POSITION PAPER

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Flexible renewable resources will be the key for an optimal electricity mix

As the Commission is due to present its Energy Roadmap 2050 in the autumn 2011, the geothermal, hydropower and biomass industry outline their recommendations for the elaboration of the energy 2050 strategy. The decarbonisation of the electricity sector will only be possible with a large additional contribution from the flexible renewable energy sources (RES) in order to replace base load production from coal, gas and nuclear. The geothermal, biomass and hydropower industries present their scenario which is not only economically attractive but also gives a significant contribution to security of supply, grid management and CO2 emission avoidance. In the end this scenario demonstrates how the interconnected renewable portfolios can meet all demands of a modern low-carbon energy system.

Geothermal, hydropower and biomass energy will be a major contributor to a 2050 energy scenario forming a less costly energy mix scenario (cf. figures 1 & 2 in annex). The decarbonization of the electricity sector will be possible only with a large additional contribution from flexible renewable energy sources (RES) in order to replace base load production from coal, gas and nuclear. Flexible RES are able to provide power whenever it is needed, following demand curves instead of resource availability curves - and in that respect are the indispensable companion of variable RES like wind power and solar radiation.

1) <u>The total costs for our electricity mix in 2050 will be cheaper with flexible RES</u>

Providing renewable base load, flexible RES do not have external costs associated with traditional fossil fuels such as storage, grid and supply infrastructures or waste management (CO2, nuclear).

Geothermal has the underground to store heat, biomass can be stored in different forms (solid, liquid) and hydropower reservoirs are used to store potential energy in form of water. This means that those technologies do not need costly storage systems. Neither is there a need for supply infrastructures from external countries when using

flexible RES. These flexible RES technologies are present in Europe and they are complementary.

Providing reliable base load, geothermal, biomass and hydropower can be easily integrated in the power systems. In addition, these technologies can provide peak load and the necessary grid regulation services to ensure system stability by compensating highly variable production patterns of variable RES technologies. Moreover, being complementary with variable RES-e technologies, their integration will promote synergies in the grid infrastructure development across Europe.

By including all external costs, we can see that flexible RES technologies are by far the most competitive ones. External costs include notably carbon capture and storage for coal and gas and underground nuclear waste management. External costs must be included in order to have a fair and transparent competition in the energy mix costs analysis up to 2050. A major contribution from geothermal, biomass and hydropower will be the most economic scenario for the 2050 electricity mix.

2) Grid management

Flexible RES can be installed everywhere in the EU to balance the grid locally or regionally. They are able to manage additional variability resulting from variable renewables deployment. To cover variability in the net load, power systems must contain a sufficient contribution from flexible RES. Another advantage of geothermal, biomass and hydropower is their capacity in being sizable in order to respond properly to the local demand.

3) Security of supply

It is important to firstly develop local energy sources such as RES produced in Europe. Governments' responsibility, together with the EU, is to provide security of supply. Importing electricity from third countries is expensive and needs cross-border infrastructures. Decentralised and diversified systems for energy generation are less vulnerable to external risk and reduce transport needs and losses. Small-scale renewable energy sources are particularly suitable to be used in decentralized generation systems and to support the need for short term energy storage, whereas the deployment of variable renewable energy sources will increase the need for large scale and long-term storage.

4) Decarbonization: Replacing base load from nuclear & coal

While contributing to boost Europe's competitiveness, the European energy mix must simultaneously respond to environmental concerns and the need to combat climate change. To this end, the EU needs to extend renewable energy technologies as much as is technically and economically feasible, in particular flexible RES technologies.

Solutions such as nuclear energy or carbon capture and sequestration are not options for combating climate change. The assessment of nuclear energy and other mitigation options must consider a framework of rapid and significant CO2 emissions' reduction where the peak of emissions should already be reached for the industrialized countries within the next two decades. Nuclear power and CCS cannot offer this.

Flexible base load technologies will be crucial for Europe's energy security. In order to decarbonize the electricity system, while ensuring its stability renewable flexible technologies such as geothermal, biomass and hydropower will play an even more important role in the future energy mix than today.

Figure: GHG emissions per electricity technologies.

