Vision for Sustainable Energy for Russia

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This paper describes a Sustainable Energy Vision for Russia. It includes a transition of the energy supply and demand with phase-out of fossil and nuclear energy over a 50-year period. It show a possible development, based on available data for renewable energy potentials, energy efficiency, and knowledge about how the elements of an an energy system can be combined. The increase in renewable energy use and the energy efficiency will only happen if the right policies are put in place. Given the increasing value of fossil fuels compared with the prices that they are traded for the Russia, many of the proposals will be cost-effective, while others, such as solar electricity are expected to be cost-effective within the decades that the vision covers, in particular is external, environmental costs are included in the evaluations. It is one proposal chosen to phase out fossil fuel by 2050, and other timelines are also possible, depending of the investments and promotion activities.

The vision describes Russia as one block, which it is not, and any implementation of a sustainable energy strategy similar to the one that this vision describes must start with a more detailed study of the distribution of the Russian renewable energy potentials compared with the energy system and the energy consumoption, as well as more detailed evaluations of development patterns and of energy efficiency potentials.

The future oil and gas production is partly based in official Russian forecasts that the authors have not evaluated independently.

Factor 4 for Energy Efficiency

In line with INFORSE's[1] global vision for sustainable energy, the Russian Vision is based on increase of energy efficiency to reach an average level in 2050 similar to best available technologies today. Most energy consuming equipments will be changed several times until 2050, and if new generations of equipment are made with optimal energy performance, and markets are made to promote the most efficient technology, it will not be a problem to reach today's best available technology, even though the efficiency gains required are very large, - in the order of 4 times, similar to an annual increase of efficiency of over 2% per year from 2010. This will not happen by itself, given that the "natural" technological development in industrialised countries has been about 1% per year[2]. It will require concerted actions from stakeholders involved, but if it is done on large scale and the market therefore is large for each new generation of efficient equipment, the changes will be cost-effective. The extra equipment costs will be off-set by energy savings. To realise this, it is, however, necessary to go beyond the conservatism of many market players in this field, and develop a truly enabling market for energy efficiency throughout the society.

The Challenge of Reducing Heat Consumption

For buildings the situation is different from equipment because buildings often have lifetimes of 100 years or more. For Russia is proposed to reduce heat consumption gradually from 400 kWh/m^2 in 2005 to 165 kWh/m^2 in 2050, a reduction of 60%; but with the consumption still above Scandinavian levels.

Efficient Transport

For transport is assumed that the conversion-efficiency from fuel to transport-work is increased 4 times with change from oil driven vehicles to electrical vehicles, partly with fuel cells (from current 15- 20% efficency in combustion engine systems to 50% in fuel cell vehicles and 60-80% for electrically driven vehicles) , and that the vehicles will be equipped with recoverage of break-energy, so the "end-use" of energy in transport is limited to the unavoidable friction losses in transport. This increase is expected to happen until 2050. Aviation and navigation are not included in this vision.

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1 International Network for Sustainable Energy, see www.inforse.org

2 Based on studies of the EU in the period 1985-2000

Growth Factors

The growth of energy services, i.e. heated floor space, transported goods and people, energy consuming production, is expected to continue for 2-3 decades and then level off for most sectors towards the end of the 50-year period of the vision. Assumed growth in activities for Russia:

