How to Become Number 1 in Renewables

A contribution from the biomass, geothermal, and solar thermal sectors

The EU aims to become number one in renewables, according to European Commission's President Juncker. Already a leader in both renewable electricity and heating and cooling, Europe now faces fierce global competition.

The only way to reach this goal for both renewable electricity and heating and cooling is with structural reforms to move away from fossil fuels and further develop a wide variety of renewable energy technologies.

Key messages:

For the heating and cooling sector:

- More attention should be paid to the energy system as a whole. Renewables for heating and cooling are available and are ready to deliver. Their potential needs to be fully reached.
- A level playing field is not yet in place. Urgently, fossil fuels subsidies must be phased-out and their externalities priced.
- Renewable energy and energy efficiency go hand in hand. They must be addressed at the same time as they face similar barriers and can generate synergies.
- Special attention should be paid to the correct implementation of existing legislation, which should be strengthened beyond 2020.
- Policy makers should also promote awareness by informing consumers as well as local public authorities and installers about all available options.
- RD&I in renewable heat technologies is needed to reduce costs, enhance system performance, and facilitate their integration.

For the electricity sector:

- Geothermal, hydropower, solar thermal electricity, biomass and biogas are desirable flexibility options addressing increasing concerns over grid management and the stability of the power sector.
- It is vital to create a European domestic market which is supported with long-term financing and other incentives in order to bring innovative projects to the commercial stage.
- New market designs that reward the flexibility from renewable power generation should be developed;
- RD&I is crucial to improve flexibility of production from RES flexible technologies and develop the new generation of geothermal, biomass and STE technologies.

Part I: Becoming Number 1 in Renewables for Heating and Cooling

In 2013 Renewable heating and cooling (RHC), including aerothermal, biomass, geothermal, and solar thermal, represented around 16.5% of the European heating sector. As the heating sector itself represents around half of the EU's final energy consumption, renewable heat consumption is greater than renewable electricity in absolute terms.

Renewable heating and cooling technologies are the only options to decarbonise the heating sector. These technologies are key for an efficient and affordable switch from fossil fuels to sustainable alternatives, be it at the residential and tertiary level, or for industrial processes. The forthcoming Heat Strategy should recognise the potential those technologies have in the achievement of a leadership role for the EU.

There is an enormous untapped potential in the heating and cooling sectors for the decarbonisation of EU economies, for the reduction of energy dependency and to increase competitiveness. An innovative and future-looking industry is today already available, mature and, under certain circumstances, cost-competitive but could progress even further if the right decisions are made today.

Renewable heating and cooling enables energy savings as it makes use of efficient enabling technologies such as cogeneration, district heating, and heat pumps. Deep renovation includes the replacement of inefficient boilers; this is the perfect moment to integrate RES in buildings. Similarly, the new generation of district heating grids can favour the integration of renewable heat, including low-temperature geothermal and solar thermal resources. **In the heat sector renewable energy and energy efficiency go hand in hand most of the time. They must be addressed at the same time.**

The RHC industry offers a wide variety of jobs, bringing immeasurable benefits in areas such as construction that have been hit hardest by the economic crisis. In 2013 direct and indirect jobs relating to renewable heat already amounted to 470 thousand[1].This number can more than double by 2030. It is of the utmost importance to set an appropriate framework: RHC technologies are already competitive in several areas, and could be much more competitive elsewhere.

In the short-term, policy-makers should ensure the following four crucial elements:

a) A level-playing field between RHC and fossil fuels;
b) Solutions to the challenge of financing the consumer's upfront investment;
c) Implementation of existing legislation and development of a new regulatory framework to ensure the integration of RHC in buildings, industry and smart thermal grids.
d) The fostering of research, development, and innovation

[1] Source: European Technology Platform on Renewable Heating and Cooling, Common Implementation Roadmap for Renewable Heating and Cooling Technologies. Available online: http://www.rhc-platform.org/fileadmin/Publications/RHC_Common_Roadmap.pdf

Figure 1: Renewable heating and cooling technologies[2].