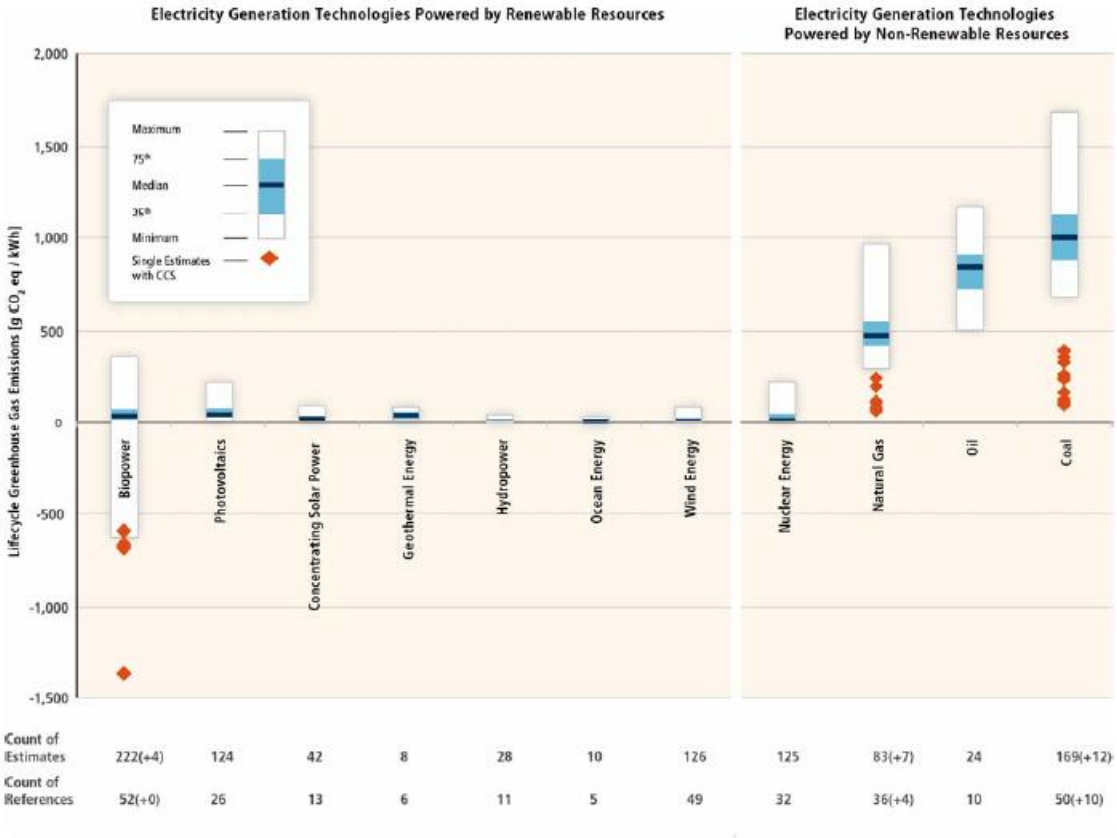

Figure SPM.8. | Estimates of lifecycle GHG emissions (g CO2-eq / kWh) for broad categories of electricity generation technologies, plus some technologies integrated with CCS. Land-use related net changes in carbon stocks (mainly applicable to biopower and hydropower from reservoirs) and land management impacts are excluded; negative estimates[10] for biopower are based on

[10] 'Negative estimates' within the terminology of life-cycle assessments presented in the SRREN refer to avoided emissions. Unlike the case of bioenergy combined with CCS, avoided emissions do not remove GHGs from the atmosphere.

Source: IPCC. 2011. Summary for Policymakers, p. 17.

The geothermal, hydropower and biomass industry can provide a significant contribution to both, our future renewable energy mix and urgently needed CO2 emission reduction. Flexible RES can meet at least 45% of the European Global Electricity consumption in 2050.

