Evaluation of European FP6/FP7 Energy Research and Demonstration Projects

Andreas Ligtvoet, Technopolis Group, Amsterdam, the Netherlands
Geert van der Veen, Technopolis Group, Amsterdam, the Netherlands

Abstract

The evaluation of the European Sixth and Seventh Framework Programme Energy Research and Demonstration projects is a major undertaking as it targets a portfolio of over 600 projects within 12 thematic areas, including sustainable energy, energy efficiency, smart grids and fuel cell technology. In this contribution we aim to highlight several aspects: 1) Dealing with a large scale programme evaluation requires the analysis of different levels of the programme and integrating the outcomes. For this project we conducted 130 case studies, a large number of interviews, and a large-scale survey among all public and private participants. 2) We included a foresight element in our evaluation which identified high expectations among European firms for impacts of new upcoming products, processes, services and business models, of which the development was supported directly or indirectly through participation in the Framework Programme. 3) We found that the Energy Research and Demonstration projects had a significant positive impact on increasing and sustaining technological leadership, access to research networks and international competitiveness of European knowledge institutes and companies. However, wider impacts on the economy and renewable energy generation are relatively limited.

Introduction: framework programmes of the European Commission

Since their inception in 1982, the Framework Programmes for Research and Technological Development (FP) are the main instrument of EU policy in the field of research: they define the objectives, priorities, and conditions of the research funding of the European Commission. They are currently considered the most important instrument for the implementation of the Innovation Union strategy. This initiative, which is part of the Europe 2020 Strategy, aims to strengthen Europe's ability to compete in a global market and to promote sustainable growth. Historically, the FPs have gone through some major changes.

Historical background

The EU research framework has evolved and developed constantly throughout the past 35+ years, according to the needs of EU innovation policy and the creation of the internal market. The first step taken towards an integrated EU research approach goes as far as 21 December 1982, when the Council approved a preparatory phase for a Community Research and Development Programme in the field of Information Technologies. EU-wide research was promoted at the time in order to reduce a perceived gap between the EU industries and their biggest competitors, mostly from the US and Japan.

The first Framework Programme, commonly known by the acronym FP1, was launched in 1984 and ran for a period of 4 years, with an allotted budget of 3.27 billion ECUs, it covered a limited number of activities and was more reactive than proactive. It is only since the launch of the Lisbon Strategy in 2000 that research policy has become one of the key elements of European policy to promote economic growth and the creation of new jobs. Prior to the Europe 2020 strategy, the Lisbon strategy was a development plan, whose main scope was to create in the EU "the most competitive and dynamic knowledge-based economy in the world" and to lay down solid basis for the creation of the single market between 2000 and 2010. Another important goal of the Lisbon Strategy was the creation of new jobs and the improvement of labour skills across the EU. The EU launched the European Research Area (ERA) in 2000 as a key element for implementing the Lisbon strategy. ERA comprises of three major aspects:

- The creation of an EU internal market for research, where people, ideas and technologies can circulate freely.
- EU-wide coordination of all research activities.
- The implementation of "ERA instruments", such as the Framework Programme to promote cross-country research.

The establishment of the ERA was followed by a pledge to increase R&D national spending to 3% of GDP during the summit of Barcelona in 2002. These policy actions led to major changes to the structure of the programme, which are particularly noticeable from FP6 onward. According to Andrée (2009), during the FP1 - FP5 (1984 - 2002) there was very little interaction between FPs and national programmes; national authorities were not engaged heavily in the preparation of research priorities and the various FPs were perceived as additional tools to national research activities, rather than an integral part of them. However, since 2002 FPs have become the most important financial and legal tool for the implementation of ERA priorities. Therefore both FP6 and FP7 have interacted more with national programmes and private investments than any predecessor. As a consequence of the growing interest in EU-wide research, the budget of the FPs has increased steadily since their start and stands at around €54 billion for FP7, making it the world's largest research programme as well as the largest budget administered directly by the European Commission.

