Belarus Vision for Sustainable Energy

International Network for Sustainable Energy -Europe and MD-IAE, November 2011.

This paper describes a Belarus Sustainable Energy Vision. It includes a transition of the energy supply and demand with phase-out of fossil energy and energy imports over a 50-year period.

If this vision is turned into reality it will have a number of positive effects for Belarus that is heavily dependant on imports for its fossil fuel supply. With a transition to domestic energy sources, Belarus will no longer be hurt directly by the energy prices increases of fossil fuels that many expect will come as a result of the dwindling resources of fossil fuels. With realisation of the vision, Belarus would also be in the front in the reduction of fossil fuel use and mitigation of climate change among former Soviet countries, a position that can be very valuable in the future. Further, the emphasis on local resources will also benefit the economy with increased employment and a more positive trade balance.

The vision includes a reduction of electricity imports, increased use of renewable energy, strong emphasis on energy efficiency, and reduction of natural gas use after 2010.

Factor 4 for Energy Efficiency

In line with INFORSE's[1] global vision for sustainable energy, the Belarus Vision is based on increase of energy efficiency to reach an average level in 2050 similar to best available technologies today. A number of studies have shown that with best available technology, on the market or close to market introduction, it is possible to increase energy efficiency with a factor four or more for most energy uses. 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 achieved 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 is about 1% per year (proven for EU countries). It will require concerted actions from stakeholders involved and stop of import of the the most inefficient products,but 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 set cost-effective requirements for for energy efficiency throughout the society. The factor four increase of efficiency is possible in Belarus electricity demand (except for construction that has very little electric intensity today), for road transport and for industrial heat and fuel demands.

The Challenge of Reducing Heat Consumption

For buildings the situation is different from equipment and vehicles because buildings often have lifetimes of 100 years or more. Many of the houses to be heated in 2050 are probably already built. Statistics indicates that efficiency of heating did not improve 2000 – 2005. On the other hand, the need for large replacement or major renovation of block houses build during the Soviet Union gives an opportunity for large increases in efficiency, if appropriate standards and support is in place. For Belarus is proposed a reduction of specific heat demand to 28 % of the 2000 level for dwellings and 37% for service sector buildings.

Efficient Transport

For transport is assumed that the conversion-efficiency from fuel to transport-work is increased 3 times (from current 15- 20% in combustion engine systems to 50-80% with respectively fuel cell systems with break-energy recoverage and direct 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 (except for aviation). This increase is expected to happen until 2050, leading to a factor 4 increase of energy efficiency. The changes are only expected after 2020, and the efficiency increase 2010 – 2020 is only expected to be 22%.

Growth Factors

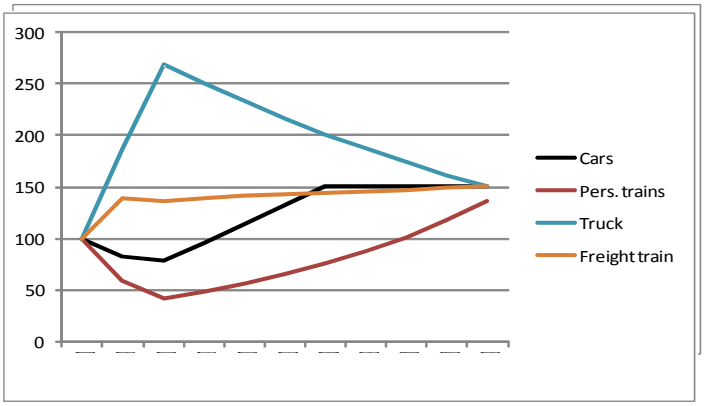
The growth of energy services, i.e. heated floor space, transported goods and people, energy consuming production, is expected to follow current trends, and then level off for most sectors

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

towards the end of the 50-year period of the vision, except public transport where a large growth is estimated 2020-2040. The development is in general not “business as usual”; but will require policies to redirect economic development to less resource-demanding sectors and solutions, such as train transport instead of road transport for personal transport and stop of electric heating. Assumed growth in activities for Belarus are:

