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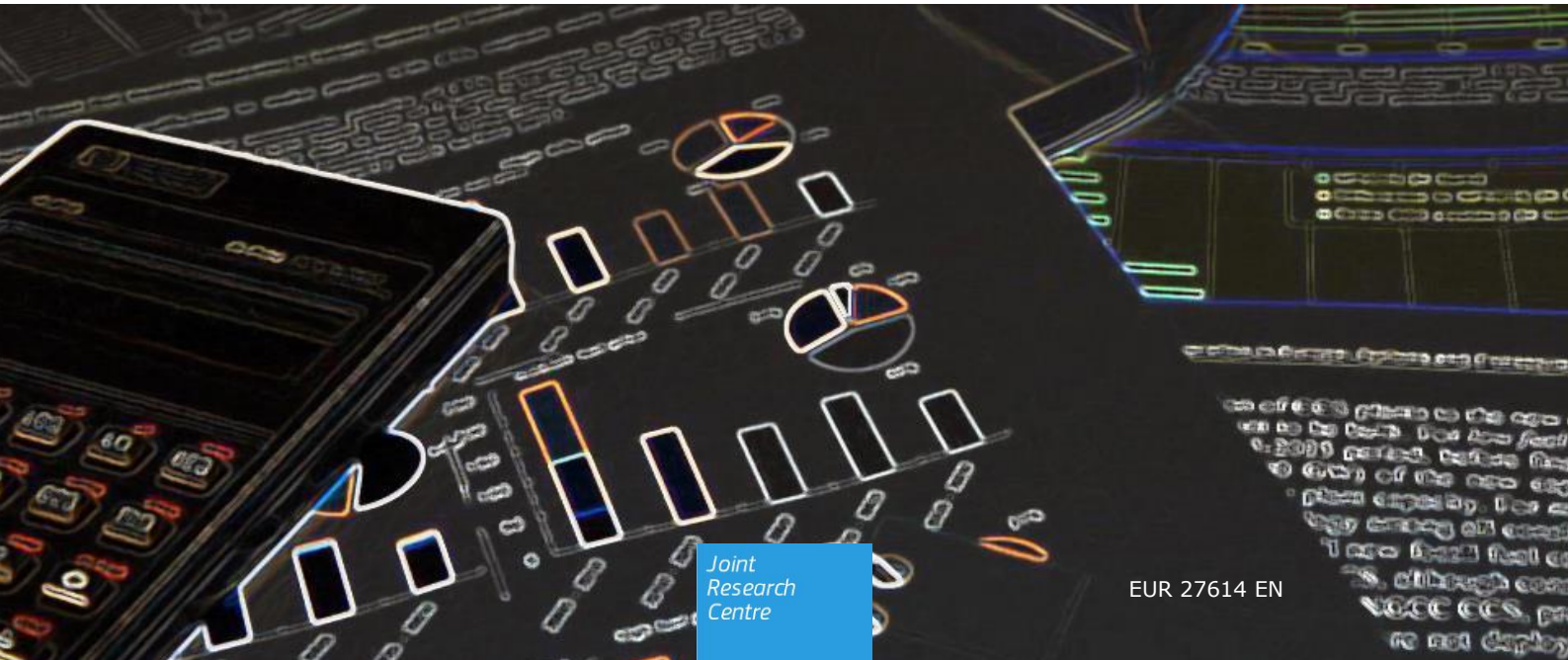
JRC SCIENCE FOR POLICY REPORT

EU R&D funding for Low Carbon Energy Technologies

Analysis of the distribution of 2007-2013 commitments

Bianca-Nicole Lepsa

2015



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Abstract
Low-carbon energy technology RD&D commitments, a Europe-wide assessment
The annual State of the Energy Union report offers the chance to assess progress towards the Energy Union targets and objectives. One of its five dimensions is the new research, innovation and competitiveness approach that should accelerate the overall energy system transformation. At the very heart of this dimension's measurement is the Integrated Strategic Energy Technology (SET) Plan and its Information System (SETIS). Through its capacities mapping, SETIS aims at providing an assessment of the public R&D investment in low-carbon energy technologies. Analysing EU commitments in low-carbon energy technologies is an additional benchmark that will serve the policymakers as the basis for planning the future EU investments needed to address the technologies challenges.

Table of contents

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Executive summary

Policy context

The aim of a resilient Energy Union is to provide secure, sustainable, competitive and affordable energy. To achieve such a high reaching goal, the Energy Union strategy bases itself on five mutually-reinforcing and interrelated dimensions: energy security, energy market, energy efficiency, the decarbonisation of the economy and, research (R), innovation (I) and competitiveness [1].

The annual State of the Energy Union report offers the chance to assess progress towards the Energy Union targets and objectives. Its fifth dimension, the new R&I and competitiveness approach should accelerate the overall energy system transformation. At the very heart of this dimension's measurement is the Integrated Strategic Energy Technology (SET) Plan and its Information System (SETIS). Through its capacities mapping, SETIS aims at providing an assessment of the public R&D investment in low-carbon energy technologies [2]. In addition to R&D investments, SETIS monitors technology progress at downstream stages of the innovation process by analysing patent applications. Moreover, SETIS will also incorporate in its regular reporting analysis on the number of active researchers in the energy sector [3].

The present document, produced in the context of the capacities mapping activities of the SET Plan, provides an assessment of the EU public commitment to RD&D in low-carbon energy technologies. It is intended as an additional benchmark that will serve the policymakers as the basis for planning the future EU investments needed to address the technologies challenges identified by the SET Plan. Moreover, considering a commitment approach to analysing EU funding, allows for inclusion of instruments that, due to their reporting methods, cannot be considered in the disbursement analysis [2].

Main findings

The analysis focuses on the SET Plan technologies addressed in the Capacities Map: bioenergy, Carbon Capture and Storage (CCS), electricity grids, nuclear fission, solar, wind, fuel cells and hydrogen, energy storage and ocean [2]. In addition, the report contains assessments on energy efficiency in the building sector, geothermal, Advanced Alternative Fuels (AAF) and Carbon Capture and Utilisation (CCU) technologies, priorities identified in *Towards an Integrated Roadmap* [4].

Figure 1 presents a summary of the flow of funds from the different funding bodies to the various technologies benefitting from financial support and the year of commitment. For the 2007-2013 period €7.2 billion were committed in total.

During the 2007-2013 period:

- The FP7 Energy theme budget lines contributed to projects with a total economic value of €2.9 billion.
- Two thirds of the EIB funding went to Germany and Spain, each receiving €400 million and spending more than half of their funding in wind, and CSP projects respectively.
- More than half of the NER300 maximum committed funding went to projects in the bioenergy sector for the development of combined heat and power from biomass.
- RSFF committed 60% of its total funds to wind technologies. More than 80% of RSFF funding went to projects based in Spain.
- Other non-energy dedicated FP7 themes have supported projects addressing the SET Plan technologies with a total economic value of more than €1.5 billion.
- The FCH-JTI programme contributed to research projects with a total cost of €874 million.
- The Euratom contributed to projects with a total value of €439 million.

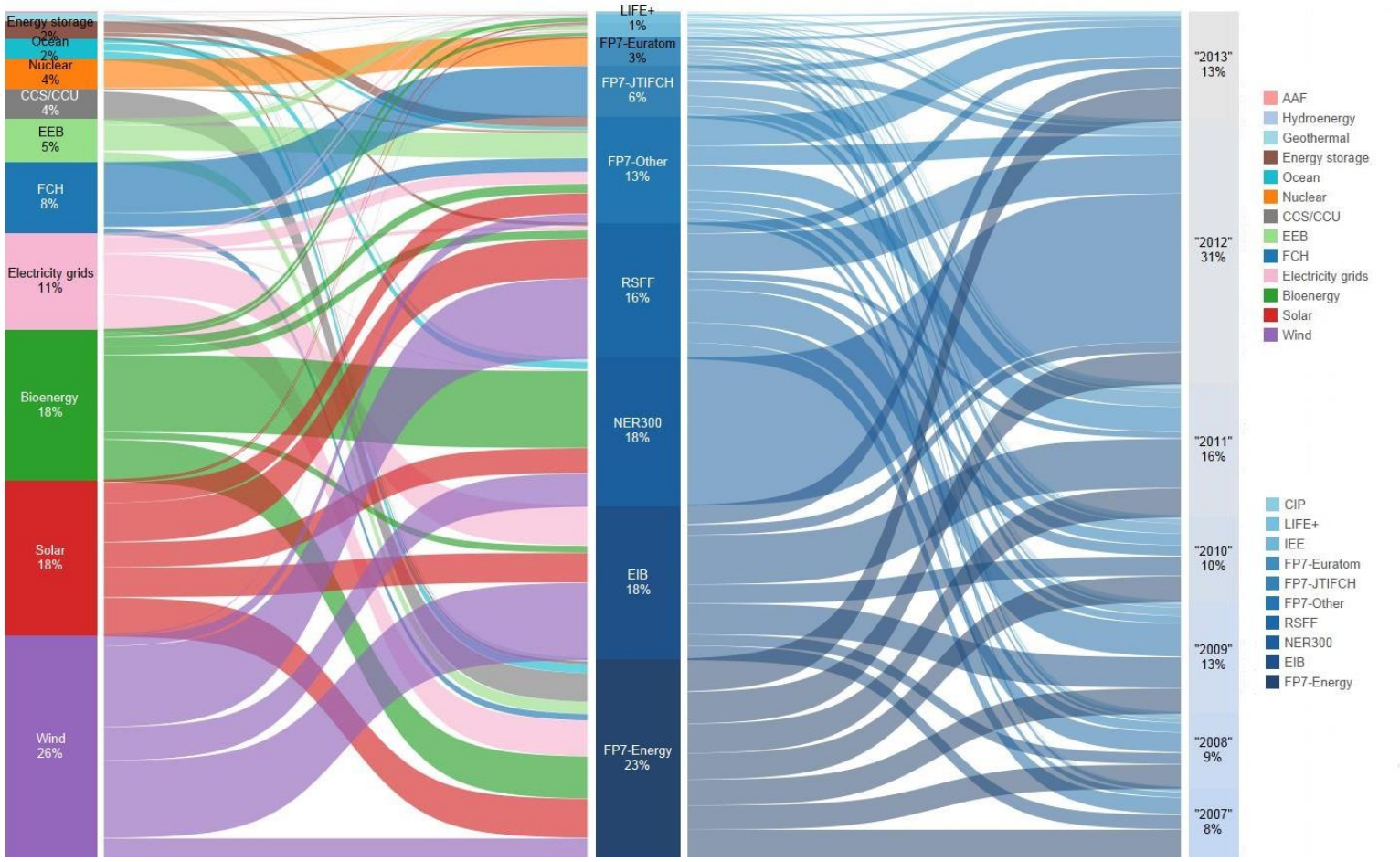


Figure 1. Distribution of funds committed to RD&D in SET Plan technologies throughout the 2007-2013 period[1]. Data sources: JRC analysis of [5-11]

[1] The €252.3 million committed through the ERDF cannot be evaluated on an yearly basis therefore the amount is not included in this diagram.