Energy in the framework programmes

Over the different FP incarnations, energy has always been a thematic pillar. The first Framework Programme (1984-1987) dedicated 47.2% of the total budget for the improvement of energy resources (nuclear and non-nuclear). The share of the budget devoted to energy decreased during the second Framework Programme (1987-1991) and the third Framework Programme (1990-1994), with 21.7% and 15.9% respectively of the budget oriented towards energy. This equated to around €1.2b and around €1b respectively. The fourth Framework Programme (1994-1998) increased the budget devoted to non- nuclear energy which was supported by the programmes JOULE and THERMIE. In total, energy research received €2.1b during FP4.

After the strong support for energy in the first four FPs both the relative importance of energy (as related to the total FP volume) as well as the absolute budgets for energy research decreased sharply (which is remarkable considering the Kyoto-protocol that was drafted in 1997). In the fifth Framework Programme (1998-2002) energy was mainly supported by the programme "Energy, Environment and Sustainable Development" (EESD). In which €1.0b was devoted to non-nuclear energy (8.0% of the budget).

During FP6, energy was mainly supported by the Priority 6 "Sustainable development, global change and ecosystems" (SUSTDEV) for which 12.1% of the budget of FP6 and €2.3b were targeted. Priority 6 was divided into three sub-priorities, of which "Sustainable energy systems" that had a foreseen budget of around €700m. The budget available for (non-nuclear) energy therefore represented only 3.7% of the budget of FP6, the lowest budget for energy during the history of the Framework Programmes.

In FP7, a total of €2.4b (for 7 years, compared to 5 years in previous FPs) was reserved for the sub-programme 'Energy' within the "Cooperation" programme of €32.4b (therefore 7.3% of total was spent on energy). With this budget FP7 was in absolute terms almost at the level of FP4, but in relative terms, the importance of energy was still lower than in the early FP years.

Objectives

The objectives of FP6 and FP7 energy research are a mixture of research policy goals and energy policy goals. The energy policy goals are: secure energy supply, sustainable energy supply and enhanced competitiveness of European energy industry. The research policy goals are: sustainable development, enhanced competitiveness of Europe, a knowledge based economy and contribution to other policy goals (i.e. energy policy). The mix of demonstration projects and research projects reflects this dual goal setting. With the Strategic Energy Technology (SET) Plan in 2008 a more coordinated approach of energy research in Europe was strived for. In practice the focus on climate change goals became stronger.

FP6 supported research on energy in a range of different technologies, with the objective to increase technological maturity of each technology. In comparison with FP5, FP6 supported larger projects with multiple participants, whereas FP5 projects dealt with one issue at a time. The larger scale of the FP6 projects was not as productive as the more focussed nature of FP5. FP7 came back to the logic that prevailed prior to FP6 and progressively gave up large projects that were designed to involve the whole value chain of the technologies from the research and technology providers to the industrial end users.

Despite clearly defined high-level, strategic, and operational objectives for energy research, the intervention logic of the European Commission lacked an explicit vision at the programme level, regarding the distribution of funding among the different energy areas. It is unclear on what criteria the distribution of research funds over the various research areas was determined.

Review objectives

Our study was launched to investigate the scientific, technological and innovation impact of energy research projects funded under FP6 and FP7. It was aimed at assessing the use of project results, the impact of the projects on the participants, and the European dimension of the projects. The objectives of the study were aimed at different levels:

- At the project level, the objective was to determine the economic and scientific impact of the projects on the participants;
- At the area level, the objective was to assess the advancement of scientific and technological knowledge due to the projects;
- At the programme level, the objectives were:
    - To assess the contribution of the EU intervention for achieving the FP6/7 objectives and the objectives of EU energy and research policy (in particular the SET Plan);
    - To analyse the complementarities and synergies between research and demonstration activities supported by FP6 and FP7;
    - To analyse the structuring and leveraging effect of EU supported activities towards activities carried out within the Member States.

Below, we first describe the methodological approach we took to this evaluation, followed by the findings of the evaluation both in terms of content and organisation/structure. We conclude with the observations of our evaluation.

