Report on the first results of H2020 projects on energy efficiency and system integration – Final report

Report for DG ENERGY

Specific contract No ENER/C3/SER/2015-659/SI2.729305/2015-665/SI2.731474 implementing Framework contract No ENER/C3/2013-484-Ricardo-AEA Ltd

CE Delft

DNV·GL

ED 62228 | Issue Number V1.5 | Date 29/03/2017

Customer:

DG ENERGY

Customer reference:

Specific contract No ENER/C3/SER/2015-659/SI2.729305/2015-665/SI2.731474 implementing Framework contract No ENER/C3/2013-484-Ricardo-AEA Ltd

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29 March 2017

Ricardo Energy & Environment reference:

Ref: ED62228- Issue Number V1.5

Executive summary

Ricardo Energy & Environment, CE Delft and DNV GL have evaluated initial results from Horizon 2020 projects under the responsibility of DG Energy. These projects fall in four areas: Energy Efficiency (EE), Low Carbon Energy (grids and storage) (LCE), Low Carbon Energy Renewable Energy System Market Uptake (LCE RES MU) and Smart Cities and Communities (SCC). Table ES1 shows the number of projects supported and the total amount of EC funding provided to each area within the scope of this study. The term 'H2020 energy programme' is used throughout to refer to the activities supported under Societal Challenge 3, on 'Secure, Clean and Efficient Energy' that are the focus of the evaluation.

Table ES1: H2020 budget split by thematic area for the sub-set of projects analysed for this study

	Number of Projects	EC Funding (€m)	% of EC Funding
EE - Buildings and consumer	60	120.6	31 %
EE – Financing	23	36.1	
EE - Heating and Cooling	10	19.1	
EE - Industry and products	13	32.5	
LCE - Grids/Storage	23	237.3	42 %
LCE - RES/Bioenergy	23	40.6	
SCC	9	176.6	27 %
Total	**161**	**662.8**	

Source: European Commission, March 2016: H2020 SC3 data

The evaluation has focused particularly on:

- Evaluating the outcomes and impacts of the projects funded under H2020 taking into account its new, holistic intervention approach, covering the whole innovation cycle and encompassing the whole value chain
- Comparing the outcomes and impacts of the projects funded under H2020 with the projects of its predecessor programmes (Intelligent Energy Europe (IEE II) and the 7th Framework programme (FP7))
- Evaluating how H2020 projects are supporting EU energy policy priorities, implementation and development
- Recommending how future H2020 funding calls could support EU Energy policy priorities, implementation and development
- Exploring the extent to which the creation of a common research and innovation framework in form of H2020 has improved the management and implementation of H2020 projects.

The first H2020 projects commenced in 2014 and no H2020 projects have yet completed, so the focus has been on the initial results and expected outcomes and impacts from these projects and from the programme overall.

This evaluation will support the European Commission in carrying out the midterm review of the Multiannual Financial Framework (MFF).

Evaluation methodology

The study team developed research questions for the evaluation in consultation with DG Energy. These comprised 26 primary evaluation questions that were assessed in detail, and a further 38 operational questions. The primary questions also addressed the key questions identified for evaluation in the Better Regulation Guidelines[1],

[1] European Commission 2015. Better Regulation Guidelines. Commission staff working document. SWD(2015) 111 final.

These research questions covered six aspects: effectiveness of the H2020 energy programme; and its efficiency; relevance of the programme objectives to the needs being addressed; coherence of the programme both with other EU programmes and other parts of the H2020 programme; EU added value; and sustainability of the impacts from the programme.

The study team used a number of strands of evidence to answer these research questions and inform this evaluation: literature and policy review; portfolio analysis of relevant projects; surveys of project participants and of coordinators of project applications not awarded funding; interviews with a range of stakeholders; and case studies of a selection of projects.

The literature and policy review involved detailed review of twenty-five documents relating to H2020, IEE II and FP7 including policy documents, impact assessments, monitoring reports and evaluations of predecessor programmes.

The portfolio analysis involved an analysis of project and participant statistics for the three programmes, and a review of the programmes against a series of identified dimensions, including analysis of strengths and opportunities. The portfolio analysis also collated Key Performance Indicators (KPIs) for H2020 projects, where available, and assessed the reliability of these KPI data. The main data sources for the portfolio analysis were previous evaluations, project files and a dataset on H2020 provided by the European Commission.

The survey of project participants, including coordinators and other partners, included questions across all the themes of the evaluation, and provided views and data that were not available from the literature. There were 638 responses to this survey, including partial responses, drawn from all EU Member States and different types of organisations.

The survey of unsuccessful applicants covered a narrower range of questions, focussing on the applicants' experience of the Horizon 2020 application process and their next steps, if known, for example in terms of seeking alternative funding or revising the scope for their proposed project. There were 56 responses to this survey, again including some incomplete responses.

The evaluation used stakeholder interviews to fill gaps in the evidence base, to check and substantiate key findings from the surveys, to address programme level issues and to inform the case studies. The study team interviewed 72 programme-level stakeholders and 61 project-level stakeholders (46 project participants and 15 unsuccessful applicants). Programme-level stakeholders included Commission staff; staff from the Executive Agency for SMEs (EASME) and Innovation and Networks Agency (INEA), National Contact Points (NCP) and H2020 evaluators.

The case studies focused on elements of the evaluation that are difficult to capture from the document review, or difficult to quantify, such as the wider impacts of the programme. 28 case studies were completed, including 7 on unsuccessful project applications.

Evaluation of Effectiveness

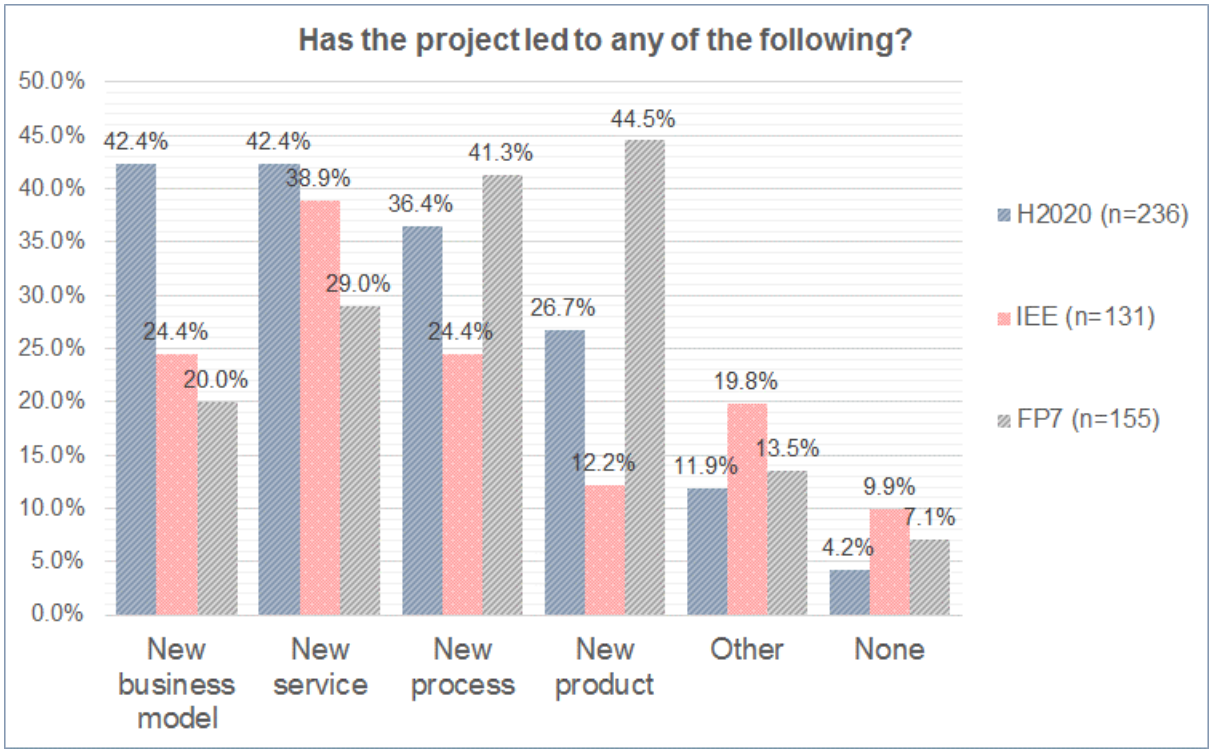
The analysis of effectiveness focuses on answering two key headline questions:

- What has the impact of the H2020 energy programme, and its projects, been on Societal Challenge 3 to date?
- To what extent can the observed direct results, indirect results, unintended effects and socio-economic impacts be credited to the H2020 programme design features?

The assessment of effectiveness considered both the direct outcomes (outputs, results and longer-term impacts) against the relevant objectives of the programmes and the key performance indicators. It also examined indirect/unintended results and impacts, and whether the identified impacts can be directly linked to the design of the H2020 energy programme.

Figure ES1 shows the expected marketable outcomes of H2020, IEE II and FP7 projects, taken from the participants' survey where respondents were asked to indicate whether their project has led or is expected to lead to one or more of these outcome types. This indicates that more H2020 projects are expected to produce new business models (42 %) and new services (42 %) than IEE II and FP7 projects. The responses varied by project type, with 70 % of H2020 Innovation Action projects expecting to lead to a new business model, and 61 % to a new service. Other types of results mentioned by respondents typically included development of new concepts and methodologies, training material and tools, and new policies.

Figure ES1: Expected marketable outcomes of the H2020 projects and predecessor programmes (share of respondents indicating)



Source: Survey of H2020 programme participants

Table ES2 shows the aggregated KPI figures for the H2020 projects that the study team judged to have provided reliable or acceptable KPIs; uncertain KPI data were not included in this analysis. Most projects did not report long term KPIs, and many did not report short term KPIs. This is because there was no obligation to do so. The KPIs that were provided were not checked and negotiated with project officers as had been done previously with IEE projects, and they include some high values that may have been reduced as a result of negotiation. For example, one project accounted for 9 000 $ktCO_2$/yr out of the total short term GHG savings of 11 600 $ktCO_2$/yr.

Table ES2: Aggregated Key Performance Indicators

	Short term KPIs (within project life)	*Longer term KPIs (by 2020)*
Primary Energy Savings		
Number of projects with reliable or acceptable KPIs	57	15
Total energy savings from these projects (GWh/yr)	4 774	12 831
Greenhouse Gas Reductions		
Number of projects with reliable or acceptable KPIs	23	8
Total GHG savings from these projects ($ktCO_2$/yr)	11 600	94 245
Renewable Energy Generated		
Number of projects with reliable or acceptable KPIs	29	7
Total RE to be generated from these projects (GWh/yr)	3 293	92 427
Investment Triggered		
Number of projects with reliable or acceptable KPIs	37	9
Total investment triggered by these projects (€ million/yr)	1 442	6 221

Source: Portfolio analysis

The evaluation assessed the contribution of H2020 projects towards increasing the Technological Readiness Level (TRL) of the relevant technologies and bringing them closer to the market using information from the survey of project participants and the portfolio analysis. Figure ES2 shows the TRL before the project and expected TRL after the project. In the great majority of cases the TRL was expected to increase by at least one level before the end of the project. The analysis is based on the 76 projects that provided information on the expected TRL at the end of the project.

The expected improvement in TRL was, in most cases, credited to H2020 programme participation. Among 115 respondents to the specific question in the survey of participants, 88 (77 %) stated that the H2020 project activities had a high or very high contribution to increasing the TRL. Only 5 % considered that there was no role of the H2020 intervention.

Figure ES2: Technological Readiness Level of H2020 projects before and after (expected) the project

TRL Before \ TRL After	TRL 1	TRL 2	TRL 3	TRL 4	TRL 5	TRL 6	TRL 7	TRL 8	TRL 9
TRL 9	0	0	0	0	0	0	0	0	3
TRL 8	0	0	0	1	0	0	0	2	2
TRL 7	0	0	1	0	0	0	0	4	1
TRL 6	0	0	0	0	0	3	4	5	3
TRL 5	0	0	0	0	0	1	8	0	0
TRL 4	0	0	0	1	1	5	6	0	0
TRL 3	0	1	3	1	3	3	2	0	0
TRL 2	0	2	1	0	1	0	4	0	1
TRL 1	0	0	1	0	1	1	0	0	0

Source: Survey of H2020 programme participants

The evaluation considered the anticipated contribution of H2020 projects to policy development. Within the portfolio of 161 projects analysed, 62 are expecting to lead to new or modified policy frameworks, of which 37 at national level and 25 at local level. Most stakeholder interviewees, including NCPs, evaluators and the Commission and Agency staff, also believe that H2020 has a positive and significant impact on energy policy, although many noted it is too early to make a robust assessment.

Project participants see H2020 projects as contributing positively to innovation and the market uptake of new technologies in the field of energy. From the participants' survey, 68 % of respondents stated H2020 played a major role in supporting innovation, and 21 % more stated it played a minor role. On market uptake, 52 % of respondents stated H2020 played a major role, and 30 % a minor role.

The available evidence also suggests that the design of the H2020 programme has a positive contribution to the results and impacts of the projects. The majority of survey respondents (55%) stated that the design of the programme has made a high or very high contribution to their project's results while 28% stated that it is too early to judge. This positive view was also supported by interviews with project participants. These interviews also identified indirect impacts in terms of improved cooperation networks and the development of new partnerships, which are highly beneficial for some project participants.

Evaluation of Efficiency

The analysis of efficiency focuses on answering two key headline questions:

- How efficiently have the observed impacts on Societal Challenge 3 of the programme been achieved?
- To what extent has H2020's common research and innovation framework improved the management and implementation of H2020 projects for applicants, and what can be done to improve programme delivery?

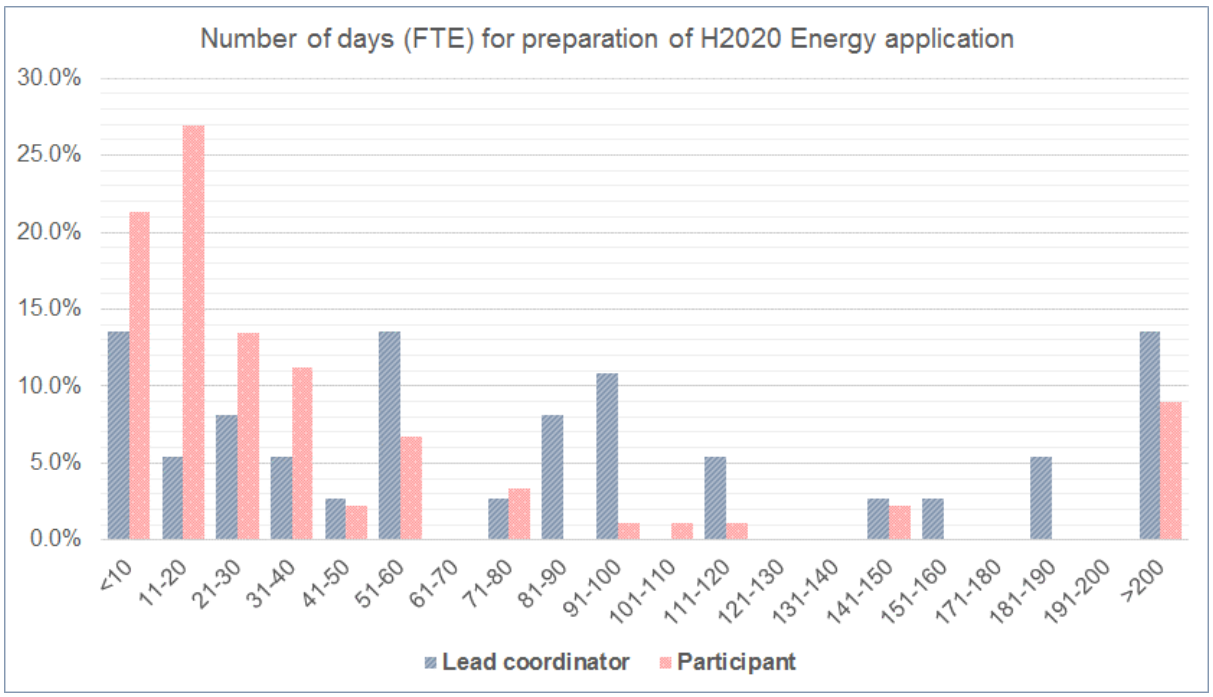
The assessment of the first question focuses on the cost-effectiveness of the programme, i.e. the operational and administrative costs in relation to the achieved direct and indirect outcomes, comparing H2020 with FP7, IEE II and other programmes where relevant data were available. To answer the second question, the study team has examined the management structures and procedural aspects of the programme and their role in the success of the programme.

Data provided by the Commission suggest that operational and administrative costs associated with the H2020 energy programme are about €30 million per year or 5 % of the total programme budget. This compares with 6-7 % for the predecessor IEE II programme. Interviews with Commission and Agency staff provided supporting evidence of efficiency improvements. For example, the project selection process is simpler for H2020, and there is now no negotiation stage. Some interviewees consider that this simplification has improved efficiency but it is also argued that this has probably had a detrimental effect on project quality and effectiveness. The fact that the size of H2020 projects of different types (RIA, IA, CSA) is, on average, larger than those of similar type under FP7 and IEE is also linked with the absence of any means for Agency staff to make changes to the budget of projects before signing the grant agreement. Even if the proposed budget appears to overestimate the costs of a selected project, there is no process through which an adjustment can take place.

Some H2020 projects have provided key performance indicators of expected impacts covering cost effectiveness of energy savings, greenhouse gas savings and renewable energy deployed. Comparison with preceding programmes can only be tentative as these are anticipated impacts based on a small number of H2020 projects, and these projects may be unrepresentative, or they may have used a more conservative approach to estimating KPIs.

The costs to H2020 participants vary significantly according to survey responses, both at the application and grant preparation stages. Figure ES3 shows a significant variation in terms of the number of days spent per application by lead coordinators. Most project participants (over 70%) spent fewer than 40 days. The equivalent responses for grant preparation ranged from under 10 days to over 60 days, with most lead coordinators spending 20 days or fewer and most partners spending 10 days or fewer.

Figure ES3: Resources spent per applicant for H2020 application process (% of respondents indicating by role)



Source: Survey of H2020 participants

Interviews with applicants suggested that the time allocated to proposal preparation was significant and often exceeded their expectations. The cost associated with preparing an application is identified as one of the main barriers to participation in the H2020 programme, with 36 % of survey respondents

considering this to be the most important barrier for participation and 70 % of respondents including it within the three most important barriers.

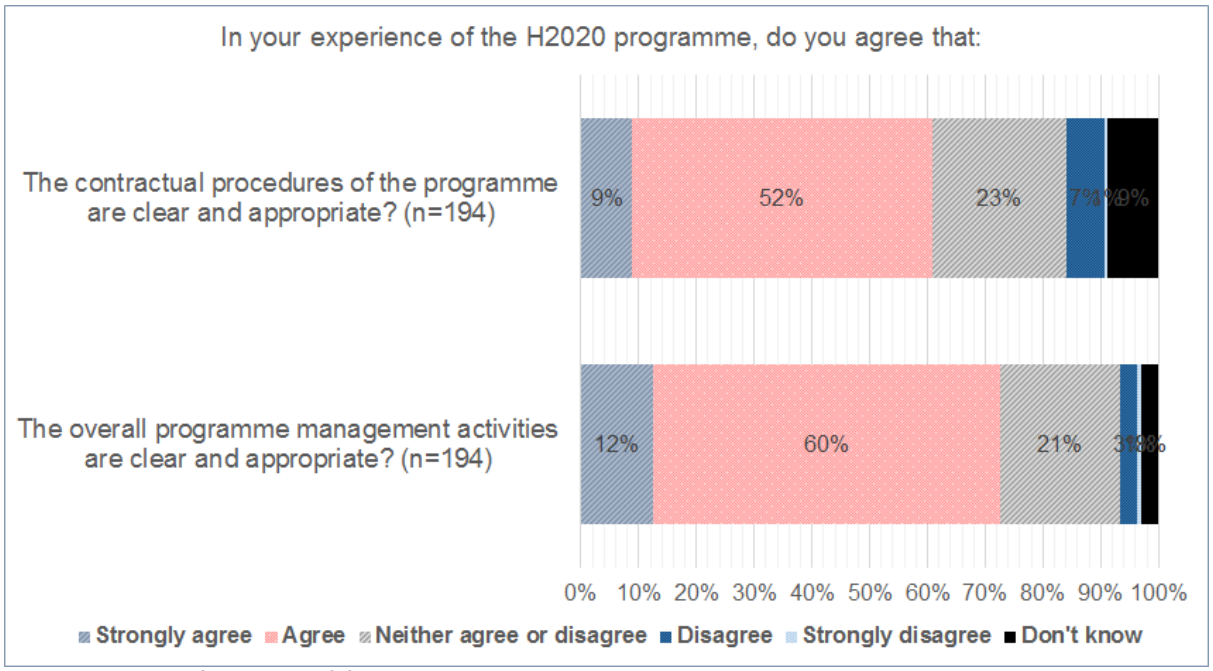
In relation to post-application costs, time-to-grant is an important element in improving the experience of participants and reducing costs. The Commission's target for H2020 was to reduce the time to 8 months, down from 12 months in FP7. 89 % of all H2020 projects and 90 % of H2020 energy projects have achieved this target.

