Assessment of energy savings potential and EU funding for heating and cooling

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Abstract

Aim of this paper is to provide a comparison between the potential energy savings and the portion of research funding for the heating and cooling sector in Europe. Data has been collected through literature research and analysed in order to assess the expected energy savings in the heating and cooling sector and, at the same time, to quantify the European Union´s funding for energy related researches and developments. On one hand, expected energy savings in the heating and cooling sector account for more than 50% of the total potential energy savings in Europe. On the other hand, the Seventh Framework Programme finance for heating and cooling issues is circa the 7% of its total energy budget and from that almost 3% account for renewable heating and cooling energy sources.

1. EU energy consumption

Europe is one of the largest economies worldwide and its energy needs rely mainly on imports for almost all of its fossil fuel needs (1) (2) (3). In fact, documented oil reserves worldwide account approximately for 1,342 bn. barrels (4) and the total oil production per day in the EU (European Union) of around 2.3 mil. barrels covers only a limited percentage of its consumption (5). Fossil fuel is imported in Europe mainly by pipeline and ship (6) (7).

In past decades, natural gas consumption has grown rapidly (8). Nowadays, a decline in the exploitation of natural gas deposits took place (9). Because of this and of the domestic energy consumption growth, the countries´ dependence on imported gas has increased.
Natural gas, renewable sources, and solid fuels are gradually replacing oil as energy source (10).

The energy consumption in Europe has been increasing constantly since 1990 (11). Most part of the energy consumption is given by H&C (heating and cooling) (about 50%), followed by electrical and transport applications (with 20 and 31% respectively) (12) (13) (14) (15).
The energy intensity in EU-15 countries is below the average of the EU-27 countries and the intensity of CO2 emissions is slightly lower than the EU-27 average (16). Electricity is the most used type of energy for cooling applications (17). Regarding to this, it has to be stressed, that 43% of electricity is produced by fossil fuels in EU-27 (18).

According to the EU 20-20-20 targets until 2020 a reduction in EU greenhouse gas emissions of at least 20% below 1990 levels is foreseen. Furthermore, 20% of EU energy consumption is expected to come from renewable resources. What´s more, a 20% reduction in primary energy

use compared with projected levels has to be achieved by improving energy efficiency (19).

1.1 EU H&C facts and figures

The absolute majority of energy consumption in the European households is given by heating and cooling applications (20), which account for about 75% of the total energy consumption of EU households. Especially for cooling purposes, the energy consumption is rising and rising - particularly in EU-15. Main reasons for this are higher living standard and comfort, especially in central Europe (21). The average energy demand for heating purposes of EU-15 countries (residential sector) is around 143 kWh/m^{2}a. In contrast to that, cooling leads to an average energy demand of ca. 33 kWh/m²a (residential sector, EU-15) as shown in Figure 1.

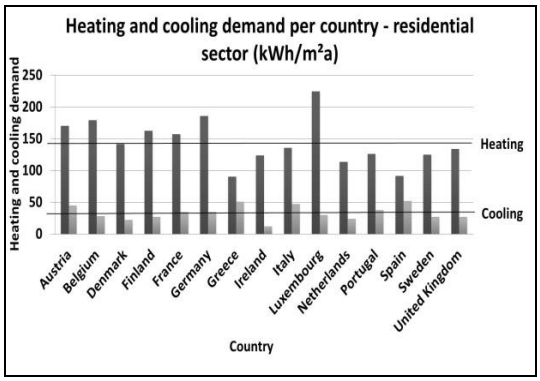

Figure 1: Heating and cooling consumption per country (EU-15) in the residential sector (kWh/m^{2}a)

Figure 2 shows the growth area of cooled floor space in some EU-15 countries during last decades and indicates future consumption in this sector.

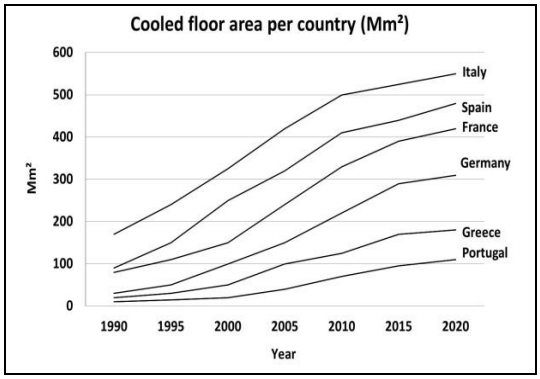

Figure 2: Cooled floor area per country in some EU-15 countries with future consumption indications (22)

2. EU finance distribution for energy research and development (R&D)

Looking at the history of EU R&D finance for the energy sector (nuclear and non) a percentage decline from 1983 until nowadays has been registered. Figure 3 shows that the EU finance for energy R&D decreased from about 47% of the total energy R&D finance in the First Framework Programme (FP1) to around 14% in the Seventh Framework Programme (FP7) (23) (24) (25) (26).