- Floor space, households: increase of 16% 2010-2020 following trends from 2000, then slow growth of about 0.6%/year leading to a 64% larger dwelling area in 2000 than in 2050.
- Floor space service sectors: no increase 2000 – 2010 based in statistics, then 16% growth 2010-2020, then growth of 2%/year until 2050, where there will be 2.1 times a large service sector as in 2000
- Electric appliances in households and service: 20% higher growth than growth in heated floorspace until 2020 and then growth following growth in heated floorspace. This will lead to an electric energy service level in 2050 of 2 times the 2000 level.
- Electric appliances in service sector: 20% higher growth than growth in heated floorspace until 2020 and then growth following growth in heated floorspace. This will lead to an electric energy service level in 2050 of 2.5 times for service sectors.
- Industry: following a 12% increase 2000 – 2010 the activity is expected to be stable 2010-205; assuming that increased value in industry will come from improved quality instead of increased quantity, following trends in Western Europe.
- Personal transport: Following a reported decrease in car use (in statistics: car ownership), the vision includes a doubling of private car use 2010 – 2030, following current growth. Then we expect a stabilisation on the 2030-level, equal to 1.5 times the 2000 level. Bus use is reported to have experienced a 22% decline 2000 – 2010, and it expected to regain the activity until 2020 and then grow 2.5%/year until 2050, where it then will be 2.1 times larger than in 2000. Rail use was reduced 58% 2000 – 2010. It is expected to regain the activity of 2020 until 2040 and the grow 36% until 2050.
- Freight transport: the vision includes an increase in freight train use of 36% 2000-2010 and then gradually slower growth 1.5 times the 2000 level in 2050. The road freight increased 2.69 times 2000 – 2010, but it expected to reduce to a more sustainable level of 1.5 times the 2000 level until 2050. Pipeline transport is expected to reduce almost 90% 2010 - 2050 with the decrease in fossil fuel use.

Graphs: Development of selected activities 2000 - 2050 for Belarus

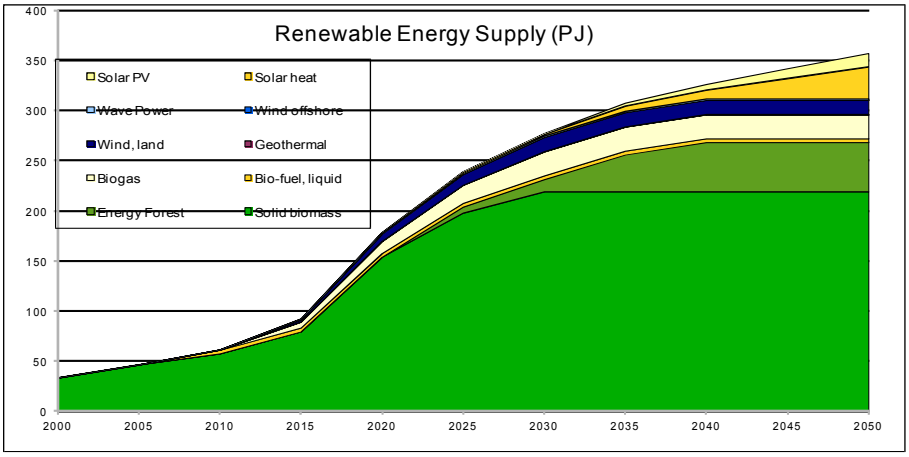


An underlining assumption for this development is a generally stable population in Belarus, with fluctuations below approx. 10%.

