Bulgarian Vision for Sustainable Energy

INFORSE-Europe and Za Zemiata, November 21, 2008, version for comments

This paper describes a Bulgarian 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 Bulgaria that is dependant on imports for fossil fuel supply. With a transition to domestic, renewable energy sources, Bulgaria 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, Bulgaria would also be in the front in the reduction of climate change, a position that can be very valuable in the future. Further, the emphasis on local resources will also benefit the Bulgarian economy with increased employment and a more positive trade balance.

The vision includes a phase-out of nuclear power, increased use of renewable energy, strong emphasis on energy efficiency, and reduction of natural gas after 2010.

Comments are welcome, see end.

Factor 4 for Energy Efficiency

In line with INFORSE's[1] global vision for sustainable energy, the Bulgarian 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 in EU countries has been about 1% per year. It will require concerted actions from stakeholders involved, but if it is done on EU-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 factor four increase of efficiency is possible for road transport, for industrial heat and fuel demands, and in electricity demand, except for the agricultural sectors that has a low electric intensity today,

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 indicate 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 socialist period gives an opportunity for large increases in efficiency, if appropriate standards and support is in place. It is proposed to step up activities to reach an increase of at least 1.5%/year in improvement of the efficiency of heat use in houses and continue that for the coming 4 decades. The technical potential for this improvement exists. In parallel, efforts to change away from electric heating must be introduced. The efficiency increase will lead to specific heat consumption in 2050 of 55% of the 2000-level, that is low compared with European averages, mainly because of the low heat demand in parts of Bulgaria.

The vision does not include heat pumps in Bulgaria as they do not have so much added value in the Bulgarian energy system; but heat pumps have been included in INFORSE vision for other countries with more intermittent electricity supply (mainly windpower).

The wood use in Bulgaria should be made energy efficient as well, to reduce resource use increase performance. Better ovens can also reduce local pollution with particles etc.