The 2014 Monitoring report (European Commission, 2016d) on the first year of implementation of H2020 pointed to positive developments in terms of simplifying project management and reporting requirements, and hence costs, in comparison to FP7. These included the introduction of a simplified funding model with a single reimbursement rate per project and a single flat rate for covering indirect costs, fewer different funding schemes, simplified time recording for staff working part time on a project, streamlined ex-ante checks, and a reduced audit burden.

Our interviews with project participants supported these findings. Interviewees also noted the efficiency improvements associated with the new web-based application and reporting process, and the added flexibility to allow budget changes within the consortium.

In terms of the management activities and contractual procedures, survey responses (see Figure ES4) confirm that most participants consider H2020 programme management activities and contractual procedures to be clear and appropriate.

Figure ES4: View of participants on the clarity and appropriateness of the management activities



Source: Survey of H2020 participants

The survey of unsuccessful applicants gave similar results, with 56 % of respondents agreeing or strongly agreeing that overall programme management activities are clear and appropriate, and 78 % agreeing or strongly agreeing that the application process is clear and appropriate.

In addition, most H2020 participants consider the programme's communication and knowledge and information dissemination activities to be appropriate and effective, with less than 10 % disagreeing. Unsuccessful applicants were also positive about dissemination activities but a significant proportion (29 %) considers that the results and processes of the programme are not well communicated.

The vast majority of H2020 participants support the view that measures to improve H2020's performance have been successful so far, with only 8 % disagreeing. There is also evidence that the programme is learning and adjusting its processes as a result of participant feedback, for example simplifying the requirement for ethics reporting for most projects.

Evaluation of Relevance

The analysis of relevance focuses on answering three key headline topics:

- Relevance of H2020 to EU policy goals and policy development
- Relevance of H2020 to the policy development and capacity of Member States
- Relevance of H2020 to EU's citizens.

The analysis uses information from a combination of sources: a literature review, interviews with stakeholders, portfolio analysis and case studies.

Literature review and stakeholder consultation support the view that H2020 is well aligned with EU policy and well positioned to contribute to EU policy priorities, implementation and design. The goals of the H2020 programme reflect EU energy headline goals, and the intervention logic clearly shows how the activities and outputs of H2020 contribute to reaching those goals.

Table ES3 shows the budget split read between activity types for H2020 and its predecessor programmes. There appears to have been a shift towards greater support of demonstration projects, but the figures are not directly comparable because the Excellent Science component of H2020 supports early stage research that might previously have come under the FP7 energy programme.

Table ES3: Comparison of budget split by activity type: EC budget spent on IEE II/FP7 vs H2020

Activity type	EC budget per activity (M€)		EC budget per activity (share)	
	IEE II & FP7	H2020	IEE II & FP7	H2020
Market Uptake	418	161	18 %	13 %
Demonstration	1 000	655	44 %	52 %
Research	851	360	38 %	29 %
Other		76		6%
Total	2 269	1 252	100 %	100 %

Source: EC provided data that underpins the SC3 Overview Report.

Compared to its predecessors, H2020 has limited flexibility to be adapted in light of changing policy priorities. This is a consequence of the size of the programme and the management structure involving a number of EU and national bodies in the design of the programme. Moreover, it issues calls every two years instead of annually as with its predecessors.

The topics covered by H2020 are relevant to EU citizens and some topics, such as smart cities and socio-economic research on consumer behaviour, actively involve citizens and address their needs. However, there is low awareness amongst citizens of the H2020 programme or of its results, and communication to citizens could be made more effective.

H2020 focuses on higher-level objectives that are closely related to the EU's 2020 energy goals for 'a reliable, sustainable and competitive energy system'. It combines features of its predecessors into a single framework while streamlining research activities into solving six societal challenges.

In the H2020 programme, there is a renewed focus on (harmonised) policy development compared to FP7. An example of this is the continuation of the Concerted Actions that were funded under the IEE II programme. At the EU level, there are recent examples of initiatives to feed H2020 project results into policy development, like integrating the results in the Renewable Energy Directive and the Energy Efficiency package, or in the design of the electricity market. At the Member State level, more than 30 % of H2020 projects are expected to have an impact on policy at national or regional level. Unfortunately, we do not have comparable figures for the IEE II/FP7 programmes, although in a survey among IEEC members and NCPs 71% of the respondents indicate that the IEE II programme

had an impact on national and regional programmes[2]. Moreover, survey respondents in the current work cited awareness raising, capacity building and policy enabling actions most frequently as the primary objective for projects supported by the IEE programme, and the most frequently reported main users of project outputs are public authorities for IEE projects.

Evaluation of Coherence

The assessment of the H2020 energy programme's coherence requires an examination of how well its constituent processes and activities have been working together and with other interventions.

The analysis of coherence addresses three primary evaluation questions:

- To what extent does the H2020 programme complement other EU level interventions that have similar objectives? (external coherence)
- What synergies and interactions exist between the H2020 programme and the European Structural and Investment Funds (ESIF) and other research, innovation and competitiveness-related EU programmes? (external coherence)
- To what extent does the overall logic, structure and activities of the work programme of the H2020 programme holistically support its purpose/objectives? (internal coherence).

There is a general consensus among stakeholders that H2020 is broadly complementary to other EU level interventions, such as COSME, ESIF and LIFE. While there is some degree of overlap between H2020 and other programmes, this was generally seen as inevitable due to the breadth of the topics and areas covered by H2020. Moreover, replication due to overlap of some aspects of projects is seen as a useful means to increase impact.

A mapping of all EU programmes/funds could be a potentially useful and effective means of helping ensure a broader coherence. A clear and comprehensive overview of all existing EU programmes/funds is currently lacking, including which programmes are funding what projects.

There is less consensus on the degree of complementarity and coherence between H2020 programme and national or regional level interventions with similar objectives. This is to be expected given that countries control their own national and regional level interventions and that no procedures/ tools have been developed as yet in practice at the programme-level to enable and encourage such synergies. Having projects start with H2020 funding and then continue with national funding, or vice versa, is seen as positive.

The findings in relation to synergies and interactions between H2020 and ESIF indicate that while the synergies and interactions may be established in theory, they do not currently appear to be working as effectively in practice. Current interactions are perceived to be somewhat informal. However, H2020 with its research & innovation focus and ESIF with its infrastructure focus are very complementary to one another, even if there is overlap in some topics. In order to realise the potential synergies and interactions, better linkages could be developed and communicated, and the programmes' processes, procedures and structures could be better aligned.

In terms of the internal coherence of the programme, the overall logic, structure and activities of the work programmes of the H2020 energy programme are seen to holistically support its purpose/objectives and complement each other reasonably well. While internal overlaps are inevitable in such a large and complex holistic programme as H2020, such overlaps are not generally seen as negative or counter-productive, but rather helping to create the basis for synergies to be identified and developed towards the achievement of greater impacts.

The integration of research, innovation and market uptake activities into one single instrument is seen by stakeholders as broadly positive, although there are mixed views. The successful integration of the market update dimension in particular is not that clear to some. It was highlighted by some stakeholders that the market uptake dimension is not particularly well understood or exploited (it should be about taking down the market barriers and building capacity), making the integration less well executed than initially thought. It should however be stressed here that the market uptake dimension is not complete or optimised as yet. While the integration process has brought important

[2] Final Evaluation of the Intelligent Energy Europe II Programme.

insights in existing technologies, it seems that the market uptake part of H2020 is suffering from recognition, valorisation and communication problems. Most stakeholders understand and appreciate the principle behind combining research, innovation and market uptake, but many feel this is not yet fully optimised across all aspects of the programme.

Evaluation of EU Added Value

The analysis of EU added value focuses on answering three headline questions, the first of which also relates to the relevance of the H2020 programme:

- What would be the effect of non-intervention, e.g. what would be the impact of stopping the H2020 programme?
- What is the additional value resulting from funding H2020 projects, compared to what could be achieved by Member States at a national and/or regional levels?
- To what extent do the issues addressed by the programme continue to require action at an EU level?

There is strong consensus from project participants, unsuccessful applicants and programme-level stakeholders that H2020 and its predecessor programmes add value at EU level, and that stopping the H2020 programme would disbenefit research and innovation and market uptake.

Important aspects of EU added value from the H2020 programme include pooling of knowledge and resources between researchers, creating synergies within the research community and harmonising policy development and actions across Member States.

It has not been possible to determine the marginal EU added value between H2020 and FP7/IEE as very few stakeholders are aware of the changes introduced for H2020 and how these relate to EU added value.

Most stakeholders believe the issues addressed by H2020 continue to require action at EU level.

Evaluation of Sustainability

The analysis of sustainability focuses on answering the question:

- To what extent are the observed effects replicated and lasting after the intervention finished?

For the projects considered in the current portfolio analysis, about 75 % included an indication of a route to longer term sustainability in their application documents. This could be plans for replication of a product, commercialisation of an activity, development of a business plan for future work or ongoing dissemination that would have a lasting effect. The proportion with an indication of sustainability was the same for the sets of IEE II and H2020 projects considered.

This may be a feature of the information requested or provided in the application documents as at least 90 % of respondents to the project participant survey, and over 95 % for H2020 respondents said that their project had led to or might lead to a new business model, service, process or product. Responses from H2020 respondents are highest for new business models and services and these are higher than for either the FP7 or IEE programmes.

Of those responding from IEE II and FP7 completed projects, about two in three respondents for IEE II projects and one in two from FP7 claimed that they have evidence of a lasting impact from their project.

Some unsuccessful applicants noted that the involvement of investment facilities in H2020 that may enhance impacts. There was both a request for further support of this type and some concern that it may not be focussed on SMEs.

Recommendations

Participation

Of 198 respondents to the survey for the 161 projects in scope for the current study, 43% had not previously participated in either FP7 or IEE. This figure is encouraging in indicating a high degree of access to new participants. The comparable number for the FP7 programme had been 63 %, though it was lower for the IEE II programme. It may be appropriate to consider ways to increase further the participation by new participants.

Recommendation 1. That the European Union consider means of encouraging further participation in the H2020 energy programme by participants that have not participated in immediate predecessor programmes. This could involve: consideration of the nature of calls and of the application process to make them more accessible to new applicants; and consideration of the nature and extent of support provided by NCPs to support new applicants.

Effectiveness

There is a gap in the availability of estimated and consistently calculated values at the time of Key Performance Indicators. These are requested for Coordination and Support Action (CSA) projects but not for other types of project. It is appreciated that there will be significant uncertainties in developing such data and particularly for Research and Innovation Action (RIA) projects. However, such data would give a further means of estimating potential impact of applications and would also provide a baseline for later review of impacts achieved.

Recommendation 2. That the European Union consider extending the requirement for provision of KPI data at application to Innovation Action (IA), and possibly also to RIA projects.

A high proportion of funding goes to EU15 states. In addition, though it is not quite as marked as for funding, a high proportion of the impacts are also in EU15 states. This may be an area for consideration, if the Commission wishes to rebalance this, at least to some extent.

Recommendation 3. That the European Union consider means of enhancing funding to and impacts in EU13 states. This could be by issuing more calls with themes that are particularly relevant to EU13 states. This may also be enhanced by additional support through NCPs in EU13 states.

It is recognised that an aim of the H2020 programme has been to provide support to projects that are closer to market than typical FP7 projects through Innovation Actions. Evidence to date suggests that, indeed the average starting TRL for H2020 projects has increased from that for FP7 projects. There is however concern from some stakeholders, that if there is too little support for Research and Innovation Actions, this may suppress the next generation of innovative ideas. This comment also arose under consideration of relevance and of internal coherence of the programme. The Commission may be content with the current position for H2020 support.

Recommendation 4. That the European Union considers the current balance of IA, RIA and CSA support in the H2020 energy programme and considers whether a change in balance is required.

Efficiency

One change in practice for H2020 is that there is no longer a negotiation with agencies about the work programme for each project. This has the merit of reducing the time to grant and a reduction has been seen. However, there is concern from some stakeholders that this eliminates an important support mechanism through which the quality of the project proposal and overall work plan could be significantly improved prior to contract and leads to a reduction in the overall support to applicants provided by the Commission and the Agencies. Thus, re-introduction of the negotiation process should be considered although, given the value of reducing time to grant for participants, it is important that this period is not prolonged. Another way this might be addressed would be by enhanced support from National Contact Points. (See also Recommendation 1, above)

Recommendation 5. That the European Union consider reintroduction of some form of negotiation stage for a certain, limited, period per project.

Significant streamlining to application processes has been made since FP7 and IEE II. These changes have been broadly welcomed across all applicant types and for all action types. This is not universally welcomed and some, particularly those who are new to H2020 can find the process and the language unclear and vague. Building on this positive change, it may be a good time to consider further improvements to the process. This could consider, for instance: further improvement in the online/IT tools to support the management of the projects through the creation of a standard platform; reducing length of application documents; and developing more tailored procedures and tools/documents adapted to the specific nature of a given action or challenge, keeping only the relevant and necessary elements.

Recommendation 6. That the European Union build on success in streamlining processes for H2020 energy projects and consider further tailoring through removal of non-essential aspects of the application and management processes, to the extent that these do not jeopardize the capacity to effectively monitor project implementation and assess progress against objectives.

One significant barrier to participation is the low success rate for applications. This is the other side of the success story of a high level of interest in the H2020 energy programme and oversubscription which also includes a high number of low quality/ out of scope applications. This necessarily means that there is insufficient funding to support many high quality applications, but also a need to reduce the number of low quality applications. Means to address this could be considered, if allowed under current H2020 rules.

Recommendation 7. That the European Union reconsider lowering the level of EU support provided to some types of projects in order to:

a. *Increase the availability of funds to support more projects in each call and address the issue of a large number of even good proposals being rejected. This can also be enhanced by providing clearer and more descriptive calls to ensure proposals address the challenges.*
b. *Increase EU leverage*
c. *Increase funding for calls supporting smaller projects.*

Relevance

The role of and relevance to citizens is strengthened in H2020, compared to its predecessors. H2020 has budget targeted at issues that are specifically relevant to citizens. H2020 introduced a role for social sciences in the funded energy projects. Moreover, as part of its integrated design, it specifically aims to involve beneficiaries of science and R&D co-creators in the funded projects, including citizens. An example of the latter are citizens that are actively involved in smart cities. Although H2020 has made some marked steps forward in improving relevance to citizens, citizens in general are still hardly aware of the programme or of its results, in spite of the fact that some call topics already ask for dissemination towards citizens.

Recommendation 8. That the European Union consider how to improve communication of the programme relevance towards EU citizens. One may consider for instance raising a campaign to generate crowd-funding as a co-finance source for H2020-projects at higher TRL-levels. An alternative to consider is the introduction of "news impact" as a criterion for evaluation of market uptake project proposals, perhaps also considering the inclusion of journalists in the commission of reviewers of proposals in some specific areas.

Coherence

A clear and comprehensive overview of all existing EU programmes/funds is currently lacking, including which programmes are funding what projects.

Recommendation 9. That the European Union consider a mapping of all EU programmes/funds as a useful and effective means of helping ensure a broader coherence.

The findings in relation to synergies and interactions between H2020 and ESIF indicate that while the synergies and interactions may be well established in theory they do not currently appear to be working that effectively in practice. Current interactions are perceived to be on a somewhat case-by-case basis. However, H2020 with its research & innovation focus and ESIF with its infrastructure focus are indeed very complementary to one another (even if there is overlap in some topics). It is also noted, however, that there is a learning process here which is not yet complete and that, importantly, support from H2020 is allocated at EU level while ESIF implementation is under Member States' shared management rules.

Recommendation 10. That the European Union, in order to realise the potential synergies and interactions, develops and communicates better linkages between H2020 and ESIF (e.g. alignment of processes, procedures and structures and reduction of administrative burden, etc.)

EU added value

It has been noted several times in this evaluation that, although projects have started following the 2014 and 2015 calls, it is too early to quantify whether the actual, as opposed to the anticipated, outputs and impacts of projects.

> *Recommendation 11. That, once H2020 has been running for longer, the European Union undertake a specific evaluation of the outputs and impacts of holistic projects that would not have been eligible for support under FP7 or IEE, and to consider whether these could have been achieved through national funding alone.*

> *Recommendation 12. That the European Union monitor the ongoing need for EU level action on these issues.*

Sustainability

Evidence of potential sustainability of projects after project completion was not clear in documentation for about a significant minority of IEE and H2020 projects examined.

> *Recommendation 13. That the European Union consider strengthening the request for information on sustainable project impacts in project applications.*

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List of abbreviations used

CAs	Coordination of network Actions
CCS	Carbon Capture and Storage
CIP	Competitiveness and Innovation Framework Programme
COM	Commission (European)
CORDA	Common Research Data Warehouse
CORDIS	Community Research and Development Information Service
COSME	Competitiveness Programme for Small and Medium Enterprises
CSA	Coordination and Support Action
DG	Directorate-General
DG Connect	Directorate-General Connect – Digital Single Market
DG ENER	Directorate-General for Energy
DG RTD	Directorate-General for Research and Innovation (Also DG Research)
EASME	European Agency for Small and Medium Sized Enterprises
EE	Energy Efficiency
EED	Energy Efficiency Directive
EIIs	European Industrial Initiatives
EFSI	European Fund for Strategic Investments
EIB	European Investment Bank
EIP	Entrepreneurship and Innovation Programme
EIT	European Institute of Innovation and Technology
ELENA	European Local Energy Assistance, an IEE initiative
EPBD	Energy Performance of Buildings Directive
ERA-NET	European Research Area Network - Part of FP7 to develop and strengthen coordination of national and regional research programmes.
ERKC	Energy Research Knowledge Centre
ESIF	European Structural and Investment Funds
EU13	EU New Member States, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia.
EU15	EU Member States pre-2004, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom
EU	European Union
EU ETS	EU Emissions Trading System
EUR	Euro currency
FP6	6th Framework Programme for Research and Technological Development
FP7	7th Framework Programme for Research and Technological Development
FTE	Full Time Equivalent
H2020	Horizon 2020, 8th phase of the Framework Programme for Research and Innovation

HLEG	High Level Expert Group
IA	Impact Assessment / Innovation Action
ICT	Information and Communication Technology
ICT-PSP	Information and Communications Technologies Policy Support Programme
IEE	Intelligent Energy Europe
IEE I	Intelligent Energy Europe Programme, 2003 - 2006
IEE II	Intelligent Energy Europe Programme, 2007 - 2012
INEA	Innovation and Network Executive Agency
INTERREG	Programme to stimulate cooperation between regions in the EU
IPR	Intellectual Property Rights
JTI	Joint Technology Initiative
KIC	Knowledge and Innovation Communities
KPI	Key Performance Indicator
LCE	Low Carbon Energy
LCE RES MU	Low Carbon Energy Renewable Energy System Market Uptake
LIFE	EU's funding instrument supporting environmental and nature conservation projects
MLEI	Mobilising Local Energy Investments, an IEE initiative
MS	Member States
NCP	National Contact Point
NGO	Non-Governmental Organisation
R&D	Research and Development
RD&D	Research, Development and Demonstration
RED	Renewable Energy Directive
REScoop	European Federation of Renewable Energy Cooperatives
R&I	Research and Innovation
RIA	Research and Innovation Action
SC3	Societal Challenge 3: Secure, Clean and Efficient Energy
SCC	Smart Cities and Communities
SET-Plan	Strategic Energy Technology Plan
TRL	Technology Readiness Level
WP	Work Package

1 Introduction

This evaluation has been prepared by Ricardo Energy & Environment, CE Delft and DNV GL for the European Commission DG Energy. This study evaluates EU funded projects within the Horizon 2020 programme and under the responsibility of DG Energy. The evaluation will support the European Commission in carrying out the midterm review of the Multiannual Financial Framework (MFF).

For clarity throughout this document we will use the term 'H2020 energy programme' to refer to the activities supported under the third specific objective for 'Secure, Clean and Efficient Energy' that are the focus of the evaluation.