- Floor space, households: 1.3% annual increase following current trend from 2000, in total 1.91 times increase from 2000 to 2050
- Floor space in service sectors: 0.5% annual increase 2000 - 2020 then slightly lower growth afte 2020, so the service sector area in 2050 will be 1.3 times the 2000 level[3]. While there is high growth in some private services, there is a large public sector that is expected to be stangnant, resulting in a total slow growth of the combined service sector
- Electric appliances in households and service: from 2000 to 2020 there is expected in total 20% higher growth than the growth in floor space. This will lead to 1.5 times increase in the service sectors electricity services in the period 2000 – 2050 and a 2.1 times increase in household sector in the same period..
- Industry: 88% growth in physical production volume, 2000 – 2050 (level in 2050 will be 1.88 times the 2000 level); and increased electrification leading to energy service level for electricity in 2050 of 2.8 times the 2000 level.
- Personal transport: the vision includes a 3- doubling of private car use 2000 – 2030, following current high growth. Then we expect a slow growth while rail use is expected to increase. In total is expected an increase of rail use of 67%, while bus use is expected to be stable.
- Freight transport: the vision includes a 3.9 times increase in the period for road and rail transports while water transport will deacrease 40% following current trends. Pipeline transport is expected to increase with increasing fossil fuel production until 2020 and then decrease to reach a level in 2050 15% below the 2000 level.

Graph: Development of selected activities 2000 - 2050 for Russia

While the energy service demand is expected to go up in all sectors, the energy consumption will go down because of the strong increase in energy efficiency included in this vision.

The energy supply shall also be improved, ad an improvement of CHP plant efficiency is proposed: gradually increasing the CHP plant average efficiency from 20% electric/57% total in 2000 to 50% electric/92% total in 2050. In the same period the electricity loss is proposed to be decreased from 17% to 10% with improved technologies. With the long transmission grids in Russia, it is probably not possible to reduce the grid losses to Western European levels of 5-7%.

Renewable Energy

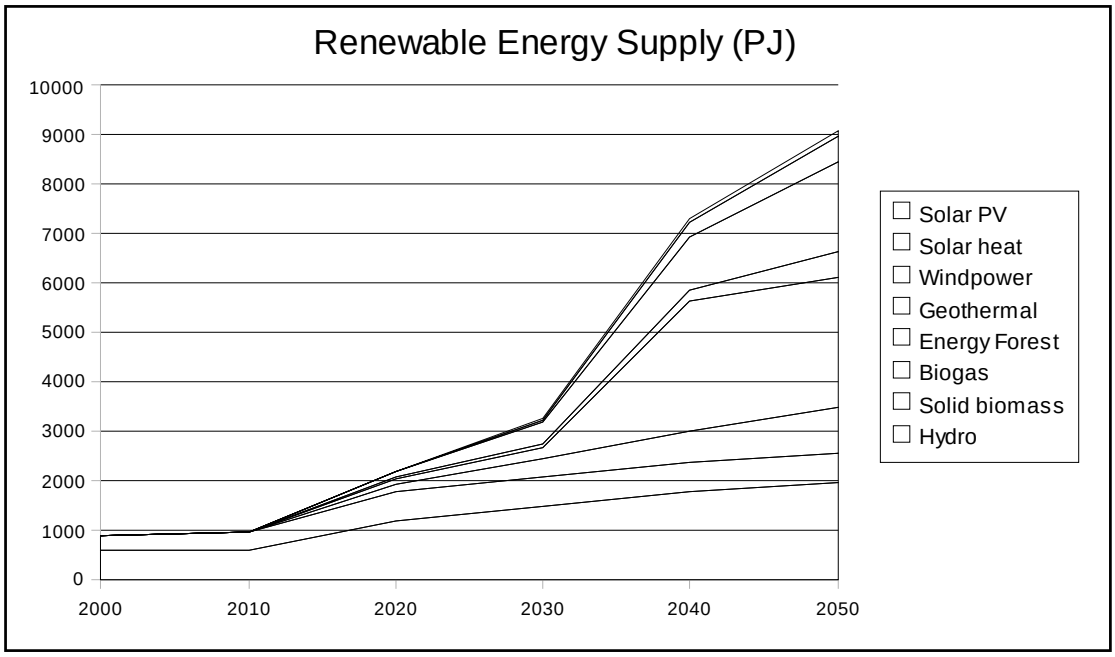
As a fraction of primary energy, renewable energy use is expected to stay at 3.5% of primary energy from 2000 until 2010 and then increase to 8% in 2020, to 17% in 2030, to 50% in 2040 and to over 90% in 2050. For electricity the share of renewable energy is above the share of primary energy and will remains so.