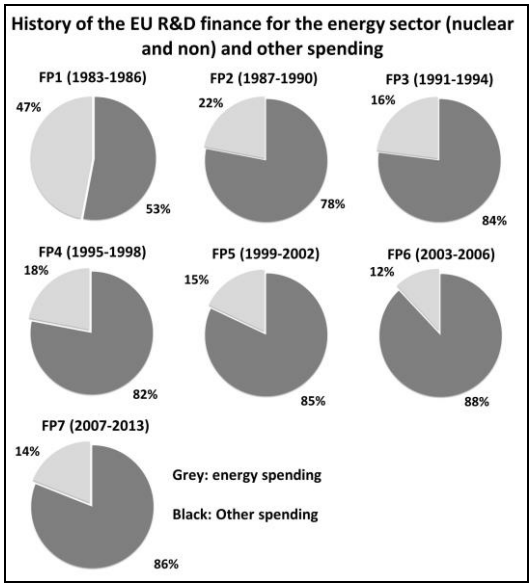

Figure 3: Energy R&D spending of the EU (1983-2013) (23) (24) (25) (26)

Nevertheless, it has to be stressed that beside the decrease in terms of percentage values, a constant rise in terms of total available amount of money took place. Hence, the finance for energy R&D in the FP6 was around 890 mil. € and at the FP7 about 2,350 mil. € (23) (24). What´s more, the total budget for the EU framework programs has almost tripled from FP6 to FP7 (from ca. 19 - 50 bn. €) (24) (27).

Going deeper in the subdivision of the energy related EU funding, it can be noticed that the sector of nuclear energy gets more EU R&D finance than renewable energy sources (RES) and all other energy sectors together (23) (25) (26) (27) (28) (29) as reported in Figure 4.

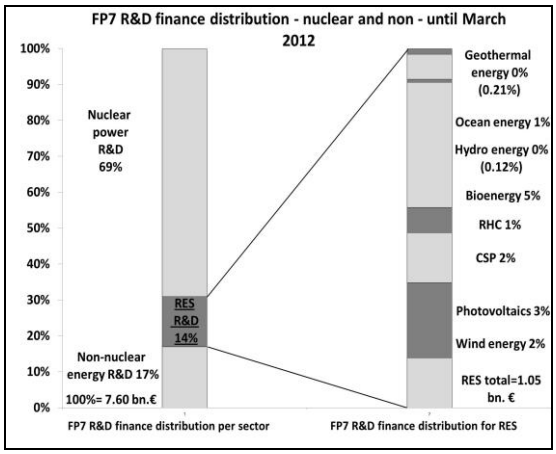

Figure 4: Seventh Framework Programme research and development finance distribution – nuclear and non – until March 2012 (23) (25) (26) (27) (28) (29)

Moreover, most part of R&D finance for RES in the FP7 is for Bioenergy, followed by Photovoltaic and at third place Wind energy as shown in Figure 4. Concentrated Solar Power (CSP) and Renewable heating and cooling (RHC) are at the 4th and 5th place with ca. 2% and 1% respectively. Ocean energy comes next and at the last places we find Geothermal energy and Hydro energy with around 0.21% and 0.12% of the FP7 RES finance (28).

In the following paragraphs the detailed distribution of EU funding within energy related programs is analysed.

2.1 The Sixth Framework Programme (FP6)

The FP6 (2003-2006) had an available budget of around 19 bn. €. This was split mainly in two parts: on one side RTD (Research and Technology Development) & Demonstration activities (ca.17.9 bn. €) and on the other side the European atomic energy community (ca. 1.3 bn. €). The part of finance for RES comes from the FP6 "Sustainable energy systems" (890 mil. €) (24).

It should be noticed that the FP6 started with a certain time delay as the European Parliament (EP) and European Council fixed the FP6 budget distribution only four month after its beginning (24). The FP7 started as well with some month time delay. Also for the Horizon 2020 (2014-2020), European R&D finance programme, a time delay for the finance distribution of ca. 1 to 1.5 years is expected.

Following the European Commission (EC) assignment method, about 37% of the whole finance for energy in FP6 has been dedicated to RES. Nevertheless, considering the contents of all FP6 financed projects, in sum around 49% of the FP6 finance for the energy sector went to RES, as several projects under other issues (e.g. within Energy efficiency, Basic research, Others,..) deal with RES R&D. Bioenergy, Photovoltaic and Wind energy got the largest amount of finance with around 17, 9 and 5 % respectively. Geothermal and Ocean energy follow with about 2% each and then CSP with slightly more than 1%. RHC is the penultimate with less than 1% and Hydro energy is located at the last place. If RHC is calculated on the basis of RES as a total it results in being ca. 2% (28).