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

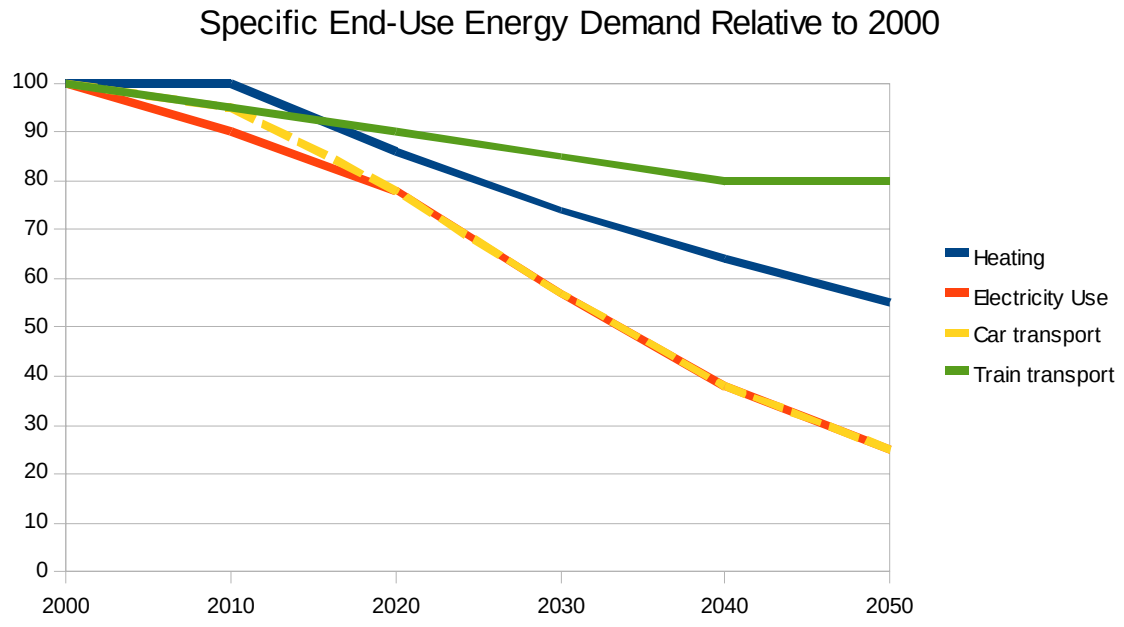
Cooling and Electric Heating

The increasing use of airconditioning is increasing energy demands in houses unnecessarily. While the increasing summer temperatures require actions to reduce indoor temperatures, there are much more energy efficient ways to that than present use of air-conditioning. First of all the cooling demand can be reduced substantially by shading sun away from windows during the warm part of the year, by trees that have a cooling effect, and most of the year also by ventilation during night time. Then the cooling demand can be met with the most energy efficient air-conditioning systems, including larger systems for larger houses. These measures combined can reduce electricity demand for air-conditioning by a factor 4 or more. The proposed strong increase of efficiency in use of electricity shall include measures to reduce cooling demand as well as more efficient air-conditioning more energy efficient.

In housing and service sectors there is also considerable use of electric heating. Gradual replacing of this with solar heating and other forms of heating is also one of the ways to use electricity more efficient in these sectors.

Efficient Transport

For transport is assumed that the conversion-efficiency from fuel to transport-work is increased 2.5 times (from current 15- 20% in combustion engine systems to 50% in fuel cell systems with break-energy recovery; direct electrically driven vehicles have even higher efficiency), and that the vehicles will be equipped with recovery 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. Most of the changes are expected after 2020.

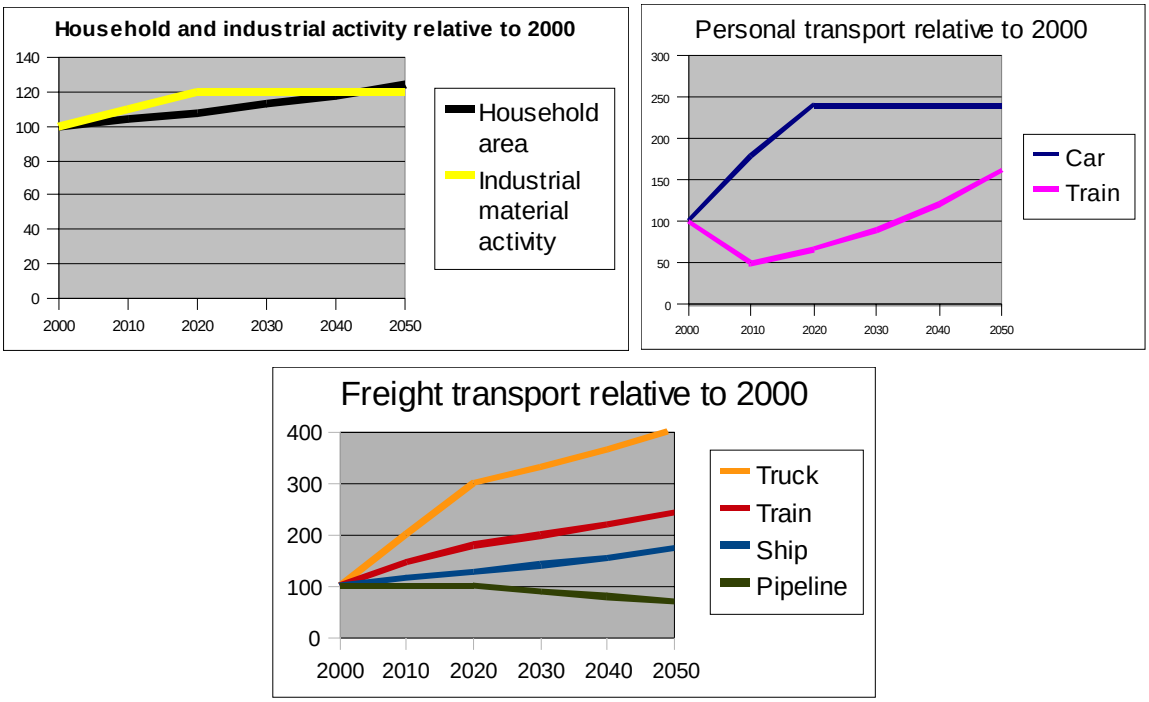


Graph: Specific energy consumption for four selected sectors, i.e. consumption relative to physical activity in the sector in the form of heated floorspace, use of electric equipment, transport of persons in person-km.