The most important developments are in windpower and biomass including use of agricultural land for biomass plantations, use of crops for biofuels and use of straw for heating and for combined heat and power (CHP) production. The installed windpower capacity is expected to grow to 170,000 MW and the use of agricultural land for energy plantations for solid biomass is expected to grow to 300,000 km2 until 2040 (1.75% of agricultural land) and then remain

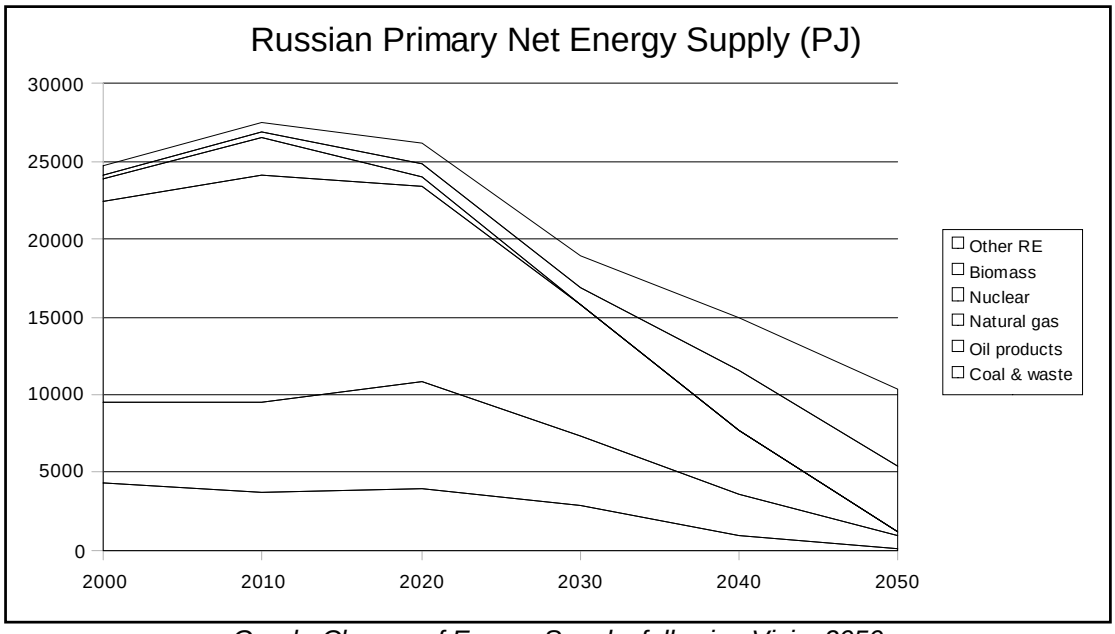
3 Because of a statistical error in the IEA data for the years 2000-2005 with an abrupt increase of 46% from 2004 to 2005, the model has an increase of 1.5 times in the area from 2000 where IEA statistics are used until 2010 and 1.75 times 2000-2050; but this is not based on actual increase

stable. Also the increased use of small hydro is important while increase in large hydro is excluded for environmental reasons. The hydropower is expected to increase from 164 TWh in 2000 to 546 TWh in 2050.

Increased use of solar and geothermal energies are included in the vision. For 2050 is included a combined area for solar heating and solar electricity of 4.6 m^2/person.