a) A level-playing field between RHC and fossil fuels

A level playing field is not yet in place. Firstly, the heat sector is dominated by heavily subsidised fossil fuels, ensuring the control of markets by incumbent historical operators. As an example, the recent European Commission (EC) study "Subsidies and costs of EU energy" highlights that subsidies to gas amount to 6.5 bn, while support to an emerging technology such as geothermal amount to 70 million. **Fossil fuels subsidies must be phased-out with the utmost urgency.**

Secondly, in most EU countries there is no carbon price, as 90% of the heat sector falls outside the scope of the ETS, and only a limited number of countries have a carbon tax in place in sectors outside ETS. Where a carbon tax is not politically feasible, and in order to offset this market failure, fuel switch to renewable sources of heating should be supported.

b) Solutions to the challenge of financing the consumer's upfront investment

Another important driver for fuel switching is access to financing, which is currently a huge barrier for integrating RHC in buildings and industrial processes. Decentralised and small scale RHC technologies require investment by consumers, and the higher upfront investment that RHC implies is a burden, in particular when small scale financing in Europe still suffers from the effects of the financial crisis. In this regard, it should be stressed that renewables for heating and cooling and energy efficiency should be addressed at the same time, notably in the building sector, as they face similar barriers and can generate synergies. Both must be addressed by the Commission in the forthcoming Smart Financing for Smart Buildings Initiative.

c) Implementation of existing legislation and development of a new regulatory framework to ensure the integration of RHC in buildings, industry and smart thermal grids

[2] Source: European Technology Platform on Renewable Heating and Cooling, Strategic Research and Innovation Agenda for Renewable Heating & Cooling. Available online: http://www.rhc-platform.org/fileadmin/user_upload/members/RHC_SRA_0418_lowres.pdf

In terms of concrete regulatory measures, it is not necessary to re-invent the wheel. It is rather a matter of spreading the knowledge about how to use a wheel properly.

Implementation of existing energy efficiency and renewable energy legislation is crucial. **Special attention should be paid to the correct implementation of articles 13 and 14 of the Renewable Energy Directive** dedicated to renewables in buildings, to the reduction of administrative barriers, to improved information for consumers, and training of installers. **Beyond 2020, these measures should be strengthened**, boosting the renovation of the existing building stock.

Overall, policy makers should promote awareness, involving citizens in their energy choices, and informing consumers as well as local public authorities and installers about available options.

d) The fostering of research, development, and innovation (RD&I)

The EU should continue supporting technological development to ensure that Europe retains its status as a world leader in manufacturing and design, reinforcing its main competitive strengths. More attention should be paid to the energy system as a whole, to the development of smart thermal grids and to new industrial processes able to decarbonise the non-ETS sectors.

RD&I in renewable heat technologies is needed to reduce costs, enhance system performance and facilitate the integration of RHC into existing infrastructure. It is also needed to increase the temperature level and cover additional industrial sectors. The RHC industry is ready to invest in R&D programmes, at a rate of 3 euros to each 1 invested by both Commission and Member States.

Part II: Becoming Number 1 in Renewables for electricity generation

Europe is the undisputed leader of innovation in renewable electricity technologies. The European know-how is exported everywhere in the world. Yet, internally, the successful story of renewable electricity technologies is at risk due to regulatory uncertainty.

Indeed, the electricity system in Europe is currently undergoing a revolution. The centralised conventional system, based on fossil fuels and nuclear and built under monopolistic market conditions, is being transformed by market liberalisation and the recent significant penetration of renewable energy sources.

The increasing deployment of fluctuating wind and photovoltaics has caused some concerns over grid management and the firmness of the power sector. Additional flexibility is therefore needed to keep the electricity demand and supply balanced at all times.

In this context flexible and more stable renewable energy sources such as geothermal, hydropower, solar thermal electricity (STE), biomass and biogas, are desirable flexibility options to generate power along with demand-side management, interconnections, and storage.

Flexible RES technologies can be used in partial load operation and in certain cases can quickly ramp their output up and down on demand. In binary technology even changes in the range of 20 to 100% with a speed of 2% per second could be achieved with proper management of turbine and by-pass valves, as has already been implemented according to the requirements of German legislation. Operators of flexible RES installations can therefore offer ancillary services to system operators and provide valuable short and long-term

flexibility at a regional level, a step between centralised and decentralised systems. This is one of the many benefits of these technologies which are not well known.