The structure of this report is as follows. (The objectives of the study are given later in this section with background to and context for the work in Section 2 and the evaluation questions introduced in Section 3.)

A number of strands of evidence have been used to inform this evaluation: literature and policy review; portfolio analysis of relevant projects; surveys of project participants and of coordinators of project applications that have not been awarded funding; interviews with a range of stakeholders; and case studies of a selection of projects. The methodology for this evidence gathering is described in detail in Section 4.

The current state of play of the H2020 energy programme is presented in Section 5, including comparison with predecessor programmes.

Answers to evaluation questions are presented in Section 6. These cover six aspects: effectiveness of the H2020 energy programme; and its efficiency; relevance of the programme objectives to the needs being addressed; coherence of the programme both with other EU programmes and other parts of the H2020 programme; EU added value; and sustainability of the impacts from the programme. Conclusions are given after the end of each sub-section.

Section 7 presents recommendations from the evaluation.

A large amount of supporting material is provided in Appendices to this report.

A large amount of supporting material is provided in Appendices to this report.

It should be noted that the current assessment has been performed is at a relatively early stage in the Horizon 2020 programme. Many projects have been approved and are underway, but the majority are generally only six months in and none have completed. When comparing impacts from the Horizon 2020 programme with those from predecessor programmes, the comparison can only be between anticipated impacts for projects supported by the Horizon 2020 programme and a mix of anticipated and realised impacts for projects supported by predecessor programmes – depending on whether the projects are complete or not. The differing nature of this information means that conclusions on impacts, and on the changes in scope and process from earlier programmes, will necessarily be provisional at this stage and subject to revision as the Horizon 2020 projects progress.

1.1 Objective of the work

The objective of the work is to evaluate EU-funded projects which are under the responsibility of DG Energy, including their rationale, implementation and achievements.

In particular, the study will:

1. Evaluate the outcomes and impacts of the projects funded under H2020 taking into account its new, holistic intervention approach, covering the whole innovation cycle and encompassing the whole value chain;
2. Compare the outcomes and impacts of the projects funded under H2020 with the projects of its predecessor programmes (IEE, FP7);
3. Evaluate how H2020 projects are supporting EU energy policy priorities, implementation and development
4. Recommend how future H2020 funding calls could support EU Energy policy priorities, implementation and development;

5. Explore to what extent the creation of a common research and innovation framework in form of H2020 has improved the management and implementation of H2020 projects. Such as and widened access to EU funding and improved project implementation.

2 Background to the study

2.1 Context for the Horizon 2020 energy programme

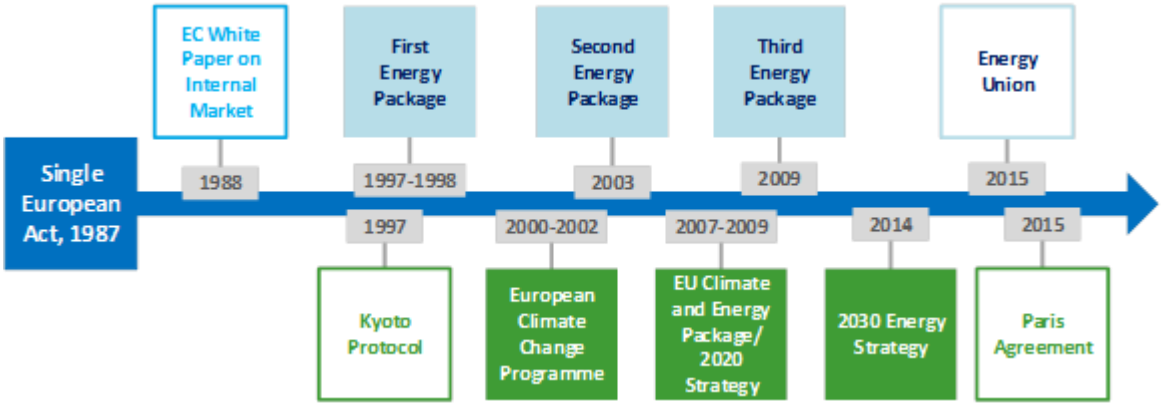
The Horizon 2020 programme (H2020) and, to some extent its predecessors, was developed in response to a series of crucial challenges faced by Europe: low growth, insufficient innovation and a diverse set of environmental and social challenges. It was recognised by Policy makers recognised that by addressing the environmental challenges, such as energy security, rising greenhouse gas emissions, and other social challenges, Europe would be able to boost productivity and generate long-term growth. Consequently, the EU has committed to ambitious climate and energy targets, and ensured that research and innovation (R&I) play a key part in delivering on these.

In 2007 the EU put forward some specific energy targets for 2020 which were enacted in legislation in 2009. Through these targets, the EU aims to reduce its greenhouse gas emissions by at least 20 %, increase the share of renewable energy to at least 20 % of consumption, and achieve energy savings of 20% or more.

Furthermore, in October 2014 EU leaders agreed to build on the 2020 climate and energy package and move towards a climate and energy framework/strategy for 2030. This 2030 strategy sets three key targets: at least a 40 % reduction in greenhouse gas emissions as compared to 1990; at least a 27 % share for renewable energy consumed in the EU; and, at least a 27 % improvement of energy efficiency. The 2030 strategy is also in line with the longer term strategy as set out in the 2050 low-carbon economy roadmap[3].

Figure 1 depicts the main policy developments and major milestones as described above through to the present day alongside a number of other EU policy developments during the past 30 years.

Figure 1: Major milestones in EU energy and climate policy



The European Energy Union has recently been brought about to help prioritise and achieve the above targets by cutting across a number of policy sectors. It is made up of five closely related dimensions that are considered to be interrelated and reinforce one another:

- A fully-integrated internal energy market using interconnectors that will enable energy to flow freely across the EU without technical or regulatory barriers.
- Energy efficiency.

[3] http://ec.europa.eu/clima/policies/strategies/2050/index_en.htm

- Climate action with emissions reductions through a renewed/enhanced EU Emissions Trading System (EU ETS).
- Security of supply through diversification of Europe's energy sources.
- R&I and financing of projects in partnership with the private sector.

In 2008 the Strategic Energy Technology Plan (SET-Plan) was launched with respect to R&I. It has been a central component of EU research and innovation policy since this time. It focused on increasing the coherence of the EU funding landscape by agreeing on common objectives and better coordinating the different funding mechanisms at European, national and regional level. Industrial players were involved through European Industrial Initiatives (EIIs), which aimed to strengthen industrial participation in energy research and demonstration, boost innovation and accelerate deployment of low-carbon energy technologies. EIIs had been established for the main areas of sustainable energy: Bioenergy, Fuel Cells and Hydrogen, Solar and Wind. Other EIIs aimed at providing good framework conditions for sustainable energy (The European Electricity Grid Initiative) or making non-renewable energy systems more sustainable. The SET-Plan was strengthened in 2013 through a Communication on Energy Technologies and Innovation[4] and in 2015 through the introduction of a more integrated approach, which also included reshaping of the EIIs, so as to enable it to address new challenges in research and innovation.

As described above, the EU climate and energy goals are ambitious and challenging. Innovation and knowledge transfer will be key to reach these targets. Concerns of citizens and society, in combination with EU policy objectives (climate, environment, energy, transport, etc.), cannot be addressed without radical and incremental innovation. This will include far-reaching changes in technologies, infrastructures, institutions and behaviours.

To foster future productivity and growth, it is important to generate breakthrough technologies and to translate them into new products, processes and services that are taken up by the wider economy. In other words, R&I are critical to make new, cleaner, low-carbon, efficient energy sources commercially attractive on the scale needed.

However, new knowledge or technologies, at whatever stage of innovation activity do not immediately translate into economic benefits. The right market conditions need to be created. In order to realise these changes, synergies in innovation networks and focus stronger on the dissemination of results of research projects to allow for valorisation into new products, processes and services are required. Equally, new technologies and solutions must compete on cost and reliability against energy systems with well-established (and amortised) technologies.

The need for public intervention in the Research Development & Demonstration (RD&D) of clean and efficient energy technologies is outlined in the Impact Assessment (IA) of the H2020 programme. The IA identifies two main types of market failures[5], which explain why the market itself will not deliver the required level of R&I. First, because of knowledge spill-overs, market allocation results in underinvestment in energy innovation by the private sector. Second, market failures associated with air pollution and carbon emissions are layered on top of market failures associated with the innovation and diffusion of new technologies. These market failures stem from insufficient pricing of externalities such as carbon emissions.

The economic-financial crisis continues to constrain public budgets of EU Member States. This means that the investment that does take place can suffer from fragmentation and inefficiencies. The intended added value of EU-level innovation programme is that this approach is better able to deliver a 'critical mass' of R&I that would have not been possible at the national level. This will then allow the EU to improve its research position on a global scale, and to improve businesses competitiveness in clean and efficient energy technologies in order to take or maintain world leadership. Ex-post evaluation evidence has demonstrated that EU research and innovation programmes *in general* support research and other activities that are of strategic importance for participants, and that in the absence of EU support would simply not take place (e.g. (Deloitte, 2011a), (European Commission, 2016a)). In other words, there are no substitutes for EU level support. Framework Programmes (FP) achieve very high levels of overall "project additionality": i.e. the great majority of FP participants would not have carried out their projects at all without FP funding. As far as energy is concerned, the

[4] https://ec.europa.eu/energy/sites/ener/files/comm_2013_0253_en.pdf
[5] A market failure is a situation where the allocation of resources does not happen efficiently.

FPs have strongly contributed to the expansion of regional, national or trans-national existing networks[6].

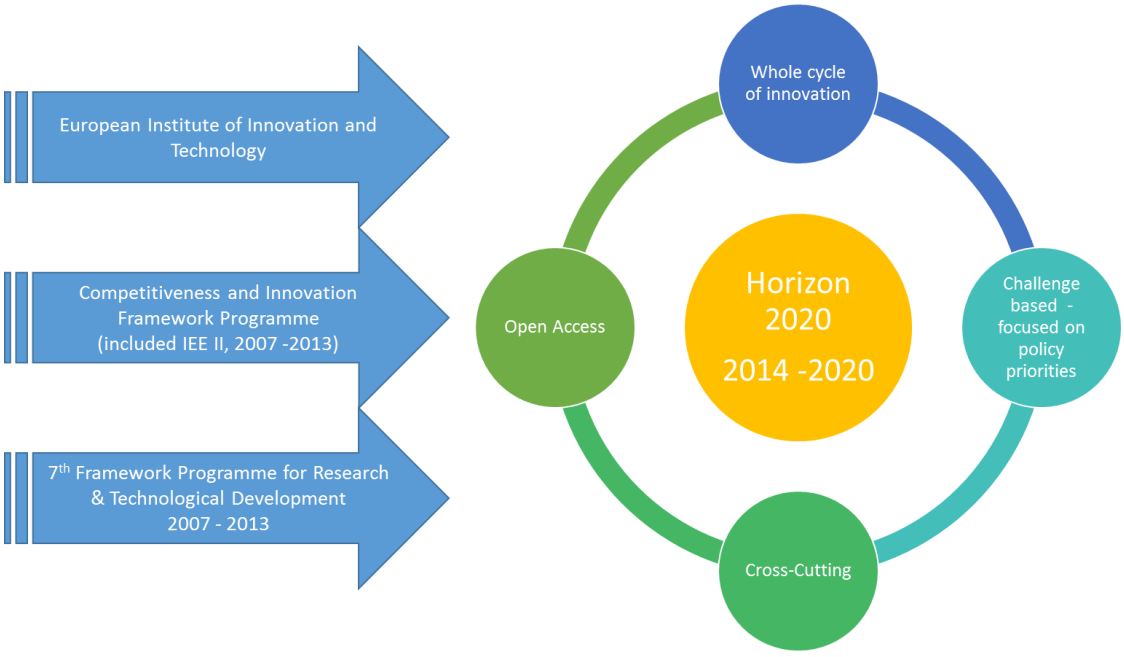
However, several evaluations raised serious concerns on the fragmentation of national and EU research policies, the lack of concrete and structured intervention logic, and barriers to new entrants because of the creation of research agglomerates.

2.2 Horizon 2020 energy programme

H2020 and its predecessors have developed against a background of decades of focused funding designed to reduce Europe's innovation gap, increase competitiveness and tackle societal issues. They were designed to address the R&I dimension within the Energy Union. H2020 aims to promote science and innovation to move Europe towards smart, sustainable, inclusive growth. It aims to do so by removing barriers to research, strengthening the science base, developing technological leadership, assisting with the coordination of research, and encouraging innovation specifically to tackle societal challenges.

The 8th Framework Programme for Research and Innovation, **Horizon 2020**, which started in 2014 and will run until 2020, was designed as an overarching framework. It brought together activities covered by the 7th phase of Framework Programme for Research and Innovation, the European Institute of Innovation and Technology (EIT), and the successor to the Competitiveness and Innovation Framework Programme (CIP). CIP included the Intelligent Energy Europe II (IEE II) programme.

Figure 2: Horizon 2020 and its predecessors



Over its planned seven-year lifespan it will provide almost EUR 75 billion of funding. It supports the three strategic priorities of Open Innovation, Open Science, and being Open to the World as laid out by Commissioner Carlos Moedas in June 2015[7] [8]. The H2020 programme takes a holistic intervention approach, supporting the whole innovation cycle and value chain, from laboratory to market place. H2020 consists of three research areas or 'pillars' – Excellent Science, Industrial Leadership and Societal Challenges. The Programme is implemented through two-year work programmes whereby

[6] https://ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/impact-of-energy-projects-fp6-fp7.pdf#view=fit&pagemode=none.
[7] A new start for Europe: Opening up to an ERA of Innovation', Brussels, 22 June 2015.
[8] It should be noted here that there are other work programmes which are separate but complementary to the H2020 Programme, i.e. European Research Council, Euratom, the Joint Research Centre and the Strategic Innovation Agenda for the European Institute of Innovation and technology (EIT).

funding opportunities are set out under various topics through calls for proposals and other actions, such as public procurements. The allocation of funds is focused under a number of societal challenge categories.

As summarised by the EU Projects Office[9] H2020 was designed to build on FP7 by focusing on innovation as well as research, providing up to 100 % funding for projects, reducing time-to-grants from an average of 12 months to an average of 8 months and providing a different arrangement of thematic approaches. Market uptake activities are a clear focus for the EU innovation programmes. H2020 has confirmed that it will continue the work in this area undertaken by the IEE II Programme, and spend at least 15 % of programme budget on these activities.

This study focuses on H2020 projects funded under Societal Challenge 3, on 'Secure, Clean and Efficient Energy'. A total of EUR 5 672.1 million has been allocated to non-nuclear energy research for the period 2014-2020. The projects under scope have been funded under four areas: Energy Efficiency (EE), Low Carbon Energy (grids and storage) (LCE), Low Carbon Energy Renewable Energy System Market Uptake (LCE RES MU) and Smart Cities and Communities (SCC).

2.3 Immediate predecessors to the Horizon 2020 energy programme

The **IEE II programme**, which was part of the CIP, ran from 2007-2013, though a number of projects are still to be completed. The programme's aim was to create better market conditions for sustainable energy by encouraging the uptake of proven intelligent energy solutions. It was designed to help to reach the EU 2020 targets.

The programme was open to all EU Member States with a budget of €730 million to fund projects[10]. These were mostly disbursed in the form of grants and tenders to public and private organisations committed to collaborating towards a cleaner, more competitive and more secure energy future. As the H2020 programme does currently, the IEE II programme was designed to form a bridge between R&I to mass market uptake. It did this through various activities aimed at accelerating market interest in the resulting energy innovations. Funding was available for different types of actions. The main areas covered were:

- Energy efficiency and the rational use of energy (SAVE).
- New and renewable resources (ALTENER).
- Energy in transport (STEER).
- Other integrated initiatives[11].

Directly preceding H2020 was **European 7th Framework Programme** or FP7 (2007-13). Whilst small compared to H2020, FP7 was considerably larger than FP6, with a budget of € 50 billion. It co-financed research on technological development and demonstration projects And €2.35 billion in funding was available for funding energy research. The objective of energy research under FP7 (FP7 – energy) was to aid the creation and establishment of the technologies necessary to adapt the current energy system into a more sustainable, competitive and secure one[12]. The SET-Plan heavily influenced FP7, via EII roadmaps which informed the topics researched under the seventh phase of the framework[13]. The programme's focus included:

- Hydrogen and fuel cells.
- Renewable technologies.
- CO_2 capture and storage technologies.
- Clean coal technologies.
- Smart energy networks.

[9] http://cerneu.web.cern.ch/horizon2020/fp7-comparison.
[10] http://ec.europa.eu/energy/intelligent/about/iee-programme/.
[11] https://ec.europa.eu/energy/intelligent/about/funding-areas/.
[12] http://cordis.europa.eu/fp7/energy/home_en.html.
[13] https://ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/impact-of-energy-projects-fp6-fp7.pdf#view=fit&pagemode=none.

3 Evaluation questions

This evaluation of the first results of the Horizon 2020 programme on energy efficiency and system integration addresses: the achievements, or impact of the programme based on anticipated impacts of supported projects; rationale for the programme; and implementation or execution of the programme. A large number of questions could be posed to evaluate the programme. Initially a set of 81 questions were identified. These are too many for each to be considered in detail in the current work. Questions have thus been merged and grouped to provide 64 evaluation questions, with 26 primary evaluation questions that will be assessed in detail. The remaining questions are operational questions that support many of the primary questions. (See Appendix 2)

The proposed numbers of primary questions are:

- Impact evaluation: 10
- Rationale evaluation: 9
- Execution evaluation: 7

The primary questions also address the key questions identified for evaluation in the Better Regulation Guidelines[14], with the addition of one evaluation question on the sustainability of the programme. The number of primary evaluation questions addressing each key evaluation area is:

- Effectiveness[15] 8
- Efficiency 8
- Relevance 3 (of which one also relates to effectiveness)
- Coherence 3
- EU added value 3
- Sustainability 1

These headings from the Better Regulation Guidelines (with the addition of sustainability) are used as the major headings for presenting the evaluation in Section 6 of this report.

4 Methodology

Five approaches have been used to address the evaluation questions:

- Review of policy and literature
- Portfolio analysis of relevant IEE, FP7 and H2020 projects
- Questionnaire surveys of IEE, FP7 and H2020 project participants and a separate survey of coordinators of applications to H2020 that were not funded
- Interviews with a broad range of stakeholders
- Development of a number of case studies.

The approaches used to address each evaluation question are shown in Table A2.1 in Annex 2. Further detail of each approach is given below.

4.1 Policy and literature review

4.1.1 Introduction/Objectives

A key source of evidence for this evaluation was provided by IEE, FP7 and H2020 programme and evaluation documents. Further relevant sources of evidence include policy documents, including the Impact Assessment for H2020, and internal documents from the Commission such as the Implementation of the Horizon 2020 Societal Challenge 'Secure, clean and efficient energy' report.

Twenty-five data sources were reviewed for this study (Table 1). Inputs were sought from the Commission, National Contact Points and project stakeholders.

[14] European Commission 2015. Better Regulation Guidelines. Commission staff working document. SWD(2015) 111 final.
[15] These headings are used as shorthand to indicate the areas covered by the key questions an evaluation must answer as in the Better Regulation Guidelines. So “effectiveness” covers the area of the question “How effective has the EU intervention been?”.

Table 1: Key Data Sources

Data source	Description	Evidence relevant to current evaluation	Reference
Documents relating to the Seventh Framework Programme (FP7)			
Ex-Post Evaluation of the Seventh Framework Programme. Commission staff working document (Jan 2016)	Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions On the Response to the High Level Expert Group on the Ex-Post Evaluation of the Seventh Framework Programme	Evaluation of FP7 – provides starting point for comparison with FP7 and H2020 energy projects	(European Commission, 2016a)
Commitment and Coherence – Ex-Post Evaluation of the 7th EU Framework Programme (Nov 2015).	Details programme's achievements and makes recommendations to strengthen Europe's position as a hub of knowledge generation and global innovation.	Beneficiaries of funding by organisation, country and theme.	(Fresco, 2015)
Evaluation of the impacts of projects funded under FP6 and FP7 for RD&D in the area of non-nuclear research (2014) *[16].	Compares the FP6 and FP7 portfolio and impacts.	FP7 portfolio data and findings from the process & impact evaluation.	(Technopolis, 2014)
Implementation of the FP7 Energy Theme (2007-2013)*	FP7 project summary based on CORDA data from 3 December 2013	FP7 portfolio data	(European Commission, 2013a)
Documents relating to the Intelligent Energy Europe (IEE) Programme, part of the Competitiveness and Innovation Framework Programme (CIP)			
Competitiveness and Innovation Programme: Performance from 2007 to 2012	Background to the CIP's programme and its achievements	Contextual background to the CIP programme	(European Commission, 2012)
IEE Project Performance Indicators. Final Report.	Established typical outputs and performance indicators of projects supported under IEE, as well as an application methodology and guide for their use. Delivered by Ricardo on	Background to IEE II Common Performance Indicator (CPI) methodology development	(Ricado-AEA, 2012)

[16] Asterisk (*) indicates that this document will be mined for programme portfolio data, as well as being reviewed as part of the wider literature review exercise.