Growth Factors

The growth of energy services, i.e. heated floor space, transported goods and people, energy consuming production, is expected to be rapid for 2-3 decades and then level off for most sectors towards the end of the 50-year period of the vision. This corresponds with present rapid growth and later approximation to the slower growth in the EU countries. 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 Bulgaria are:

- Floor space, households: 4% increase 2000 – 2010, following current trends, then 4-5% increase per decade, leading to a level in 2050 of 124% of the 2000 level.
- Floor space in service sectors: strong (42%) increase 2000 – 2010, following current increase in heat and fuel consumption in the sector, continued strong increase after 2010, gradually levelling off, leading to a level in 2040 of 3 times the 2010 level.
- Electric appliances in households and service: 14% increase 2000 – 2010, then 10% higher growth than heated floorspace until 2020 and then growth following growth in heated floorspace. This will lead to an electric energy service level in 2050 of 1.44 times the 2000 level.
- Electric appliances in service sector: 52% increase 2000 – 2010 following current trends, then 10% higher growth than heated floorspace until 2020 and then growth following growth in heated floorspace. This will lead to an electric energy service level in 2050 of 2.2 times the 2000 level.
- Industry: growth of 10%/decade until 2020 and the stable (no growth in physical production volume), i.e. no growth in drivers for energy demand; assuming that increased value in Bulgarian industry will come from improved quality instead of increased quantity, following trends in Western Europe.
- Personal transport: the vision includes a 2.4 times increase in private car use 2000 – 2020, following current high growth. Then we expect a stabilisation on the 2020-level. Train use is expected to fall by 50% 2000 – 2010 following current trends and then start to increase 3%/year leading to a 2050 level of 1.6 times the 2050 level. As part of the increased train use, there are large opportunities to improve use of existing train lines in Sofia other places, where trains are a good alternative to the congested roads.
- Freight transport: the vision includes in the period of 2000 – 2010 a doubling of road freight, 48% increase in train freight and 16% increase in shipping following current trends, then a gradually slower growth leading to freight levels in 2050 of respectively 4 times, 2.5 times and 1.7 times the 2000 level for road, rail, and ship freight. Pipeline transport is expected to remain unchanged until 2020 and then gradually reduce with reducing fossil fuel use until 2050.



Graphs: Development of selected activities 2000 - 2050 for Bulgaria

An underlining assumption for this development is that the population development in Bulgaria will not fundamentally change the growing economy, but the modest growth expected in housing area reflects the current trend of lower population.

Renewable Energy

As a fraction of primary energy, renewable energy use is expected to grow from the 2000-level of 4% to 6.5% in 2010, to 19% in 2020, 28% in 2030, 53% in 2040 and above 95% in 2050. For electricity the renewable share is above the share of primary energy, starting with 8% in 2000 and increasing to 34% in 2020 and 75% in 2040.