These technologies, however, have been neglected in recent energy scenarios and policy-making. In 2012, Flexible RES produced (excluding STE) only 525TWh, representing less than 15.8% of the total EU electricity consumption.

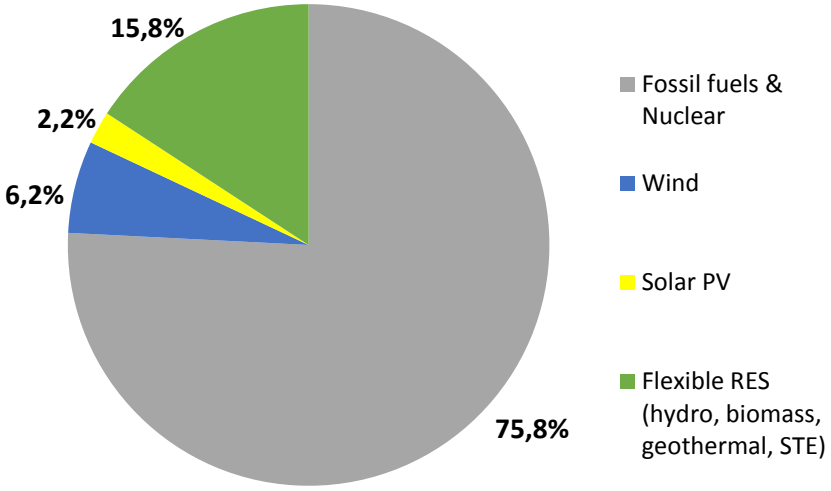

Figure 2: Gross electricity generation from Flexible RES and other technologies in 2012. Source: Eurostat

A stable electricity system needs to be based on a variety of sources and technologies, producing power close to demand centres, where it has the highest value and ensure electricity security. This approach can alleviate the need for additional transmission and distribution infrastructure as well as costly storage. Overall, this will result in lower system costs and more social support for the transformation of our energy system.

