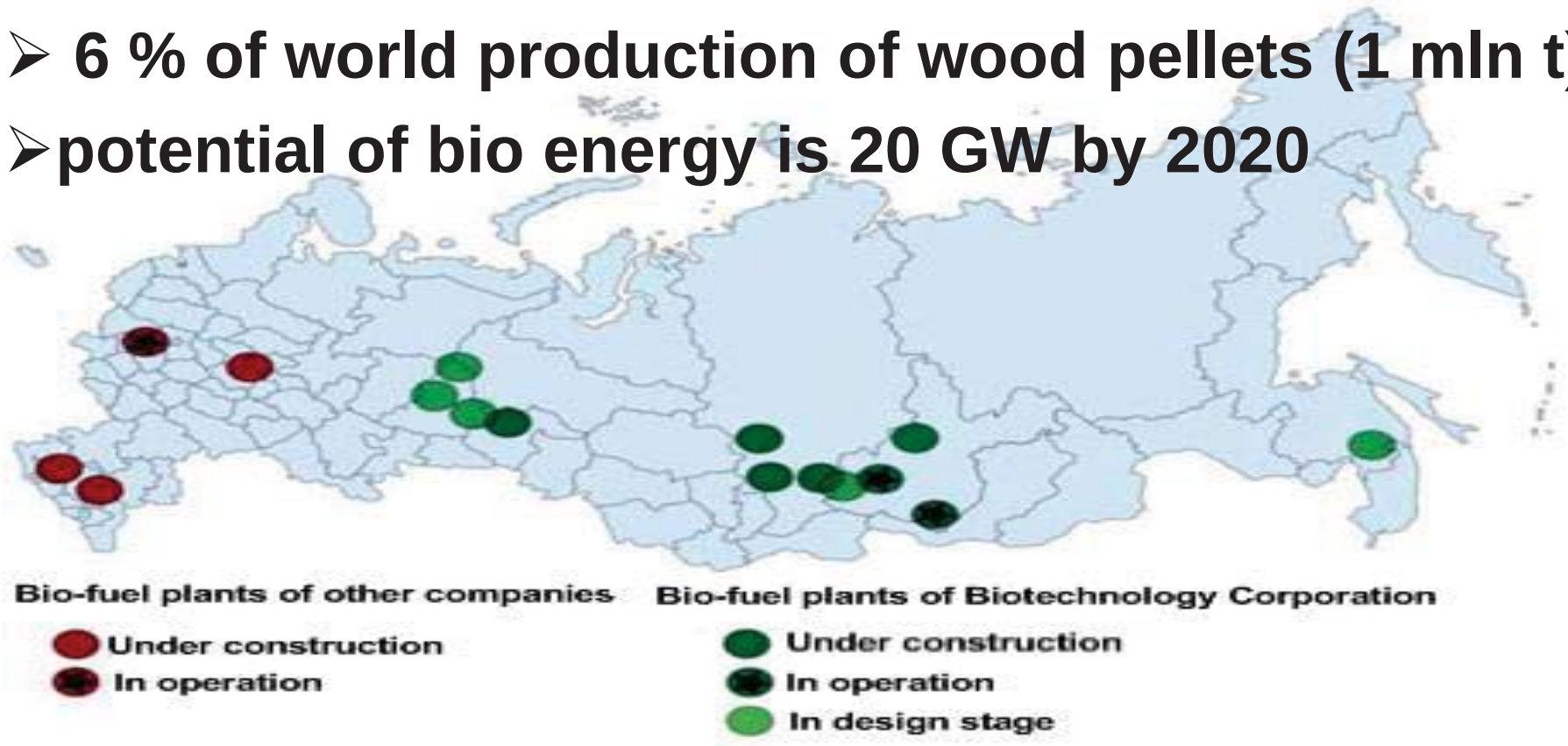


Energy potential of geothermal sources in Russia is extremely high. According to some estimates, this potential exceeds that of all fossil fuel in the country by a factor of 10 to 15. Actually geothermal sources at the water temperatures within 30°C - 200°C range are available on the most territory of the country.