- The IEE commitment of €115 million was split between projects that fell directly under the management of EACI (71%) and those administrated by the EIB under the ELENA programme. The total cost of the projects was €2.7 billion. This highlights the impressive leverage ratio of ELENA.
- With just 1% of the total EU committed funding, LIFE+ provided support to SET Plan relevant projects totalling €207 million.
- Within its priority areas, the ERDF dedicated €252.3 million to RD&D in the SET Plan portfolio of technologies to projects with a total value of almost €1 billion (Figure 2).

From a technology perspective, the period was characterized by the following:

- Wind technologies received more than a quarter of the funds, followed by the solar and bioenergy sectors which received just under a fifth each (Figure 1).
- The hydroenergy and the AAF sectors received the least support within the group of technologies examined, each being supported with less than 0.2% of the total funds. Geothermal technologies got just under 1% mainly due to a €39 million NER300 commitment in 2012.
- The EU-level commitment to the further development of nuclear technologies has remained almost constant since the onset of the Euratom programme.

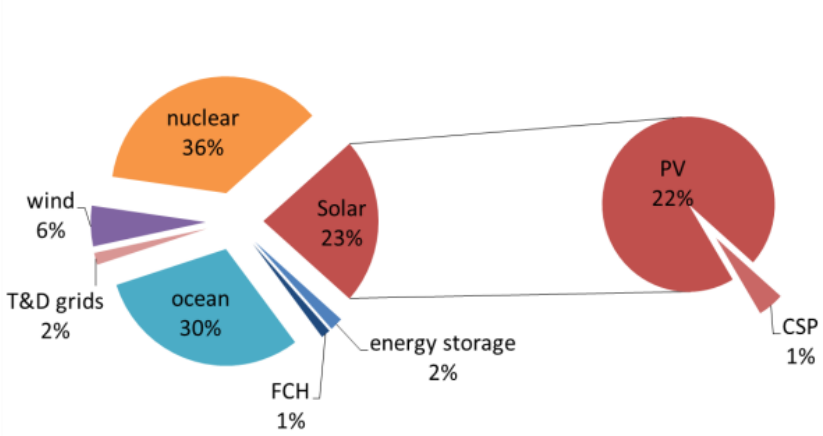


Figure 2. Distribution of funds committed to RD&D in SET Plan technologies through the 2007-2013 period by the ERDF. Data sources: JRC analysis of [5-16]

Figure 3 shows the funding flows to the different themes identified in the document *Towards an Integrated Roadmap: Research & Innovation Challenges and Needs of the EU Energy System* [4]. More than 70% of the funding was dedicated to themes 10 and 13.

Related and future JRC work

In the context of the annual State of the Energy Union SETIS will continue to monitor the flow of public investment both from EU and national sources, reporting annually with reference to the year of disbursement. SETIS will also monitor and report on the corporate component of R&I investment, on patent trends, and on the number of researchers active in the low-carbon energy sector.

Quick guide

In contracts to the Capacities Map which tracks investments by disbursement year, the present publication provides an assessment of EC investment by commitment year for the entire duration of the programmes [2]. European public funding is made available on a yearly basis, as per the budgetary year that each work programme draws its financing from, irrespective of the year when contracts are signed or the duration of the projects [17, 18]. Considering this, the investment reported here is structured according to the source of financing and budgetary year that the commitment (contract) pertains to.

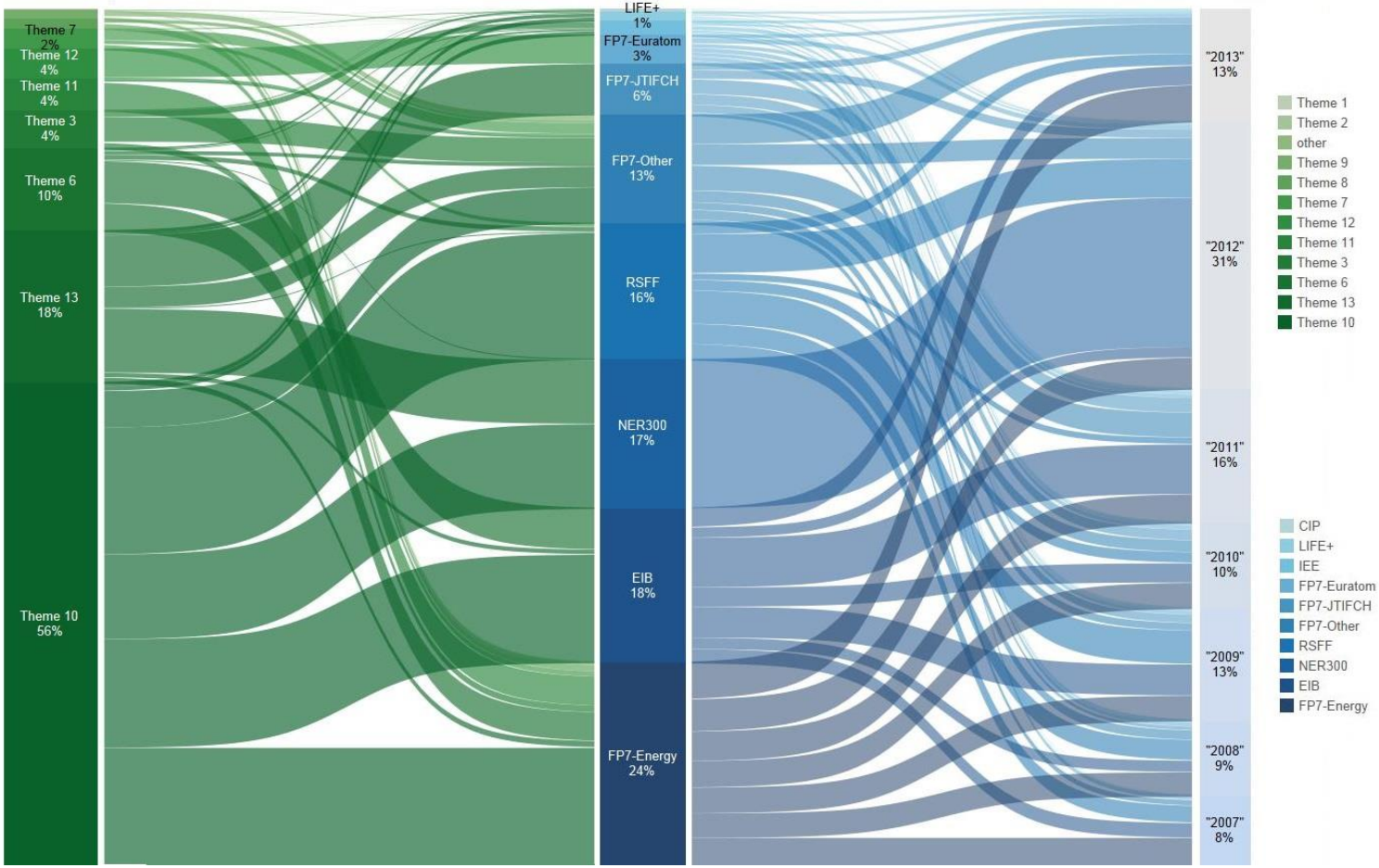


Figure 3. Distribution of funds committed to RD&D in the SET Plan associated themes as identified by the *Towards an Integrated Roadmap* document throughout the 2007-2013 period[2]. Data sources: JRC analysis of [5-11]

[2] ERDF commitment cannot be evaluated on a yearly basis, therefore it is not presented in this diagram.

1. Introduction

1.1 Scope

Since 2008, the European Union (EU) has been implementing the Strategic Energy Technology (SET) Plan. The strategy aims to accelerate low-carbon energy technology development, transfer and up-take in order to achieve the 2020 energy and climate change goals and contribute to the worldwide transition to a low-carbon economy while maintaining industrial leadership in the field [19, 20].

The Strategic Energy Technologies Information System (SETIS) is the European Commission's (EC) information system for the SET Plan. It identifies technology options, priorities and challenges, monitors and reviews progress regarding implementation. Furthermore, it assesses the impact on policy and proposes corrective measures if needed. Therefore, part of the scope of the SET Plan is that of capacities mapping, in order to provide an assessment of public and corporate research and development (R&D) investment in low-carbon energy technologies in the EU. The goal is to offer a benchmark that will serve as the basis for planning future investments needed to address the key technology challenges identified by the SET Plan.

Acknowledging the limitations of the present analysis in gathering investment data, this report seeks to provide an estimation of the European RD&D committed investment for the 2007-2013 programming period. The analysis focuses primarily on the SET Plan technologies addressed in the latest Capacities Map: bioenergy, CCS, electricity grids, nuclear fission[3], solar, wind, fuel cells and hydrogen, energy storage and ocean [2]. In addition, the report contains assessments on energy efficiency in the building sector, geothermal, advanced alternative fuels (AAF) and carbon capture and utilisation (CCU) technologies, additional priorities identified in the document *Towards an Integrated Roadmap: Research & Innovation Challenges and Needs of the EU Energy System* [4].

The report is structured as follows: section 2 provides a description of the methodology, while the following chapters provide specific information and analysis for the technologies in question.

1.2 Methodology for the estimation of the committed European funding

Funding through EU instruments and European banks

At European level, the main bodies involved in the financing R&D activities relevant to the SET Plan technologies are the European Commission (EC), the European Investment Bank (EIB) and the European Bank for Reconstruction and Development (EBRD) (Figure 4).

[3] Nuclear energy as included in the SET Plan priority technologies only concerns Generation IV reactors. Due to the difficulty in obtaining R&D investment data specific to Generation IV reactors, the total investment for nuclear fission is investigated in this study.

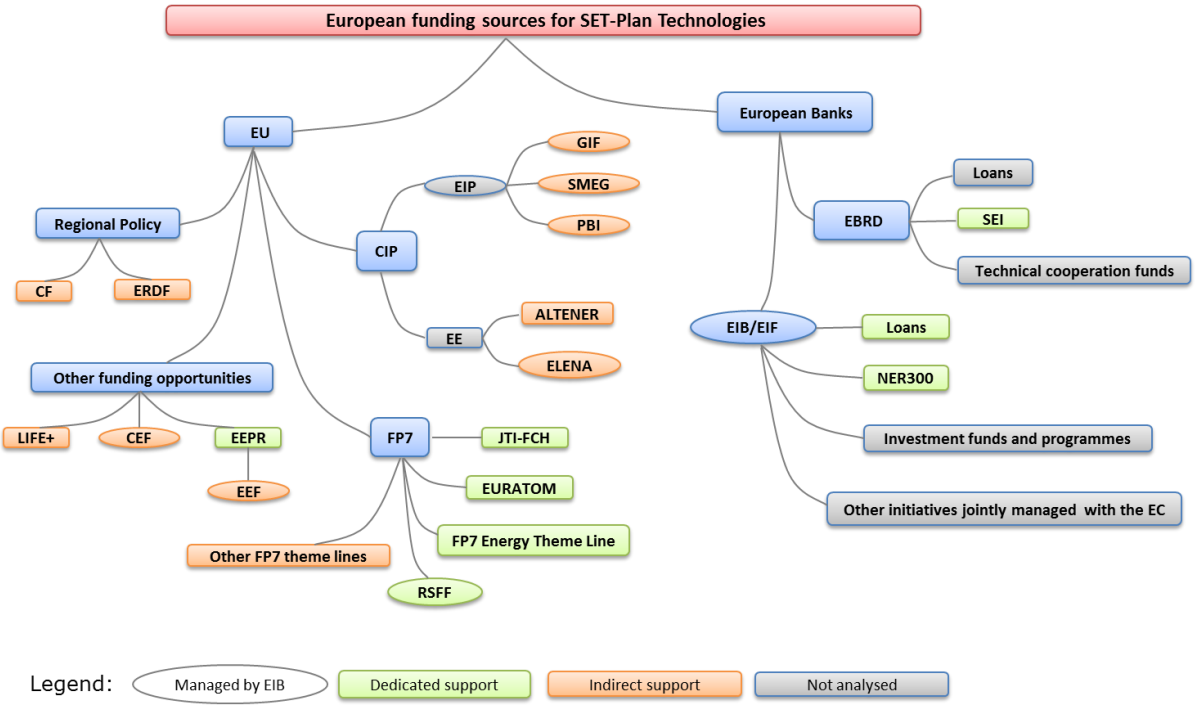


Figure 4. Sources of financing for R&D in SET Plan technologies at European level [2]

EC funding opportunities for research and innovation come from five main instruments:

- The 7th Framework Programme for Research, Technological Development and Demonstration activities (FP7) which includes the Euratom Framework Programme for Nuclear Research and Training activities (FP7-Euratom) and the Fuel Cells and Hydrogen Joint Technology Initiative (FP7-FCH JTI);
- The Competitiveness and Innovation Framework Programme (CIP);
- The regional policy with its Structural and Cohesion Funds (CF) and the European Regional Development Fund (ERDF).