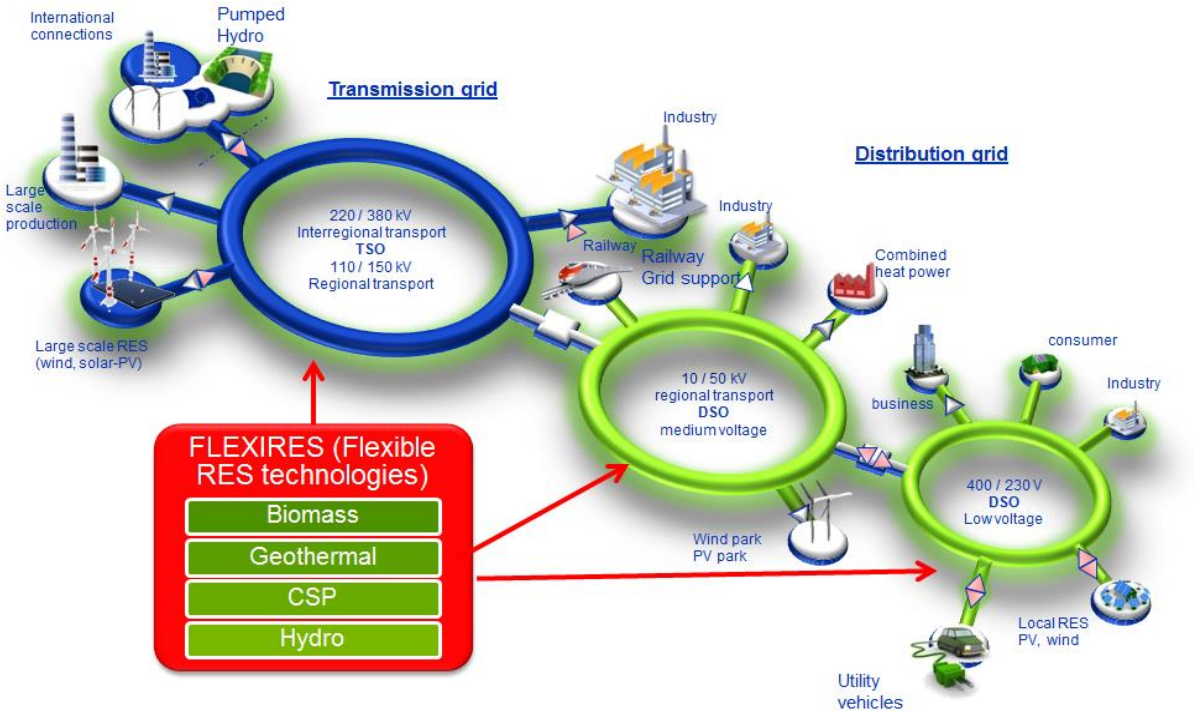

Figure 3 Source: Courtesy of DNV GL, adapted from 'De Bosatlas van de energie; Noordhoff Uitgevers B.V. 2012'

In this framework, it is worth noting that while renewable electricity technologies have been blamed for distorting the market, this is certainly not the case for geothermal, biomass, biogas, STE. As shown in the "Subsidies and costs of EU energy" study, these technologies have been allocated a staggeringly insignificant amount of public support compared to mature or less mature technologies. For example, in 2012, geothermal received only €70 million. In comparison, solar PV received €14.7bn, coal €9.7bn, wind €11.2bn, nuclear €6.6 bn. This significant discrepancy is all the more regrettable given that the European industry is ready to deploy new innovative and low-carbon technologies.

Policy-makers should ensure the following crucial elements:

For the short-term:

- **A *domestic* market**. To maintain the global leadership for flexible renewables in Europe and to develop this industry, it is vital to create a European domestic market. This market needs to be supported for next 5-10 years from a well-coordinated combination of financing sources to reduce costs and bring innovative projects to the commercial level.
- **Improvement of the current regulatory framework,** e.g. use of cooperation mechanisms as foreseen in the existing RES Directive.
- Development of a European strategy for ensuring grid flexibility with renewable dispatchable power plants and mitigating system costs.
- An analysis by the EC of how stable sources of renewable energy such as geothermal power, hydropower, biomass and solar thermal electricity, can help to develop grid flexibility while limiting costs of storage and grid infrastructures.
- Better protection of investors/investments against retroactive changes in national policies and/or regulatory frameworks with a strong mediator role for the EC between investors and governments.

For the medium-term:

- Development of new market designs that reward the flexibility from renewable power generation.
- Update of ENTSO-E's Ten-Year Network Development Plan (TYNDP) with data on flexible renewable sources.
- Horizon 2020 and R&D national programmes to finance flexible renewable demonstration plants.

For the medium and long-term:

- RD&I to improve flexibility of the production from RES flexible technologies and develop the new generation of geothermal, biomass and STE technologies.

Conclusions

The Commission's objective to become number one in renewables is something to be proud of. But the Commission must act now on this statement and promote its vision. Renewables for heating and cooling and for flexible power generation be central stage if the EU wants to be world's number one in renewables. This requires a holistic approach, structural reforms, and political courage.

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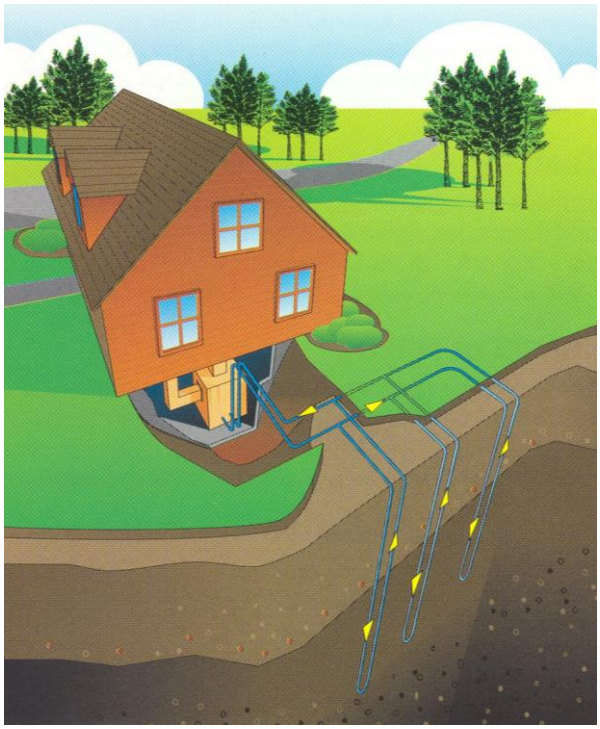
ANNEX