Data source	Description	Evidence relevant to current evaluation	Reference
	behalf of EACI		
Guidelines for calculations of IEE Common Performance Indicators.	Step by step guidance to CPI development for projects	Sets out recommended CPI methodology to be followed by project coordinators applying for IEE II funding, including suitable reference sources, and M&E guidance	(EACI, 2013a)
Interim Evaluation of the Intelligent Energy-Europe II Programme within the Competitiveness and Innovation Framework Programme	Interim IEE II evaluation	Useful supplementary/ corroborating information for the Final IEE II evaluation	(Deloitte, 2009)
Final Evaluation of the Intelligent Energy – Europe II Programme within the Competitiveness and Innovation Framework Programme*.	Reports the main conclusions from the Final Evaluation of the Intelligent Energy-Europe Programme	IEE II Portfolio data Covers a range questions specified by DG Energy structured into the following evaluation criteria: relevance, effectiveness, efficiency, coherence and synergies, utility, sustainability and impact	(Deloitte, 2011a)
Intelligent Energy – Europe II Performance Report (2007 – 2011) (European Commission)	Presents some of the main results achieved by the programme, from its start until 2011. Prepared by Commission Staff in May 2012	The report does not cover all the actions financed under the IEE II in the period 2007-2011, but gives an overview of the programme's performance	(IEE II, 2012)
Intelligent Energy – Europe II Performance Report (2007 – 2012)* (EACI)	Presents some of the main results achieved by the programme, from its start until 2012. Prepared by the Executive Agency for Competitiveness and Innovation (EACI) in the first quarter of 2013 and published in April 2013	IEE II Portfolio data Describes both achievements and outlook (what remains to be done) of individual projects. It does not include details of all actions financed under IEE II since 2007.	(European Commission, 2013c)
Intelligent Energy – Europe II Implementation Report (2012)*	Review of IEE II programme execution issues	IEE II Portfolio data Useful point of comparison to H2020 programme execution issues	(European Commission, 2013d)
Impact and achievements of bioenergy projects funded under Intelligent Energy – Europe.	Presentation on 'Impacts & achievements of IEE-II Bioenergy projects' held on 22 May 2014 by Executive Agency for Small and	Includes preliminary analysis of impacts achieved in IEE II as well as the methodology used for the impact assessment (e.g.	(EASME, 2014)

Data source	Description	Evidence relevant to current evaluation	Reference
Proceedings of the IEE-II Bioenergy conference.	Medium-sized Enterprises (EASME)	indicators), and overall conclusions	
Review of bioenergy projects implemented under IEE II (Draft final report, In progress)*	Analyses the long & short-term impacts of the 47 IEE II Bioenergy projects, as well as reviewing outputs. Includes case studies of selected projects	IEE II Portfolio data Includes detailed analysis of bioenergy impacts achieved in IEE II and overall conclusions	(Ricardo Energy & Environment, 2016)
Evaluation of Intelligent Energy Europe Support for Sustainable Energy Communities Final Report*.	Evaluation and outcomes of the Sustainable Energy Communities Initiative – which formed part of the broader IEE-II programme. The initiative aimed to support public authorities improve institutional capacity for sustainable energy	IEE II Portfolio data Findings of the evaluation include: activities and participants, relevance, effectiveness, key outcomes, EU added value and long-term impacts of the initiative	(ICF Consulting, 2015)
Evaluation of the Project Development Assistance implemented under the Intelligent Energy Europe. Final Report*	Evaluation and recommendations on the Project Development Assistance (PDA) facilities support, aimed at mobilising investments in sustainable energy at local level	IEE II Portfolio data Summarises grants made and total planned investments for the range of PDA facilities	(PWC, 2016)
Evaluation of the BUILD UP Skills initiative under the Intelligent Energy Europe Programme, Summary and Final Reports	Summary report of the BUILD UP skills initiative, a European scheme funded by the Intelligent Energy Europe (IEE) programme	IEE II Portfolio data Summary report, setting out main points of the wider evaluation of the initiative	(COWI, 2016)
Ex-ante evaluation of a successor of the “Intelligent Energy – Europe II” (2007-2013).	A combined ex ante evaluation and impact assessment for a successor to the ‘Intelligent Energy – Europe II’ (IEE-II 2007-2013)	Includes an evaluation of the IEE-II programme in order to make forward-looking assessments for its successor	(Deloitte, 2011b)
Reports on the Horizon 2020 programme, focussing on Societal Challenge 3 on Secure, Clean and Efficient Energy			
H2020 Impact assessment.	Presents in full the impact assessment of the Commission’s proposals on “H2020” - The Framework Programme for Research and Innovation	Assesses the expected impacts of H2020 on Europe’s economy and society – so this document could be used to match the actual outcomes and results against initial expectations. Outlines the ‘problem definition’	(European Commission, 2011)

Data source	Description	Evidence relevant to current evaluation	Reference
		and links it to lessons learned from the past (i.e. in past programmes)	
H2020 Work Programme 2014 - 2015, 'Secure, Clean and Efficient Energy'.	Summary and rationale for EE, LCE and SSC calls	Sets out challenges and expected impacts of the three calls – essential for comparing actual impacts against	(European Commission, 2015a)
Implementation of the Horizon 2020 Societal Challenge 'Secure, clean and efficient energy'*	H2020 Energy work programme (WP) 2014-2015 data	H2020 portfolio data	(European Commission, 2016b)
H2020 Work Programme 2016 - 2017, 'Secure, Clean and Efficient Energy'.	Summary and rationale for EE, LCE and SSC calls	Sets out challenges and expected impacts of the three calls – essential for comparing actual impacts against	(European Commission, 2016c)
Horizon 2020 Monitoring Report 2014	First Annual Monitoring Report focuses on the implementation of the Work Programme 2014-2015, which was adopted in December 2013	H2020 Portfolio data Covers 58 calls within the Horizon 2020 Work Programme and six calls from the Work Programmes of the Public-Private Partnerships (Joint Undertakings), resulting in 101 call deadlines having closure dates equal to or preceding 31 December 2014	(European Commission, 2016d)
Other documents			
Energy Technologies & Innovation Strategy. COM(2013) 253 final. (2013).	Includes: What has the EU achieved (includes the SET Plan and the Intelligent Energy Europe (IEE) programme); Energy technology and innovation strategy to 2020 and beyond; Implementing the energy technology and innovation strategy	Contextual background to the IEE II and H2020 programmes	(European Commission, 2013b)
Energy Research in Europe (2013)	Compendium document by Energy Research Knowledge Centre (ERKC)	Reviewed for material to inform how H2020 influences/informs national energy research programmes	(minimal relevance)

4.2 Portfolio analysis

A further key source of evidence that has informed the evaluation is portfolio analysis, in which participant statistics and descriptive data on the projects under scope were evaluated. The resulting dataset enabled an analysis of participant statistics for the three programmes, and a review of the programmes against a series of identified dimensions, including analysis of strengths and opportunities (see Section 7). The dataset also provided a critical evidence base to answer a number of the evaluation questions, as set out in Appendix 3.

A three-staged approach was taken to gather all the necessary information:

Table 2: Portfolio analysis – activities undertaken

Activity	Description	Scope	Notes
Evaluation report review	Extraction of programme level portfolio information from a series of programme/initiative evaluation reports	FP7 programme IEE programme – all projects/initiatives evaluated by March 2016	It is recognised that information extracted from the reports is not always consistently available or comparable across programmes.
Project report data-mining	Project documents were data-mined for an agreed list of information. Project documents include the CORDA and IEE project database records, supporting project documents (e.g. proposals, project technical annex) and project websites.	161 H2020 Energy Programme projects (supported under 2014/15 calls) 90 IEE projects that have not been covered under any previous IEE related evaluation	See Table 3 for a summary of the projects covered. The full list of projects can be found in Appendix 3. The data fields for which data was sought are in Appendix 5.
DG RTD data file: European Commission, 2016: H2020 SC3 data	Some elements of the H2020 portfolio characteristics were calculated using a data file provided by DG RTD.	161 H2020 Energy Programme projects (supported under 2014/15 calls) The file has also been used in an unedited format to gather data for the full H2020 SC3 project portfolio for projects granted awards by March 2016.	The data file underpins the data presented in the EC internal document "Implementation of the Horizon 2020 Societal Challenge 'Secure, clean and efficient energy'" (European Commission, 2016b).

Table 3: Projects & approach for project report data mining - summary

Programme	Number of projects
FP7*	0[17]
IEE*	90
H2020 - EE[18]	106
H2020 – LCE system[19]	23
H2020 – LCE RES MU[20]	23
H2020 - SCC[21]	9

**Note that the FP7 projects under scope, and the remaining IEE projects under scope of this study were reviewed at an aggregate level as part of the 'Evaluation Report Review' described above.*

The portfolio analysis exercise also allowed the collection of H2020 projects' projected Key Performance Indicator (KPI) data, where available. This KPI data has been assessed for the extent to which it can be considered reliable, using the criteria in the box below. The KPI data is presented in Section 6.

Box 1: H2020 Key Performance Indicator Reliability Assessments

All H2020 EE CSA projects are required to provide estimated KPI data on primary energy savings and investment triggered as a result of their project. Other H2020 projects may elect to provide this, or other KPI data, but are under no obligation to do so.

Subject to the level of detail provided by H2020 projects around their KPI assumptions/ rationale/ background calculations, data reliability was assessed:

- Data is ranked as RELIABLE where it appears that projects have closely followed IEE KPI development guidance[22]. This guidance was referenced in the CSA application template.
- Data is ranked as ACCEPTABLE where it appears that projects made some effort to follow IEE KPI development guidance and/or there is some justified, traceable basis provided for their KPI estimates.
- Data is ranked as UNCERTAIN where minimal/ no effort has been made to follow the IEE KPI development guidance and/ or no assumptions/ rationale/ background calculations are provided.

Where provided in project documents, KPI data has been collated for impacts during the lifetime of the project (i.e. short-term data) and impacts through to 2020. In some cases, projects presented KPI data for other timescales, or the timescale was not clear from the documentation, and these are not included in the summary data.

4.3 Questionnaire surveys of project participants

4.3.1 Introduction/Objectives

Two surveys were developed for this evaluation: with participants in all FP7 and IEE projects in the energy area and H2020 projects in scope for this evaluation (see Table 3 and Appendix 3); with coordinators of applications to 2014 and 2015 calls that did not receive funding.

[17] No FP7 projects were included in data mining as all had previously been included in a programme evaluation. A list of 132 projects was provided from the FP7programme –projects in related areas to the H2020 areas covered by the current evaluation. This was only used to identify FP7 project survey respondents of particular interest for interview.
[18] Energy Efficiency (EE)
[19] Low Carbon energy (grids and storage) (LCE)
[20] Low Carbon energy (Renewable Energy Sources - Market Uptake) (LCE RES MU)
[21] Smart Cities and Communities (SCC)
[22] https://ec.europa.eu/energy/intelligent/files/implementation/doc/guidelines-iee-common-performance-indicators.pdf

These provided evidence to supplement the review of secondary data sources, and in particular, gathered data that was not necessarily available from the published literature e.g. on the programme execution. The evaluation questions covered by the survey of project participants are indicated in the evaluation matrix in Appendix 2. The survey for unsuccessful applicants covered a narrower range of questions, focussing on the applicants' experience of the Horizon 2020 application process and their next steps, if known, for example in terms of seeking alternative funding or revising the scope for their proposed project.

These surveys used a survey tool and were accompanied by a letter of introduction signed by DG Energy's Director for Renewables, Research and Innovation, Energy Efficiency. The project team piloted the surveys before their launch.

4.3.2 Survey for project participants

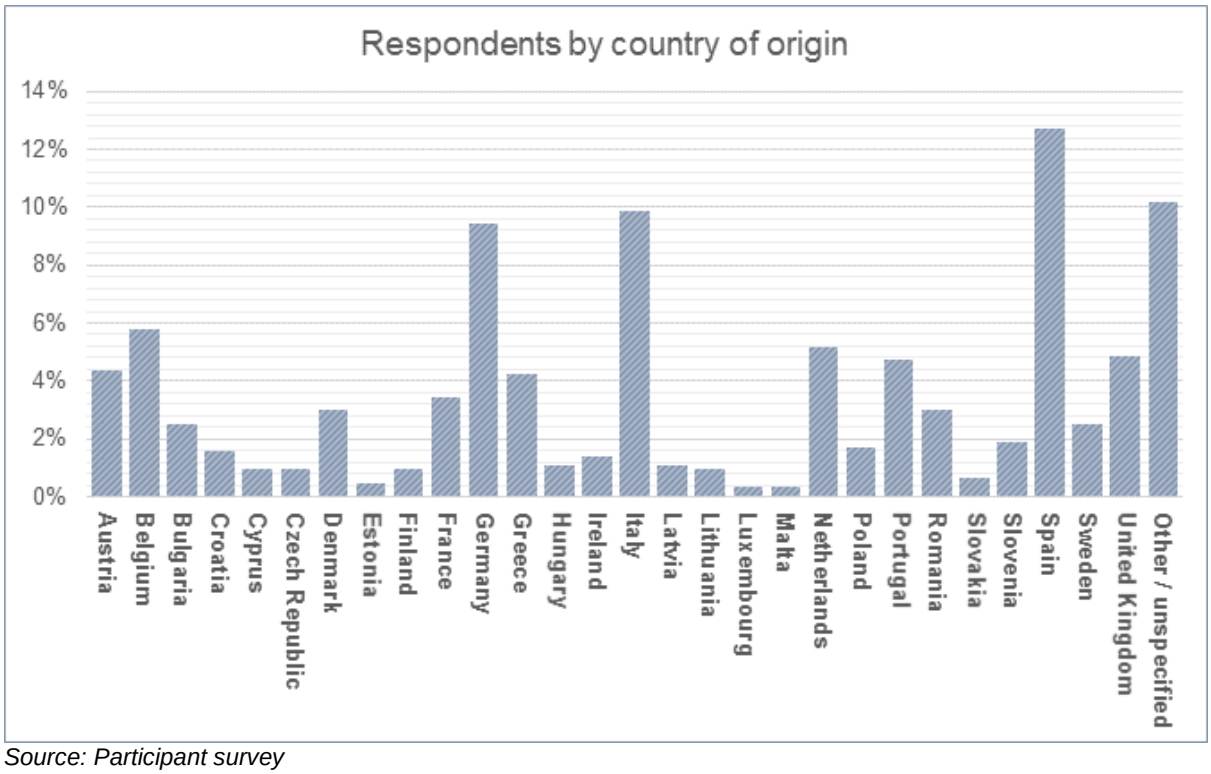
The first survey targeted participants in all FP7 and IEE projects in the energy area and H2020 projects in scope for this evaluation. The full survey script is included in Appendix 5.

The survey was open from 7 to 29 July 2016 and was emailed out to 7 898 people.

The total number of respondents to this survey was 638 (8 % response). It is important to note that respondents did not answer all questions. Therefore, below and throughout our analysis we provide an indication of the number of responses received when referring to different questions from the survey.

The information below summarises the key characteristics of those who responded. Figure 3 provides an overview of respondents by country, with the highest number of respondents from Spain, Italy and Germany respectively.

Figure 3: Survey for participants in funded projects – respondents by country



Source: Participant survey

The following table summarises the different organisational types of respondents, with reasonable spread across the different types.

Table 4: Survey for successful participants – respondents by organisation type

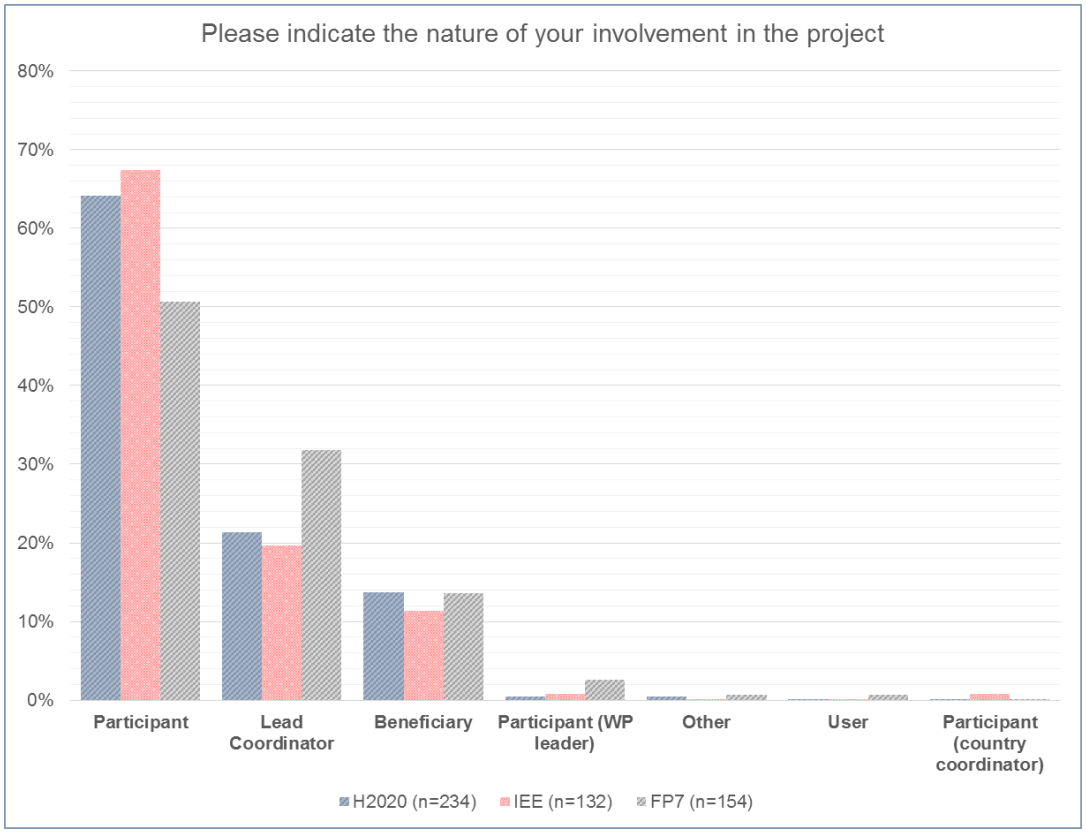
Organisation Type	Number of Respondents	Percentage of Respondents
Large private company	77	12
Public body	86	14
Research organisation	125	20
SME	130	21
University	106	17
Other	106	17
TOTAL	**630**	**100**

Table 5 provides an overview of the number of different respondent types against the three programmes, Horizon 2020, IEE and FP7, with Figure 4 providing a breakdown in percentage terms for each programme. From this, as one might expect, it is clear that the majority of respondents were project participants, followed by coordinators and beneficiaries across the three different programmes.

Table 5: Survey for participants in funded projects – respondent type across programmes

	Programme		
Respondent	H2020	IEE	FP7
Participant	150	89	78
Lead Coordinator	49	26	50
Beneficiary	32	15	21
Participant (WP leader)	1	1	4
Other	1	0	1
User	0	0	1
Participant (country coordinator)	0	1	0
TOTAL	**233**	**132**	**155**

Figure 4: Survey for participants in funded projects – respondent type across programmes (% values)



Source: Participant survey

For Horizon 2020, Table 6 and Table **7** present a breakdown of the survey responses in terms of the different action types and programme areas. Broadly, the responses are representative of the number of projects for the action types and the programme areas. There is a slight over-representation of responses from IAs (of the action types) and of SCC projects, with the CSA and RIA action types slightly under-represented in the survey if anything.

Table 6: Survey responses by Horizon 2020 Programme action type

Action	Projects	%	Reponses	%
CSA	98	61 %	125	56
IA	33	20 %	61	27 %
RIA	30	19 %	36	16 %
TOTAL	**161**		**222**	

Table 7: Survey responses by Horizon 2020 Programme area

Area	Projects	%	Responses	%
EE	106	66 %	127	64 %
LCE	23	14 %	27	14 %
LCE RES MU	23	14 %	25	13 %
SCC	9	6 %	19	10 %
TOTAL	**161**		**198**	

4.3.3 Survey for unsuccessful applicants

The second survey targeted applicants (coordinators only) to the H2020 2014/15 work programme who have been notified that their funding application has been unsuccessful. This survey was developed following a discussion with DG Energy who wished to survey this group of stakeholders. The full survey script is included in Appendix 5.