Methodology

This evaluation required a large amount of empirical work. Figure 1 below gives an overview of the data collection and analysis efforts. As the objectives described above addressed different levels of the FPs, we combined qualitative (such as interviews for case studies) and more quantitative methods (such as electronic survey) in an integral manner:

- Desk study, both at programme level (e.g. policy documents), area level (e.g. technological road-maps), and project level.
- The CORDA (COmmon Research DAta Warehouse) database and EC monitoring information provided information on the background details of projects and their participants. Limited additional monitoring information was available (such as progress reports), especially for FP6 projects.
- Interviews with 200+ participants, from all technological areas, national and organisational backgrounds, including both project coordinators as well as participants. Additional interviews were held on the programme- and area-levels, such as with EU and MS policy stakeholders, key experts and EC representatives.
- An electronic survey sent to all FP6 and FP7 participants of which email addresses were available through the CORDA database.
- Electronic workshops with policy stakeholders and technical experts were held on the basis of draft area reports. These online discussions (one for each area) delivered valuable contextual interpretation and served to validate conclusions at the area level.

These tools were used to produce three main types of output:

- 130 case studies of individual FP projects. After a portfolio analysis the number of case studies were distributed across the different areas, type of sub-technologies and type of funding instruments. These case studies describe the background of the project and its participants, results and impacts (scientific, technological, economic and energy-related).
- 12 area reports of technological areas, based on case studies and information from the electronic surveys, with additional desk work and interviews. They discuss the main impacts on the technology field and its constituents (companies, research institutes, universities, public organisations). The area reports were validated in the electronic workshops.
- A final evaluation report (Van der Veen et al, 2014) focusing on the level of the Framework Programmes.

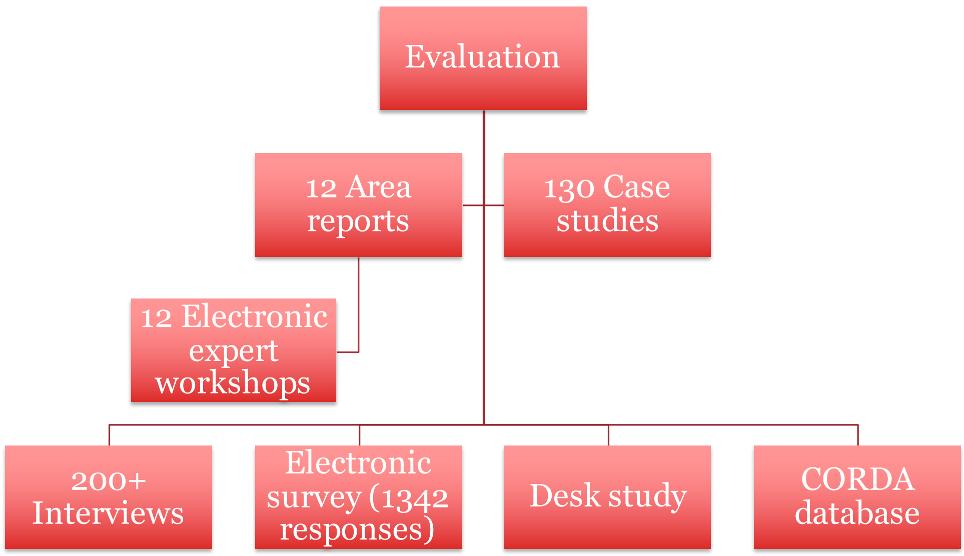

Figure 1. Methodological structure of the evaluation

All data sources above were analysed in an integral manner through our evaluation database. The selection and implementation of case studies was informed by the information from the electronic survey, but the case studies also served as validation with individual participants. This cross-validation has improved the reliability of the results. The final qualitative and quantitative analyses are based on the integrated and validated evaluation database.

The main report is focused on the level of the Framework Programmes, but uses examples and evidence from the area and project level extensively. Both the area reports and the main reports make extensive use of the integrated data from the electronic survey and the case studies – which in turn rely mostly on interviews with FP participants.

Case studies

The case studies were selected in close discussion with the European Commission according to a number of selection criteria:

- Due to the need to focus on measuring impacts of the FP, a focus on finished or almost finished projects was chosen.
- A balance between the FP6 (67%) and FP7 (33%).
- A balance between the research areas covered in this evaluation, with a slight overrepresentation of small areas (such as the "Other" area) in order to have enough material for each area.
- A focus on projects that are likely to be successful, by analysing the first responses of the survey for 'potential high-impact projects'. For this purpose 20% of case studies were selected later after the survey response was available.
- Discussion with the European Commission led to include particular projects of high interest.

