The possibilities for a Sustainable Energy Transition for EU

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Within the framework of a global vision for a change to sustainable energy until 2050 (Vision 2050), INFORSE-Europe[1] and member-organisations work on European and national visions for the transition of the energy systems. These visions show the opportunities as well as some of the obstacles to such transitions. The visions combine large increasesin renewable energy with strong energy efficiency measures, moderate growth, and a sustainable transport system.

Renewable Energy Development
The vision follows the EU target of 12% renewable energy in 2010, and shows how to realise the target of 25% renewable energy in 2020 as well as a transition to more than 95% renewable energy by 2050. The description of the vision includes overviews of the development of the different forms of renewable energy.

Windpower
The "Windforce10" report (updated in 2002 with the Windforce12 report) gives an overview of how it is possible to realise a large development of windpower in EU-15, following the current trends. Its targets are taken up by INFORSE, as well as by Greenpeace International, European Wind Energy Association, and others. The expected development starts with realisation of the 70,000 MW target set by European Wind Energy Association and others. It continues with a target of 220,000 MW windpower for 2020 and a final development to 375,000 MW windpower by 2040, utililising 88% of the estimated potential. Because of the large use of energy efficiency, it is not necessary to use all the full potential of windpower.
For the new EU countries is expected a modest development to 15,000 MW of windpower for the ten countries combined

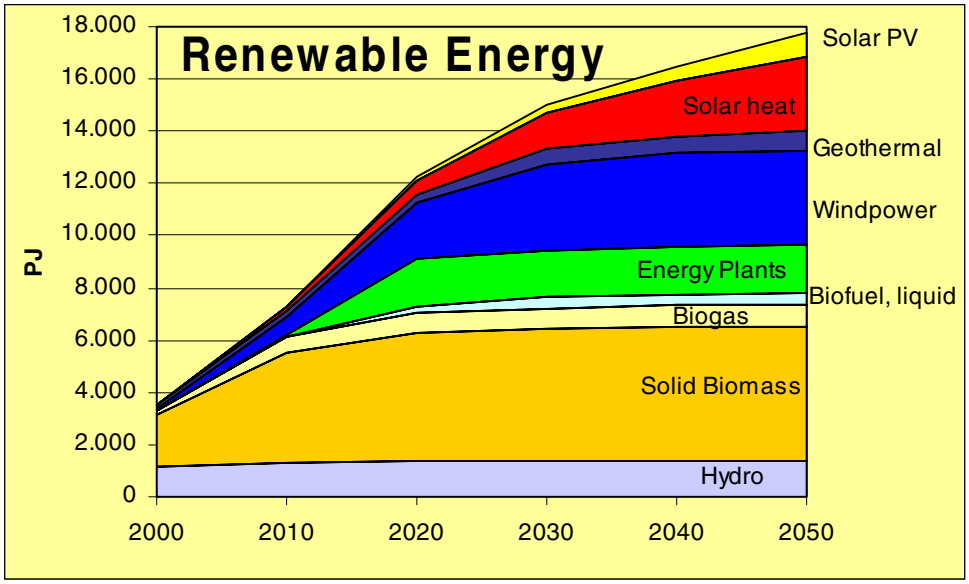
Solar
Solar heating as well as solar electricity is expected to play large roles. Solar heating can cover 10% of the heating demand, and more if seasonal storages are introduced. The use of solar heating is expected to raise to about 4.5 m2/capita, each m2 with a yield of 400 kWh/year in average. After 2030 is expected some use of seasonal storages, as solar will cover more than 10% of heat demand in some sectors in some countries.
The use of solar electricity (expected mainly as PV, but also solar thermal electric) is expected to increase to about 5.5 m2/year each with an expected annual average output of 100 kWh/m2. This would give an expected electricity production of almost 200 TWh for EU. Most of the development will take place in the later parts of the period.

[1] International Network for Sustainable Energy – Europe, a network of more than 60 independent organisations working for a transition to sustainable energy, see www.inforse.org. The network also publishes Sustainable Energy News, material for distance education on renewable energy, follow EU-policies, and education for sustainable energy.