The survey was live from 19 July until 10 August 2016 and was emailed out to 917 people.

The total number of respondents to this survey was 56 (6 % response rate). It is important to note that respondents did not answer all questions. Therefore, below and throughout our analysis we provide an indication of the number of responses received when referring to different questions from the survey.

The information below summarises the key characteristics of those who responded. Figure 5 provides an overview of respondents by country, with the highest number of respondents from Italy, Spain and Germany respectively.

Figure 5: Survey for unsuccessful applicants – respondents by country

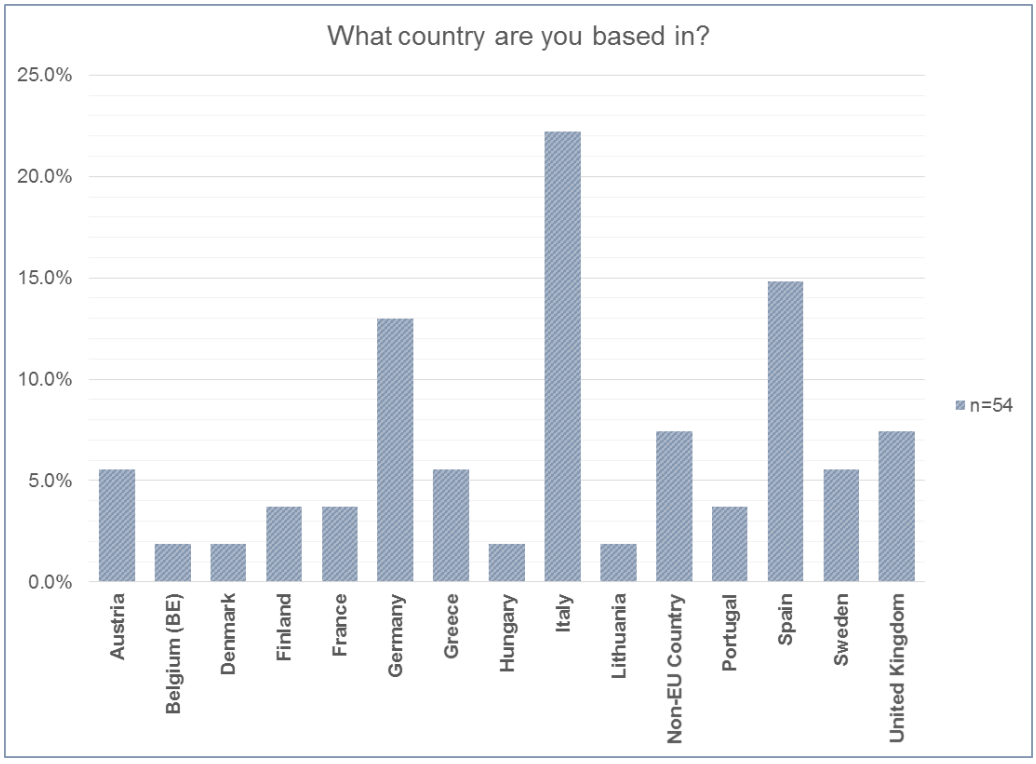


Table 8 summarises the different organisational types of respondents, with the majority of responses from Universities and Research organisations.

Table 8: Survey for coordinators of H2020 applications that have not been funded – respondents by organisation type

Organisation Type	Number of Respondents	Share of Respondents
Large private company	6	11 %
Public body	4	7 %
Research organisation	16	30 %
SME	10	19 %
University	18	33 %
Other	0	0 %
TOTAL	**54**	**100 %**

4.4 Stakeholder Interviews

4.4.1 Introduction/Objectives

There has been a need to explore certain issues relevant to the evaluation in more depth. This has involved detailed discussions with a number of key stakeholders through sets of interviews. The interviews have been used to fill gaps in the evidence base and to provide further substantiation/triangulation of key findings from the survey. The interviews have also focussed on programme level issues that have been harder to capture within the survey format (e.g. the relevance and coherence issues as well as programme execution issues). In addition to the above, interviews have been used to provide evidence to inform the case studies (see Section 4.5).

4.4.2 Interview scripts

Seven interview scripts were developed during the course of this evaluation. These have been aimed at either a programme level or at a project level (as summarised in Box 2). The complete interview scripts are presented in Appendix 6. Three of the interview scripts have focused on the programme level, one each for the H2020, FP7 and the IEE programmes. A further three interview scripts have focussed on the project level for H2020, FP7 and IEE *project participants*. Finally, one interview script has focussed at a programme and at a project level, to some extent, for coordinators (only) of applications for applicants to the H2020 energy programme that did not receive funding (i.e. *unsuccessful applicants)*. The evaluation questions as set out in the evaluation matrix (see Appendix 3) have been included for reference in each of the interview scripts so that the script questions may be easily tracked back to the original evaluation question(s).

Box 2: Types of interview scripts used.

- Programme level: 3 scripts, one each for H2020/ FP7/ IEE
- Project level *project participants*: 3 scripts, one each for H2020/ FP7/ IEE
- Project level *unsuccessful applicants*: 1 script, for H2020.

The interview scripts were constructed to introduce the reason for and the scope of the interviews and to provide a confirmation of any confidentiality and attribution aspects. The scripts then each ran through the sets of specific evaluation questions that have been identified in the evaluation matrix as being required at either the programme or project level to evaluate either effectiveness, efficiency, relevance, coherence, EU added value or sustainability. We have recognised the importance of simplifying the questions in the scripts, providing context and breaking them down into sub-questions where necessary, including those targeted at particular stakeholders, in order to receive a focused, and more easily analysed, response.

The two programme-level scripts targeted at the FP7 and IEE stakeholders differ from the H2020 script in that they both ask an initial screening question, namely: do you have any familiarity with the H2020 Programme and its projects? If the FP7 (or IEE) respondent answers 'yes' then the subsequent line of questioning is comparative, i.e. how does their experience of FP7 (or IEE) compare/ contrast with their knowledge and understanding of H2020. If the respondent answers 'no' then the subsequent line of questioning is based on the applicability/ materiality of FP7 (or IEE) to H2020, i.e. the extent to which FP7 (or IEE) is able to evolve into H2020.

A number of additional questions were included in the script to be targeted at H2020 unsuccessful applicants, namely: Has or could your particular project proposal be funded through other means? Are you planning to re-submit your application to a future H2020 call? If you do not intend to resubmit, could you explain why not?

Box 3: Interview script integration with case studies.

NOTE: This evaluation has used a series of case studies (see section 4.5 and Appendix 7) to describe and characterise the H2020 energy programme's indirect outcomes. The case studies are focussed on those aspects of the evaluation which might not have been completely captured from the literature review, or which have been difficult to quantify, such as the wider impacts of the programme. A number of the interviews for the project participants (21) and unsuccessful applicants (7) have then also doubled-up as initial case study interviews as part of the case study task and its sequence of up to three deep dive interviews. In this instance a slightly modified interview script has been used in order to merge the questioning (and prevent duplication) with the first deep dive interview script for the case studies. The interviewee responses were then recorded as part of the interview task and/or case study task as appropriate.

4.4.3 Interviewee selection

The identification and selection of stakeholders to be interviewed was undertaken in a number of ways, namely:

- Contacts for specific Commission staff and Agency staff with experience of the H2020, FP7 and IEE programmes, were provided to the project team by the Commission.
- Interviewees from National Contact Points for the H2020 energy programme were chosen to cover countries from different geographical regions and also with a range of success rates for applications. The interviewees for the IEE and FP7 NCPs were also chosen to reflect a geographical distribution.
- The specific H2020, FP7 and IEE evaluators for interview were selected based on a number of lists that included active evaluators in combination with a geographical distribution.
- H2020, FP7 and IEE project participants and H2020 unsuccessful applicants were identified and selected for interview through the Survey task in order to provide a means to further validate/clarify project level issues in relation to the evaluation questions. Project level interviewees had all previously completed a questionnaire survey (see previous section on survey task) for project participants or for unsuccessful applicants and had all indicated that they were content to be approached for interview. Volunteers from projects within the scope of this evaluation were approached and the interviews undertaken dependant on availability (a balance was ensured across project types and topics).

4.4.4 Interviews conducted

Table 9 presents the interviews conducted by stakeholder group at a programme level. Many of the Commission staff, Agency staff and NCPs were interviewed face-to-face by the project team in Brussels. The remaining interviews were conducted via telephone and through subsequent email follow-ups.

Table 9: Distribution of programme level interviews completed versus (target)

Stakeholder group	IEE	FP7	H2020/ EE	H2020/ LCE system	H2020/ LCE RES MU	H2020/ SCC	Total
Commission staff	2(1)	3(6)	1(2)	1(1)	1(1)	1(1)	**9(12)**
Staff from Executive Agency for SMEs / Innovation and Networks Agency	5(5)	n/a	5(5)	4(4)	4(4)	3(3)	**21(21)**
National Contact Points (NCP)	4(5)	2(5)	18(20)				**24(30)**
Evaluators	3(5)	5(5)	10(10)				**18(20)**
							72(83)

Table 10 presents the interviews conducted by stakeholder group at a project level. The interviews were conducted via telephone and through subsequent email follow ups. It should be noted that project level interviewees were volunteers that had previously indicated their willingness (but not actual availability) for interview in the survey task of this project. In particular, the number of H2020 unsuccessful applicant volunteers were rather low (and particularly so for LCE RES MU and SCC).

Table 10: Distribution of project level interviews completed and versus (target)

Stakeholder group	IEE	FP7	H2020/ EE	H2020/ LCE system	H2020/ LCE RES MU	H2020/ SCC	Total
Project participants	7[a](10)	10(10)	10[b](10)	8(8)	8(8)	3(5)	**46(51)**
Unsuccessful applicants	n/a	n/a	8(10)	6(10)	1(10)	(10)	**15(40)**
[a] 4 successful with H2020; 3 unsuccessful. *[b] 5 previous participants in IEE; 5 non-participants in IEE.*							**61(91)**

4.5 Case studies

4.5.1 Introduction/Objectives

Detailed case studies have been used to describe and characterise key outcomes from the programme in terms of its socio-economic effects. The case studies focus on elements of the evaluation that are difficult to capture from the document review, or difficult to quantify, such as the wider impacts of the programme.

An approach of detailed case studies has been used. These case studies combine data from the survey, project databases and portfolio analysis with up to three interviews and comprise an adversarial approach (See Appendix 7).

4.5.2 Case study selection

The amount and distribution of case studies

In the Inception report, the following distribution was suggested for the 36 case studies:

- A number of 30 case studies was proposed for ongoing or completed projects. These were divided as 15 H2020 cases, and 15 within the IEE II/FP7 programmes, within the strand 'research' and 'market uptake' respectively.

- Within this distribution of 36 case studies it was planned to include approximately six unsuccessful applicants (15 %). These would all be from the H2020 programme.

Case studies are most helpful where projects are complete and comment can be made on the impacts, particularly any indirect impacts. None of the H2020 projects were complete at the time of this evaluation so here we can only consider early or anticipated impacts. The agreed targeted distribution of case studies, together with the case studies conducted is stated in the table below.

H2020, FP7 and IEE project participants and H2020 unsuccessful applicants were identified and selected for a case study using a similar procedure as for the interviews. Survey respondents that had indicated they were willing to be approached for an interview, were approached for a case study as well.

4.5.3 Case studies conducted

Table 11 presents the amount and distribution of case studies conducted. The case studies were conducted via telephone and through subsequent e-mail follow ups.

Looking at the project participants, for some of the programmes and areas, notably H2020/LCE system, the amount of case studies is somewhat below target. An explanation is that the targeted project participants indicated their willingness to participate in an interview while participation in a case study requires some more time and their consent to publish the case study. Not all targeted participants were willing to make the additional time investment, or were available for an interview within the time-frame of the evaluation.

Looking at the non-participants, we couldn't find any interview partners for the H2020 LCE RES MU area. The reason is that this area was severely under-represented in the survey responses of non-participants indicating they were willing to participate in an interview. We were, however, able to partly compensate for this by including more H2020/EE case studies than the targeted amount.

Table 11: Distribution of case studies conducted

Stakeholder group	IEE	FP7	H2020/ EE	H2020/ LCE system	H2020/ LCE RES MU	H2020/ SCC	Total
Project participants (*successful proposers*)	7(7)	4(7)	4(5)	1(4)	4(4)	1(2)	**21(30)**
Non-participants *(unsuccessful applicants)*			5(2)	1(2)	0(1)	1(1)	**7(6)**
							28(36)

Note: The number between brackets indicates target

5 Current state of play

5.1 Governance structure of H2020 energy programme

A number of entities are involved in the management of the Horizon 2020 Energy programme, covering the design, implementation, coordination, monitoring and evaluation aspects.

At the EU level these include the Commission services (DG ENER, DG RTD, DG CONNECT) and its two Agencies, Innovation and Network Executive Agency (INEA) and The European Agency for SMEs (EASME).

In the case of the H2020 energy programme, DG ENER and DG RTD are the main Directorates General with responsibility for developing the work programme and the relevant calls and allocating

the budget made available within H2020[23]. Beyond that, both DGs monitor the implementation of the programme, taking into account information made available by the two Agencies to which the implementation of most of the programme activities has been delegated. Both DGs are also responsible for the evaluation of the H2020 Energy programme and for reporting to the Programme Committee (see below). DG CONNECT has also been involved – through sub-delegation from DG ENER and DG RTD - in the design of specific topics within the work programme for which the focus of the activities is ICT.

The overall responsibility for the H2020 programme, including common support services, is with DG RTD. In the case of SC3 related activities, DG RTD is responsible for the implementation of calls related to renewables and fossil fuels. Furthermore, DG RTD is responsible for the overall monitoring and evaluation of the overall H2020 programme. This includes setting the overall framework for reporting by all relevant DGs and setting the performance indicators monitored. At the more practical level, DG RTD – through the Common support centre - is responsible for operation of the Horizon 2020 IT platform that covers all aspects of the programme implementation (information provision, issuing of calls, partner searches, management of application procedure, reporting, etc.). The CSC provides as of 1 January 2014 common services in legal support, ex-post audit, IT systems and operations, business processes, programme information and data to all research DGs, executive agencies and Joint Undertakings implementing Horizon 2020.

The two Agencies (EASME and INEA) are essentially responsible for implementation of the programme. This includes management of project applications, the evaluation and selection process, signing of contracts and subsequent monitoring of project implementation until completion. The Agencies also play a role in design of the work programme, especially as regards the implementation aspects INEA is responsible for implementation of activities in the Competitive Low-Carbon Energy Technologies and Smart Cities and Communities calls not carried out by the Commission services. They represent around 75 % of the total budget under SC3. EASME is responsible for activities in the area of Energy Efficiency and the SME instrument These represent around two thirds of the total number of projects under the SC3 but only around 21 % of the budget. EASME provides substantial policy feedback to DG ENER in particular on energy efficiency based on project results. Both Agencies report progress to DG ENER and DG RTD on a frequent basis and also review and approve project selection.

The Programme Committee on Secure, Clean and Efficient Energy is the formal body through which the Commission consults the Member States on the work programme. It consists of representatives of the 28 EU Member States and the H2020 associated countries. Besides providing input to the design of the work programmes, it is the body to which the Commission services report progress. Furthermore, the Programme Committee members review the projects selected under each call and can, in specific circumstances, block the selection of specific projects. The members of Programme Committees are delegates and experts of national governments. Meetings are organised by the European Commission and usually take place three to four times per year

The Commission services draw on the advice of the Horizon 2020 Advisory Group on Energy (AGE) with a total of 30 members[24]. AGE includes experts from a broad group of stakeholders, including industry, research and civil society. It provides advice on strategic priorities for the work programmes and on broader issues related to the development of innovation in the energy sector that are linked to the H2020 programme.

At the national level, National Contact Points (NCPs) provide important support to potential applicants though information and promotional activities. NCPs circulate documentation and provide specialist advice and on-the-ground guidance in relation to application procedures and partner identification. Contact Points are established, operated and financed under the responsibility of the Member States and the countries associated to the H2020. However, the Commission services provide support to NCPs (information material, training) and are also responsible for defining minimum standards of service to be adhered to by all NCPs. Particularly in relation to Horizon 2020 Energy a network of energy NCPs (C-Energy 2020)[25] has been formed. This is a continuation of similar networks under FP6 and FP7.

[23] Responsibilities between DG ENER and DG RTD are divided on a thematic basis – while DG ENER is responsible for energy efficiency, energy systems (including energy storage) and Smart Cities and Communities, DG RTD is responsible for renewable energy technologies and CCS. Cross-cutting issues are managed jointly.
[24] http://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetail&groupID=2981
[25] http://www.c-energy2020.eu/

As can be seen, there are significant interactions between the different entities involved in the programme, even if DG ENER and DG RTD and the Agencies maintain the key responsibility for the design and implementation of the programme. Nonetheless, it is important to note that the structure follows that for the FP7 programme relatively closely. There are a couple of important qualitative differences from the IEE-2 programme. A key one is the elimination of the interface between programme applicants and the Agency. Under IEE, before and after the application, the Agency could advise participants to better shape their proposals (including revision of proposed budget as part of the negotiation). The only similar structure available under the Horizon 2020 programme is that of the NCPs, although there is now no scope for changes once a proposal has been submitted for evaluation. The impact of this rather significant change is examined in Section 6.3.

Furthermore, the Commission services consider that under H2020 there is less flexibility in the interaction between the Commission and Agencies, due to the more rigid procedure imposed by the call procedures.

5.2 Analysis of current performance of H2020 energy programme – portfolio analysis

This section presents a series of key Horizon 2020 portfolio characteristics, as derived from the sources set out in Section 4.2. As far as possible it compares the H2020 energy programme portfolio characteristics with those of the predecessor programmes. It is not always possible to directly compare portfolio analysis data that has been drawn from different sources. For example, the IEE and FP7 evaluation reports set out the information in different categories and in different units, or in some cases information has not been reported. We have sought to overcome this challenge as far as possible by making reasonable assumptions about the data from the three programmes in order to draw comparisons. Where comparisons are not possible due to divergences in the presentation of the data, we have identified this and presented the data available.

Throughout this section we have reviewed the information in terms of strengths and weaknesses of the H2020 energy programme portfolio relative to predecessor programmes.

5.2.1 Split of programme budget between actions

For the projects under the scope of this study, the EC have contributed nearly 60 % of the available budget to IA projects under the H2020 Energy programme. These projects have the highest average financial contribution per project.

Table 12: Programme budget split by action for the sub-set of projects analysed for this study

	# H2020 Energy programme projects from 2014 and 2015 calls	Total EC Contribution to H2020 Energy programme (€)	Average funding per H2020 Energy programme project (€)	Split of EC Funding %
CSA	98	162 091 560	1 653 996	24 %
IA	33	394 651 320	11 959 131	60 %
RIA	30	106 068 868	3 535 629	16 %
All projects considered	**161**	**662 811 747**	**4 116 843**	**100 %**

Source: European Commission, March 2016, H2020 SC3 Data file (in confidence)

For the *overall* H2020 Societal Challenge 3 portfolio, IA activities in Horizon 2020 receive a higher sum of EU funding per project than under FP7 (EUR 11.95 million compared to EUR 8.3 million). For RIA projects the average EU contribution has also increased (EUR 4.7 million compared to EUR 4.1 million). The increase of absolute budget for IA activities is offset by the significant number of smaller-scale Coordination & Support Actions targeting market uptake. Such projects have previously been financed under the IEE II programme (European Commission, 2016b).

The Energy priority area within the FP7 Cooperation Programme signed 374 grant agreements with a total EU financial contribution of EUR 1 851 million (European Commission, 2016a). This is an average contribution of EUR 264 million and 53 grants per year. Comparable figures, assuming that the projects in scope for the current work cover the same areas as the FP7 energy programme, are

EUR 250 million and 31 projects per year for research and demonstration activities in the first two years of H2020. Thus average grant size is higher than for FP7 in these areas. The comparable split of programme funding for the FP7 energy projects is estimated to be 54 % for demonstration projects (equivalent to IA), and 46 % for research (equivalent to RIA) projects. A higher share of funding goes to IA projects under the H2020 energy programme (60 %), than under FP7, whereas a far lower share goes to RIA projects under the H2020 energy programme (16 %).