FP7 has been the main EU instrument for funding research between 2007-2013 and was structured in five Specific Programmes: Cooperation, Ideas, People, Capacities, Euratom and JRC activities. Additionally to the dedicated Energy, Nuclear and FCH budget lines, all of the other FP7 programmes have also supported research activities in the clean energy technology sector in the analysed timeframe [21].

The **CIP** programme aimed to encourage competitiveness, targeting mainly Small and Medium Enterprises (SMEs) and supporting innovation activities (including eco-innovation) by providing better access to finance. For the period 2007-2013, the CIP programme had an overall budget of €3.6 billion [22]. The main annual work sub-programmes relevant, in terms of investments in the SET Plan technologies, have been the Entrepreneurship and Innovation Programme (EIP) and the Intelligent Energy Europe Programme (IEE). Pilot and Market Replication Projects (MRP) and its executing instrument, the European Local Energy Assistance (ELENA) facility, are used within both the EIP and IEE programmes with the aim to reproduce at large scale any "innovative techniques, processes, products or practices of Community relevance, which have already been technically demonstrated with success" [23].

Two other financing instruments, relevant in the context of clean energy technology, are the European Regional Development Fund (**ERDF**) and the Cohesion Funds. The ERDF focused investments on key priority areas, known as "thematic concentrations": innovation and research, the digital agenda, support for the SMEs and the low-carbon economy. These aim to strengthen the EU economic and social cohesion by correcting

the imbalances between European regions [24]. For the 2007-2013 programming period, the Cohesion Funds were dedicated to 15 MS whose gross national income per inhabitant was less than 90 % of the EU average. The funds were allocated to projects aimed at reducing economic and social disparities and promoting sustainable development [25]. Thus from the SET Plan perspective, the ERDF and CF invested mainly in renewable energy R&D projects.

Additionally to EC funding, large scale investment was also assured through European banks via loans, structured financing options, equity and carbon funds, and numerous initiatives and programmes managed jointly with other European or national/ regional institutions.

The European Investment Bank (**EIB**) finances the full range of research, development and innovation (RDI) activities of the innovation cycle, including applied research within the energy sector [26]. Additionally to its energy-dedicated lending line, it also manages and participates in several other European and international initiatives and programmes that support clean energy projects.
A debt-based financial instrument implemented and managed by the EIB to support RDI in Europe is the Risk Sharing Financing Facility (**RSFF**). This instrument has provided significant financing in support to RD&D in clean energy technologies by adding value in areas where the market was not able to provide the required funding and by catalysing private investment. The EU provided up to €1 billion over the 2007-2013 in order to increase the bank's capacity to assume and manage risk, to facilitate a larger volume of lending and guarantee financing of riskier projects. The amount (released in two equal instalments over two periods: 2007-2010, and 2011-2013), was matched by the EIB from its own funds [27]. From the expected investments, 15% were directed to research and innovation projects in the energy sector [28].
The European Energy Programme for Recovery (**EEPR**) has dedicated €4 billion to co-financing renewable energy projects in the fields of gas and electricity infrastructure, offshore wind and carbon capture & storage. Due to unallocated funds, by the end of 2010, a new financial facility, the European Energy Efficiency Fund (EEEF) sprung out of the EEPR in 2011. This EIB-managed instrument is dedicated to support energy efficiency and decentralised renewable energy investments with an allocated budget of €146.3 million [29].

In 2010 the New Entrants Reserve (**NER300**), the world's largest funding programme for innovative low carbon energy projects was launched. The first call for projects was in November 2010, while the award decision deadline was set for the second half of 2012. The programme covers 300 million allowances (approx. €4-5 billion) from the new entrants reserve of the EU Emission Trading System (ETS) for the co-financing (50%) of commercial demonstration projects of environmentally safe CCS and RES technologies within the EU, and the EIB acts as the implementing agent [30, 31]. During 2011-2012, the EIB has monetized allowances worth of more than €1.6 billion while in the last two months of 2013 it has increased the available financial resources for projects with another €128.6 million [32].

Another important financial institution which supported R&D activities in the clean energy technology sector is the European Bank for Reconstruction and Development (**EBRD**). Projects have benefited from EBRD loans and equity through several initiatives, programmes and funds: the Sustainable Energy Initiative (SEI) with its dedicated Sustainable Energy Financing Facilities (SEFF) and Western Balkans Sustainable Energy Direct Financing Facility (WeBSEDFF), technical cooperation and carbon funds.

Two other complementary European-wide funding instruments have contributed significantly to the R&D of the clean energy sector.

European Commission's **LIFE+** is an environment dedicated programme that supports the implementation and the development of EU environmental policy and legislation by

co-financing large, transnational pilot or demonstration projects. With a total budget of €2.1 billion for the 2007-2013 period, it financed three main areas: nature and biodiversity; environmental policy and governance; and information and communication. The environmental policy and governance component of LIFE+ has also co-financed innovative, pilot projects that contributed to the development of technologies, methods and instruments relevant to the SET Plan [33].

Allocation of European funds by year & technology

The analysis of the commitment of funds clean energy technologies is based on a different methodological approach than the annual Capacities Map exercise [2].

European public funding is made available on a yearly basis, as per the budgetary year that each work programme draws its financing from, irrespective of the year when contracts are signed or the duration of the projects [17, 18]. Considering this, the present report structures the data according to the source of financing and budgetary year that the commitment (contract) pertains to, namely the budgetary year that the call/ work programme draws its financing from. This differs from the Capacities Map which analyses the yearly disbursements, namely the annual reimbursements of the costs incurred under the projects' contracts. This commitment approach to analysing EU funding, allows for inclusion of instruments that, due to their reporting methods, cannot be considered in the disbursement analysis of the Capacities Map [2].

The main data sources for the present report were FP7, CIP, IEE/ ELENA, LIFE+ and NER300 information at project-level as provided by DG RTD or retrieved from EC CORDA, ERKC web-portals and other relevant official repositories [5-11]. The EIB has provided project-level data on committed funds through its RDI-dedicated loan line and the RSFF. The project databases of DG Regio and INTERREG were used to identify and determine the investments allocated through ERDF [12-16]. Annual (implementation) reports and other dedicated programmes or technologies reports and analysis were also used as supporting documentation.
The only assumption made in this analysis was to consider that, for projects that cover more than one technology, the funding has been equally allocated among the technologies addressed.

Each of the data sources used for the other European-wide financing instruments and programmes has its specific reporting methodology. This introduces certain limitations to our present assessment. We discuss the limitations in the section below.

Limitations of the current analysis

Due to the wide range of data sources and their different investment reporting methods, the following instruments and programmes have not been included in this assessment:

- The investment provided at European level through the European banks could be determined, from the project-level data provided by the EIB and the EBRD annual reports. However, the information provided by the EBRD annual reports is incompatible with the level of detail envisaged by this report;
- The EEPR implementation reports provide a wealth of information for this financing instrument. However, as the reporting is based on a payments-approach, this funding mechanism had to be excluded from our analysis. It should be noted that based on the payments declared as of 2014, the amount with which the EEPR is expected to have contributed for the 2007-2013 period is of at least €678 million [34, 35].

2. Advanced alternative fuels

Advanced alternative fuels can play a substantial role in the transition to a sustainable mobility. However, little investment has been seen in the development of catalysts and process technologies for CO_2-based and CO_2-neutral liquid and gaseous fuels. For the entire 2007-2013 programming period only the FP7 research theme of "Nanosciences, nanotechnologies, materials and new production technologies" (FP7-NMP), the IEE and LIFE+ have contributed to RD&D in this sector:

- In 2008, the IEE has contributed for the first time €1 million to one project of a total value of €1.4 million.
- This initial commitment was followed by two contributions: in 2010 LIFE+ promoted with €5 million two projects with a total cost value of €12 million and in 2012 FP7-NMP supported with little under €3 million a project with a total cost of €3.5 million.

It should be noted that despite the limited EU support offered so far, many MS have shown interest in the sector (AT, BE, BG, CY, DE, DK, EL, ES, FR, IT, NL, PL, PT, SE, RO). Most of the participants were however research-oriented (HES and REC) organisations, with just one SME taking part in the FP7-NMP project.

3. Hydropower

This is a mature technology, and despite the fact that there is room to increase the availability and productivity of hydropower equipment and plants, there seems to have been little interest in the sector in terms of RD&D support at European level. For the period analysed in the present report only the FP7-Energy research theme line has offered support: in 2007 it committed €5.6 million to two projects while in 2013 it granted another €4.3 million to one project.

27 organisations (of which 6 SMEs) from 9 MS participated in the projects, with a fifth of all funds going to German and Swiss organisations in the education sector.

4. Bioenergy

For the 2007-2013 programming period, the total commitment to bioenergy technologies was of the order of €1.2 billion, distributed during the period among the financing bodies as shown in Figure 5 and Figure 6. Of the total support, €651 million were dedicated to developing sustainable advanced biofuels.