Industrial competitiveness and renewables for heat and flexible electricity generation

Geothermal:

Geothermal District Heating plant in Copenhagen. Copyright EGEC



Shallow geothermal system, copyright IF technology/ ReGeoCities

From the earth, a renewable energy resource delivering heat and power 24 hours a day throughout the year, an energy resource nearly infinite and available all over the world.

By definition, geothermal energy is the energy stored in form of heat below the earth's surface. It has been used since antiquity for heating, and for more than 100 years also for electricity generation. Its potential is inexhaustible in human terms, comparable to that of the sun.

Geothermal electricity in Europe is growing continuously, not only in traditional areas but also in areas with low-medium temperature resources through the utilisation of binary plant technologies. Indeed, after some years of slower development in Europe, the geothermal electricity market has seen a renewed momentum in the last 5 years. The second generation geothermal technology, so-called Enhanced Geothermal Systems, is only in operation in Europe up to now, whereas research projects are on-going in the U.S. and Australia.

Beside electric power generation, geothermal energy is today used for district heating, as well as for heating (and cooling) of individual buildings, including offices, shops, small residential houses, etc.

With 1.3 million units of geothermal heat pumps installed, Europe is the world leader, in terms of installed capacity, in the shallow geothermal market. It is also leading in innovation such as in underground thermal energy storage. Main competitors are for heat pumps manufacturers in China and the USA.

With 247 geothermal district heating (geoDH) systems in operation, Europe in also the global leader for geoDH where global competition exists mainly for heat exchangers and pipes. Regarding direct uses, even though this geothermal sector started in Europe, China is now leading the market due to the large demand there.

In the EU, geothermal employment appears to be fairly stable at about 50 thousand direct and indirect jobs, mostly in heat-related applications (EurObserv'ER, 2012). As geothermal technologies are site specific (geology is different all over Europe) and capital-intensive, many geothermal companies have developed customised products (example: drilling rigs manufacturers). It is expected that the factories and the jobs created will remain local and cannot be exported. The sector will move from a geological approach to an engineering approach where systems can be replicated but can hardly be industrialised. It is estimated that 85% of the geothermal value chain in Europe is local and it is planned to remain as such. Because of the nature of the work, we can assume that construction and O&M cannot be relocated, meaning that they are "European" jobs. Regarding equipment (rigs, turbines), the number of large manufacturers is not forecast to boom internationally.

Biomass

Biomass in heating:

The EU, together with the United States and Brazil (mainly for ethanol), is a dominant producer and employs the largest number of workers in the sector (345 thousands according to IRENA). As agricultural and forestry operations play a large role in the sector, bioenergy can support rural economic development as cultivation and harvesting biomass feedstock indeed requires large numbers of people.

To date, technically reliable, sustainable and economically attractive biomass heat solutions exist. Biogas and solid biomass can already provide heat at various temperatures at costs competitive with fossil fuel alternatives. In the coming years, these solutions will continue to improve and new solutions should also be available so as to cover the different consumption types. With biomass supply set to increase significantly by 2020, a sustainable, innovative and cost-efficient advanced biomass feedstock supply will bring reductions in supply costs and a decrease in production costs.

The EU is a global leader in biomass technologies and provides a wide range of high quality biomass combustion installations with high efficiency, controlled and clean combustion and automated operation and modulation both for domestic and commercial uses. Through a permanent commitment in innovation and R&D the European biomass industry keeps improving the quality of the products that are put to the market. As an example, the most performant EU biomass boilers and stoves can reach 90% energy efficiency today with very low levels of emissions (NOx, SOx and particulate matters).