Survey

An electronic survey was sent to all participants and coordinators in FP6 and FP7 Energy projects. A recommendation letter from the European Commission was attached to the invitation. Data collection took place from the end of October 2013 to mid-January 2014. Our evaluation team provided support to dozens of participants via email or telephone. Additionally, key indicators were reviewed or collected for a large share of interviewees.

The survey yielded 1342 responses covering 573 projects in total, which means that the analysis included at least 1 response for 89% of projects. A typical FP project had 2.4 survey responses on average. For at least 75 projects the coordinator was one of the survey respondents, although this is likely to be higher since a number of responses could not be traced back to the specific participant (only to a specific project).

The division of responses across organisation types was analysed. Here we see that 22% of responses came from higher education institutions, 34% of private companies, 5% of public organisations, 21% of research centres and 17% of other (or unknown organisations). Compared to the actual distribution, HES (Higher or secondary education) and REC (Research organisations) were slightly overrepresented, while other and public organisations were slightly underrepresented. Respondents who indicated that they themselves were not able to provide realistic estimations of outputs, outcomes and impacts were excluded. The total number of responses for this analysis was therefore reduced to 964.

Involvement of experts

For each of the 12 area reports an online expert workshop was held with over 100 participants in total. Experts were selected from academia, national and European policy stakeholders, industry representatives and FP participants. The feedback from these electronic workshops was integrated in the final version of the area reports. The individual area reports include the list of the participants in the electronic workshops.

Interviews

A large number interviews was carried out for case studies totalling over 200 individual interviews with FP participants. Additionally, policy stakeholders and academic experts were consulted for each individual area report.

Use of Database

We used Filemaker, a database development and publishing package, to facilitate effective collaboration among four Technopolis offices and three partner organisations. This database combined the information delivered by the EC's directorates of Energy and Research, and enabled the project team to view and edit the information simultaneously in one central environment. The basis for this database were the CORDA tables containing contact, project and organisation information related to 642 FP6/7 energy projects. The information in these tables contained information on the projects themselves such as total costs, time span and project description.

Linked to each project was information on the organisations that participated, their roles and financial contributions. The database contained all the contact details for interviewees and whether the project itself was selected for a case study. In addition, the survey responses were added to the data set, linked to projects and their participants. For a limited set of projects, information on publications and patents was also available, which was linked to the projects. This environment enabled the team members to have all the relevant information for the projects they reviewed in one place, without the risk of using unsynchronised information. Additionally, they could verify and comment on the key indicators that were given by survey respondents to add to the integrity of the survey.

Extrapolation and imputation

The Framework Programme aims to achieve a wide range of impacts, from capacity building for R&D, to development of new technologies, improving the competiveness of Europe and the building of sustainable networks. Many of these aspects cannot be covered in simple quantitative indicators and are covered in a qualitative way (through the case studies, interviews and qualitative survey questions).

However, a number of aspects are more easily covered by quantitative indicators, such as publications, PhDs, expected turnover, new products etc. In our participant survey we collected data on participants' estimates of these indicators.

In order to provide rough estimates of the total mid-term impacts associated with participation in the Framework Programme, sticking to just the survey data is not enough as our 1300+ responses only represent 18% of total participations. Simply aggregating the totals from our survey would therefore be a large underestimation of the total impacts so far.

In order to generate rough estimates of total impacts, imputed values were generated on the basis of a custom multiple imputation model. This model imputes the values of missing respondents by looking at similar participants. Similarity is defined on the basis of a number of background characteristics of a typical participant:

- Thematic Area (e.g. Wind, PV)
- Type of project (e.g. Integrating Projects (IP), Focused projects (STREP) or Networks of Excellence (NoE))
- Framework Programme (e.g. FP6, FP7)
- Type of organisation (e.g. Research Centre, Company)
- Size of contribution (in euro EC contribution)

On the basis of these background characteristics, a sample of the most similar participants (at least 10) were identified. The missing response was imputed as the typical value of this sample (median).