Biomass
Until 2010 biomass is expected to grow to about 90% of the target for 2010 in the EU White Paper for Renewable Energy from 1997 for EU-15. The current trends are well below the target from the White Paper, so even 90% of the target is ambitious for 2010. While a large part of this development until 2010 is expected to be reached with biomass for heating, it is expected that biomass later will be used for cogeneration of heat and power. It could also be used for production of hydrogen for transport.
After 2010 solid biomass is expected to grow up to a sustainability limit of 4100 PJ for EU-15, indicated by the German Advisory Council on Global Change in 2003 (WBGU). This is an additional growth of 10%. The limit for the 10 new countries is set to 1000 PJ, following other estimates.
In addition to solid biomass is included use of biogas of 750 PJ (210 TWh gas), 8 times the level in 2000 for EU-15 and 104 PJ for the 10 "new" countries.
Energy forest is expected to be used after 2010, and to reach a level of about 7% of present agricultural land by 2020.
In addition to this is included liquid biofuels, to be used in transportation, construction and other sectors. The use of biofuels is expected to reach 330 PJ (91 TWh of fuel) using about 7% of the agricultural land.

Hydropower
For hydropower is expected a 20% growth for EU-15. This is similar to the growth expected until 2010 in the EU White Paper for Renewable Energy, but in the vision it is only expected to be realised by 2020. For the "new" countries is expected a 35% growth.

Geothermal energy and others
The use of geothermal energy for heating and electricity is expected to give 700 PJ in for EU-15 and 316 PJ for the new countries, mainly for heating.



Graph: Development of renewable energy forthe 25 EU countries according to the sustainable energy vision.

Factor 4 for energy efficiency
The vision is based on rapid growth of energy efficiency to reach an average level in 2050 similar to close 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 technologies, even though the efficiency gains required are very large, - in the order of 4 times. This will not happen by itself, given that the "natural" technological development (business a sususal) is 0.5 -1% per year increase of energy efficiency. It will require concerted action from all stakeholders involved, but indications are that if the market is large enough for each new generation of efficient equipment, it will be a cost-effective development - the extra equipment costs will be off-set by energy savings. It will also benefit equipment manufacturers that will get better products, also for the world market. 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 the 15 "old" EU countries, the target heat consumption is 60 kWh/m2 as 2050-average. This will require about a 57% reductions compared with current EU-average. If energy-efficiency measures are included in renovations, such a change is possible.. This could be realised by
• raising building-codes to current low-energy housing levels by 2010,
• require that all major renovations include a major energy-renovation, and
• embark on a major program for passive-houses to achieve that the majority of new buildings are passive houses.

For the new EU-countries is also expected a 57% increase in efficiency for space heating, but at a higher level of specific heat demand.

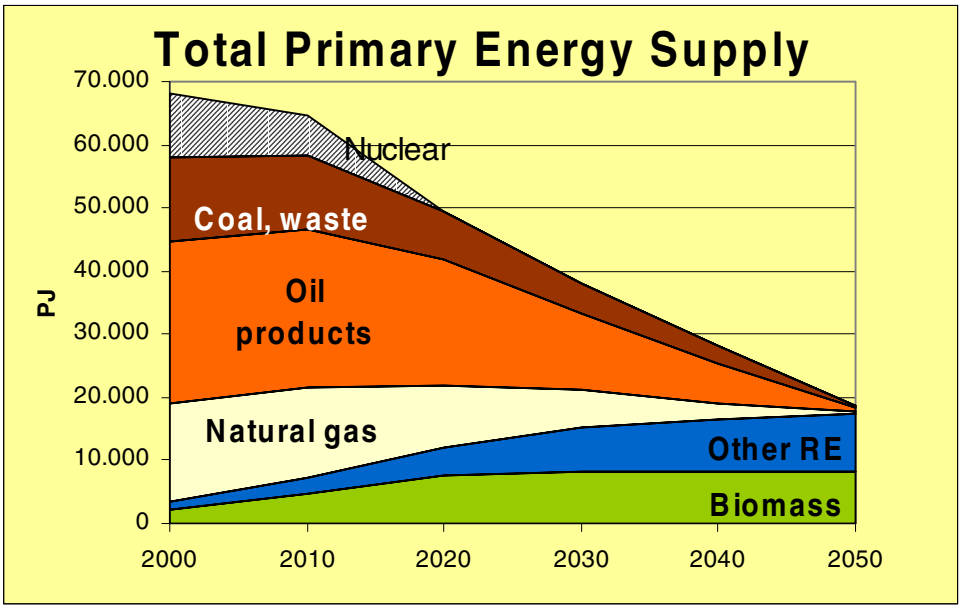
Efficient Transport
For transport is assumed that the conversion-efficiency from fuel to transport-work is increased 2.5 times (from current 15- 20% in combustion engine systems to 50% in fuel cell systems; direct electrically driven vehicles have even higher efficiency), and that the vehicles will be equipped with recovering of break-energy. The total efficiency increase is assumed to be in the order of 4 times compared with today's average.
For rail, and navigation are "only" included increase in efficiency gains of 40% and 25% respectively.