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ANNEX: The main advantages of flexible RES:

- they deliver power 24 hours a day, throughout the year
- they are available all over Europe with minor land use
- they are local resources, creating local employment
- they can be modulated according to type of resources, to size and nature of equipments, and in order to meet demands
- they supply base-load energy with a load factor higher than 60%

Figure 1: Energy costs with external costs (figures 2010, after AT Kearney analysis, June 2010 for ESTELA)

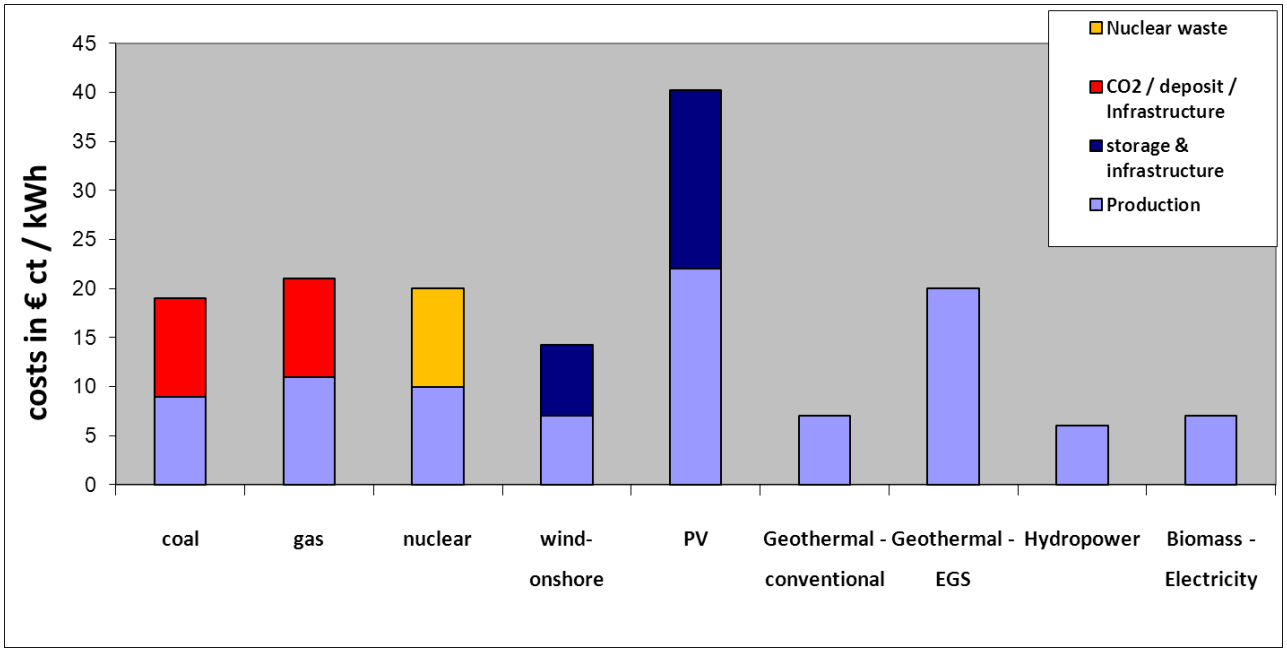
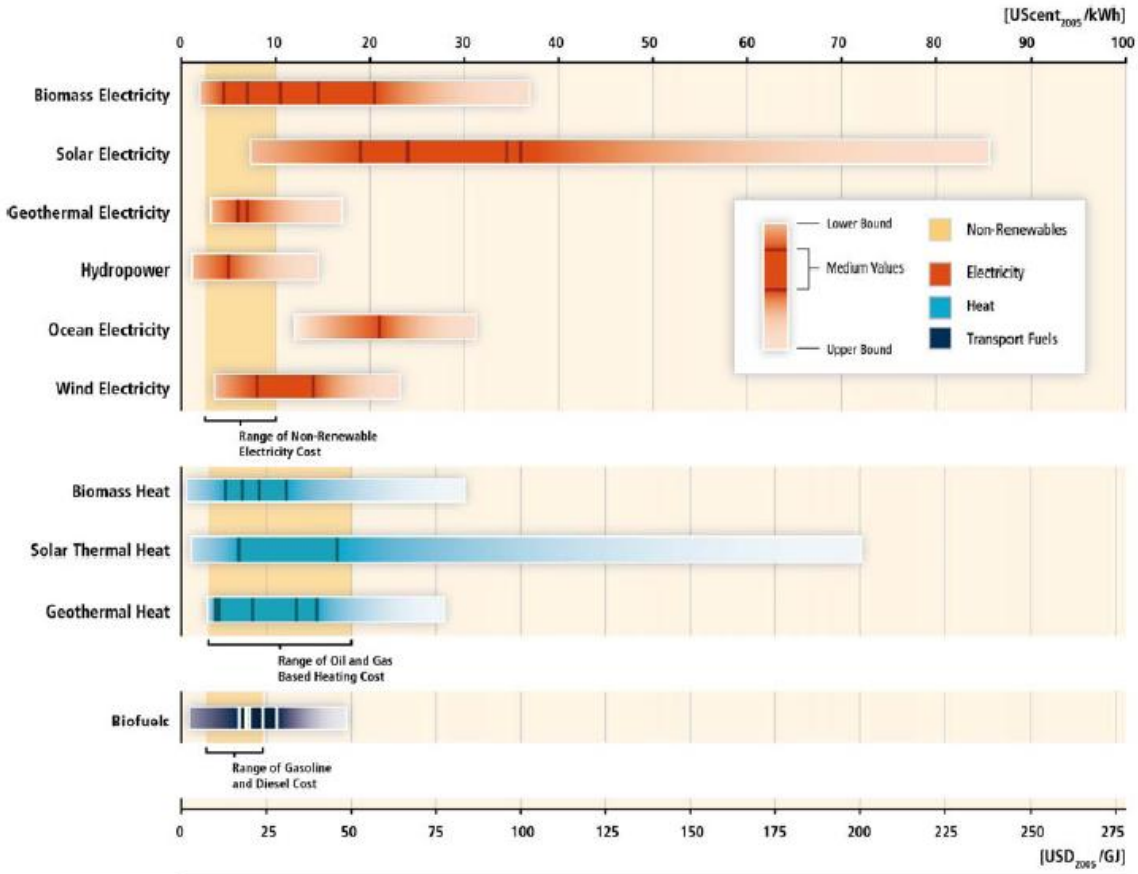