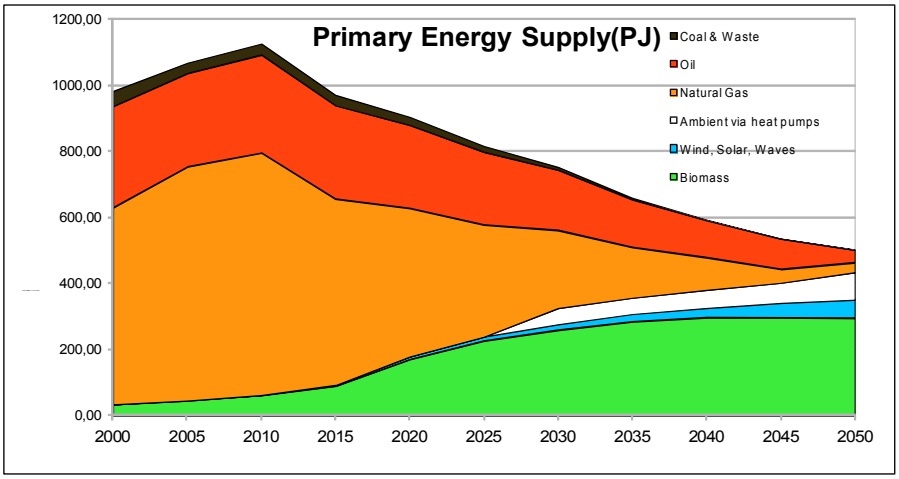
Renewable Energy

As a fraction of primary energy, renewable energy use is expected to grow from the 2000-level of 3.5% to 5.5% in 2010, to 20% in 2020, 39% in 2030, 61% in 2040 and 85% in 2050, where the remaining 15% is fossil fuel use for non-energy purposes, and as such not fossil fuel use for energy. For electricity the renewable share is below the share of primary energy, starting with below 1% in 2000, increasing to 22% in 2020, 65% in 2030 and 100% in 2045 and later.

The most important developments are in windpower (2000 MW installed capacity) and biomass including important use of agricultural land for biomass plantations, use of straw for heating and for combined heat and power (CHP) production. The use of agricultural land for energy plantations for solid biomass is expected to be 4000 km^2 , the current area of non-used agricultural land. Also increase use of solar is including in the vision to the reaching 8 m2/person of solar collector for heat (3 m2/person) and for electricity (5 m2/person). There is also a smaller increase in use of hydro-power. Geothermal is not included as the temperatures are low and the potential is uncertain.



Graph: Increase in renewable energy supply, following this vision



Graph: Change in primary energy supply, following this vision. The decrease after 2020 is because assumptions of a less material growth than today and strong emphasis on energy efficiency.

Fossil Energy
Fossil fuel use is expected to grow until 2010 to cover electricity production and increasing heat and transport demands and then gradually be phased for energy use until 2045, but some use might continue for non-energy purpose.

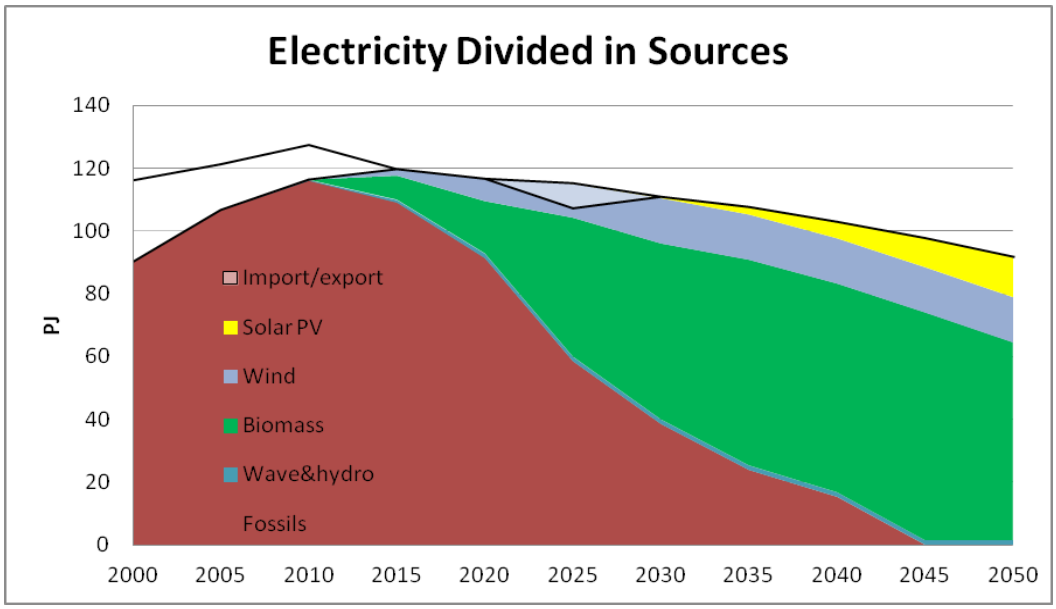
Energy Conversion
The energy conversion system will also have to be changed. The electric grid is likely to increase in importance, because electricity will also be used for transport, directly or via conversion to hydrogen. The increase in electricity demand and the change to biomass power will require construction of biomass CHP plants to produce 20 TWh (72 PJ) of electricity until 2050 with 80% of the construction until 2030. This will require construction of 3000 - 4000 MW of biomass CHP plants of which 2500 – 3500 MW until 2030.