As can be seen in Table 16, the overall budget for IEE for the period 2007-2011, was approximately EUR 475 million[26]. This is an average of around EUR 95 million per year of the programme. (All IEE projects are broadly considered to have market update objectives, and for the purposes of this study it is assumed that 100 % of IEE funding went to the equivalent of CSA projects). The budget for the full period of IEE II, from 2007 to 2013 was EUR 727 million[27] or about EUR 105 million per annum. Market uptake activities, for H2020 energy programme projects have EU funding of about EUR 81 million per year. For all H2020 projects funded under SC3 to date, this figure rises to EUR 87.6 million per year. To date, the overall budget awarded to H2020 Energy Programme projects is lower than that awarded to corresponding projects under its predecessor programmes per year. However, the H2020 energy programme data takes into account only those projects that are within the scope of the current work and that had been awarded funding as at the commencement of this study.

5.2.2 Split of proportion of EC funding within actions

Differences in proportions of EC contributions exist between different types of action in line with the Rules for Participation [28]. Average contributions are show in Table 13[29]:

Table 13 Average EC contribution by action

	H2020 Energy Programme	Overall SC3 portfolio (2014/15 calls)
CSA	99 %	99 %
IA	80 %	74 %
RIA	97 %	91 %

Source: European Commission, March 2016: H2020 SC3 data

5.2.3 Split of EC budget by thematic area

The total, and proportionate split of EC funding for the H2020 energy programme projects is presented in Table 14. This data is compared to the full Societal Challenge 3 portfolio of projects, as presented in the DG RTD report[30]. For FP7, numbers of projects in different thematic areas in the Energy Theme are provided, along with a broad split of the budget (European Commission, 2013a) in Table 15.

[26] This includes all funding areas: Promotion and dissemination projects, EUR 310.2 million; project development assistance (ELENA), EUR 97 million; tenders, EUR 50 million; concerted actions, EUR 13.3 million; and other policy initiatives, EUR 4.8 million.
[27] Of this, EUR 467.4 million is for promotion and dissemination projects. Excluding STEER projects, the total for SAVE, ALTENER and integrated initiative projects is EUR 389.1 million. Concerted Actions have a budget of EUR 28.5 million. (Figures from European Commission, December 2016).
[28] Article 28, REGULATION (EU) No 1290/2013, December 2013 (https://ec.europa.eu/research/participants/data/ref/h2020/legal_basis/rules_participation/h2020-rules-participation_en.pdf)
[29] Corresponding information was not found for the FP7 and IEE programmes
[30] Note that the data presented in the report, does not always match the data for the full SC3 portfolio given the data file. This is likely in part due to the fact that manual updates were made to the data after the publication of the report.

Table 14: H2020 budget split by thematic area for the sub-set of projects analysed for this study

	H2020 Energy Programme projects			All H2020 SC3 projects[31]
	# Projects	EC Funding total (€)	% Funding	% Funding
EE - Buildings and consumer	60	120 631 835	31 %	18 %
EE - Financing	23	36 096 828		
EE - Heating and Cooling	10	19 127 283		
EE - Industry and products	13	32 460 938		
LCE - Grids/Storage	23	237 307 015	42 %	51 %
LCE - RES/Bioenergy	23	40 614 309		
SCC	9	176 573 540	27 %	10 %
Total	**161**	**662 811 747**		

Source: European Commission, March 2016: H2020 SC3 data

Table 15: FP7 budget breakdown by thematic area

Category	Thematic area	# projects	% split of budget
Renewable energies	Bioenergy	60	42 %
	Wind	27	
	Heating and cooling	25	
	Ocean	12	
	Hydro Power	2	
	Concentrated Solar Power	18	
	Photovoltaics	30	
	FET/Mat	29	
Fuel Cells and Hydrogen	Fuel Cells and Hydrogen	8	15 % (including contributions to the JTI)
Smart Grids	Smart Grids	58	15 %
Carbon Capture & Storage / Clean Coal	Carbon Capture & Storage	53	10 %
Energy Efficiency	EE/Smart Cities/Communities	40	13 %
Socio-economic	Socioeconomic	9	unknown

Source: Implementation of the FP7 Energy Theme (2007-2013), European Commission Internal Report

The budget breakdown for IEE II from 2007 to 2011 by thematic area is given in Table 16. In addition to the projects funded under the Energy Efficiency topic, many of the projects under Energy in transport, Integrated Initiatives, ELENA and Concerted Actions are related to energy efficiency objectives.

[31] Other areas covered by the SC3 projects are: decarbonising fossil fuels (6.9 %), contribution to FCH JU (9.1 %, and socio-economics and others (4.2 %)

Table 16: IEE budget breakdown by thematic area, from 2007 to 2011[32]

Topic	€m	% of promotion and dissemination project budget
Energy efficiency and rational use of buildings - SAVE		**24.7 %**
Energy-efficient buildings	34.3	11.1 %
Products and consumer behaviour	24.3	7.8 %
Industrial excellence in energy	18.1	5.8 %
Energy in transport (energy efficiency related) - STEER	**52.3**	**16.9 %**
New and renewable energy resources - ALTENER		**31.6 %**
Electricity from renewable energy sources	30.8	9.9 %
Heating and cooling from renewable energy sources	16.3	5.3 %
Small-scale applications	14.8	4.8 %
Bioenergy	36.1	11.6 %
Integrated initiatives		**26.8 %**
Energy efficiency and renewable energies in buildings including Build Up Skills	16.4	5.3 %
Creation of local and regional agencies	5.2	1.7 %
Local energy leadership	32.9	10.6 %
Mobilising Local Energy Investments (MLEI)	5.3	1.7 %
Energy Services	11.3	3.6 %
Energy education including U4energy	12.1	3.9 %
Total for calls – SAVE, STEER, ALTENER and Integrated	**310.2**	**100 %**
Market replication projects – ELENA Technical Assistance Facility	**97[33]**	
Concerted Actions[34]	**13.3**	
Tenders[35]	**50**	
Other policy initiatives[36]	**4.8**	
Total for 2007 - 2011	**475.3**	

Source: (IEE II, 2012)

The thematic areas across the different programmes are not directly comparable – hence have not been presented in the same table. The overall H2020 SC3 portfolio is spending 18% of budget on energy efficiency projects. This is more than FP7 (13 %). However, it is far less than 65 % committed to energy efficiency projects by IEE under various areas.

H2020 is placing a lower proportion of funding into projects on renewable energy and grids compared to FP7 (51 % - compared with 57 % for FP7). This is also more than the proportion of the IEE II programme budget allocated specifically to renewable energy projects (20.6 %).

[32] Note that the source document (IEE II, 2012) states that "the report does no cover all actions financed under the IE II in the period 2007 to 2011 but gives an overview of the programme's performance. Figures are taken from the budget given in each section of the report and the total and % breakdown by area of the promotion and dissemination budget align with the figure in the Executive Summary (p6) of the source.
[33] EUR 15 million in 2009, EUR 15 million in 2010, EUR 30 million in 2011, EUR 37 million in 2012
[34] EPBD 4.7 MEuro, Energy Services Directive 3 Million, Renewable Energy Directive 5.6 MEuro.
[35] Includes supporting Ecodesign and Energy Labelling Directive EUR 9.9mm , supporting Renewable Energy Directive EUR 8.4m, supporting recast of EPBD EUR 0.5m, supporting Sustainable Energy Europe Campaign incl. EU Sustainable Energy Week and EACI communication activities EUR 6.5m, supporting ManagEnergy EUR1.5m, supporting the portal on energy efficiency in buildings (Build up) EUR 1.9m, supporting the urban mobility portal (ELTIS) EUR 1.7m, Promotion of sustainable urban mobility plans,EUR 0.8m, supporting the Clean Vehicle Portal EUR 0.5m . supporting Covenant of Mayors: EUR 5.8 m.
[36] Standardisation initiative in biofuels 0.75 MEuro, Standardisation initiative in buildings 1.88 MEuro, International Partnership for Energy Efficiency Cooperation (IPEEC) 0.92 MEuro, International Renewable Energy Agency (IRENA) 1.2 MEuro

5.2.4 Numbers of participants

The 161 projects in the H2020 Energy Programme involve 2002 participants – an average of 12.4 participants per project[37]. The average number of participants in the FP7 Energy Theme was 11.6 participants per project (Technopolis, 2014). H2020 demonstration projects involve 17 participants on average, compared to 12 in FP7 (European Commission, 2016b). Data on IEE projects indicates that participation numbers varied from 5 to 22 per project (ICF International, 2015). The 90 IEE projects which we explored in detail, had an average of 10.2 participants per project.

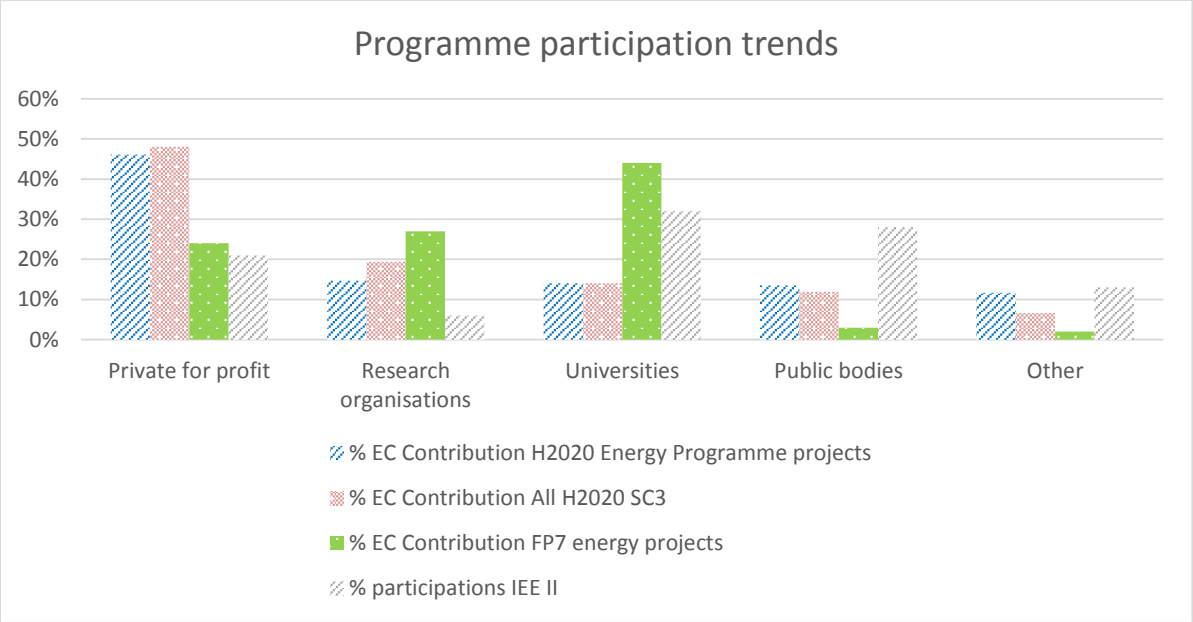
Average participation rates for H2020 point to larger consortia being assembled than for predecessor programmes. This quantitative data provides a contrast to anecdotal evidence from some interviewees that there is a perception that H2020 is seeking to simplify the composition and size of project teams compared to predecessor programmes.

5.2.5 Participants' sectors

The H2020, FP7 and IEE data on sectoral participation has been collated and is presented in Figure 6. For FP7 there are a number of conflicting sets of figures on participation by share of funding. We have selected data from the programme's ex-post evaluation, on the understanding that it is likely to be robust and is the most recent available (Fresco, 2015). The IEE participation rate data is presented in terms of split by number of participants, rather than by share of funding (Deloitte, 2011a). In order to map it on to the participant sector categories used by H2020 and FP7 some assumptions have been made[38].

It can be seen that participation rates by sector across the H2020 energy programme portfolio and the full Societal Challenge 3 portfolio are broadly the same. University participation was far more prevalent within FP7 than the other programmes, while H2020 is giving relatively more funding to participants from industry than was the case under previous research programmes. Public body participation was highest under the IEE II programme.

Figure 6: Programme participation trends[39]



Sources: European Commission, March 2016, H2020 SC3 data (in confidence) ; Final Evaluation of the Intelligent Energy-Europe II Programme within the Competitiveness and Innovation Framework Programme., Deloitte, 2011 ; Commitment and Coherence – Ex-Post Evaluation of the 7th EU Framework Programme (2007-2013), FP7 Expert Group, 2015

[37] *European Commission, March 2016: H2020 SC3 data*

[38] Private for profit = Private Commercial; Research organisations = Public Commercial; Universities = Private non-profit; Public bodies = Government; Other = Other, International organisation & European Economic Interest Group

[39] H2020 data in the figure derived from the SC3 data file, so takes into account all projects awarded grants up to March 2016.

5.2.6 Participant locations

Over 95 % of participants come from an EU Member State. As with the IEE programme, Germany, Spain, the UK, Italy and France are the five Member States that received the most funding for H2020 Energy programme projects; these countries also had the highest number of participants. These five countries have the highest Gross Domestic Product (GDP) and number of inhabitants among EU Member States, so this pattern of participation would be expected. Of the remaining H2020 energy programme participants, 3.5 % come from Associated States, with the remaining 1 % coming from a Third Party country. The corresponding EC funding given to each location aligns with the proportion of participants that come from these areas.

In the case of the IEE II programme, the distribution of projects per beneficiary is EU-15 - 72.1 %; EU-12 - 26.0 %; European Economic Area/Other- 1.9 % (Deloitte, 2011a). The distribution of IEE funds is unbalanced between the Member States – in general the Northern countries received more IEE funds than the Southern and Eastern countries. However the Eastern countries received proportionally more EC funding for IEE projects in relation to their low GDP (Deloitte, 2009).

For the FP7 programme, it was identified that high shares of EU funding are allocated to large, research intensive countries like France, Germany, the Netherlands, and the United Kingdom. These countries often host centres of excellence that have made substantial investments in acquiring and maintaining top-level qualified staff and professional support structures. In contrast, Mediterranean countries that suffered from the economic crisis reduced their public R&I expenditures (Fresco, 2015). Anecdotal evidence from the interviews suggest that these countries have different structures for funding research than Northern countries, e.g. one interviewee from Italy pointed to less well developed links between industry and the research community than in Germany. The economic crisis compounded this structural issue, and made it more challenging for such countries to participate in research programmes. The share of FP7 funding for organizations from new EU Member States, as well as the success rates of proposals coordinated by researchers from these countries, were significantly lower (Fresco, 2015).

5.2.7 Repeat participation

For the H2020 Energy Programme projects, of the 2002 participants, 43 % are new to the EU R&I Framework Programme, i.e. they have not participated in FP7. It can be seen that more new participants are being drawn from the private-for-profit sector and the 'Other' category. There is very little new participation from Universities or Research Organisations (see Table 17).

Table 17: Breakdown of repeat participants to H2020 Energy Programme projects

	New participants to H2020 energy programme (%)	Repeat participants to H2020 energy programme (%)
Private for profit	22 %	19 %
Research organisations	2 %	13 %
Universities	0 %	13 %
Public bodies	6 %	6 %
Other	13 %	5 %
Total	43 %	57 %

Source: European Commission, March 2016, H2020 SC3 data (in confidence)

This finding is corroborated by results from the survey of project participants. Of 198 respondents from the 161 H2020 projects within scope for the current study, 40% had participated in FP7, 35% in IEE, and 43% had not previously participated in IEE or FP7. Highest previous participation rates in IEE projects are for CSA actions (51% of relevant respondents). Highest previous participation in FP7 projects is for RIA actions (70% of relevant respondents).

The FP7 programme had a higher number of new participants than H2020 with 63 % having not participated in FP6 (Technopolis, 2014). This figure appears to be lower for IEE II applicants. For example, in the 2012 call, 32 % of the applicants indicated that they applied to IEE II for the first time,

while 35 % of selected beneficiaries indicated that they applied to IEE II for the first time (European Commission, 2013d). This number aligns with unique participation data from individual IEE initiatives. For example, ICF International's Evaluation of IEE Projects Supporting Sustainable Energy Communities found that 72 % (188 participants) had previously taken part in an IEE project, with 46 % having been involved in three or more previous projects. The H2020 energy programme is therefore attracting more new participants than IEE II, but fewer than FP7.

5.2.8 Project duration

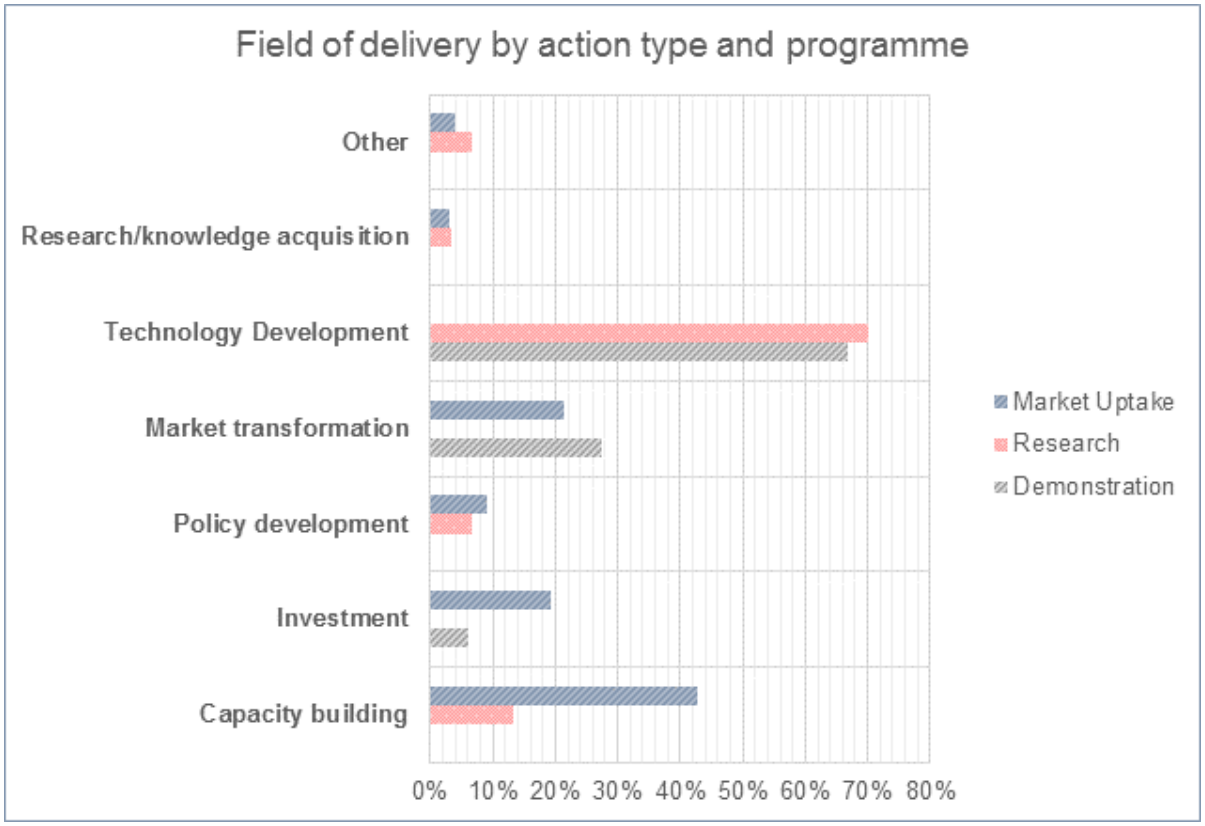
Project durations between the three programmes are broadly similar. The mean project duration for H2020 projects considered is 36.8 months. IEE programme documents indicate that projects last between 18 months (e.g. Build Up Skills Pillar 1 (COWI, 2016)) and 36 months (Deloitte, 2011a). The mean duration of the 90 IEE projects whose documents we reviewed was 32.7 months. The median project duration of FP7 energy projects was 40 months (Technopolis, 2014).

5.2.9 Delivery mechanisms

Based on subjective interpretation of the projects' documents, there appears to be a variety of primary delivery mechanisms in use by H2020 energy programme projects. It is worth noting that some interviewees cited several delivery mechanisms for their projects, so the analysis below which considers just the single, primary delivery mechanism should be treated with caution.

As would be expected, market uptake projects predominantly use mechanisms such as capacity building and market transformation as vehicles to achieve project objectives. Research and demonstration projects are more heavily focused on technology development. Fewer projects appear to use simply research or knowledge acquisition as their primary delivery mechanism.

Figure 7: Primary delivery mechanisms for H2020 energy projects by action type



Source: Portfolio analysis

As would be expected given the market uptake focus of the IEE II programme the key delivery mechanism utilised by the projects was predominantly capacity building[40]. There is no explicit discussion of this area in the FP7 literature, but there is an implicit understanding that its research and

[40] Based on a review of the various IEE documents in the literature review task

demonstration projects most frequently utilise technology development, investment and knowledge acquisition to deliver projects' objectives.