For certain variables with large variances (such as turnover, energy impacts), the custom imputation model resulted in estimations that were too low since extreme large values are almost never assigned to missing responses (since the imputation model is based on medians). For these variables, a more straightforward extrapolation, which used sample means, was also used. However, as there was a likely positive response bias because less successful participants were less likely to report, these figures were probably too optimistic. The best estimate is likely to be somewhere in between the imputed and extrapolated values.

For both methods, uncertainties are high, and the responses for many questions show large variations. It should therefore be stressed that these results should be interpreted with care, and that these estimations should be seen as ranges of likely values, not as absolute measures of impact.

Project portfolio

More than 600 non-nuclear energy projects were supported in FP6 and FP7. FP6 supported the implementation of 266 non-nuclear energy-related projects, while 376 projects have been promoted under FP7. The success rate for proposals was around 20% both in FP6 and FP7, indicating that there were five times more projects than EU funding. While in FP6 demonstration projects received 45% of the total EU contribution to projects this share increased to 54% in FP7.

Bioenergy was the area with the largest EU support under FP6 and FP7, receiving a combined total of €517 million in FP6 and FP7. Energy Efficiency and Smart Grids received €461 and €394 million, respectively. Carbon Capture and Storage/Clean Coal Technologies (CCS/CCT) received €271 million, photovoltaics (PV) €251 million and Fuel Cells and Hydro (FCH) €198. At the other end, Socio-economic (€47 million), Future Emerging Technologies/Materials (€82 million), Other Renewables (€109 million), Concentrated Solar Power (€112 million), Renewable Heating & Cooling (€131 million), as well as Wind Power (€179 million) received the lowest EU contributions. Socio-economic research actually declined in budget between FP6 and FP7, while some other areas such as Bioenergy, Energy Efficiency and PV benefitted less from the increase in overall budget than the other areas.

From FP6 to FP7, the EU funding share increased from 48% to 58%. This is in part due to increased maximum funding rates for certain types of legal entities, e.g. SMEs, for which maximum funding rates increased from 50% in FP6 to 75% in FP7. Another factor may be changes in participation patterns. Unfortunately, data for FP6 are not sufficiently detailed to allow for an analysis of the evolution of the participation by type of organisation.

Funding rates do not vary greatly between areas with two exceptions: Future Emerging Technologies/Materials and Socio-economic show higher funding shares, and lower project total costs, which is due to a higher participation of research organisations eligible for higher funding rates.

Project participants

In FP7, almost half of the participants are private companies, another almost half are research organisations (with equal shares for higher education and scientific institutes on the one hand and research centres on the other hand); 6% are public organisations and 3% are other organisations. For many areas, distributions reflect this overall picture. A noticeable difference exists for Energy Efficiency. Here, the participation of both types of research organisations is very low indicating perhaps the stronger demonstration focus in this area and/or a certain lack of research activity. In this area, the share of public organisations is very high. Because of the lack of data on FP6 participants it is not possible to identify how industry participation developed between FP6 and FP7. The average number of participants by project decreased from 14 in FP6 to 11 in FP7, which is a reflection of progressively giving up very large and complex projects in FP7.

While 38 out of 4,615 organisations participated in 15 or more projects, on average each organisation participated in 1.7 projects, and 78% of the organisations participated in one project only. 63% of the participations in FP7 were by participants who had not been active in FP6. This clearly indicates that the FPs allowed new organisations to join and receive funding for their activities. The renewal rate is below average in the small area Socio-economic (43%), but also in the large areas Carbon Capture and Storage/Clean Coal Technologies (51%), PV (56%), Smart Grids (59%) and Wind (59%). Renewal is above average in the areas Concentrated Solar Power (64%), Bioenergy (68%), Other Renewables (70%), Heating & Cooling (74%) and Energy Efficiency (84%).

Participation in FP energy research projects is strongest in metropolitan areas in (North) Western Europe. In FP7 Spain, Portugal and UK increase their participation (compared to FP6), while the 13 new Member States decrease participation.