Decoupling Growth
The growth of energy services, i.e. heated floorspace, transported goods and people, energy consuming production, is expected to reach saturation levels during the 50-year period of the vision. This is in line with the perception that the average Western European

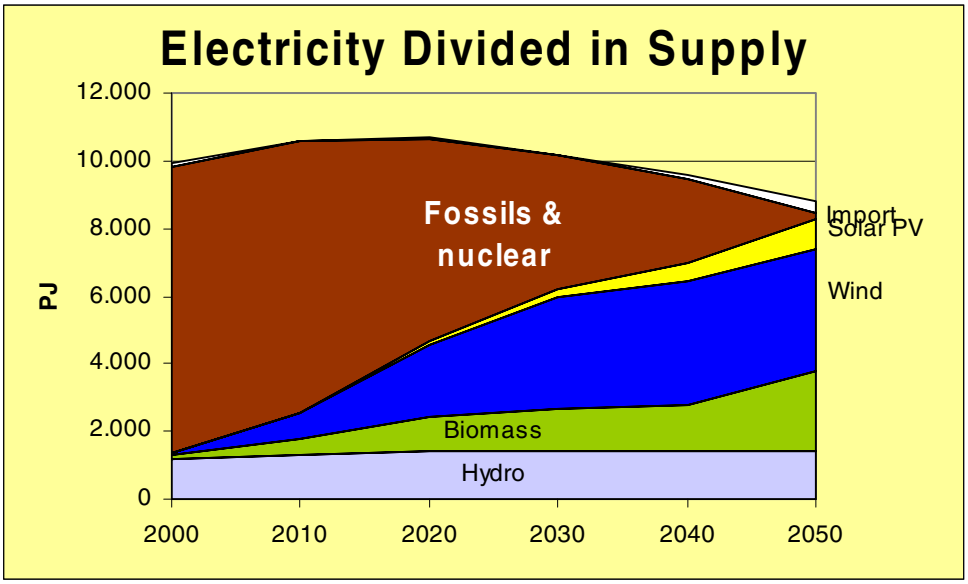
has reached a sufficient level of material consumption to satisfy needs. If this is to be realised, it will require that the growth of energy services does not follow the expected economic growth, i.e. that the economic growth is decoupled from growth in material consumption such as energy services. Alternatively the economic growth could come to a halt. For the 15 “old” EU-countries, the growth 2000 – 2050 varies from +40% for use of household appliances to – 35% in road transport. The reduced road transport is not in line with current trends; but it is certainly part of the visions of a large number of NGOs that want to reduce road transport to improve environment, in particular in towns, where most alternatives exists.
For the 10 "new" EU countries is expected higher growth than for EU-15, mainly for service and road transport. For both these sectors is expected a 2.5 times increase.

Energy Conversion, Hydrogen& Heat Pumps
The energy conversion system should be developed to cater for the changes. The electric grid is likely to increase in importance, because electricity will also be used for transport, directly or via conversion to hydrogen, and some heating will be via the use of heat-pumps. The large dependence on intermittent electricity supply make it necessary to have flexible electricity consumption and energy storages in some form. It is expected that use of current storage in hydropower, pump-storage etc. combined with more flexible consumption for heat via heat pumps and for hydrogen can provide the necessary regulation at least until 2040. An obvious possible flexibility in power plants is to combine cogeneration plants with heat-pumps. When there is over-supply of electricity from solar and wind, the plant changes from producing electricity to consuming electricity, while still giving the heat users the necessary heat, and without loosing efficiency from turning to single production of heat or electricity. From 2040 there might be need in addition for electricity storages, e.g. as chemical storages.
For the "new" EU countries the use of windpower is expected to be less, and the need for electricity, leading to a lower fraction of intermittent supply, and less need for electricity storages.