6 Answers to evaluation questions

6.1 Introduction

Drawing on the evidence strands outlined in Section 5, this section presents an evaluation of the H2020 energy programme. The primary evaluation questions introduced in Section 3 and listed in Appendix 2 are considered and addressed. These questions are organised under themes of evaluating effectiveness, efficiency, relevance, coherence, EU added value and sustainability. Conclusions based on the evaluation are given at the end of each section and these form the basis for the recommendations given in Section 7.

6.2 Evaluation of effectiveness

The analysis of effectiveness of the H2020 Energy programme focuses on answering the following key headline questions:

- What has the impact of the H2020 energy programme, and its projects, been on Societal Challenge 3 to date?
- To what extent can the observed direct results, indirect results, unintended effects and socio-economic impacts be credited to the H2020 programme design features?

The assessment of effectiveness considered both the direct outcomes (outputs, results and longer-term impacts) against the relevant objectives of the programmes and the key performance indicators. It also examined indirect/unintended results and impacts.

Furthermore, the analysis aims to establish whether the identified impacts can be directly linked to the design of the H2020 energy programme.

6.2.1 What has the impact of the H2020 energy programme, and its projects, been on Societal Challenge 3 to date?

6.2.1.1 Introduction

In this section we will examine the performance of the H2020 programme was examined in relation to the general and specific objective defined at the outset of the programme (– as identified in the relevant documents in relation to societal challenge 3 (European Partliament and Council, 2013) (European Council, 2013) which have been presented in the intervention logic).

A number of - questions were developed have been identified to break down the headline question and to help build an answer. this question.

- What are the direct results (expected/intended effects) of the H2020 projects and the projects of its predecessor programmes with respect to the Societal Challenge? Do they match objectives/expectations?
- What is the current & future socio-economic impact of the programme in relation to Societal Challenge 3?
- What are the indirect results (including unexpected/unintended effects) of the H2020 projects and the projects of its predecessor programmes? Where possible to ascertain, do these match objectives/expectations?
- Who is using the programme's outputs? To what extent?
- What has been the progress towards achieving an impact based, where applicable, on the performance indicator(s) of the specific objective(s)?
- Do impacts differ between countries? If yes, how and why?
- Does H2020 play an adequate role in supporting innovation in the considered field?

The analysis here is based on the synthesis of input from multiple sources of evidence – quantitative and qualitative - including the portfolio analysis (already presented in Section 5.2), the surveys of

successful participants and unsuccessful application coordinators and the interviews at project and programme level with project participants and other relevant stakeholders. It should be noted that there are important limitations to the capacity to assess impacts at project and programme level at this point in time as none of the projects supported have been completed, so there is an important limitation in terms of assessing results and impacts of projects. Even outputs reported are often expected rather than actual. When possible to tell, the focus has been on the expected results and impacts on the basis of the input from the project participants and relevant stakeholders. The predecessors (FP7 and IEE II) have been used as benchmarks, where relevant data is available.

Programme objectives.

Before moving to the analysis of the results, we briefly summarise the objectives of the programme (Table 18) and link them with the respective expected outcomes (outputs/results/impacts).

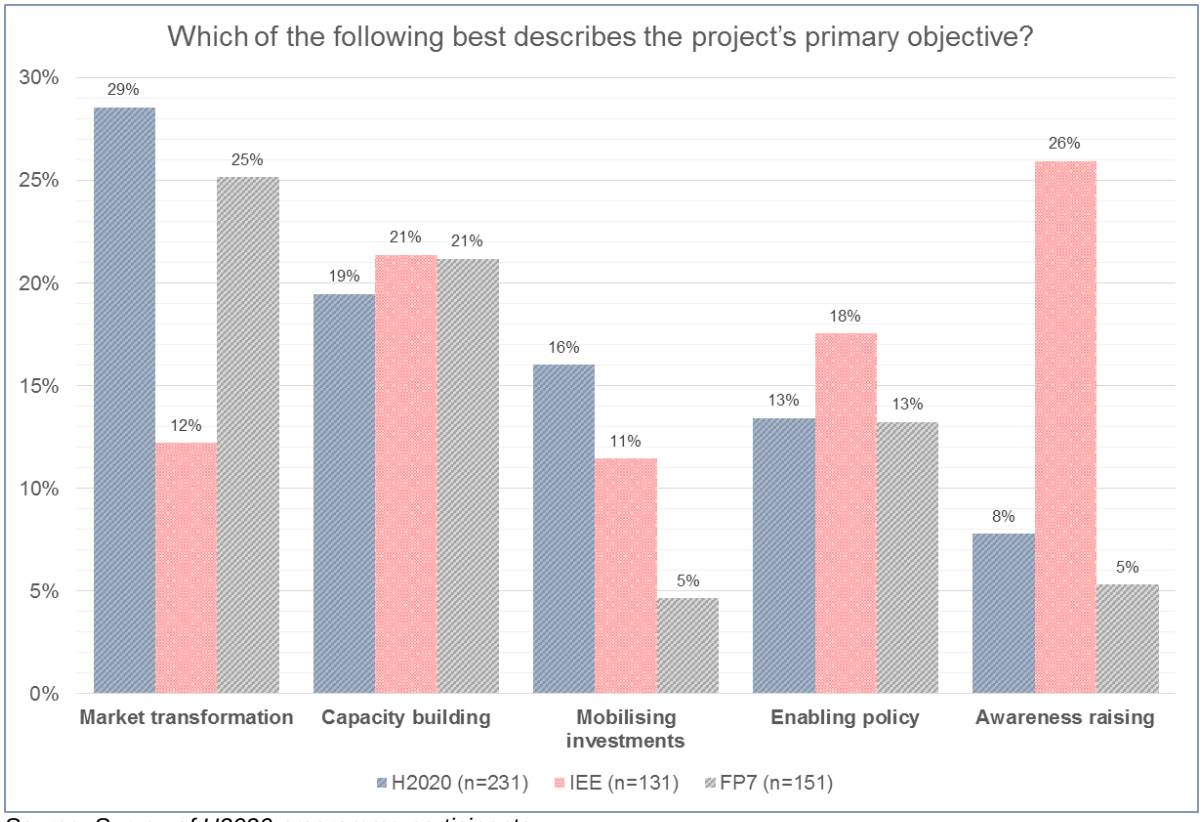
Table 18: Objectives and outcomes of the Horizon 2020 energy programme

Objectives	Expected Outcomes
General • Develop a reliable, affordable, publicly accepted, sustainable and competitive energy system reducing fossil fuel dependency • Achieve 20-20-20 targets concerning greenhouse gas emissions reduction, renewables and energy efficiency • Increase the effectiveness of research and innovation in responding to key societal challenges by supporting excellent research and innovation activities • Strengthen its scientific and technological bases by achieving a European Research Area	**Impacts** • Greater energy savings, renewable energy production and CO2-emissions reduction and achievement of the objectives in relation to greenhouse gas emissions, increasing share of renewables and increasing levels of energy efficiency. • Increased competitiveness of the firms in the sector and job creation. • Completion of the European Research Area in the energy area. • More reliable, affordable, publicly accepted, sustainable & competitive energy system
Specific • Support research, development, demonstration and market roll-out at affordable prices of efficient, safe, secure and reliable low-carbon energy technologies and services. • Develop efficient energy technologies and services to be taken up on European/international markets • Address innovation bottlenecks that energy technologies are facing • Develop an enabling environment for mass deployment of technological and service solutions, processes and policy initiatives for low-carbon technologies and energy efficiency • Support the implementation of the research and innovation agenda set in the Strategic Energy Technology Plan	**Results** • Bring new technologies closer to the market and develop and test business models in the selected thematic and technology areas • New knowledge creation contributing towards strengthening energy related scientific and technological research across the EU • Improve the capacity for decision making and developing and implementing policies related to energy issues; strengthen the level of public engagement • Improve the market conditions at regulatory, administrative and financing level for low-carbon, renewable and energy-efficient technologies and solutions • Contribute towards strengthening the participants' competitiveness
Operational Support R&I activities in the following thematic areas: • Reducing energy consumption and carbon footprint by smart and sustainable use • Low-cost, low-carbon electricity supply • Alternative fuels and mobile energy sources • Smart European electricity grid	**Expected outputs:** • R&I projects implemented in identified thematic areas, technology areas as well as the type of activities supported • Entities involved in the various projects by type and country; • Publications • PhDs, researchers • IPR (patents)

Objectives	Expected Outcomes
• Development of new knowledge and technologies • Develop robust decision making and public engagement • Market uptake of energy innovation	• Technologies supported towards higher Technology Readiness Level (TRL) • New processes, services, business models, prototypes and testing activities • Tools/methods/models developed to support decision making and public engagement • Measures facilitating sustainable energy policy implementation and removal of relevant barriers • Dissemination and outreach activities

Against the indicated objectives, the responses of the participants' survey provide a view of the focus of the H2020 projects in comparison to its predecessors. In relation to the predecessors, there is greater focus given on market transformation (i.e. technology development; bringing new technologies closer to the market) and mobilising investments in comparison to both IEE and FP7. Furthermore, in contrast to the IEE programme, awareness raising was not identified as an important objective. (See Figure 8).

Figure 8: Primary objective of supported projects (% of respondents indicating)



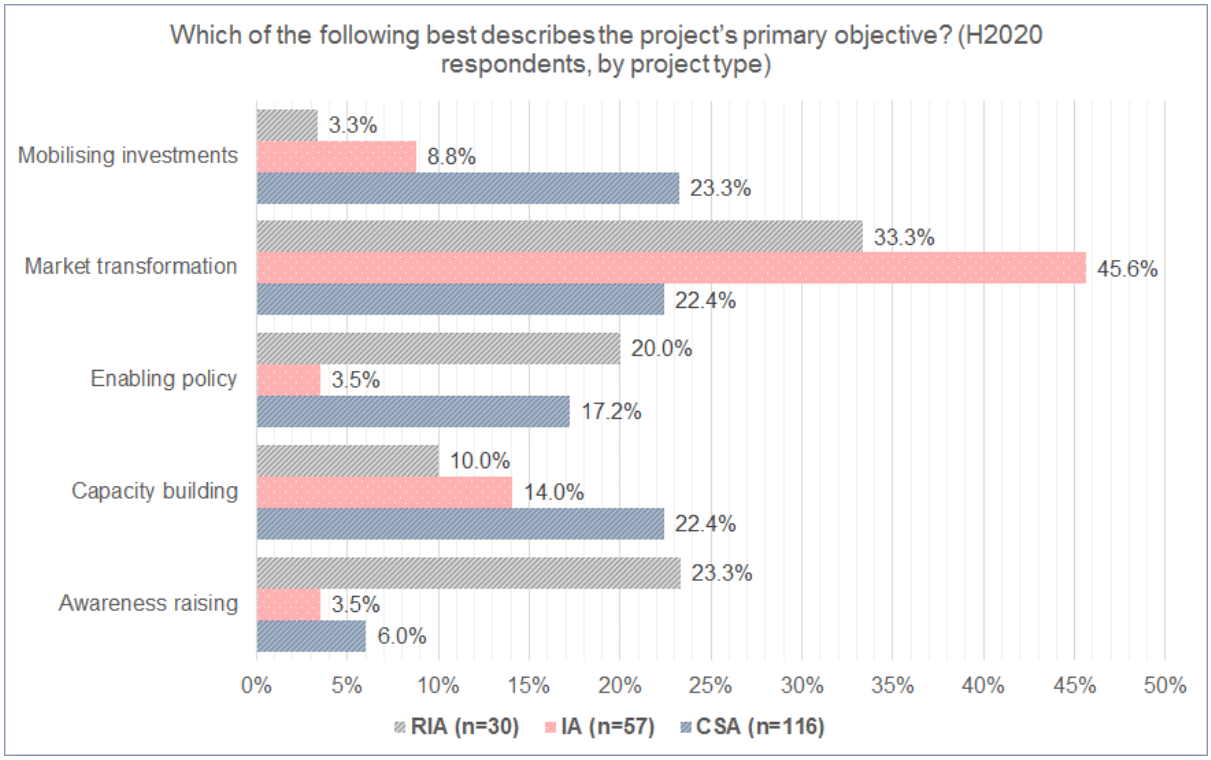
Source: Survey of H2020 programme participants

The analysis of the responses by project type help explain better these patterns (see Figure 9). Thus, as expected. market transformation is mainly the focus of research (RIA) and demonstration (IA) projects while capacity building is the priority of CSA projects. Furthermore, investment mobilisation is also the focus of a large number of CSA projects, including those selected under Energy efficiency finance for sustainable energy and the project development assistance calls. Enabling policy is often identified by CSA projects but also by RIA projects, where development of new knowledge in relation to energy technologies is identified as supporting policy making. Similarly, there is significantly high share of RIA projects focusing on awareness raising. In this case, a more detailed review of these projects indicates that most of them are related to the development of new ICT-based solutions for energy efficiency which, according to the work programme document, were expected to *"motivate and*

support citizen's behavioural change to achieve greater energy efficiency taking advantage of ICT" (European Commission, 2015a, p. 24). Thus awareness raising is, to some extent, linked to these projects.

On the other hand, it has not been possible to explain why awareness raising is not identified as a prime objective from the large majority of participants in CSA projects while there is much greater focus on market transformation in contrast to the IEE II programme participants. Possibly, there was a different interpretation of the term "market transformation" among CSA participants (focusing on changes to framework conditions and supply and demand aspects rather than technology development) while awareness raising was seen as less important in comparison to the objectives of capacity building and enabling policy.

Figure 9: H2020 projects primary objectives by project type (% of respondents indicating)



Source: Survey of H2020 programme participants

6.2.1.2 What are the direct results (expected/intended effects) of the H2020 projects and the projects of its predecessor programmes with respect to the Societal Challenge? Do they match objectives/expectations?

In this section we examine the available evidence concerning the direct results of the H2020 projects and attempt to assess whether they appear to match expectations.

6.2.1.2.1 Direct results of the programme

It is still too early to provide a detailed and complete analysis of the actual results of the H2020 projects supported. There is no information available besides some expected outputs and results taken from the project documentation that was analysed as part of the portfolio analysis. This focused on a few key performance indicators (KPIs) including expected primary energy saving, greenhouse gas reduction and renewable energy produced. Table 19 to Table 21 summarise the results of this analysis based on reported KPIs that were judged to be reliable or acceptable by the study team[41] . Most projects did not report long term KPIs, and many did not report short term KPIs. This is because there was no obligation to do so. The KPIs that were provided were not checked and negotiated with project officers as had been done previously with IEE projects, and they include some high values that may have been reduced as a result of negotiation. For example, one project accounted for 9 000

[41] Reported results refer to the total figures including the reliable, acceptable and uncertain figures reported in project documents. The methodology was presented in Section 4.2.

ktCO2/yr out of the total short term GHG savings of 11 600 ktCO2/yr. There are also discrepancies between the expected energy saved reported in Table 19 and greenhouse gas reduction in Table 20.

Table 19: Total primary energy saved from H2020 projects by type of action (in GWh) (reliable and acceptable data only)

	RIA	IA	CSA	Total
Short term (within project lifetime)				
Number of projects	1	3	53	57
Energy saved (GWh/yr)	61	22	4 690	4 774
Long term (by 2020)				
Number of projects	1	0	14	15
Energy saved (GWh/yr)[42]	132	0	12 698	12 831

Source: Portfolio analysis

Table 20: Total greenhouse gases reduction associated with H2020 projects by type of action (in ktCO2/yr) (reliable and acceptable data only)

	RIA	IA	CSA	Total
Short term (within project lifetime)				
Number of projects	1	4	18	23
Total greenhouse gases reduction ktCO2/yr	3	11	11 586	11 600
Long term (by 2020)				
Number of projects	2	1	5	8
Total greenhouse gases reduction ktCO2/yr	41 757	2	52 485	94 245

Source: Portfolio analysis

Table 21: Total renewable energy generated by H2020 projects by type of action (in GWh/yr) (reliable and acceptable data only)

	RIA	IA	CSA	Total
Short term (within project lifetime)				
Number	0	0	29	29
Total renewable energy generated (GWh/yr)	0	0	3 293	3 293
Long term (by 2020)				
Number	0	0	7	7
Total renewable energy generated (GWh/yr)	0	0	92 427	92 427

Source: Portfolio analysis

In the absence of specific targets, it is also not possible to assess whether these results can be considered as satisfactory.

However, a relevant benchmark in the case of CSA type projects is the comparison with the results for the IEE projects analysed. The comparison of the average results, as reported in the project documents, suggests much lower expected energy savings and renewable energy production per project for H2020 projects but comparable long term GHG emissions avoided. However, this comparison should be treated with great caution as reliable and acceptable data only were used to calculate H2020 averages while all reported data were used for IEE projects, and the H2020 KPIs were not mandatory and were not negotiated with project officers. Furthermore, while many IEE

[42] The approach to assessing whether project KPI information is reliable, acceptable or uncertain is presented in Section 4.2

projects may have five or more years since completion by 2020, for H2020 projects in 2020 many will only recently have completed, or potentially not even completed yet.

Table 22: Average performance of H2020 (CSA) and IEE projects per project. (Number of projects in brackets). Reliable and acceptable KPI data only for H2020 projects – all reported KPI data for IEE.

	Unit	*During project lifetime*		*until 2020*	
		H2020 - CSA	***IEE***	***H2020 - CSA***	***IEE***
Primary energy saved	GWh/yr	88 (53)	38 034 (70)	907 (14)	32 308 (69)
Tonnes CO_2 avoided	$ktCO_2e/yr$	644 (18)	1 665 (77)	10 497 (5)	10 120 (80)
Renewable energy produced	GWh/yr	114 (29)	2 136 (46)	13 204 (7)	1 467 665 (48)

Source: Portfolio analysis

Marketable outcomes of the H2020 projects

More specific evidence on the direct results of the supported projects comes from the participants' survey in which they were asked to indicate whether their project has led or is expected to lead to any concrete marketable outputs, including new products, processes, services or business models.

In total 197 of the 277 (71.1 %) of H2020 survey participants saw a concrete marketable outcome as a result of the projects in which they participated (see Figure 10). Introduction of a new business models is most frequently indicated and this reflects the fact the applicants were expected to identify a new business model associated with the proposed projects. Still, new business models were mainly identified among demonstration (IA) projects (see Table 23) and much less so among CSA or RIA projects. Beyond that, new services were the most commonly indicated (42.4 % of H2020 respondents), followed by new processes (36.4 % of respondents) and less so for new products (26.7 % of respondents). Only 4.2 % of H2020 participants indicated that they do not expect any (marketable) results. A number of H2020 respondents referred to other types of results (11.9 %) which typically included development of new concepts and methodologies.

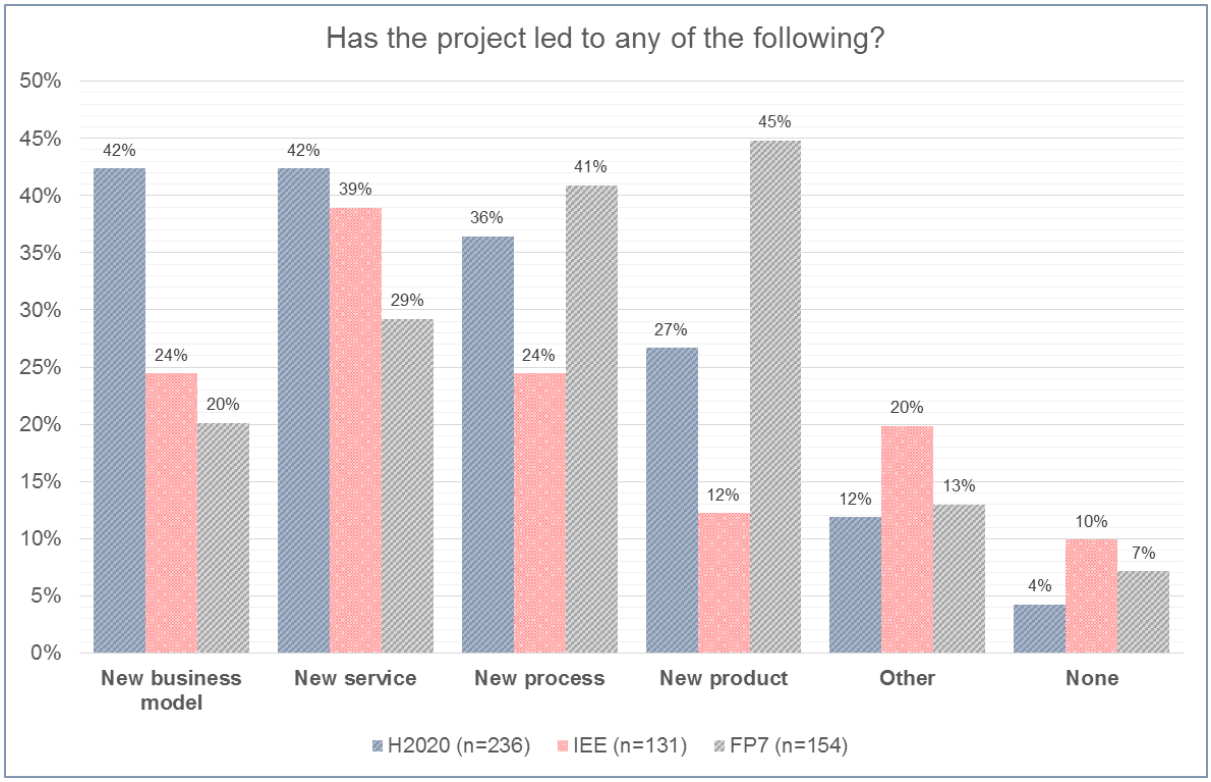
The comparison with the responses of participants to the two predecessor programmes points to a significant increase in the share of new business model development, something that was much less common in both the FP7 and IEE II. This was also the finding of the previous FP7 evaluation from Technopolis.[43].