*)Source: data from eothermal Energy Society of Russia http://geo.web.ru/conf/kuril_kam2005/title4.html

Bio energy in Russia

- 6 % of world production of wood pellets (1 mln t)
- potential of bio energy is 20 GW by 2020



Plans to construct 30 biotechnological plants to produce 2 mln t of liquid and 3,5 of mln t of granulated solid bio fuel per year

Website of Corporation Biotechnologies: http://www.corpbiotech.ru/projects/index.phtml

Problems of RES development (1)

1. RES are uncompetitive as compared to fossil fuel power

Technology	Plant capacity, MW	Energy cost, $/MW·h
Large size hydro-electric power plant	10-18000	30-40
Small size hydro-electric power plant	1-10	40-70
Onshore wind power plant	1-3	50-80
Offshore wind power plant	1,5-5	80-120
Bio mass energy	1-20	50-120
Geothermal energy	1-100	40-70
Solar light energy	1 kW-20MW	200-800
Solar thermal energy	50-500	120-180
Coal power plant	300-627	50-87*)
Gas-turbine power plant	392	58*)
Nuclear power plant	1200	43*)

*) Rounded figures

Source:1. V.P. Shuysky, S.S. Alabyan, A.V. Comissarov, O.V. Morozenkova. World markets of renewable energy sources and national interests of Russia: http://institutiones.com/general/1800-mirovye-rynki-vozobnovlyaemyx-istochnikov-energii.html.
2. Projected Costs of Generating Electricity: 2010 Edition by IAE and NEA of OECD, ISBN 978-92-64-08430-8, OECD 2010.

Problems of RES development (2)

2. There is no both regulatory and legislation basis, which would help to make investments into RES more economic effectively.

General immaturity of RES market in Russia, characterized by the following :

- needs for revision and adaptation of wholesale and retail market rules to be ready to the presence of RES objects;
- absence of comprehensive approach to RES development in Russia resulting in the presence of the large number of small isolated private initiatives in this sphere;
- low level of technical and economical expert evaluation and the lack of experience in RES designing that causes low level of designs appropriate for bank financing.

Problems of RES development (3)

3. Russia considerably lags behind of the EU and other developed countries in the area of development and construction of wind-driven power and solar power plants that is due to:
   - almost zero demand for these plants in the country,
   - absence of state support resulted in insufficient financing of R&D programs in this area.

   Development of the purely Russian plants being competitive with the foreign units in terms of its technical and economical characteristics will require:
   - financing of long-term research and experimental studies program and development of production capacities (several billion dollars);
   - at least 10-year period for experimental development.

//I. SPECIFIC FEATURES OF POWER INDUSTRY IN RUSSIA

1. Cheap energy resources unlike other countries

Russia possesses:

- **over 15% of world proven fuel resources;**
- **less than 3% of population (4 times lower than that of the USA);**
- **6% of energy world's consumption.**

that predetermines *high export fraction* of the industry branch

2. High contribution of Russian energy sector to GDP, 5% as compared to 1.5% worldwide

Russia is

- ❑ the most cold country (2/3 its territory is permafrost regions);
- ❑ extended country (9 clock zones).

Russia has

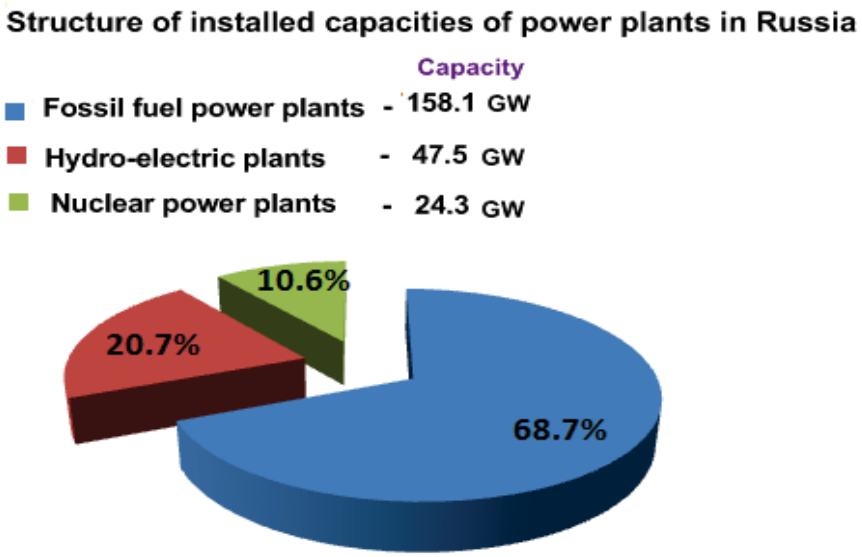
- ❑ low population density 3% (4 times lower than in the USA);
- ❑ comparatively undeveloped energy infrastructure (7 times weaker than that in the USA)*);
- ❑ energy efficiency of the Russian economy is five times lower than the world average value;
- ❑ energy load to the economy is four times higher than the world average value