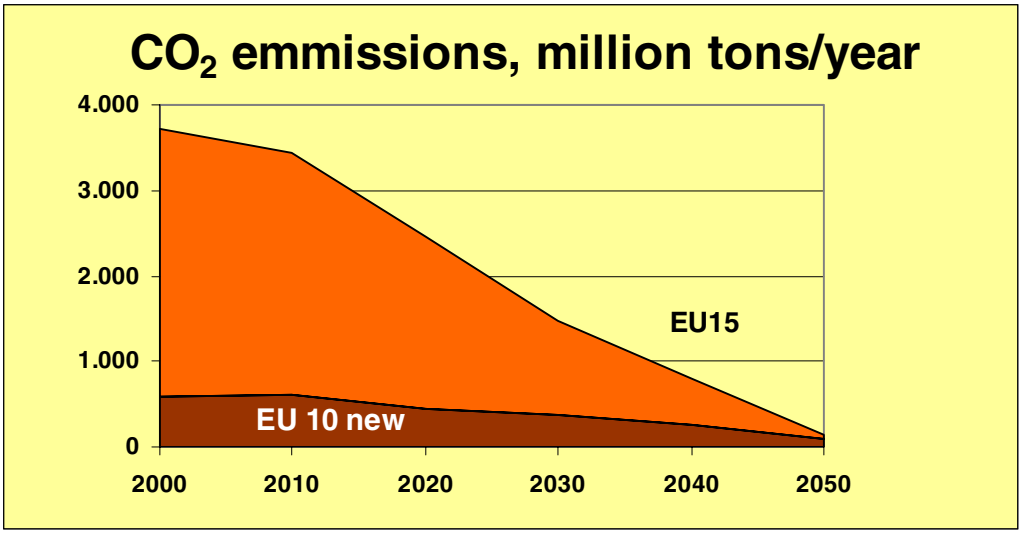
Results of the Vision
The vision will lead to decreasing primary energy demand as the efficiency in end-use and in the energy conversion system is larger than the increase in demands for heated houses, electric appliances, etc. The vision includes an increasing reliance on electricity, and as an effect the electricity supply is not reduced considerably; but a large part of this is assumed to be used for transportation.



Graph: The development of the Total Primary Energy Supply of the EU, if we follow the vision.



CO_2
The reduction of CO_2 from energy use is expected to follow the 8% reduction target for 2010, followed by a 30-40% reduction in 2020, more than 50% reduction in 2030, and more than 95% in 2050.



Graph: Development of CO2 emissions according to the vision.

Effect for Nuclear and Fossil Energy
Nuclear energy is expected to be phased out as the current nuclear reactors are stopped because of age, safety problems etc. In this vision, this is expected to happen until 2020. For fossil fuels are expected a gradual phase-out of coal-use until, a slow but increasing phase-out of oil use till 2050 and a growing gas consumption until 2010, followed by phase-out until 2050.

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

Effects for Energy Trade
Energy trade is expected to be much less than today, and if the efficiency potentials are realised EU-15 might not be an energy importer after 2040. The new EU countries have lower potentials for wind power, as well as for wavepower and other ocean energies that could supplement wind energy, but can also be sufficient or almost self-suffucient with energy by 2050, depending on the level of efficiency increase and growth.

Economic and employment effects
The energy efficiency measures are expected to be cost-effective, either because they are already cost-effective or because they can become cost-effective if implemented on a large scale. The renewable energy technologies are expected to become cost-effective in general before their main implementation phase. Solid biomass is cost-effective today and it is therefore given priority 2000 - 2020. Windpower is cost-effective today in some

sites, while it is expected to become cost-effective after 2010 in most relevant sites (main implementation 2010-2020). Energy crops and small-scale use of solar heating are both expected to become cost-effective after 2010 if the current trends continue (main implementation respectively 2010-2020 and 2010-2040). Solar for district heating and industry as well as PV is expected to become cost-effective after 2020 (main implementation after 2020).
Biogas is already cost-effective today, if additional benefits are included such as improved fertiliser qualities of the degassed manure.

The replacement of mainly imported energy with renewable energy and energy efficiency will give considerable employment benefits, in particular because most of the solutions are cost effective.

Measures for Implementation
A transition to sustainable energy as described in this vision can be introduced in a number of ways; but it will not happen by itself. It will require efficient policies and measures for energy efficiency, renewable energy, and a sustainable transport system. Proven measures already exists for this. They include internalisation of internal costs with energy taxes, awareness raising, quality and efficiency labelling, minimum efficiency standards, feed-in tariffs for renewable electricity and gas, most energy-related R&D allocated for sustainable energy, land-use planning to minimise transport, etc. Such measures have shown their abilities to give the necessary trends of change for specific technologies in individual countries, sustained for more than a decade. If these measures are used in a concerted way in the EU countries for the period until 2050, there can be little doubt that they can bring about the transition to sustainable energy.

Read more at: www.inforse.org/europe, where you also can find information about the global vision and visions for Denmark, Slovakia, Romania and other countries.