Biomass for Electricity

Dedicated biomass plants are plants specifically designed to use biomass as fuel. They often use low cost fuels such as wood chips and, in some cases, agricultural by-products such as straw. Co-firing offers a possibility to produce large amounts of renewable electricity using existing power facilities. In this case high quality wood fuels such as pellets are used. Pellets are milled to powder and burned with coal in existing conventional power plants. In some recent cases cofiring plants have been converted to use 100% biomass. Cofiring or conversion of existing coal fired plants to biomass results in fairly low electricity generation costs.

Electricity can be generated from a wide range of biomass technologies. Biomass can be converted into electricity using processes similar to those used with fossil fuels, such as:

- Steam/turbine: This technology is based on the direct burning of biomass in a boiler to produce steam. The steam then drives a turbine, which turns a generator to convert the power into electricity.
- Gasification: Through gasification, biomass is heated in an environment that enables the solids to be converted into a synthesis gas, which can then be burned in conventional boilers or used in turbines to produce electricity.
- Organic Rankine Cycle (ORC): This technology is based on a turbogenerator working as a normal steam turbine to transform thermal energy into mechanical energy and finally into electric energy through an electric generator.

These technologies can be used in CHP plants together with heat production or only in power plants.

Solar Thermal

China is by far the world leader in solar hot water, representing 67% of the total installed capacity in operation, which amounted to 269.3 GWth by the end of 2012.[3] Europe, with an installed capacity of 42.8 GWth represents 15.9% of the total. Even though China is by far the largest market and the largest manufacturer, the European solar thermal industry is seen in the world as a technology leader with strong capacity of innovation. From 1995 to 2010, the sector reached a learning curve of 23%.

Several innovations on manufacturing process, i.e., welding, have helped to reduce manufacturing time and costs, while enlarging the raw materials options (now both copper and aluminum are widely used in the sector). In terms of capacity, the European sector has invested in counter cycle, meaning that there is enough capacity to address a steep rise on demand for collectors. While its traditional market is the preparation of domestic hot water for the residential sector, large applications for district heating or industrial process heat have seen significant growth. For instance, in Denmark the total solar thermal installed capacity reached 550 MWth in 2013, with almost half of the total installed capacity referred to very large installations (262 MWth). The newly installed capacity in 2013 amounted to 73MWth, 90% of which for large installations (ESTIF 2014).

The European market reached a turnover of 2.3 billion EUR in 2013 and an estimated 27 600 full time equivalent workers employed in the sector (ESTIF 2014). Depending on the markets, approximately half of the turnover is downstream of the value chain, pushing for the creation of local jobs in planning & design, commercialization, installation and maintenance, while over 80% of the market is supplied by European manufacturers.

[3] Solar Heat Worldwide: Markets and Contribution to the Energy Supply 2012. Edition 2014

Solar Thermal Electricity

Solar Thermal Electricity (STE), also known as Concentrating Solar Power (CSP), is a technology that produces heat by concentrating solar irradiation. This heat can be used to generate electricity with a steam turbine or as process heat for industrial applications. By storing the thermal energy and/or using hybridization, STE is able to firmly deliver electricity on demand without additional cost – even after sunset. STE is grid-friendly not only due to thermal energy storage, but also due to the use of conventional turbine technology to generate electricity.

In Europe, 56 plants with an installed capacity of 2380 MW are currently connected to the grid, another 4 plants are under construction. The 4 technologies available are Parabolic Troughs, Central Receivers, Parabolic Dishes and Linear Fresnel Reflectors.

With only 4.5 GW installed globally, STE technology is relatively new and has a strong potential for further innovation and cost reduction. By 2020, sustainable STE electricity will be the most competitive source of dispatchable electricity in the parts of the world with good Direct Natural Irradiation (DNI).

Seizing the advantages of STE for EU energy security requires in particular strengthening the internal electricity market through new transmission lines (especially between the Iberian Peninsula and the rest of Europe, also in Italy and Greece) and EU support for a programme to build RES power plants in its Southern Neighbourhood.