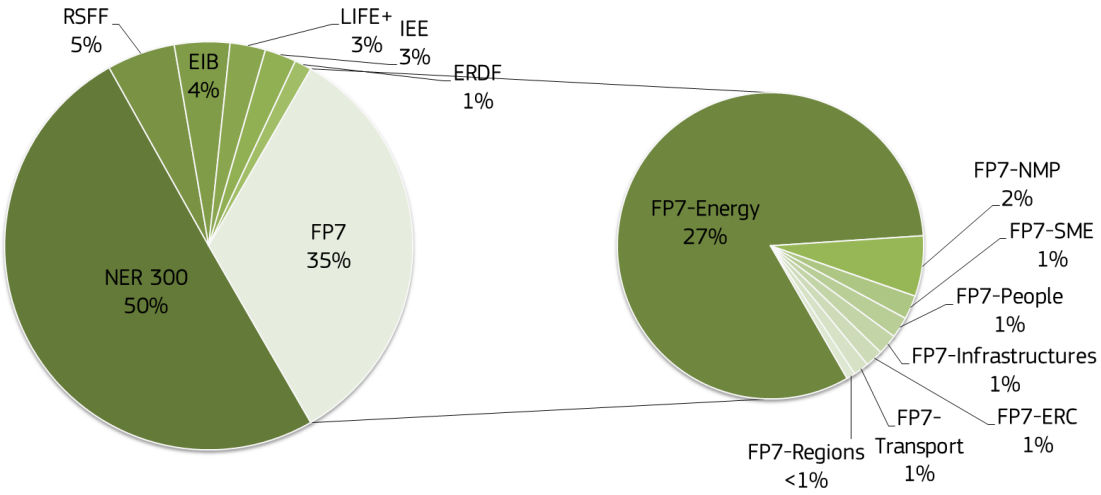
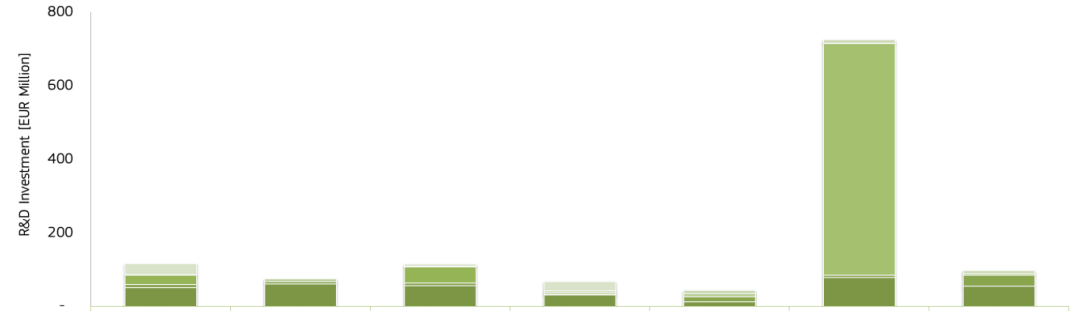


Figure 5. Contribution share of EU funding to bioenergy technologies by funding source. Data sources: JRC analysis of [5-16]

The funds were allocated to more than 700 participants from 44 countries. Of these participants, around 180 were SMEs that received €54 million from community funds, more than half of this amount assigned to projects developing combined heat and power from biomass.



	2007	2008	2009	2010	2011	2012	2013
EIB	30			25			
LIFE+	2	-	4	4	9	9	7
IEE	-	7	4	5	9	1	5
NER300	-	-	-	-	-	629	-
RSFF	25		43				
FP7-Other	9	6	8	1	13	7	30
FP7-Energy	51	61	56	31	13	78	54

Figure 6. Annual EU contribution to bioenergy technology by funding source, excluding ERDF. Data sources: JRC analysis of [5-11]

It should also be noted that:

- France (€204 million) and Netherlands (€199 million) got the highest share of NER300 committed financial resources, for one bioenergy project each;
- The countries with the highest share of IEE, non-ELENA funding, Germany (€5 million), UK (€4 million) and Italy (€3 million) invested one third of their respective funding in bioenergy projects;

Sweden (€11 million) and Spain (€7 million) dedicated more than 40%, and 20% respectively of the LIFE+ funds received, to sustainable advanced biofuels.

6. Carbon Capture, Storage and Utilisation

For the 2007-2013 programming period, the total commitment to CCS technologies was of the order of €245 million, distributed solely through the various themes of the 7th Framework Programme (Figure 7).

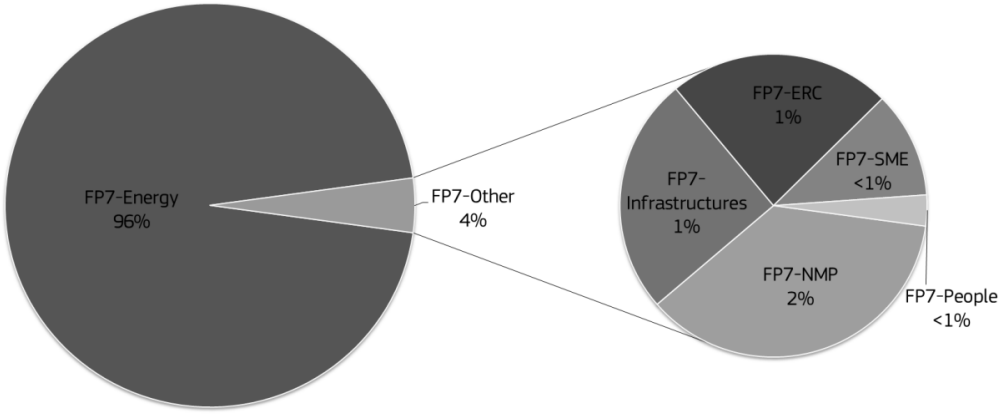
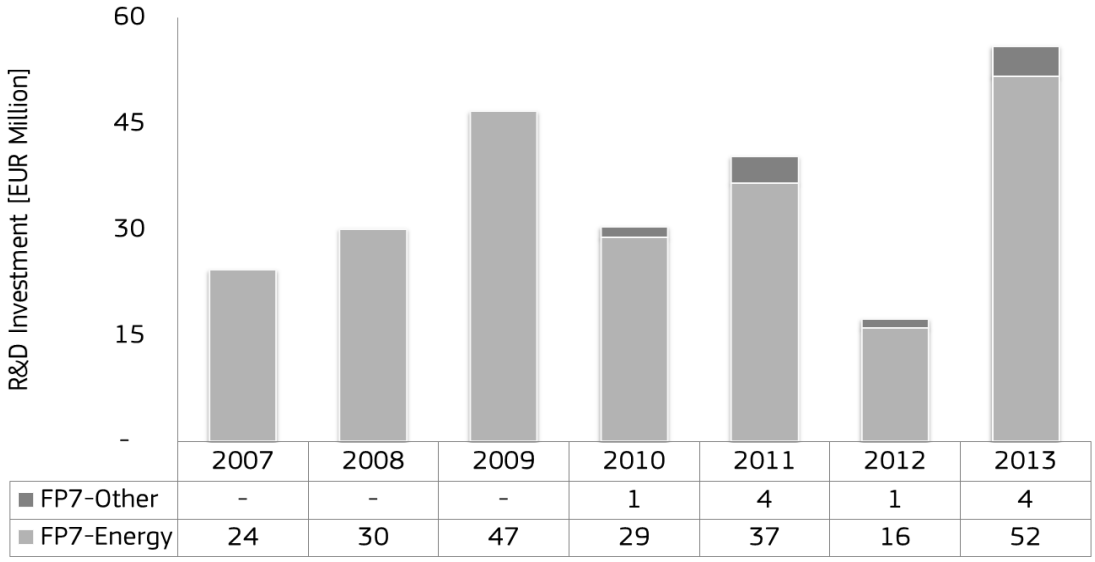


Figure 7. Contribution share of EU funding to CCS technologies by funding source. Data sources: JRC analysis of [5-16]

Starting with a commitment of just under €25 million from FP7-Energy theme, the financial support to CCS more than doubled in 2013 with a total value of €56 million, of which 8% from other FP7 theme lines (Figure 8).



	2007	2008	2009	2010	2011	2012	2013
FP7-Other	-	-	-	1	4	1	4
FP7-Energy	24	30	47	29	37	16	52

Figure 8. Annual variations in EU support of CCS technologies by funding sources. Data sources: JRC analysis of [5-11]

This sector attracted more research oriented (HES and REC) organisations than private companies. However, of the total of 490 participants, 66 SMEs from 24 countries received more than €20 million of community funds.

Similarly to CCS, the conversion of captured CO_2 to useful products has been promoted solely through the financing of FP7. Thus, for the 2007-2013 programming period, projects in this area received just under €11 million, 67% of which came from the FP7-NMP research theme. The majority (86%) of the total funding was directed to private companies in Italy, Netherlands and Israel.

7. Energy efficiency (in the build environment)

For the 2007-2013 programming period more than €425 million were dedicated to increasing the energy efficiency across the energy system with 84% committed to RD&D that would bring energy savings in the build environment (Figure 9 and Figure 10).

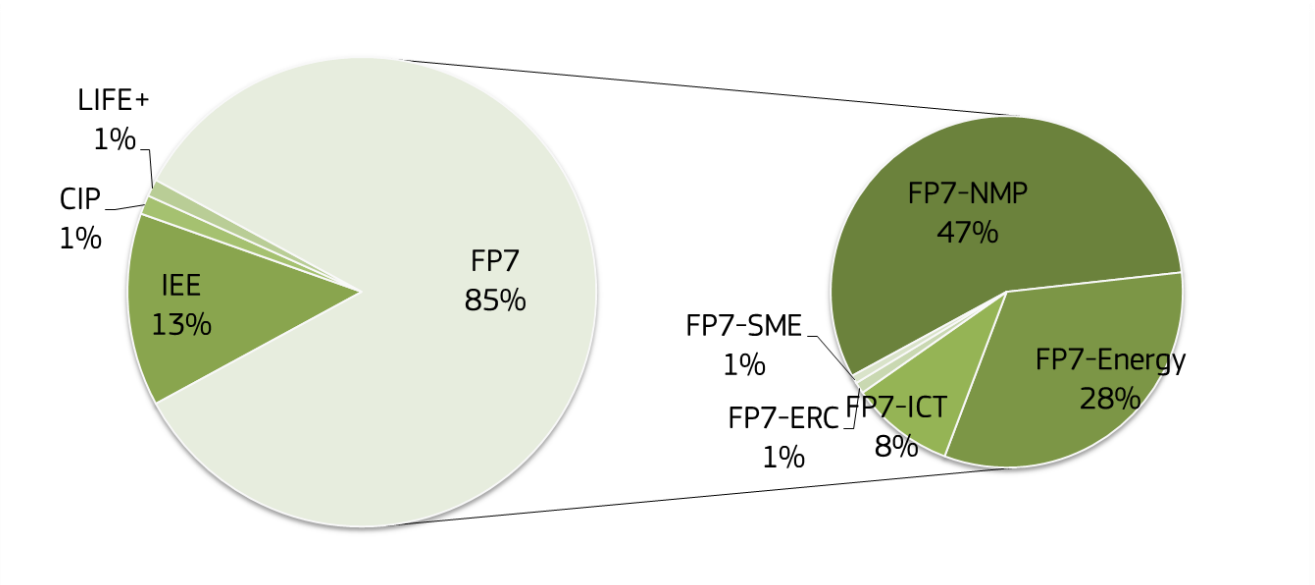
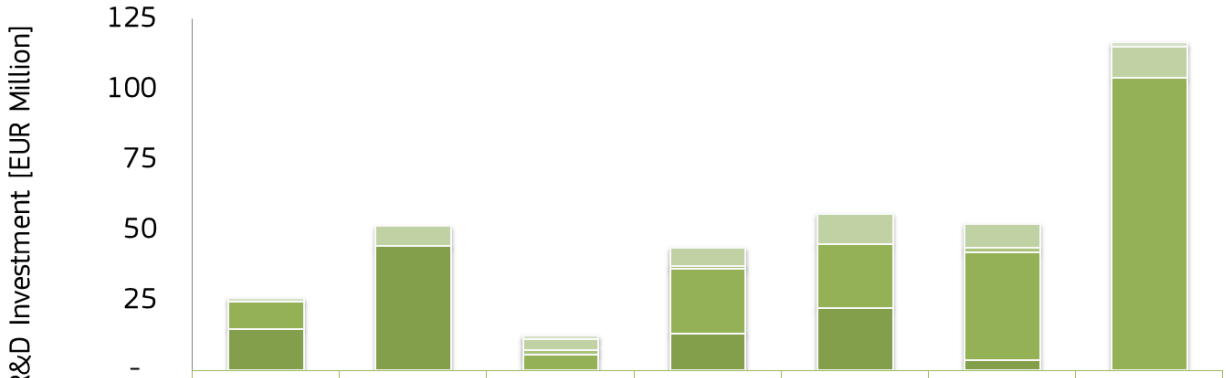


Figure 9. Contribution share of EU funding to energy efficiency technologies for the build environment by funding source. Data sources: JRC analysis of [5-16]

The relative SME participation (i.e., share of SMEs in the total number of participants) in the energy efficiency projects was high, the private company (PRC) participation reaching 60% of the total of over 930.