The geographic distribution of participations is most suitably described relative to the national GDP. Participation is unevenly distributed including differences between Member States, and between regions. Averaged over FP6 and FP7, the Netherlands and Spain participated very strongly relative to the national GDP, while the participation of France and the United Kingdom was very low. A certain tendency towards lower participations can furthermore be found in those countries that have become EU Member States since 2004 as well as in southern Europe as well as in northern Scandinavia. Central Eastern and most of Central Western European participation lost ground from FP6 to FP7, while Spain, Portugal and the UK increased. Participation by Non-EU countries increased from FP6 to FP7. Some regional hot spots are created by the location of administrative seats of research organisations and companies, while the project work may actually be conducted in other regions.

Project budget and EC contribution

The average EU contribution per project increased from FP6 to FP7, suggesting larger, more capital intensive projects closer to commercialisation, especially in the Bioenergy and Smart grid areas. While in FP6 the average project total budget was €6.5 million with an average project EU contribution of €3.1 million, these figures increased in FP7 to €8.8 and €5.1 million, respectively. As on the other hand the number of participants per project decreased, this is a clear indication that the nature of the projects has evolved towards larger, more capital intensive projects. The largest projects in terms of total budget mainly have demonstration character (although for many projects there was no indication of the formal type of projects). This shows that certain technologies have come closer to commercialisation. Bioenergy and Smart Grids are the most prominent areas in this regard.

Outcomes and impacts

FP6 and FP7 pursued objectives at different levels. As indicated, we identified in particular different levels of objectives. These are described below.

Programme level results

At the level of the programme, both FP6 and FP7 were aimed at increasing efficiency of the European energy system and at mitigating global climate change. These two objectives are long-term objectives and are difficult to assess. Besides, the FPs were expected to structure and provide guidelines for the future of the EU energy policy on the one hand and of the EU energy research policy on the other hand. To that regard, the FPs have fulfilled their commitments: they allowed the elaboration of long-term strategy of the EU. Even though socio-economic projects for instance suffered from insufficient interactions between the participants with the EU officials and industry representatives, the projects have produced valuable tools, models and knowledge on energy.

The FPs also aimed to establish the European Research Area. As far as energy is concerned, the FPs have strongly contributed to the expansion of regional, national or trans-national research networks. Participants in the projects consensually underlined how they benefited from the programme to start working with new partners from other countries. Projects had strong impacts regarding transnational cooperation, networking and collaboration within the value chain.

Area level results (technological)

At the level of the areas, both FP6 and FP7 aimed at reducing the cost of technologies (by increasing efficiency). The state-of-the-art of technology was very heterogeneous across areas, implying different objectives. At times, the projects were aimed at developing a second generation of technology (e.g. biofuel) or improving existing plant (small hydropower) or buildings (refurbishment for Energy Efficiency), while in other cases, state-of-the-art at the start of FP6 was fragmented basic knowledge and the objective was to take stock of existing knowledge (e.g. socio-economic research).

FP6 was in some cases an opportunity to identify research challenges/bottlenecks that were further investigated during FP7. In other cases, FP6 supported a large variety of technologies in order to identify later on the most promising ones. From that perspective, FP6 projects paved the way for further research in the subsequent FP.

Overall, FP7 was much more focused than FP6 in the sense that fewer technologies were supported and fewer projects were funded within each area. Our analysis showed that whatever the level of maturity of technology prior to the start of the FPs, the programmes have enabled an improvement of the technologies. At the level of the areas, FP6 and FP7 have thus permitted outstanding progress.

Impacts on individual projects and participants

First of all, projects in general reached their technological and scientific objectives. Most project participants (70%) indicated that the project had or would reach its objectives. A further 20% to 25% indicated that the project largely achieved its objectives. Only a small minority (around 10%) indicates that the objectives were only reached partly, and only 1% indicates that the project failed.

Secondly, scientific outputs of FP participants were substantial. Scientific organisations reported on average around eight scientific publications per participation, half of which were published in high impact journals. An extrapolation for (almost) finished projects showed that in total around 18,000 articles and 8,000 articles in high impact journals had been published so far. Just over 11% of participants indicated that their participation was associated with at least one patent application or grant.