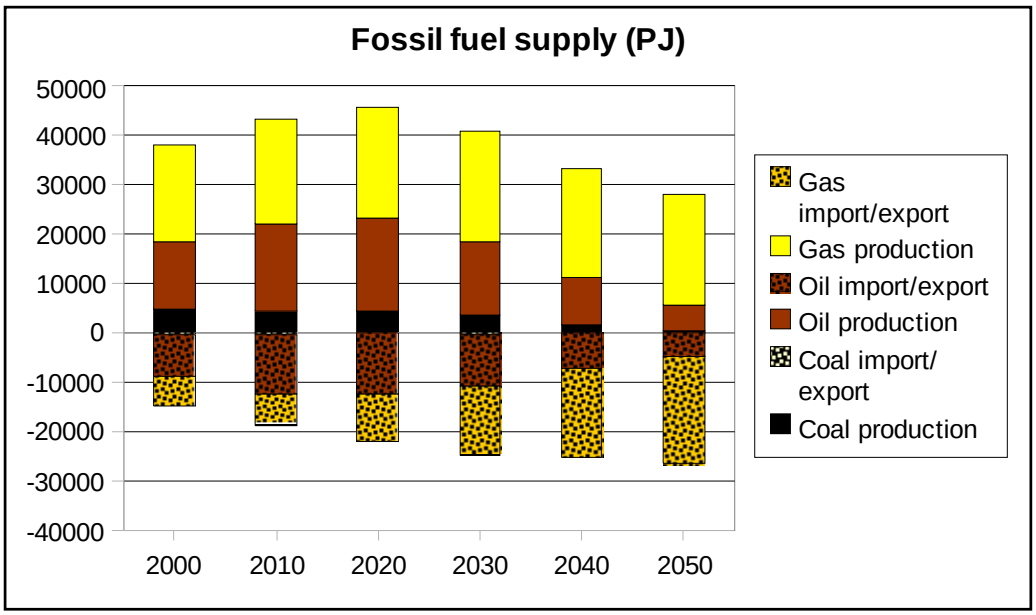
Graph: Development of Renewable Energy Supply for Russia, following Vision2050



Graph: Change of Energy Supply, following Vision2050

Nuclear and Fossil Energy

Nuclear energy is expected to be phased out until 2030. Fossil fuel use is expected to grow until 2010 and then gradually be phased out until 2050. The production of oil is set to follow low official Russian forecast until 2020 and then decrease based in a total production potential (oil reserve) of 52 times the 2000 production (R/P ration = 52 in 2000). The production of gas is set to follow the low official estimate until 2020 and then remain stable until 2050 (the gas R/P ratio is estimated to be 167 for 2000 in which case a stable production can be maintained). Coal usen will wary until 2020 and then decline to 1/3 of the 2000 level in 2040 and to less than 5% of the 2000 level in 2050.