	2007	2008	2009	2010	2011	2012	2013
LIFE+	1	-	1	-	-	-	2
IEE	-	7	4	7	11	8	11
CIP	-	-	2	1	-	2	-
FP7-Other	10	-	5	23	23	38	104
FP7-Energy	15	44	-	13	22	3	-

Figure 10. Annual EU contribution to energy efficiency technology for the build environment by funding source. Data sources: JRC analysis of [5-11]

The countries with the highest share of ELENA funding, Spain (€8 million), Italy (€6 million) and UK (€5.7 million) invested more than 50% of these funds in projects addressing the energy efficiency in the build environment.

8. Electricity grids

Electricity grids are a key enabler for the efficient deployment of sustainable energy. The RD&D and infrastructure development projects in this sector aimed at modernising the European electricity grid and ensuring a smart integration of renewable energy production into the existing network.

Figure 11. Contribution share of EU funding to electricity grids technologies by funding source. Data sources: JRC analysis ofFigure 11 shows that, in terms of funding distribution, the share has been almost equal between EIB and FP7 (mainly FP7-Energy theme line).

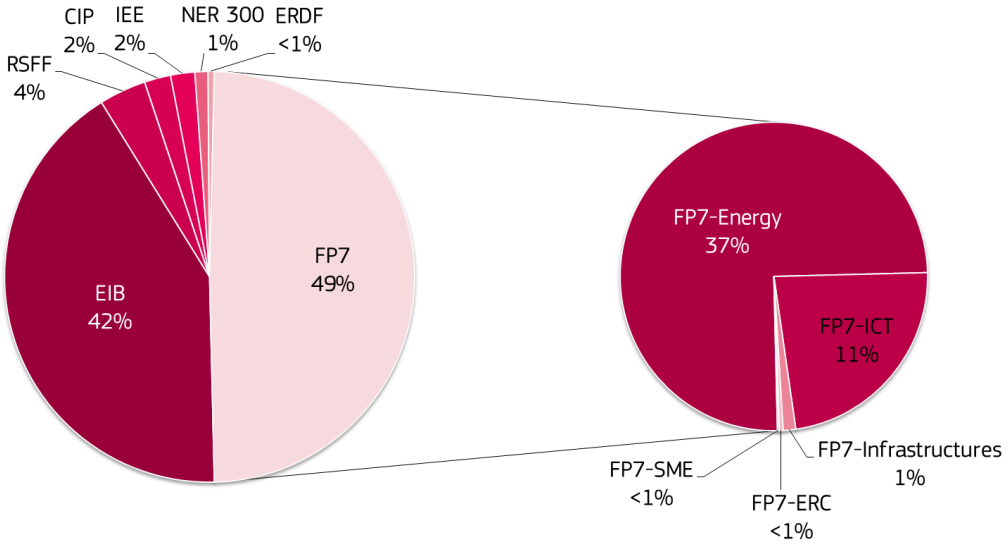
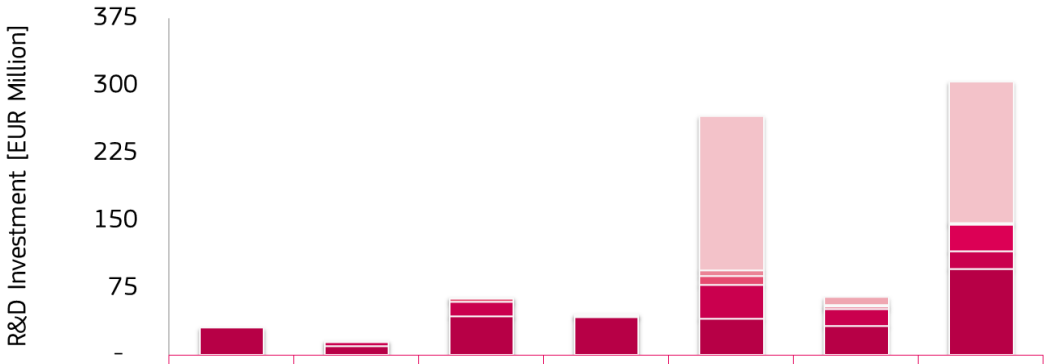


Figure 11. Contribution share of EU funding to electricity grids technologies by funding source. Data sources: JRC analysis of [5-16]

The financial commitment to projects in the electricity grids sector has gone through significant variations throughout the 2007-2013 period. We can identify an overall increasing trend, with significant spikes (due to the presents of projects financed through EIB loans) in support in 2011 and 2013 (Figure 12).



	2007	2008	2009	2010	2011	2012	2013
EIB	-	-	-	-	172	-	157
NER300	-	-	-	-		8	-
IEE	-	1	1	2	6	2	3
CIP	-	-	4	-	10	3	-
RSFF	-	-	-	-	-	-	29
FP7-Other	-	5	16	1	38	18	19
FP7-Energy	30	9	43	42	40	32	96

Figure 12. Annual EU contribution to electricity grids technologies by funding source, excluding ERDF. Data sources: JRC analysis of [5-11]

The sector has seen one of the most intense participations with a total of more than 650 participants of which more than half private companies from 37 countries. Despite a large participation of the private sector, a smaller relative number of SMEs (approximately 20% of the PRC) was observed compared to other technologies with similar maturity. Interest in the technology came mainly from Spain and Germany, with more than 140 participations and 80% of the EIB support.

9. Energy storage

The energy storage sector received increasingly more support throughout the 2007-2013 period (Figure 14), totalling €150 million from four different EU financing instruments (Figure 13). The funding supported projects with participation from 27 countries of which 20 EU MS. The top recipient was Germany, which received €10 million from the FP7 programme (half of it from the energy theme line) and another €5.7 million from the LIFE+ programme.

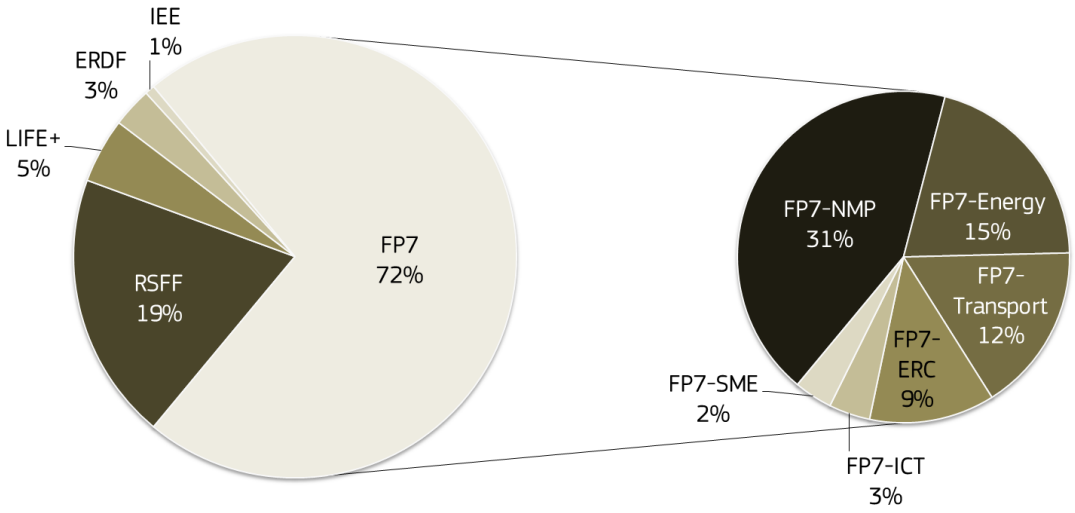
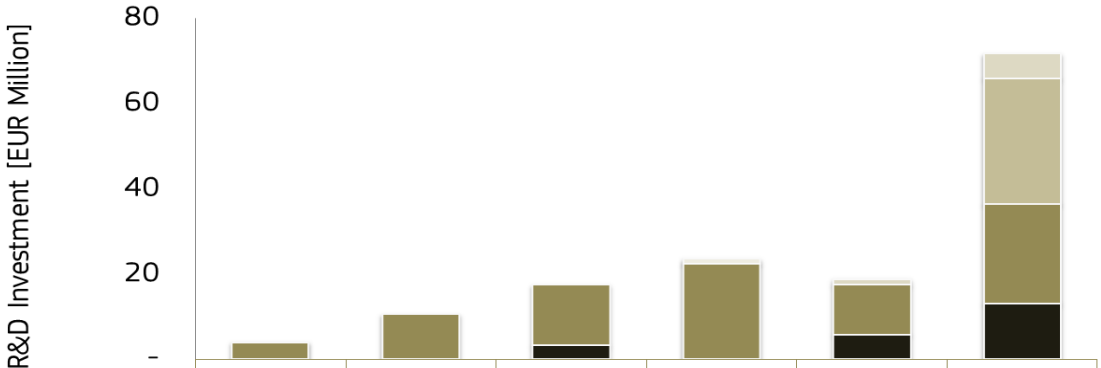


Figure 13. Contribution share of EU funding to energy storage technologies by funding source. Data sources: JRC analysis of [5-16]

France and Spain were also in the top 3 MS that received community support for unlocking the potential of energy storage: the FP7 programme granted €10 million to France, while the entire RSFF funding (€29 million) for the technology went to Spain for a cross-technology (energy storage, CSP and electricity grids) project.



	2007	2008	2010	2011	2012	2013
LIFE+	-	-	-	-	1	6
IEE	-	-	-	1	-	-
RSFF	-	-	-	-	-	29
FP7-Other	4	11	14	22	12	23
FP7-Energy	-	-	3	-	6	13

Figure 14. Annual EU contribution to energy storage technologies by funding source, excluding ERDF. Data sources: JRC analysis of [5-11]

From the 300+ participants 56 were SMEs, more than a quarter of them of French origin.

10. Fuel cells and hydrogen

The main aim of the RD&D effort in the field of fuel cells and hydrogen (FCH) is to make these technologies a competitive solution for the decarbonisation of the transport sector. In order to ensure a constant collaboration between industry and research organisations, the FCH Joint Undertaking (JTI), a public-private partnership that offers channelled financial support was established in 2008.