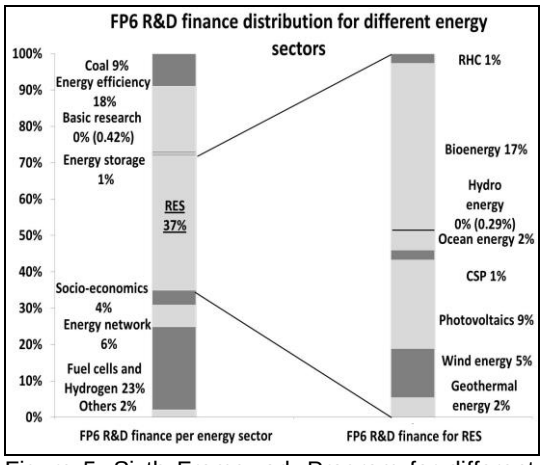

Figure 5: Sixth Framework Program for different energy sectors (2003 – 2006) (28)

Within the FP6 about 55% of the finance went for R&D in the field of electricity, ca. 20% for heat and around 25% for other R&D activities. In contrast to that, the RES budget was slightly higher for heat than for electrical based technologies (28).

2.2 The Seventh Framework Programme

Officially at the FP7 approximately 45% of the finance for the energy sector has been dedicated to RES (23). As shown in Figure 6, until March 2012, following the EC assignment classification, this goal has been matched almost perfectly. As in the FP6, Bioenergy, Photovoltaic and Wind energy got the largest amount of finance. In contrast to FP6 here in order CSP, RHC, Ocean energy, Geothermal energy and Hydro energy follow. RHC is to find in the deep lower half with around 3% of the total and ca. 8% of the RES (28).

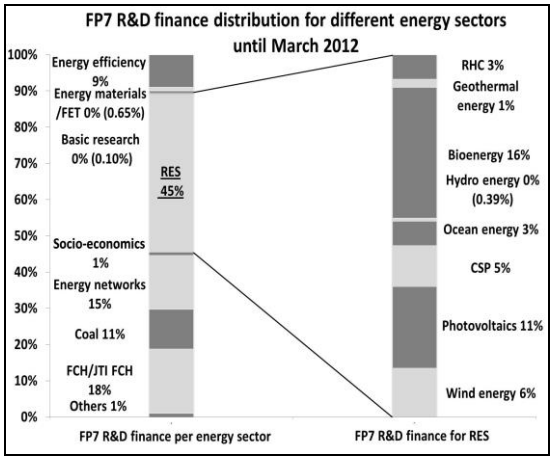

Figure 6: Seventh Framework Programme for different energy sectors (2007 – 2013) (28)

Comparing FP6 and FP7 it is visible that in the RES sector almost all energy forms increased percentualy compared to that one present in FP6, especially CSP with ca. 5 times. Only Bioenergy and Geothermal energy show a percentual reduction in the Seventh Framework Programme

compared to the priovios one. Of the last three energy forms named only Geothermal energy results in having a significant decrease with about half of the percentage than in FP6.

Regarding all other non-nuclear energy forms only the topic of Coal and Energy networks rised up. It has to be stressed that the area of Energy networks more than doubled its percentage from FP6 to FP7. All other topics show a percentual reduction. Especially Energy efficiency looses almost half of its percentage, Socio-economics shows around one third of the formal percentage in FP6, while the topic of energy storage dissapears completely. Also the field of Fuel Cells and Hydrogen/Joint Technology Initiative Fuel cells and hydrogen (FCH/JTI FCH) suffers from a significant percentual reduction in FP7.

The drastic percentual reduction of the Energy efficiency EU fundings is clearly in contrast with the EU 20-20-20 targets of 20% reduction in primary energy use with projected levels of 1990 by improving energy efficiency.

In FP7 a new topic appears in the non-nuclear energy sector: Energy materials/Future Emerging Technologies (FET). Anyway at the moment, it is provided with less than 1% of the non-nuclear energy funds.

3. Comparison between savings and EU funding for H&C R&D

Going through all FP7 projects finance in the energy sector, until March 2012, it emerges that around 7% have been dedicated to H&C R&D. Within FP6 these were slightly higher with 8% (28).

The EC considers the biggest energy savings to be made in the following sectors: residential and commercial buildings (tertiary), with savings potentials estimated about 27% and 30% respectively, the manufacturing industry, with the potential for around 25% reduction, and transport, with the potential for approximately 26% reduction in energy consumption (30).