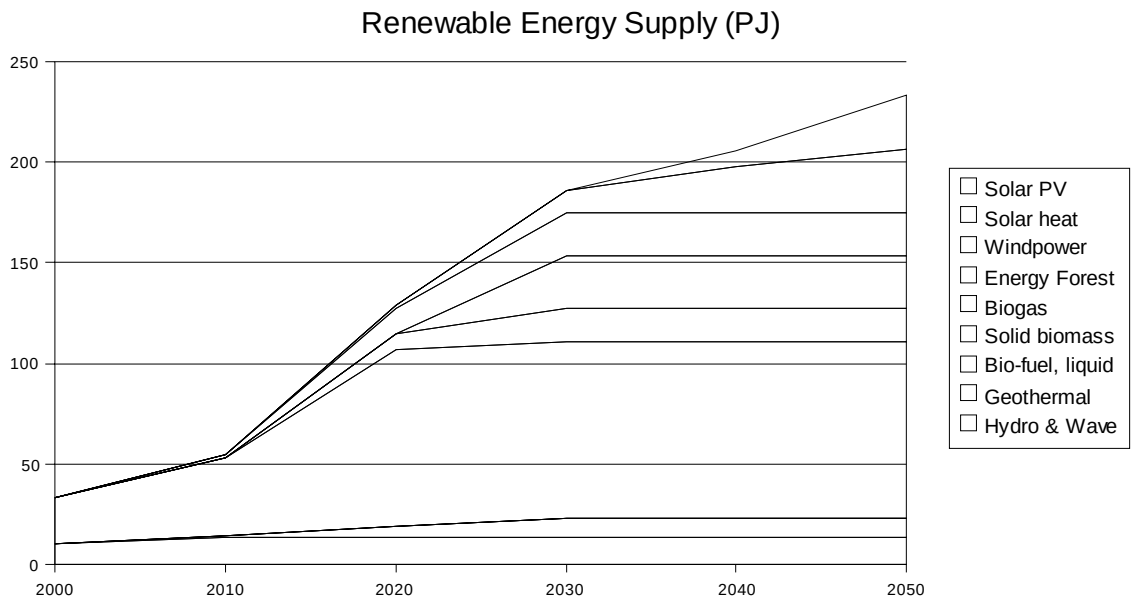
The most important developments are:

●windpower with development of 1700 MW on land until 2020 and a total of 3000 MW until 2030 including 1000 MW off-shore in the Black Sea. In 2007 34 MW of new windpower was installed.

●biomass including important use of agricultural land for biomass plantations, and use of straw for heating and for combined heat and power (CHP) production. Straw that is today burned on the fields can be used for energy, and the potential is estimated to 35PJ equivalent to 35% of the Bulgarian straw production from wheat and barley. The use of agricultural land for energy plantations for solid biomass is expected to increase to 1700 km^2 until 2030, similar to 42% of the current area of non-used agricultural land.

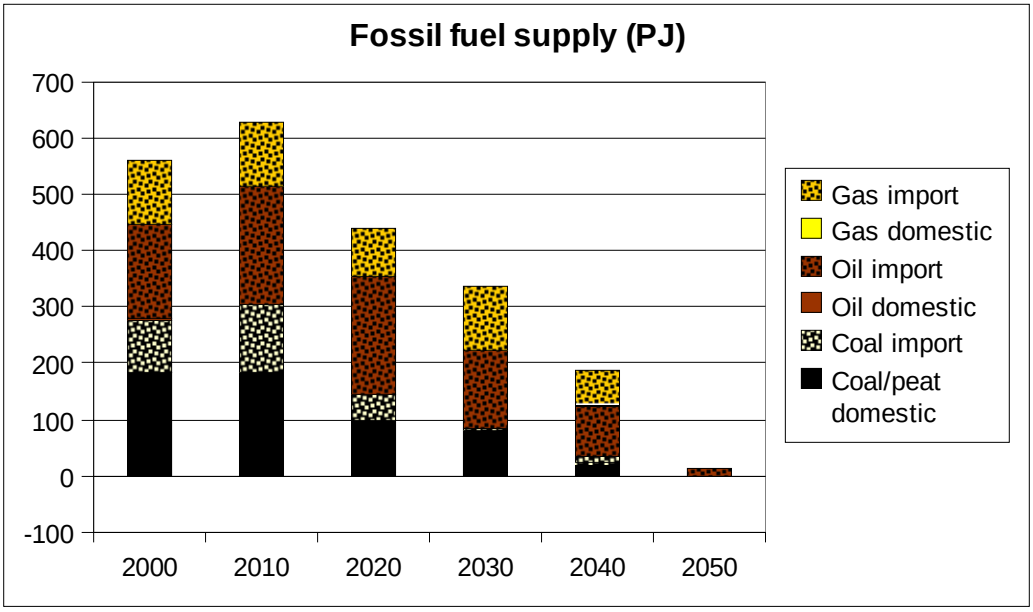
●solar heating with 1 mill. m2 by 2020 and 25 mill. m2 in 2050. Solar PV is also expected to play a role after 2020, with 49 mill. m2 installed by 2050.