For the 2007-2013 programming period, it was the JTI that contributed with the highest share of funds (€417 million) to research activities in the FCH sector (Figure 15 and Figure 16).

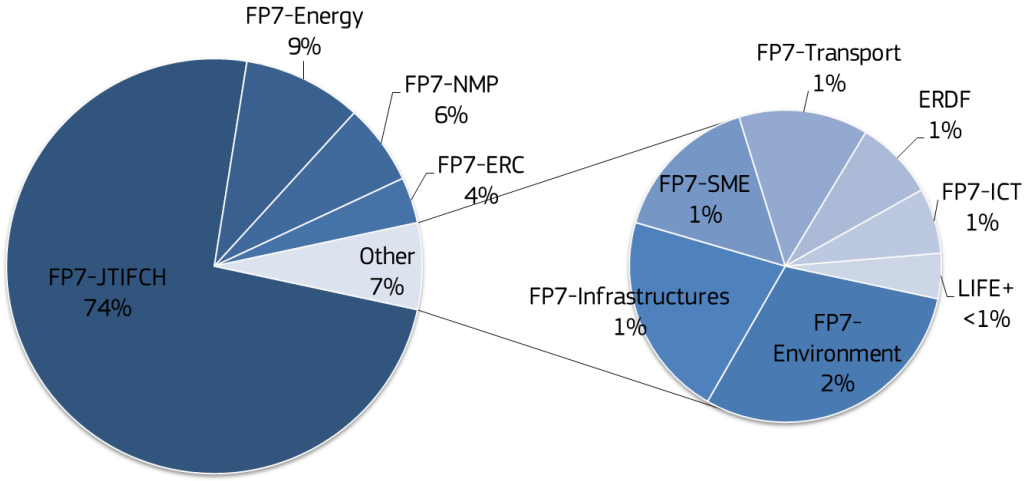
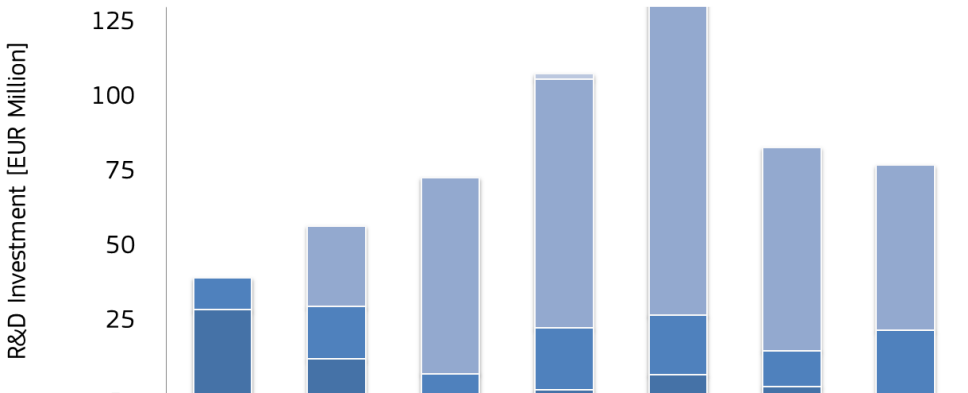


Figure 15. Contribution share of EU funding to FCH technologies by funding source. Data sources: JRC analysis of [5-16]

Germany received the largest share of funding, namely 24% of the total funds allocated to this technology. Other MS with significant participation and investment in FCH were the Benelux countries, Denmark and Italy. In total there were over 1400 participations from 34 countries with a relatively significant involvement of SMEs (22%).



	2007	2008	2009	2010	2011	2012	2013
Life+	-	-	-	2	-	-	-
FP7-JTIFCH	-	27	66	83	117	68	55
FP7-Other	11	18	7	21	20	12	22
FP7	29	12	-	2	7	3	-

Figure 16. Annual EU contribution to FCH technologies by funding source, excluding ERDF. Data sources: JRC analysis of [5-11]

11. Geothermal

Geothermal technology received a small share of EU public funding, namely €62 million, the third smallest contribution between all technologies during 2007-2013 (Figure 17). In 2012 a single Hungarian project received more than 60% of the total sectorial investment (Figure 18).

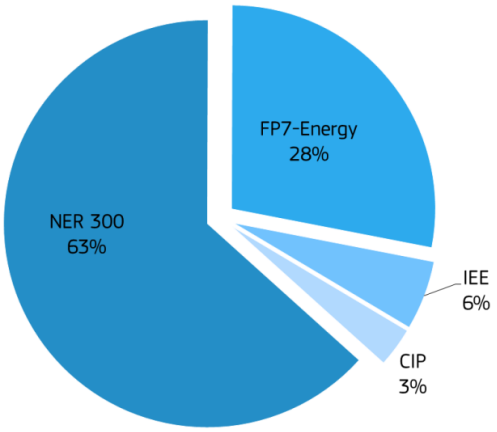
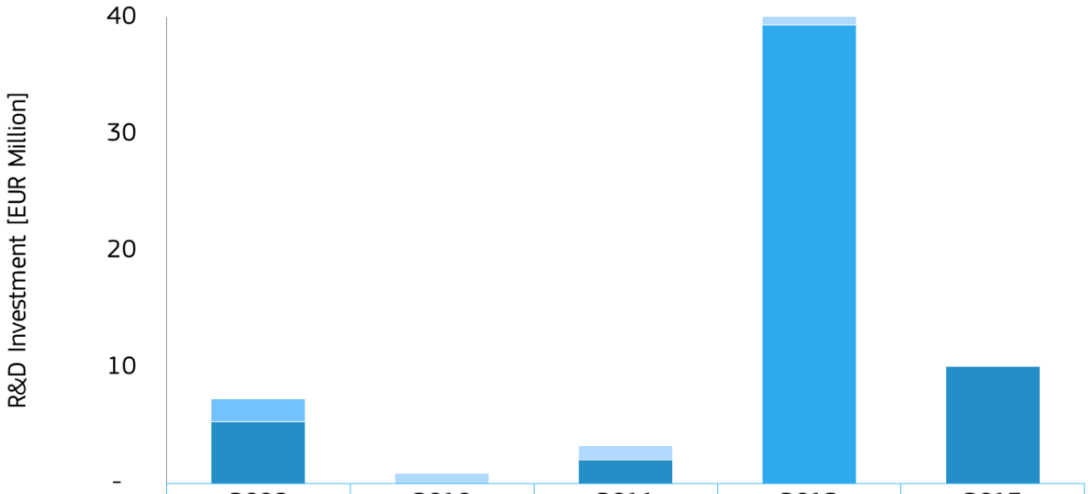


Figure 17. Contribution share of EU funding to geothermal technologies by funding source. Data sources: JRC analysis of [5-16]

Several other MS have shown interest in geothermal technologies but the support they received is negligible by comparison: France, Germany and Netherlands received more than €3 million each through the FP7-Energy theme line.



	2009	2010	2011	2012	2013
IEE	-	1	1	1	-
CIP	2	-	-	-	-
NER300	-	-	-	39	-
FP7-Energy	5	-	2	-	10

Figure 18. Annual EU contribution to geothermal technologies by funding source. Data sources: JRC analysis of [5-11]

The number of research oriented organisations (HES and REC) was double that of private companies, a potential indication that new research areas are being explored in the geothermal technologies sector.

12. Nuclear energy

Participants from 36 countries, of which 23 MS, participated in nuclear fission energy technology projects. The total value of these projects was of over €464 million, 71% of which was covered by community funds (Figure 19 and Figure 20).

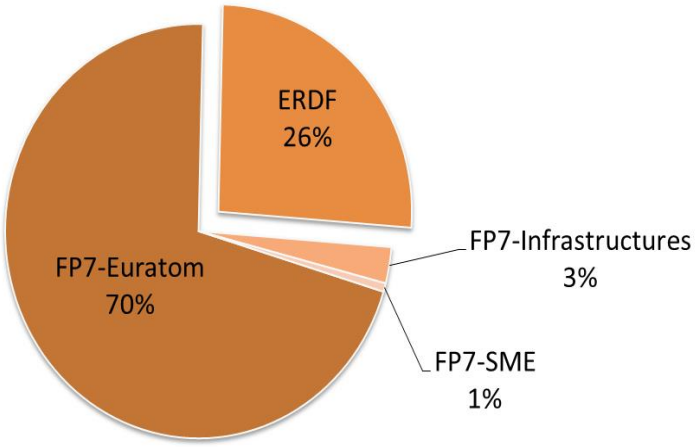
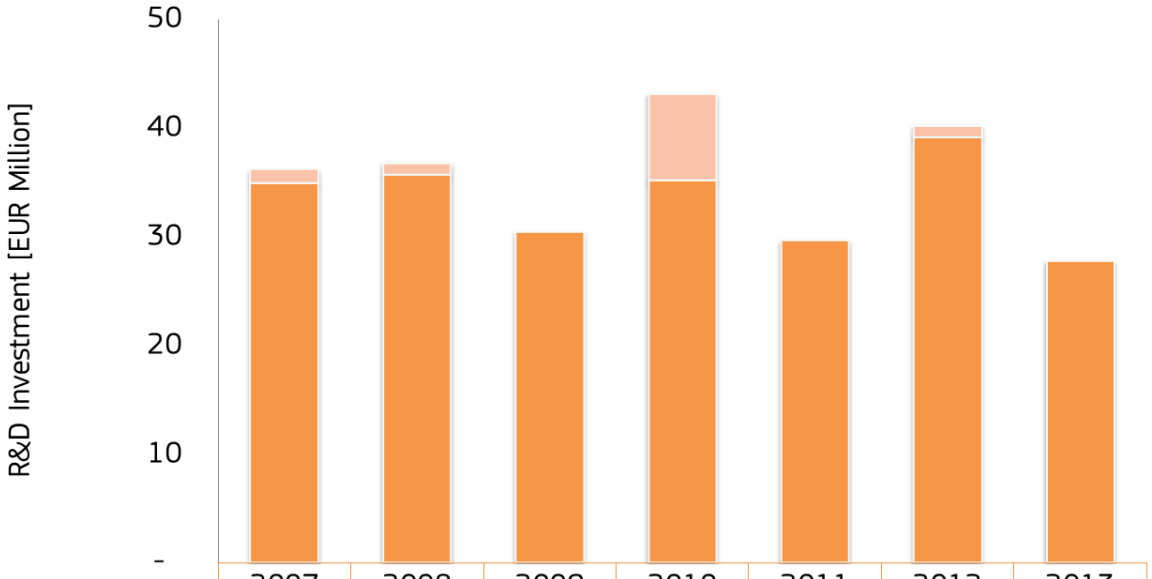


Figure 19. Contribution share of EU funding to nuclear (fission) energy technologies by funding source. Data sources: JRC analysis of [5-16]

More than 380 private-sector companies have participated in nuclear energy projects. Nevertheless research oriented organisations (HES and REC) had an overwhelming 70% participation share in EU-funded projects throughout the period.