The feed-in of intermittent electricity supply from windpower and later solar PV can be managed with regulation on thermal and power plants; but it will be necessary to construct heat storages in the form of hot water tanks to the CHP plants to decouple heat production and heat demand. With such storages CHP plants can better follow electricity demand. The intermittent electricity production from windpower will only be 30% of demand in 2050, and much less earlier according to the vision, so it will not require electricity storages. The regulation can be done by the thermal power plants, assisted by flexible load of the proposed electric vehicles and heat pumps with heat storages.

In the vision is included from 2030 large heat pumps that will supply to district heating when there is large electricity production from intermittent supply or CHP plants. in 2050 they will cover 45% of district heating supply.

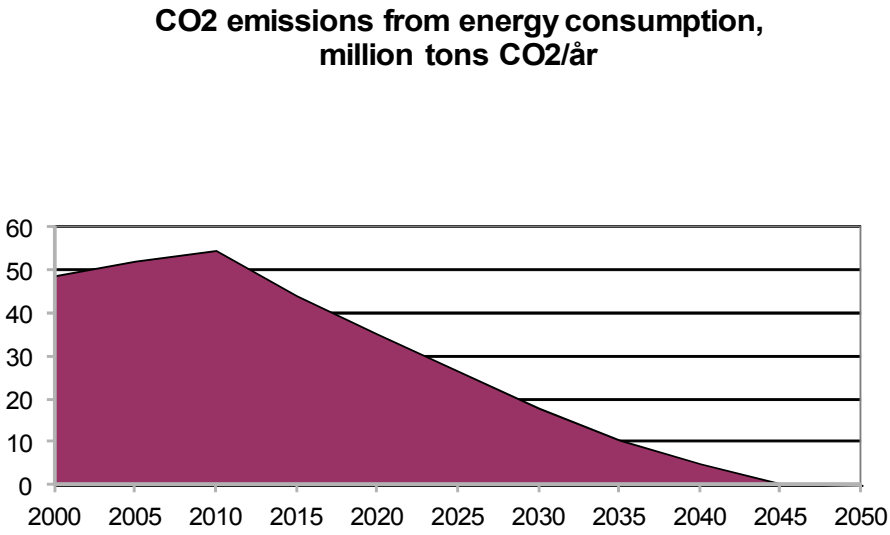
District heating is expected to remain its share in heat supply, but the delivered heat will gradually decrease with increased efficiency in heating and industry.

Gas networks are expected to have decreasing importance. They might play a role for transportation of hydrogen or biogas, and for gas storages that still will play roles as energy storages.



Graph: Development of electricity production and sources, following the vision. The reductions in power consumption after 2030 is caused by implementation of the large energy efficiency potentials in electricity use.

Energy Trade
Energy trade is expected to be much less than today, only a moderate electricity exchange is expected. Net electricity import is expected to be phased out in a few years, and there might even be export in some periods (in 2025 in the graph above).



Graph: Phase out of CO_2 emissions from energy

The above graph shows the CO_2 emissions from energy resulting from realisation of this vision. There will still be greenhouse gas emissions from other activities such as agriculture, probably including CO_2 emissions.

The assumptions used in the vision are described in more details in the documents:

A vision for Belarus based on INFORSE's Vision2050 - Background note, 1/12-2010.

and

Vision for a sustainable energy development for EU – 25, 2000 – 2050

These notes and other information on the vision will be available on www.inforse.org/europe

Comments should be sent to ove@inforse.org and iaebd@mail.ru

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