Figure 2: Range in recent levelized cost of energy for selected commercially available RE technologies in comparison to recent non-renewable energy costs.

Source: IPCC. 2011. Special Report on Renewable Energy Sources, Summary for Policy Makers, page 10



Notes: Medium values are shown for the following subcategories, sorted in the order as they appear in the respective ranges (from left to right):

Electricity	Heat	Transport Fuels
Biomass: 1. Cofiring 2. Small scale combined heat and power, CHP (Gasification internal combustion engine) 3. Direct dedicated stoker & CHP 4. Small scale CHP (steam turbine) 5. Small scale CHP (organic Rankine cycle)	**Biomass Heat:** 1. Municipal solid waste based CHP 2. Anaerobic digestion based CHP 3. Steam turbine CHP 4. Domestic pellet heating system	**Biofuels:** 1. Corn ethanol 2. Soy biodiesel 3. Wheat ethanol 4. Sugarcane ethanol 5. Palm oil biodiesel
Solar Electricity: 1. Concentrating solar power 2. Utility-scale PV (1-axis and fixed tilt) 3. Commercial rooftop PV 4. Residential rooftop PV	**Solar Thermal Heat:** 1. Domestic hot water systems in China 2. Water and space heating	
Geothermal Electricity: 1. Condensing flash plant 2. Binary cycle plant	**Geothermal Heat:** 1. Greenhouses 2. Uncovered aquaculture ponds 3. District heating 4. Geothermal heat pumps 5. Geothermal building heating	
Hydropower: 1. All types		
Ocean Electricity: 1. Tidal barrage		
Wind Electricity: 1. Onshore 2. Offshore		

The lower range of the levelized cost of energy for each RE technology is based on a combination of the most favourable input-values, whereas the upper range is based on a combination of the least favourable input values. Reference ranges in the figure background for non-renewable electricity options are indicative of the levelized cost of centralized non-renewable electricity generation. Reference ranges for heat are indicative of recent costs for oil and gas based heat supply options. Reference ranges for transport fuels are based on recent crude oil spot prices of USD 40 to 130/barrel and corresponding diesel and gasoline costs, excluding taxes.

Figure SPM.5| Range in recent levelized cost of energy for selected commercially available RE technologies in comparison to recent non-renewable energy costs. Technology subcategories and discount rates were aggregated for this figure. For related figures with less or no such aggregation, see [1.3.2, 10.5, Annex III].