	2007	2008	2009	2010	2011	2012	2013
FP7-Other	1	1	-	8	-	1	-
FP7-Euratom	35	36	30	35	30	39	28

Figure 20. Annual EU contribution to nuclear (fission) energy technologies by funding source, excluding ERDF. Data sources: JRC analysis of [5-11]

Also, interesting to note is the fact that a third (€85 million) of the total SET Plan ERDF contribution identified went to a single Czech project (total costs of €100.2 million) for the development of advanced nuclear systems [36].

13. Ocean

One of the least supported technologies in terms of R&D financing, ocean technology has benefitted from €239 million of community funds - almost equally sourced from FP7-Energy, ERDF and NER300 (Figure 21).

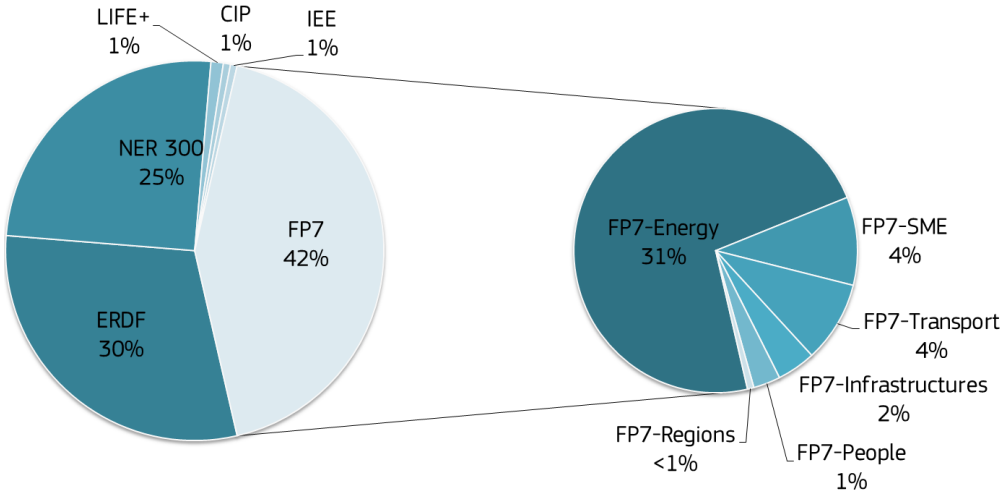
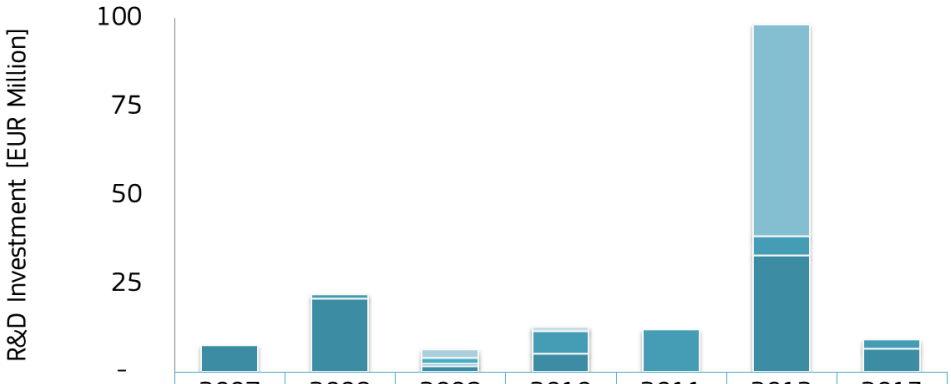


Figure 21. Contribution share of EU funding to ocean energy technologies by funding source. Data sources: JRC analysis of [5-16]

Similarly to most of the other technologies that had succeeded in NER300 calls (geothermal, CCS and wind), 2012 has been the year when ocean R&I received its highest share of committed support (60%) of which 20% went to a single wave technology project in Ireland (Figure 22). It should also be noted that ERDF has committed a third (€71 million) of its total funding to ocean projects aiming at increasing regional and local research capacity.



	2007	2008	2009	2010	2011	2012	2013
IEE	-	-	-	1	-	-	-
LIFE+	-	-	3	-	-	-	-
NER300	-	-	-	-	-	60	-
CIP	-		1	-	-	-	-
FP7-Other	-	1	1	6	12	5	3
FP7-Energy	7	21	2	5	-	33	6

Figure 22. Annual EU contribution to ocean energy technologies by funding source, excluding ERDF. Data sources: JRC analysis of [5-11]

17 countries participated in ocean energy projects, but the geographical focus was mainly around those countries with large coastal areas, with the UK enjoying the largest participation share in all the EU programmes.

14. Solar energy

During 2007-2013, solar energy has received the second highest level of support, raising more than €1.3 billion in community funds (Figure 23).

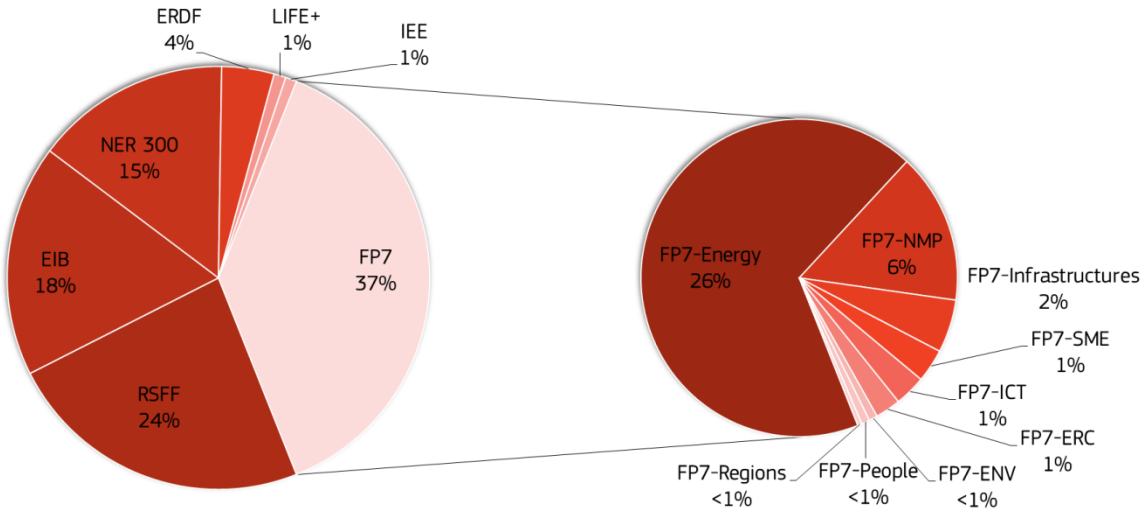
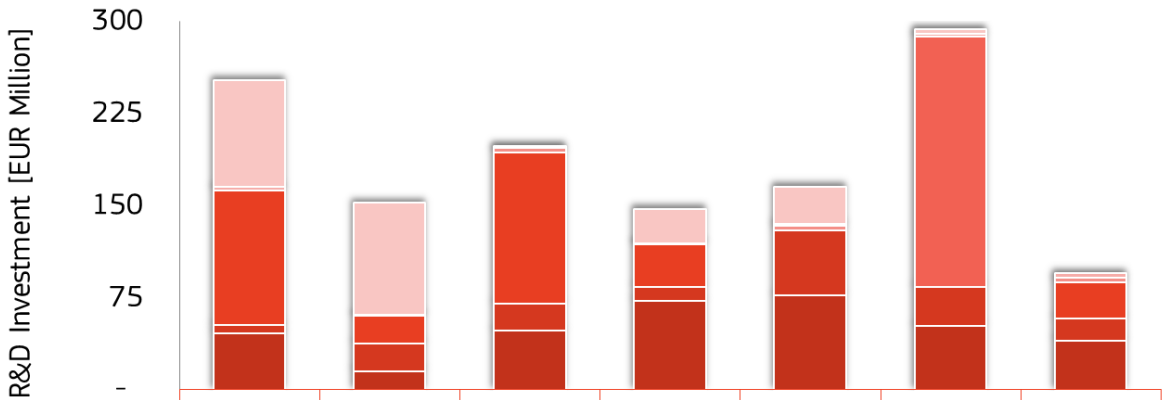


Figure 23. Contribution share of EU funding to solar energy technologies by funding source. Data sources: JRC analysis of [5-16]

The commitment was distributed more or less equally through the years (Figure 24).



	2007	2008	2009	2010	2011	2012	2013
EIB	87	91	-	29	30	4	-
LIFE+	2	-	2	0	2	2	4
IEE	-	1	3	-	4	-	3
NER300	-	-	-	-	-	203	-
RSFF	110	22	123	35	-	-	29
FP7-Other	6	23	22	11	53	32	18
FP-Energy	46	15	48	72	76	52	40

Figure 24. Annual EU contribution to solar energy technologies by funding source, excluding ERDF. Data sources: JRC analysis of [5-11]

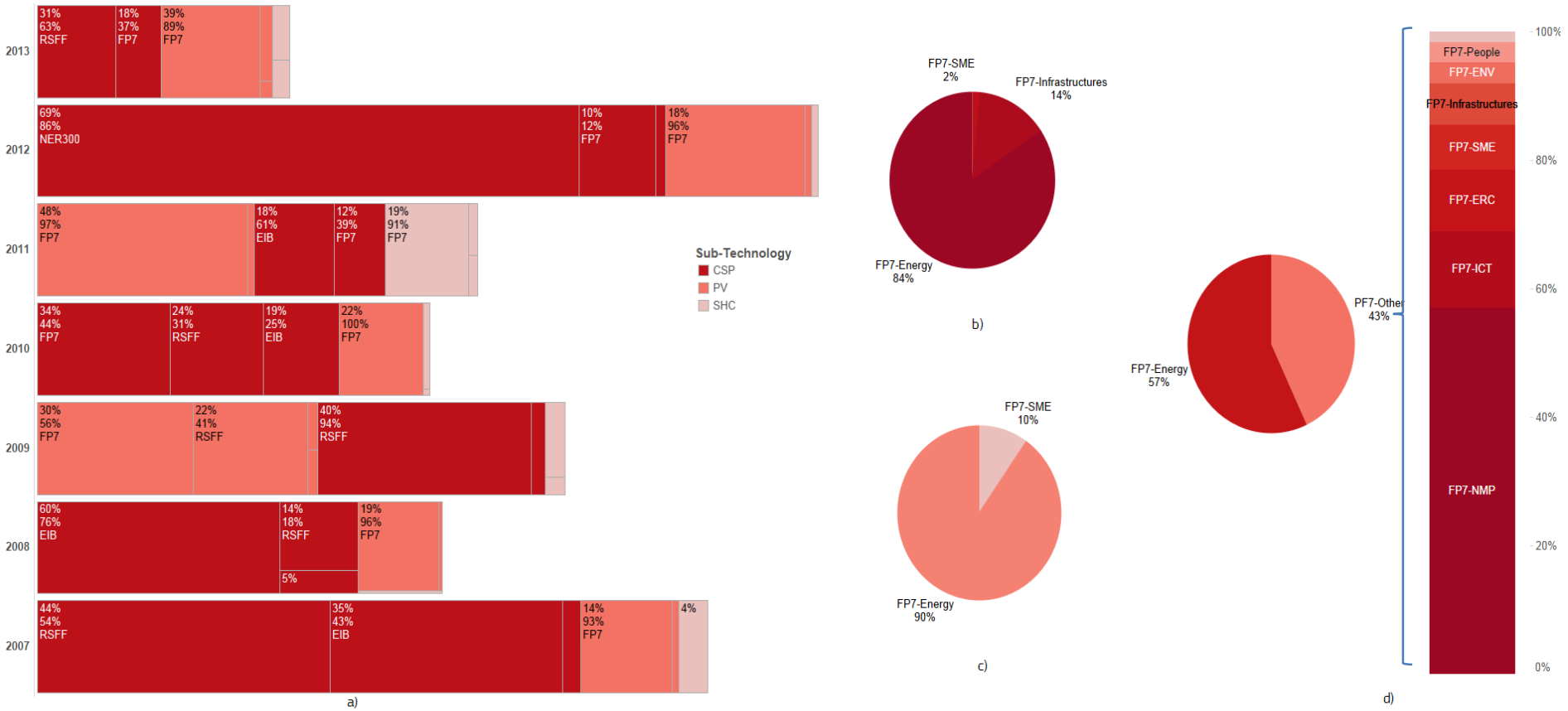


Figure 25. Contribution share to solar energy subcategories by funding source, excluding ERDF: a) CSP, SHC and PV as percentage of total annual R&D investment and sub-technology annual R&D investment; b)-d) FP7 distribution share for CSP, SHC and PV. Data sources: JRC analysis of [5-11]