Thirdly, participants indicated that their participation had led to substantial organisational impacts, especially in terms of improved networks and knowledge position. In terms of economic organisational impact, around 20-25% of participating companies saw a substantial improvement of more than 5% for turnover and profit. The large majority (76%) of companies indicated that there had been an increase in their general competiveness. However, for only around 2% of participants their participation had a very large effect of more than 25% increase in turnover, profit, or market share.

Fourthly, participants had high expectations regarding the potential turnover and impacts on energy savings, renewable energy generation, and CO_2 reduction, but uncertainties are high and the road to impact long. Concrete economic and energy impacts at the moment were still limited, but not absent. The aggregate expected annual turnover by participants related to these innovations amounted to €18-75 billion by 2020. Note that these impacts would only take place under the condition of substantial additional private and/or public investment and no major negative shifts in policy and market conditions.

In total 18% of participations indicated to have had an impact on national policy making. Areas with particular high impact were Smart Grids and Other Renewable Energy sources.

Finally, a first exploration of the efficiency of the Framework Programme in terms of scientific outputs, showed that the FPs delivered value for money in technological and scientific terms. A full assessment of efficiency was not possible due to lack of complete bibliometric data, counterfactual information, and appropriate benchmark programmes.

European Added Value

Although European Added Value (EAV) was not yet a well operationalised concept, and EAV is hard to measure, it can be concluded that the FP energy programmes permitted the creation and organisation of activities (e.g. research clusters) that would have not been possible at the national level. The FP energy investments have clearly promoted transnational cooperation and networking, improving the Union's research position on a global scale and improving business competitiveness in renewable energy technologies. Both FP6 and FP7 have supported the emergence of global research champions and allowed the EU to take or maintain a leadership position in certain areas such as biofuels, wind and smart grids. The energy research in FP6 and FP7 has therefore certainly contributed to the creation of European Added Value.

Skewed impacts

Scientific, technological and potential innovations as outputs and outcomes of projects have been relatively widespread, with large shares of participants indicating that they did indeed associate their participation in the Framework Programme with these outputs and outcomes. A large share of project participations (68%) resulted in a concrete potential innovation outcome. However, when we move from 'potential innovation' to actual market implementation and the size of market impact (measured in turnover, but also energy impacts such as power savings and renewable power generation), a big divide occurs between those innovations with a large impact and those with very little or no impact. Only a small number of innovations manage to offer major added value, but when they do their impact indeed can be very large. This skewedness in impacts is caused mainly by external reasons (although internal reasons in terms of technological success, and more soft aspects as an entrepreneurial spirit are of course preconditions), especially in terms of market conditions, such as:

- Competition with other technologies.
- Available capital for the final steps of development, production scaling and marketing and sales.
- Regulation (as a driver, such as feed-in tariffs, or a barrier, such as a ban on CCS).

This skewedness is also evident in our sample. Only a handful of companies already report concrete impacts in terms of turnover at the moment (±1% of our sample), although many more have (uncertain) expectations. Looking at expected turnover, we see that 10% of participants are responsible for 90% of expected turnover.

This skewedness has a large impact on the possibilities of predicting and evaluating impacts of such large research programmes. Clearly, extrapolation and imputation become more difficult the smaller the ‘high impact’ sample becomes. This is one of the reasons why the uncertainty bands are relatively large, but is also means that the survey sample of ‘high impact’ projects is so small that it becomes difficult to discern concrete success factors from a quantitative perspective.

Potential improvements

Fragmentation of policy efforts. Both programmes have performed quite well in creating new networks; they have been less successful in promoting actual cooperation and concrete alignment between national and EU research policies. They have also been less successful in closing the knowledge gap between the old and new Member States. This has resulted in a large number of projects that were rarely related to each other even within the same technological area. Interviewees also lamented that there had been little effort from the Commission services to promote interactions between projects and avoid overlaps, which should be one key advantage in terms of EAV and a priority for the European Institutions. There seems to be a lack of concrete instruments or a structured approach aimed to achieve this very purpose.

Clusters of excellence become barriers to new entrants. Over time research financing through FPs has promoted the creation of research agglomerates with specialised research institutions that have professionalised project proposal preparation and submission, making it harder for new entrants and smaller players to participate successfully.