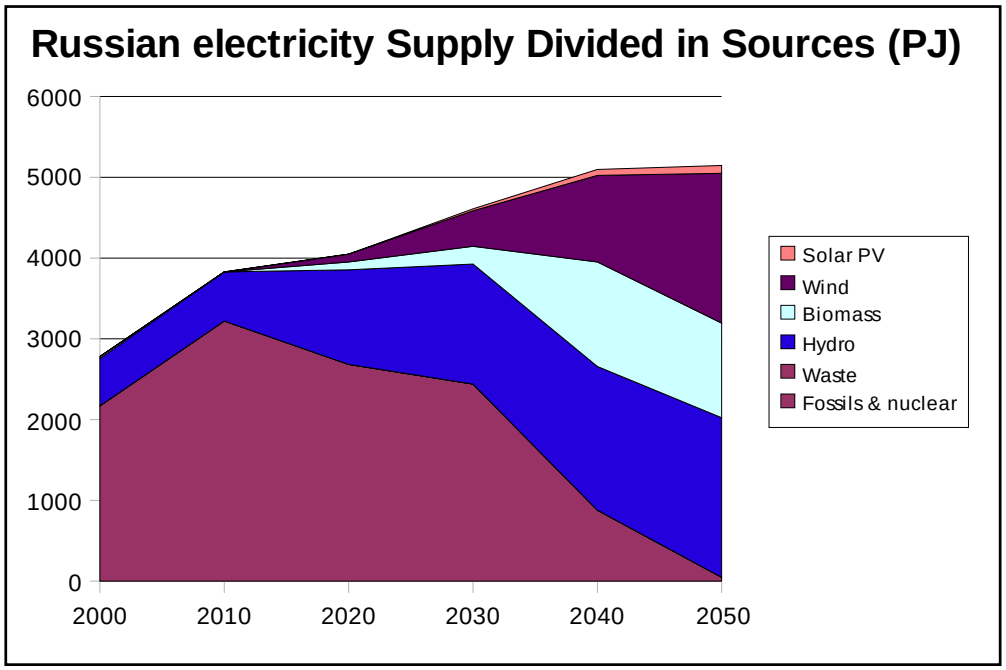


Graph: Fossil fuel development for Russia, according to Vision2050

Energy Conversion, Hydrogen& Heat Pumps

The energy conversion system will also be changed. The electric grid is likely to increase in importance, because electricity will be used increasingly for transport, directly or via conversion to hydrogen. The increasing dependence on intermittent electricity supply makes it necessary to have energy storage in some forms and maybe flexible electricity consumption.The fraction of intermittent power is expected to be 10% in 2030 and 37% in 2050. Current hydro pump storages can be used for this; and flexible electricity consumption with heat pumps and hydrogen production will further compensat the intermittent production. As energy storages will be needed hot water tanks in district heating networks to and there will also be needed some hydrogen storages. The combination of hydro-pump storages and flexible electricity consumption is expected to be able to fully compensate for the fluctuating production; but there can be regional issues of intermittent production that need further attention.

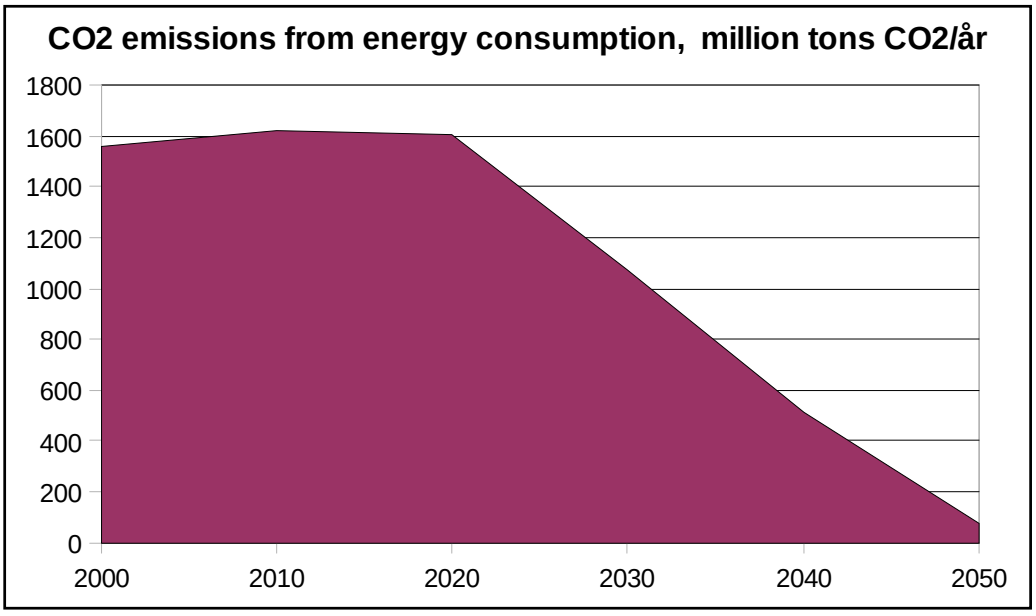
Gas networks could continue for export. They might also play a role for transportation of biogas and maybe for hydrogen.



Graph: Development of electricity production and sources, following Vision2050

Energy Trade

Energy trade is expected to be ess than today, only a moderate electricity exchange is expected as well as gas export .



Graph: Phase out of CO_2 emissions

The assumptions used in the vision are described in more details in the document: "A sustainable energy vision for Russia until 2050, -Background note", March 2008, INFORSE-Europe, available from www.inforse.org/europe

The vision was developed by Gunnar Boye Olesen, INFORSE-Europe in cooperation with and Igor Babanin, Greenpeace Russia

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