Partly because of its large share of total energy consumption, the biggest energy savings potential lies in the residential (households) and commercial buildings (tertiary) sector. Buildings account for ca. 40% of the EU's energy requirements. In residential buildings, retrofitted wall and roof insulation offer the greatest opportunities to save energy (31).

Total energy consumption within the EU-27 in 2008 was around 1,799 Mtoe (32). The total energy consumption potential corresponds to overall savings estimated at 390 million tons of oil equivalent (Mtoe) each year. It has been estimated that more than 50% of this 390 million tons per year (ca. >230 Mtoe) are attributed to energy savings in the H&C sector (30).

If the expected energy savings potential (more than 50%) and the EU R&D finance for H&C (7%) get compared a huge mismatch emerges as shown in Figure 7.

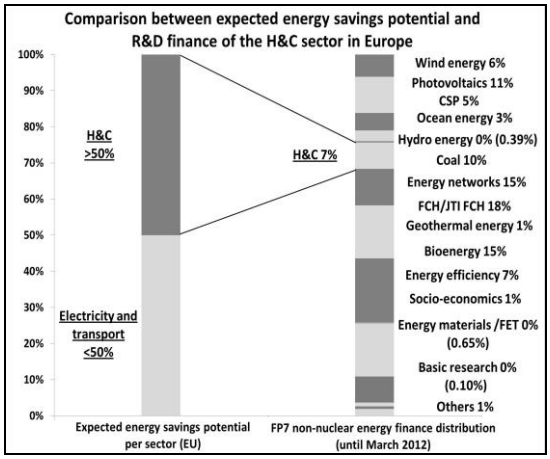

Figure 7: Comparison between expected energy savings potential and R&D finance of the H&C sector in Europe (28) (30)

It has to be added that only about 3% of the above mentioned ~7% EU finance for H&C R&D belongs to RHC (28).

4. Future outlook – Horizon 2020 (2014-2020)

In order to evaluate possible future scenario of EU funding assigned to energy related issues and in particular to the exploitation of RES for H&C, the future Horizon 2020 funding program is now considered.
Based on a linear regression, trough data of the FP6, FP7 and the European National Renewable Energy Action Plans, a prediction concerning the future EU R&D finance distribution for the energy sector from 2014 - 2020 has been carried out. As shown in Figure 8 Bioenergy, Photovoltaic and Wind energy would remain still the sectors with the majority of EU RES R&D finance (25) (26) (28) (33).

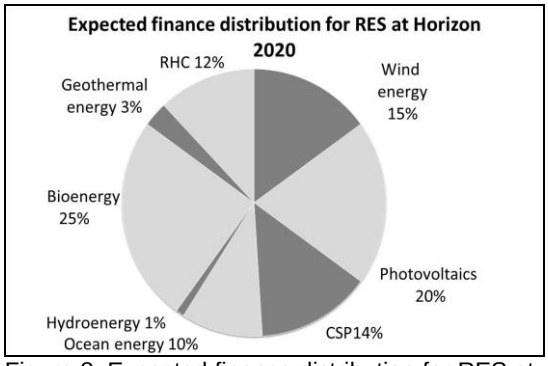

Figure 8: Expected finance distribution for RES at Horizon 2020 (2014-2020) (25) (26) (28) (33)

It would follow in order: CSP, RHC, Ocean energy, Geothermal energy and Hydro energy. RHC still remains one of the energy sectors with the lowest EU R&D finance (25) (26) (28) (33).

Regarding the monetary quantification, it has to be added that the total EU budget is presumably going to rise by around 2.5% from FP7 to the Horizon 2020. That means an increment from ca. 1,000 to 1,025 bn. € (27) (34).

5. Conclusions

The expected energy savings potential of the H&C sector in the EU and the finance given from the EU through the so-called Framework Programmes to practice R&D in the sector of H&C show a significant discrepancy (about 50% and 7% respectively) (28) (30).

H&C is expected to account for more than half of the whole energy savings potential in the EU. In contrast to that the EU gives only around 7% of the energy R&D finance to the H&C sector (27) (28). Furthermore, the finance for RHC as part of the H&C R&D should rise appropriately in the next 10 years period, fitting the EU 20-20-20 target to rise RES energy consumption coming from renewable sources to 20% in 2020. This would also help to decrease greenhouse gas emissions of 20% below 1990 levels (19).

In contrast to that, currently the EU is financing R&D of nuclear energy about 5 times more than that one of RES and H&C R&D about 2 times more than that one of RHC (27) (28) (29).

An appropriate support to practice R&D in the field of H&C, especially RHC, would lead to decrease significantly the energy consumption in Europe. Finally that would be a significant step forward for reaching the EU 20-20-20 goals.

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