Also geothermal, biogas and hydropower plays a roles in the vision, though hydropower only on the level of 2000 because of environmental problems with new hydropower developments.

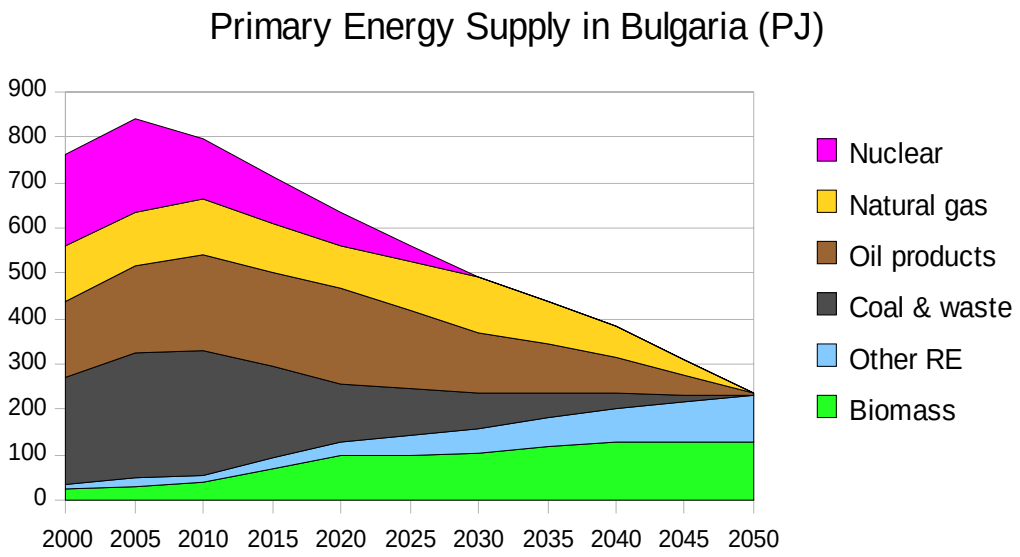


Graph: Increase in renewable energy supply, following this vision

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 out until 2050.



Graph: Fossil fuel supply in Bulgaria according to Vision2050



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.