Additionality. While it is clear that most projects would not have been carried out without EU financing, it is not possible to determine if these projects truly contributed to the development of research excellence in the EU and have had a strong impact in terms of turnover and profit for the individual company participating. The proper analysis of EAV would strongly benefit from a counterfactual analysis of the real impact of FP6 and FP7 programmes, looking at what would have been the outcomes in the absence of the intervention. This would be possible through a dedicated analysis on the follow-up of FP6 and FP7 rejected proposals (which was not done in this evaluation because data on these projects were not supplied by the EC).

Major data issues

Files on individual projects at the European Commission were not made accessible for the evaluators. Applications, progress reports, final reports and other communication between the project participants and EC officials could only be used by the project team if made public by the project partners themselves (in practice this meant that only final reports that were published on the internet could be used).

In addition, the CORDA database that contains data on the contracted projects for the Framework Programme turned out to be incomplete and not up-to-date. As a consequence, a large part of FP6 projects could not be taken into account in the analysis and many FP6 project coordinators and project participants could not be surveyed (because even names and contact data were unavailable). Contract data that were mentioned in CORDA referred to the original contracts that had been closed between the consortia and the EC, and project changes that occurred during the projects were not conveyed to the evaluation team. Unambiguous characterisation of the projects (e.g. demonstration or research project; thematic area) was missing.

With a referral to privacy legislation, the contact data of unsuccessful applicants were not provided to the evaluation team. This meant that the intended survey among this group (in order to e.g. provide counterfactual information that could be used for determining additionality of the FP) was not possible.

Furthermore, the data-collection within the Strategic Energy Technologies Information System (SETIS) on FP7 (by means of the Energy Research Knowledge Centre (ERKC)) had not progressed to such an extent that the information could be already used for this evaluation.

In order to overcome these issues large efforts were made by the evaluation team, especially in retrieving e-mail addresses of coordinators for FP6 projects. Most of these were found, but many participant addresses remained unknown. As a consequence FP6 projects are underrepresented in the survey, and for some issues no conclusions could be drawn about FP6.

Conclusions and recommendations

We observed that the budgets for FP6 and FP7 for energy were not in relation to the political importance of energy and climate change and the public debate on climate change at the time of the conception of the plans. This may have been due to the fact that the European Commission lacked an explicit vision at the programme level of the distribution of funding among the different energy areas in order to reach the high-level objectives. It was unclear on what criteria the distribution of research funds over the various research areas was determined.

There were significant differences in organisational set-up between FP6 and FP7. These differences seem not to have led to large differences in participation, appreciation and impact between FP6 and FP7. Differences in timing and the lack of information on a large part of FP6 projects make direct comparison difficult.

Overall, FP6 and FP7 can be considered scientifically and technologically successful in the sense that they have contributed to the (further) construction of the European Research Area in the field of energy. This does not mean that the link to the market is made: before the cost reduction that is aimed for is achieved in the market, further development of project results is generally necessary. Economic impacts were not as high as expected.

It is too early to tell whether the main objectives of FP6 and FP7 at the programme level with respect to energy (increasing efficiency of the energy European system and at mitigating global change) have been met. These two objectives are long-term objectives and are difficult to assess. Furthermore, the FPs have permitted elaborating the long-term energy strategy of the EU. The energy research in FP6 and FP7 has therefore certainly contributed to the creation of European Added Value.

In terms of recommendations, we focus on the relevant elements for energy evaluators: in order to improve future evaluation and monitoring, data management at the EC must improve and evaluators must get access to all data available. We recommend that the content of CORDA be improved, so that the information is complete, up-to-date, accurate, and provides structured information in relation to policy goals. Project application forms should be drafted in such a way that all applicants (including unsuccessful ones) consent in making their e-mail addresses available to external parties for evaluation purposes. To facilitate future evaluations and assessment of project results, participants should be required to present a follow up plan and update the European Commission with the results after the end of the project up to x years after the end of the project. For instance an account of all publications, spinoffs and their estimated turnover, could be asked for depending on the project content and scope.

References

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