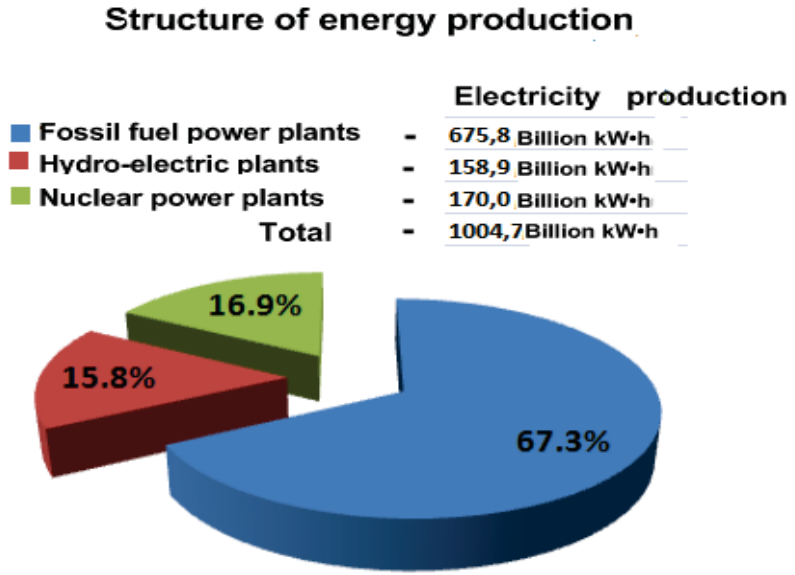
*) Source: Prospects of the fuel-energy complex of Russia: analysis and forecast. "Russian Newspaper" - Economy "Energy" No. 5664 (288) 22.12.2011

3. Low concern over warning climate

It is important that Russia is relatively neutral with regard to climate warming, or even it could possibly gain from it in case of implementation of the international mechanism to sale release quotes to other countries.

Status of energy sector in Russia





Structure of installed capacities of power plants in Russia

Structure of electrical energy production by power plants in Russia

Strategic task

Strategic task is to decrease the share of gas-fired power:

- assurance of the country energy security - diversification of the primary energy sources
- Russia being the world's largest gas exporter, should assure gas supply to abroad
- the level of gasification inside the country is only 63%, and resources are needed for its further gasification

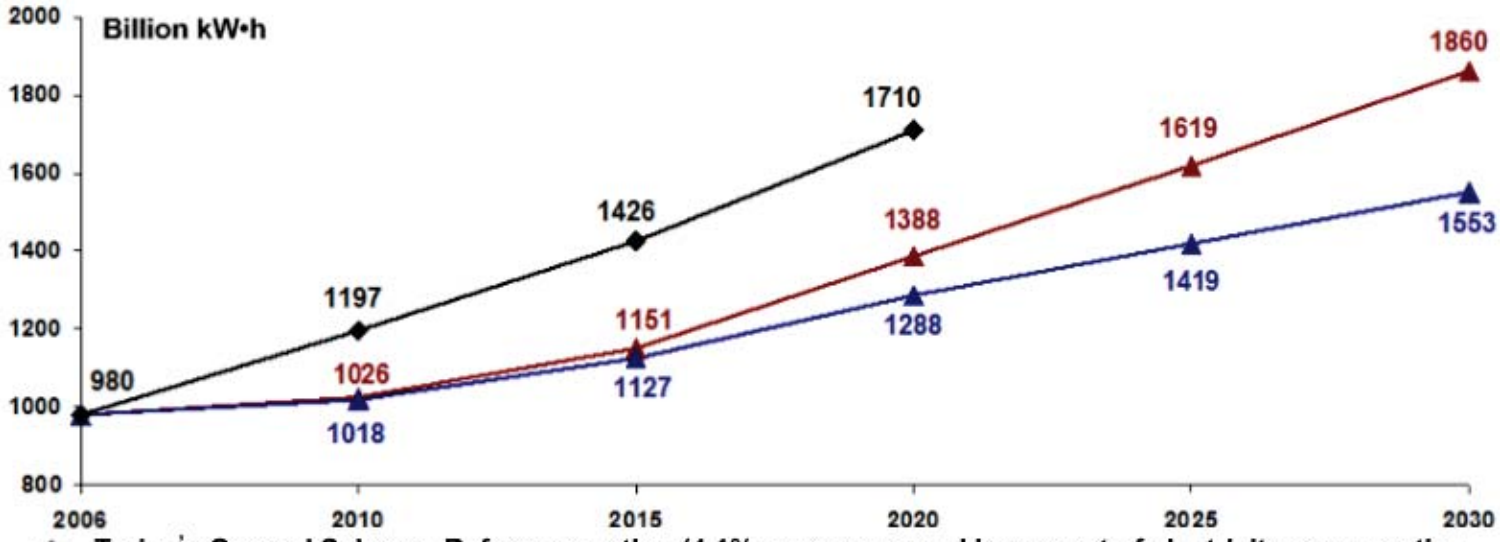
Mid-term perspective

Development of energy sector for the mid-term perspective in the Russian Federation is directed by two official documents, namely:

- ✓ General Scheme of deployment of electrical energy objects for the period up to 2020, and

- ✓ Energy Strategy of Russia up to 2030

Forecasted dynamics of electric energy consumption in Russia up to 2030



Specific energy consumption per capita in domestic household and business sector, kW•h /person

	2010	2030	
Russia	1970	2880	The difference decrease
USA	8840	9450	with the USA - by factor of 4.5 to 3.3
Western Europe	3800	4800	with Western Europe - by factor of 1.9 to 1.7

Decree by the RF Government of 8 January 2009 No. 1-r "The main directions of state policy in the area of increase of electric energy effectiveness on the basis of use of renewable energy sources for the period up to 2020", Information-legal portal: Garant: http://www.garant.ru/products/ipo/prime/doc/94737/ /

Special attention to nuclear power in Russia

The leadership of the Russian Federation considers the development of *nuclear, coal, and hydro-electric energy as the main stream to* provide the industry and population with electrical energy and heat.

The former President of the Russian Federation D. Medvedev declared:

"… special attention should be paid to the nuclear power sector. Certainly, Russia will continue developing nuclear power by updating safety systems of nuclear reactors. Comprehensive studies should be carried out in the area of radwaste processing. We have to understand what to do with this heritage"

Website of the President of Russia: http://kremlin.ru/news/11755

IV. PROSPECTS FOR DEVELOPMENT OF NUCLEAR POWER

Official position of the RF towards Nuclear Power development in Russia

The Russian Federation confirms its intention to develop nuclear power as a strategic direction for the development of the country. We are convinced that in spite of the severe accident at the Fukushima I Nuclear Power Plant, there are no alternatives to nuclear power in the foreseeable future. It is impossible to meet the challenge of humanity's energy supply without it. To date, out of all relevant sources of energy, the nuclear power is not only an environmentally friendly and cost-effective, but also a safe source of energy, naturally, provided a responsible approach towards it is taken.

Memorandum of the Russian Federation for the 2012 Nuclear Security Summit

March 27, 2012

http://eng.news.kremlin.ru/ref_notes/80

Nuclear Power in Russia Today

- 10 nuclear power plants in Russia including
- 33 operated nuclear power units of
- 24.2 GW of total installed capacity.
- 16% of total electricity production
- about 5% of total energy consumption
- was ranked the19th place in the world's list of countries using nuclear energy nuclear energy share in the energy
- 10 nuclear units are under construction: Kalinin NPP (VVER-1000), Beloyarsk (BN-800), Leningrad (VVER-1000 two units), Novovoronezh (VVER-1000 two units), Baltik (VVER-1000 two units), Rostov (VVER-1000 two units)

NP after Fukushima accident

- more attention will be paid to safe operation of power units, in particular, those which reached the end of their design lifetime and for which a possibility of their lifetime extension is considered.
- Since 2004, no incidents classified by the International Scale INES above zero (min) level have been detected in the Russian NPP
- the Program of load factor increase initiated by Russian nuclear utility OAO Rosenergoatom Concern for the period up to 2015

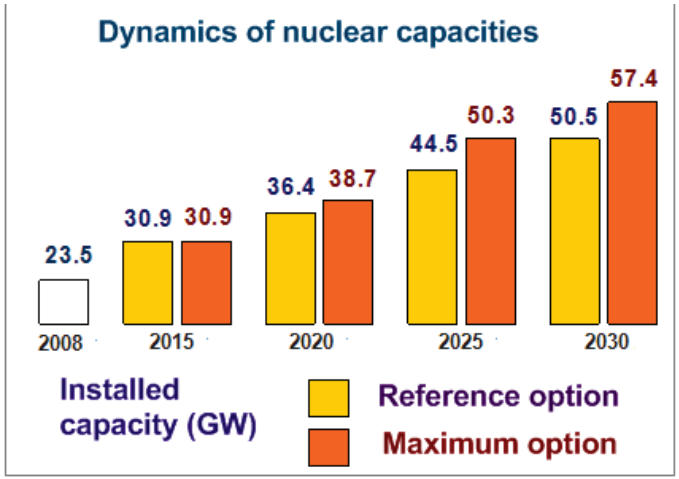
Russia is one of the world leader in the construction of NPP abroad