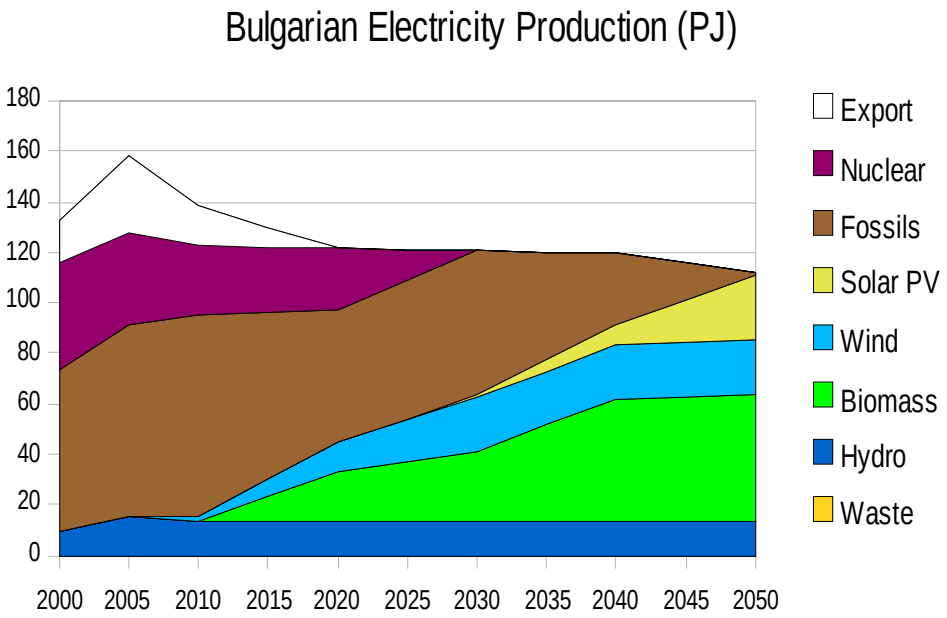
Energy Conversion, Hydrogen

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 power plants to produce 8.5 TWh (45 PJ) of electricity and 25 PJ heat until 2050. This will require construction of 1500-2000 MW of biomass power plants until 2020, with about half of this in operation by 2020.

The increasing dependence on intermittent electricity supply from windpower and later solar PV can be managed with regulation on thermal and hydropower plants; but it might 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 10% of demand in 2020 and then increase to 33% in 2040 and 43% in 2050, according to the vision.

District heating will remain important with increasing share of heat demand, but after 2020 lower heat delivered because of better insulated houses. In 2050 it might cover 50% of heat demand in housing and service sectors up from 45% in 2000.

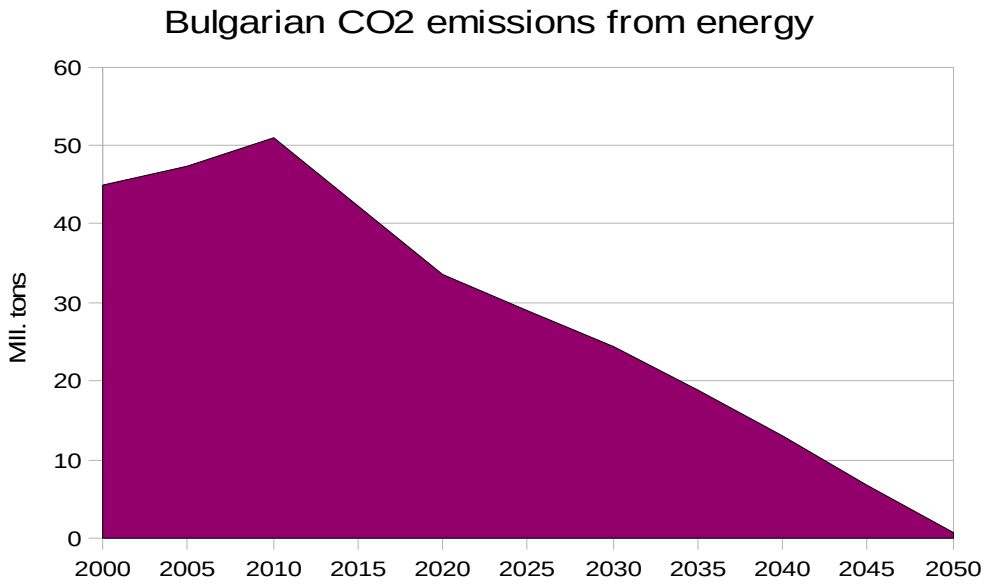
Gas networks are expected to have decreasing importance. They might play a role for transportation of hydrogen or biogas, but probably not for long-distance transport.



Graph: Development of electricity production and sources, following Vision2050. Net export is indicated on the top of graph, and is in this representation part of nuclear power production. In practice the export is not from one specific source of electricity.

Energy Trade

Energy trade is expected to be much less than today, only a moderate electricity exchange is expected. Net electricity export is expected to be phased out while electricity exchange with little net import or export is likely to continue in the following decades.



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 Bulgaria based on INFORSE's sustainable energy vision. Background note, October 10, 2008.

and

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

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

Comments should be sent to ove@inforse.org and