More than 60% of the funding went to projects developing CSP technologies while only a very small fraction (5%) went to Solar Heating and Cooling (SHC). Unlike CSP where the financing effort was almost equally contributed (average contribution of 28%) by the main financing instruments managed by the EIB (RSFF, EIB loans and NER300), SHC and PV have received the bulk (80%, and 74% respectively) of the funding from EU's largest R&D dedicated programme, FP7 (Figure 25).

The participation to solar projects during 2007-2013 has been impressive counting almost 1000 participants from 49 countries. More than a quarter of the participants were SMEs, 60% of which researching SHC technologies despite a low level of RD&D investment in this sector.

15. Wind energy

One of the most mature of the technologies considered in the present report, wind has attracted the highest level (25%) of R&D resources (€1.82 billion) at community level (Figure 26). This significant level of investment is mainly due to the RSFF and the EIB loans, which committed 60%, and 50% respectively of their total funds for 2007-2013 to this technology. The EIB managed instruments (RSFF, loans and NER300), which together provided 86% of the total funding for this technology, address mainly the financial needs of riskier projects. Hence, more than 40% of the funding went to demonstration activities of off-shore technologies in Germany, Belgium, France and Portugal.

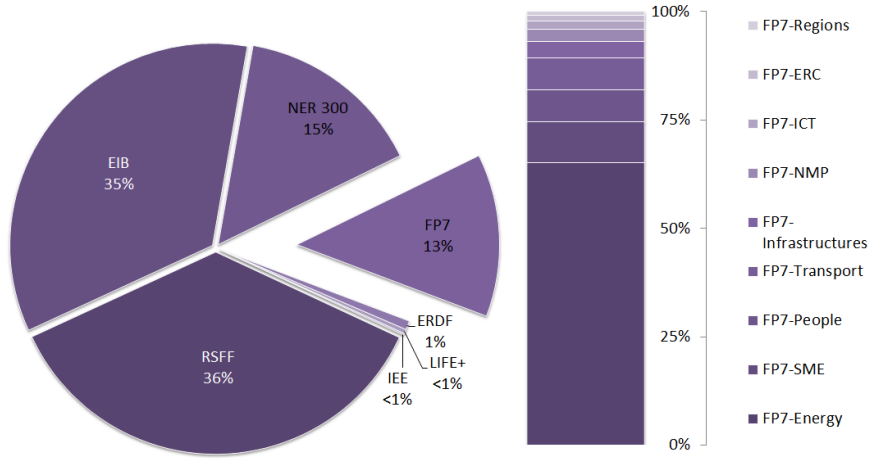
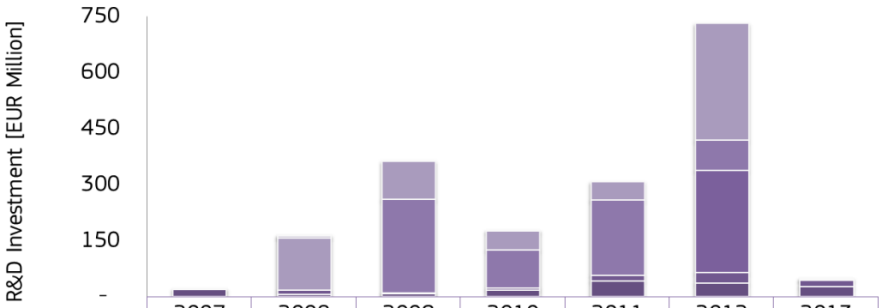


Figure 26. Contribution share of EU funding to wind energy technologies by funding source. Data sources: JRC analysis of [5-16]

Despite a clustering around countries with significant wind capacity (DE, DK, UK, BE, ES, IT, IE, NL), the geographical span of the projects addressing the wind sector was significant with more than 500 participations (36% of which SMEs) from 26 countries. There was a preference towards offshore demonstration projects along the western shores of Europe, while other countries (ES, IT, EL) have also shown increased participations in FP7 research activities, LIFE+ and exploratory IEE projects.



	2007	2008	2009	2010	2011	2012	2013
IEE		1	-	1	-	-	-
LIFE+		6	-	-	-	-	1
RSFF		140	103	50	50	313	3
EIB		-	250	102	200	80	-
NER300	-	-	-	-	-	273	-
FP7-Other	3	11	1	7	16	28	18
FP7-Energy	18	6	9	17	42	37	26

Figure 27. Annual EU contribution to solar energy technologies by funding source, excluding ERDF. Data sources: JRC analysis of [5-11]

16. Conclusions

During the 2007-2013 period:

- The FP7 Energy theme budget lines contributed to projects with a total economic value of €2.9 billion. Within this single FP7 theme there were more than 2550 unique participants, over 1100 of which joined several projects. Over 1300 private organisations took part in the FP7 Energy theme calls, in excess of 500 of them being SMEs. It is worth noting that 20% of the SMEs participating in the FP7 Energy theme programme contributed to bioenergy projects, all addressing the development of combined heat and power from biomass.
- Two thirds of the EIB funding went to Germany and Spain, each receiving €400 million and spending more than half of their funding in wind, and CSP projects respectively.
- More than half of the NER300 maximum committed funding went to projects in the bioenergy sector for the development of combined heat and power from biomass. From a country perspective, Sweden and Germany were awarded the highest number of projects while France (€204 million) and Netherlands (€199 million) received the highest share of committed financial resources.
- RSFF committed 60% of its total funds to wind technologies. More than 80% of the RSFF funding went to projects located in Spain.
- Other non-energy dedicated FP7 themes have supported projects addressing the SET Plan technologies with a total economic value of more than €1.5 billion. In all of the non-energy FP7 themes analysed there were in excess of 2700 participations[4]. More than 1330 of these participants were private organisations, including at least 830 SMEs. 27% of the SMEs participating in the non-energy FP7 themes calls analysed dedicated their activities to addressing EEB challenges.
- The FCH-JTI programme contributed to research projects with a total cost of €874 million. Within this programme there were around 1200 participations, including some 590 private organisations of which over 260 SMEs.
- The Euratom contributed to projects with a total value of €439 million. For the 2007-2013 period there were more than 1350 participations in the Euratom calls, including 370 private organisations of which 86 SMEs.
- The IEE commitment of €115 million was split between projects that fell directly under the management of EACI (71%) and those administrated by the EIB under the ELENA programme. The total cost of the projects was €2.7 billion. This highlights the impressive leverage ratio of ELENA. The countries that received the highest share of funding through the EACI calls were Germany (€4.7 million), UK (€3.5 million) and Italy (€3.1 million) which invested about two thirds of the funds equally in projects addressing EEB and bioenergy technologies. From ELENA, Spain (€8 million), Italy (€6 million) and UK (€5.7 million) received the highest share, which they all invested mainly in EEB.
- With just 1% of the total EU committed funding, LIFE+ provided support to SET Plan relevant projects totalling €207 million. Almost 40% of the dedicated contribution went to Germany (€11 million) for storage and wind projects, Sweden (also €11 million) mainly for bioenergy and PV and Spain (€7 million) mainly for EEB and bioenergy projects.
- Within its priority areas, the ERDF dedicated €252.3 million to RD&D in the SET Plan portfolio of technologies to projects with a total value of almost €1 billion.

From a technology perspective, the period was characterized by the following:

- Wind technologies received more than a quarter of the funds, followed with equal shares by the solar and bioenergy sectors. However, it has to be noted that the ranking of the wind sector is mainly due to just two EIB managed instruments, RSFF and EIB loans, which provided 71% of the total wind investments.

[4] The term denotes both unique and multiple participations of all legal entities.

- The hydroenergy and the AAF sectors received the least support within the group of technologies examined, each being supported with less than 0.2% of the total funds. Geothermal technologies got just under 1% mainly due to a €39 million NER300 commitment in 2012.
- Despite the events at Fukushima, which had a major impact on policy regarding the nuclear sector in a number of countries, the EU-level commitment to the further development of the technology has remained almost constant since the onset of the Euratom programme.

More than 70% of the funding was dedicated to themes 10 and 13. Around 2% of the investment went to projects in one or more of the SET Plan technologies addressing challenges associated to themes that fall out of their direct scope:

- Electricity grids, energy storage and EEB projects focusing also on the (pro)consumer behaviour (Theme 1) and uptake of the technology (Theme 2).
- Electricity grids and EEB projects aiming to provide the system with flexibility by developing demand response solutions (Theme 8) or demonstrating a holistic system approach at local or urban level (Theme 9).

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List of abbreviations and definitions

AAF	Advanced Alternative Fuels
CIP	The Competitiveness and Innovation Framework Programme
CSP	Concentrated Solar Power
CCS	Carbon Capture & Storage
CCU	Carbon Capture and Utilisation
CF	Cohesion Funds
Country acronyms:	
	BE Belgium, DE Germany, DK Denmark, EL Greece, ES Spain, IE Ireland, IT Italy, NL Netherlands, UK United Kingdom
EC	European Commission
EEB	Energy Efficiency in Buildings
EIB	European Investment Bank
EIP	Entrepreneurship and Innovation Programme
ELENA	European Local Energy Assistance
ERDF	European Regional Development Funds
EU	European Union, EU28
FCH	Fuel Cells & Hydrogen
FP7	The 7th Framework Programme for Research, Technological Development and Demonstration
FP7-FCH JTI	FP7 FCH Joint Technology Initiative
FP7-NMP	FP7 Nanosciences, nanotechnologies, materials and new production technologies
HES	Higher Education & Scientific Institutes
IEE	Intelligent Energy Europe
IR(T)	(Theme in) document *Towards Integrated Roadmap*
MRP	Market Replication Projects
PV	Photovoltaic
REC	Research Centres
PRC	Private Companies
R(D)&D	Research (Development) & Demonstration
RDI	Research, Development & Innovation
RSFF	Risk Sharing Financing Facility
SET Plan	Strategic Energy Technology Plan
SHC	Solar Heating & Cooling
SME	Small & Medium Enterprise

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