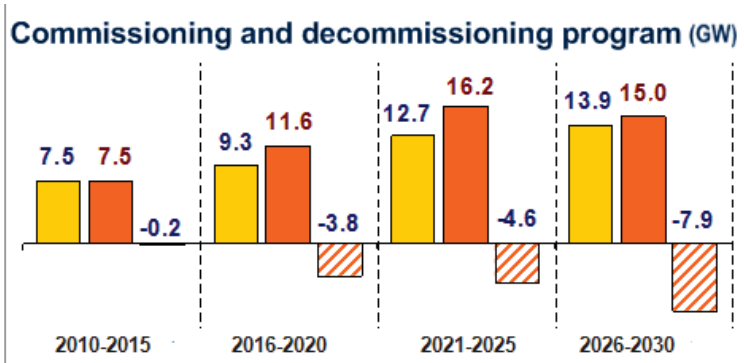
Russia is going to construct nuclear units in 15 countries in total.

The package of possible Contracts comprises 35 units.

Intergovernmental Agreements have already been signed on 19 of them :
China - 4 units, India - 4, Belorussia - 2, Armenia - 1, Ukraine - 2, Vietnam - 2, Turkey - 4.
Russia is going to participate in the following tenders: Bulgaria - 2, Egypt - 3, Argentina - 2, Kazakhstan - 2, Slovakia - 1, Hungary - 2, Czech Republic - 2, Bangladesh - 2, Jordan - 2.

Prospects of Nuclear Power development in Russia





Commission during 2010-2030 :
Reference option 43.4 GW Max option 50.3 GW

Deployment geography

Decommissioning list

NPP	Decommissioning year
Novovoronezh NPP	2016, 2017, 2021-2025
Kola NPP	2018, 2019, 2026-2030
Leningrad NPP	2018, 2020, 2021-2025, 2026-2030
Bilibino NPP	2019, 2020, 2021-2025
Beloyarsk NPP	2021-2025
Kursk NPP	2021-2025, 2026-2030
Smolensk NPP	2026-2030
Kalinin NPP	2026-2030
Balakovo NPP	2026-2030

Dynamics of nuclear power development according to the Energy Strategy of Russia up to 2030

General arrangement of energy generating facilities up to 2030, information from website of the Agency for forecasting energy balances (ZAO «APBE»): http://www.e-apbe.ru/scheme/

Long-term development of NP

Strategy of nuclear power development up to 2050 is been preparing now in Russia.

The following ambitious goals are set up to the nuclear power sector of Russia:

- to increase the share of nuclear electricity up to 30% and more with achievement of NPPs total installed capacity up to 100 GWe and more by 2050 and continue to operate at this level for further long-term (hundreds of years) period;
- to assure extension of export potential of Russia with achievement of as much as 25% of the world's export of nuclear energy technologies.

Nuclear power and global warming

Nuclear power units in Russia contribute significantly to solution of the problem of global warming. Owing to their operation annual release of 210 million tons of carbon dioxide is prevented.

Transition to the closed fuel cycle opens the possibilities of increasing share of nuclear power in the long-term perspective up to 50% and more, this would facilitate decreasing greatly CO_2 release by the energy complex of the country.

CONCLUSIONS REMARKS

Russian plans for RES development look rather modest vs EU countries.

This is caused by the following factors:

- Energy sector of Russia is provided with comparatively cheap energy resources than in the other countries, this makes the use of renewable energy currently non-competitive.
- Russia is the most cold and extended country with very low population density. Geographical and climate features don't let using widely some kinds of renewable energy over the whole territory of the country, but only in some limited regions.
- Russia is relatively neutral to climate warming, Therefore a concern over this problem is reasonably less as compared to the developed countries.

The main factors impeding development of solar and wind energy sources are the following:

- Russia considerably lags behind of the EU and other developed countries in the area of development and construction of wind-driven power and solar power plants

- development of purely Russian plant design would require significant time and money

Nuclear power

- Russia holds leading position in the world on development of nuclear technologies.
- Development of nuclear technologies means development of high technologies that is very important for Russia's future.
- This branch is an important channel of high technology export, which brings big income to Russia even today
- Russia is the leader in constructing NPPs abroad and it has plans to expand further export of NPPs and services of nuclear fuel cycle.
- Russia is also leader in the development of advanced nuclear power technologies including fast neutron reactors and closed fuel cycle.

Nuclear power development is acknowledged to be an important strategic goal related to the updating economy and industry of Russia

References

E. V. Poplavskaia, A. N. Chebeskov, V. S. Kagramanyan

"Green Growth Strategies and Nuclear Power in the Russian Federation"

Thanks for your attention!

Grazie per la vostra attenzione!