In addition, the survey analysis suggests an increase in the share of new services in H2020 projects (again, mainly from IA type projects). The lower overall share of new products and processes in H2020 projects in comparison to FP7 projects reflects the fact that new products and processes are more characteristic of research and demonstration type projects with a lower share of the total responses. Indeed, among IA projects of H2020, new product/process development was more characteristic even if still not as high in comparison to new business model and services.

Respondents indicating "other" outcomes could provide additional text and these outcomes included development of new concepts and methodologies, training material and tools, and new policies.

[43] Only 6 % of respondents to that survey made reference to new business models.

Figure 10: Expected marketable outcomes of the H2020 projects and predecessor programmes (share of respondents indicating)



Source: Survey of H2020 programme participants

Table 23: Concrete marketable outcomes of the H2020 projects by project type (share of H2020 participants indicating)

Type of marketable outcome	CSA (n=116)	IA (n=58)	RIA (n=30)
New product	11 %	50 %	33 %
New process	39 %	40 %	27 %
New service	38 %	60 %	47 %
New business model	41 %	71 %	27 %
Other	15 %	3 %	17 %
None	6 %	0 %	0 %

Source: Survey of H2020 programme participants

Box 4: Case study - Technology development

Developing Cryogenic Energy Storage at Refrigerated Warehouses as an Interactive Hub to Integrate Renewable Energy in Industrial Food Refrigeration and to Enhance PowerGrid Sustainability (CRYOHUB) - Demonstration project (IA); Budget: EUR 8.3 million

Programme: H2020. Call: H2020-LCE-2025-3.

CRYOHUB project aims to extend the potential of large-scale Cryogenic Energy Storage (CES) and apply the stored energy for both cooling and energy generation. The intention is to enable the utilisation of Renewable Energy Sources (RES) when not needed for direct power supply to liquefy and store cryogens. This can then be used to cool the refrigerated warehouse onsite, or stored and then reconverted to energy when there is grid demand leading to significant overall energy efficiencies.

The project will contribute to the enhancement of existing knowledge about integration of the energy system, an area that is currently lacking and will likely become more important when the share of renewable energy in energy production rises. It will push existing technology from a TRL

level of 5-6 (technology demonstration) to full scale prototype ready to be tested as an operational environment (TRL 7-8). The project is expected to new products and services development around control systems for the grid.

Box 5: Case study – Development of supply chains in bioenergy

Securing future-proof environmentally compatible bioenergy chains (SECURECHAIN) - Market uptake project (CSA) – Budget: EUR 1.8 million

Programme: H2020. Call: H2020-LCE-2014-3.

The objective of SecureChain project is to promote a transferable Sustainable supply chain model for local bioenergy chains in Germany, Netherlands, Sweden, Spain, Greece and Estonia and fosters sustainable, environmentally compatible mobilisation of biomass sources and a proactive promotion of the market. It aims to remove non-technology barriers, such as regulatory aspects, price variations, institutional approaches to promote the development of bioenergy chains.

It is based on the development of local clusters (learning labs) that support SMEs offering tailored support and a way to form contacts and networks in their area, meet potential partners from other parts of the supply chain. It supports 21 SME pilot projects to develop their businesses through the provision of quality assurance tools with training, a life cycle analysis and risk assessment of their supply chains enabling them to acquire sustainability certification, all delivered through specialised and financial advisors. Eventually, they should mobilise more biomass and maximise the share of sustainable bioenergy in the final energy consumption.

In the case of the Catalan Cluster, the leadership provided has already helped address the large number of landowners, improving coordination and decision making along the supply chain.

Other measurable outputs, comparable to those identified in the FP6 and FP7 evaluation (see Table 24) are not currently available for the H2020 energy programme, even though some of them represent key performance indicators. There is no data on such indicators for most projects and, when provided in the relevant documentation, they often represent expected outputs that are not possible to validate. Such indicators are only expected to become available in later stages of the H2020 programme implementation.

Table 24: Summary of performance indicators of energy related to FP6 and FP7 projects

Output Indicator	Mean (median)	Imputation for the whole programme
Number of scientific publications	7.9	±18 000
Number of scientific publications in high impact journals	4.1 (2.5)	±8 000
Number of PhDs	1.6 (1.0)	±4 000
Number of participants with at least one patents applied for or granted	0.1 (0.0)	± 500
Number of participants with at least one patent applied for or granted by consortium partners	0.1 (0.0)	±500

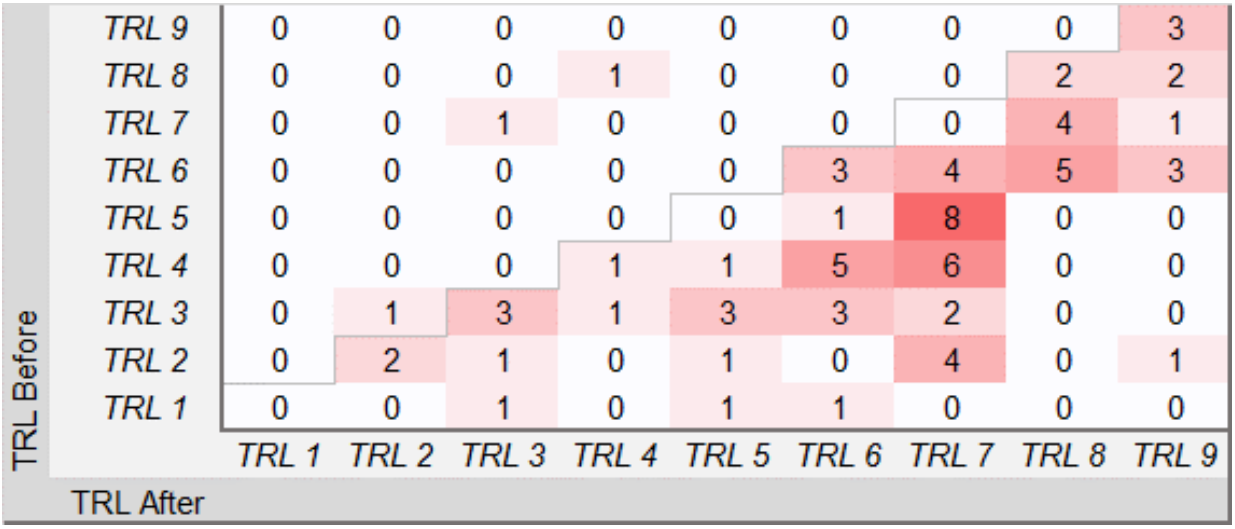
Source: Technopolis, 2014,

6.2.1.2.2 Impact on technologies - TRL analysis

The contribution towards increasing the Technological Readiness Level (TRL) of the relevant technologies and bringing them closer to the market was another aspect examined in the participants' survey. Figure 11 and Figure 12 below present the TRL before and after the project as indicated by the project participants in the survey and in the portfolio analysis. It clearly shows that for the great majority of cases there is a minimum level of change towards higher TRL. However, the analysis

covers only 76 projects for which the respondents provided relevant input. In 54 cases, the expected TRL at the end of the project was not provided.

Figure 11: Technological Readiness Level of H2020 projects before and after (expected) the project



Source: Survey of H2020 programme participants

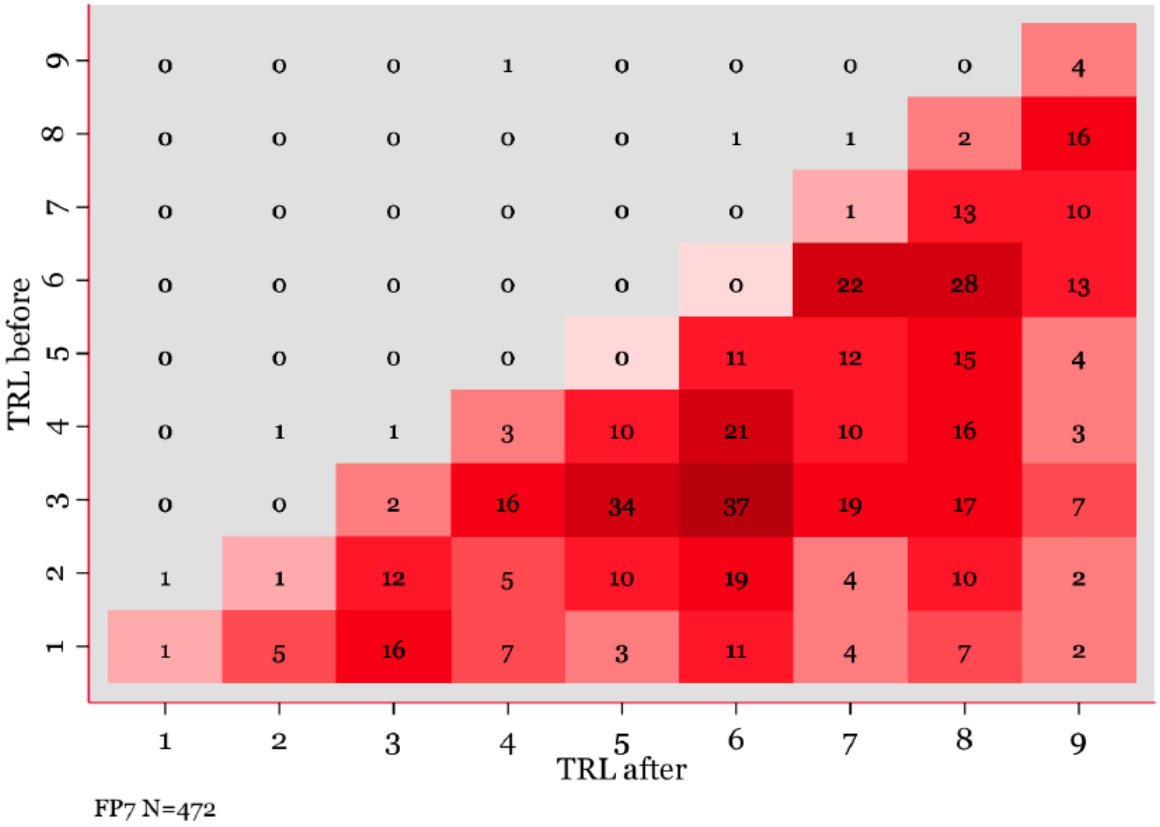
Figure 12: Technological Readiness Level of H2020 projects before and after (expected) the project – portfolio analysis[44]

Source: Portfolio analysis

The picture is similar to that in Technopolis' evaluation of FP7 energy projects indicating a general trend for increase in the TRL during the projects.

[44] In the case of the portfolio analysis, the data on TRL level was provided within a range.

Figure 13: Technological Readiness Level of H2020 projects before and after (expected) the project



Source: (Technopolis, 2014)

Within the sample of H2020 projects analysed, most of them had an initial TRL level closer to five (technology validated in relevant environment), rather than TRL between three and four in the case of FP7, which still referred to laboratory stage of development. The same picture comes from the project portfolio (see Table 25) where the majority of projects had a starting TRL level of five or more. In general, this is in line with the expectation that H2020 should be more closely linked with innovation development and closer to the market.

It should also be noted that there is a certain bias in the sample of projects that were within the scope of the study. There were no projects in the portfolio from calls that focused on TRL two and three projects (these were primarily H2020-LCE calls[45]) and there were also no Future and Emerging Technologies projects. Nonetheless, the conclusion that there is an overall shift towards higher TRL levels is still valid. In its advice for the 2016-2017 work programme, the Advisory Group on Energy recommended that the balance between the type of projects supported be urgently reconsidered and that funding for research activities with medium to lower TRL levels be increased in future calls (Advisory Group on Energy's, 2015).

Keeping these comments in mind, the analysis still points to a positive contribution of the H2020 programme. In total, for 59 of the 76 projects for which data is available (78 %) the respondents indicated that the TRL improved during the project, very similar to that reported in the Technopolis analysis of FP6 and FP7 projects.

Furthermore, the average level of improvement reported is expected to be smaller, on average 1.7 in comparison to 2.48 according to the Technopolis study. Namely, H2020 projects were generally more mature at the start of the project, but, while the average TRL level at the end was still higher than that

[45] These were the following calls: LCE 1 - 2014: New knowledge and technologies, LCE 2 – 2014/2015: Developing the next generation technologies of renewable electricity and heating/cooling, LCE 10 – 2014: Next generation technologies for energy storage, LCE 11 – 2014/2015: Developing next generation technologies for biofuels and sustainable alternative fuels, LCE 17 – 2015: Highly flexible and efficient fossil fuel power plants

of the FP7 projects (6.4 in comparison to 6.2), the overall level of TRL improvement achieved is reduced.

Table 25: Shift of Technological Readiness levels of H2020 and FP6/FP7 projects

Indicator	FP6/FP7 (Technopolis)	H2020 (H2020 survey)
TRL improved during the project	75 %	78 %
TRL before the project	3.8	4.7
TRL after the project	6.2	6.4
TRL improvement	2.5[46]	1.8

Source: (Technopolis, 2014), Survey of H2020 programme participants

It is also important that the achieved TRL improvement is, in most cases, credited to the H2020 programme participation. Among 115 respondents to the specific question in the participants' survey, 88 (77 %) stated that the H2020 project activities had a high or very high contribution to increasing the TRL. Only 5 % considered that there was no role of the H2020 intervention.

6.2.1.2.3 Impact on Energy policy

The contribution to energy policy is a key objective of the H2020 programme. Indeed, an important number of projects identified this as an objective of the programme. Within the portfolio of 161 projects analysed, a total of 37 projects indicated that they were expected to lead to new or modified policy frameworks at national level while 25 more at local level (62 in total). These were predominantly linked with the CSA type projects. Their contribution is expected to take place through a combination of policy documents and other relevant publications, workshops and other events with the participation of relevant ministries or other public authorities or through development of (IT) tools intended to be used by authorities to support policy making.

The survey of participants provides some additional supportive evidence of expected direct impacts on energy policy. As already shown in Figure 9 (Section 6.2.1.1), enabling policy was identified as one of the main objectives of the H2020 projects by around 13 % of respondents and it is more common among RIA and CSA project participants (20 % and 17 % respectively) and not so among IA projects (only 3.5 %). Furthermore, the survey respondents indicated that there is a possible contribution of H2020 to energy policy harmonisation among Member States. This is stated as one of the top three drivers for participation in H2020 projects according to 43 % of the survey participants

Stakeholder interviewees (including NCPs, evaluators and the Commission and Agency staff) are generally supportive of the presence of a positive and significant impact of H2020 on energy policy, even though it was often indicated that it is too early to make a proper assessment. Some focus on the greater market orientation of the H2020 programme – in comparison to FP7 – as a key reason for why impact on energy policy (at EU or national level) should be expected. This is based on what is generally seen as an increased level of involvement of policy makers in H2020 projects. It should be noted that when comparing with the IEE – which had a more explicit focus on market uptake and impact on the policy framework – the Commission and Agency staff appear more sceptical while NCPs interviewed did not provide specific views on this topic besides recognising the policy orientation of the IEE projects. In the participants' survey, public authorities were most frequently cited as one of the top three users of results from IEE projects – 73% of respondents. The most frequently cited main users of results from FP7 and H2020 projects are businesses and industry R&D (Figure 17 (Section 6.2.1.6)).

Box 6: – Case studies - Contribution to energy policy development

Auctions for Renewable Energy Support: Effective use and efficient implementation options (AURES) – Market uptake project (CSA) – Budget: EUR 1.5 million

Programme: H2020. Call: H2020-LCE-2015-3.

[46] TRL averages are calculated to 2 decimal figures and rounded. Thus the rounded difference may not be equal to the difference of the rounded numbers.

The project aims to identify and evaluate suitable auction design options and their effects under different market conditions and ultimately develop best practices and policy recommendations for future auction design. It looks into the interaction of auctions with other energy policy mechanisms and markets with capacity building of policy makers and market participants.

The project is particularly relevant to energy policy given the legal requirement that MS begin auctions for renewable energy in 2017. It provides direct support to DG Energy on the policy development for the next stage of Renewables Auction requirements but also several member state governments in designing effective auctions. Creation of successful auctions will enable growth and help to mature and stabilise the renewables sector as an efficient and effective energy generation sector. In addition, the results of the project can be used by supply companies in their response to bidding invitations.

A large number of outreach activities (40) have already taken place indicating high level of interest including an 'Auction Academy', presentation in conferences and directly consulting with several MS governments.

Partnership for New Energy Leadership 2050 (PANEL 2050) - Market uptake project (CSA) – Budget: EUR 1.79 million

Programme: H2020. Call: H2020-EE-2015-3-MarketUptake

The aim of Partnership for New Energy Leadership 2050 project is to create durable and replicable sustainable energy networks at local (municipality/community) level, where relevant local stakeholders collaborate for the creation of local energy visions, strategies and action plans for the transition towards low carbon communities in 2050. The PANEL 2050 project will focus on the creation of these sustainable local energy networks in Central and Eastern European countries, where this type of network at local level is almost completely absent. Therefore, additional support is needed for the creation of the first successful local energy networks that have the potential to set an example and a new standard for local energy road mapping in other local communities in the CEE region. Furthermore, the PANEL 2050 project will not choose a specific focus on a certain type of stakeholder, but will try to work at the local level and assemble all relevant and available stakeholders related to sustainable energy. The number and type of stakeholders will vary very much in different local settings and the ambition of this project is to create sustainable energy networks at a local level that will connect and involve all relevant stakeholders that are present at local level into the local policy development and implementation. At present, the involvement of local shareholders in local policy development in any field in CEE countries is very limited and the aim of this project is to create durable sustainable energy networks in a number of local communities in different CEE countries that will also be a replicable example that can be spread to other communities in CEE countries. Introducing the stakeholder concept to energy planning will help generate sustainable energy policies and create a more sustainable future for Europe.

6.2.1.3 What is the current & future socio-economic impact of the programme in relation to Societal Challenge 3?

Information on the socio-economic impacts of the H2020 programme comes primarily from the project portfolio analysis which relies on Annex I documents providing information on the expected job creation – short and long term, the number of people trained and the expected level of investment associated with the H2020 projects supported. The tables below (Table 26 to Table 28) summarise the results of the analysis. Data were available for only a small number of projects which means that totals presented cover only a small subset of the H2020 Energy programme. Extrapolating to the total programme for the period covered (2014-2015) on the basis of the data available is rather problematic given that it is not possible to know how representative they are of the total programme and the projects supported.

In terms of the number of jobs created, the reported portfolio analysis suggests a total of 53 402 jobs expected to be created by the end of the 26 projects analysed (over 3 500 jobs/project) and around 168 000 by 2020 from 17 projects. These are very high numbers coming from a small number of projects when considering that, for the total of FP7 the estimated direct jobs created were 950 000 plus 2 900 000 full time equivalent (FTE) jobs (indirect). There is also significant variation with only two projects reporting a total of 40 000 jobs created by the end of the project period and one project referring to a total of 137 018 jobs by 2020. We should also note that several interviewees (project

participants) said that they felt necessary to overstate one's numbers in order to be successfully funded. Thus, in the absence of any check of the reliability of such data we consider that these figures are unrealistic and should be used as a basis of assessing the impacts of the H2020 energy programme.

Table 26: Expected number of jobs created from supported projects

	Number of projects reporting	Average (per project)	Total
Until end of the project (direct)	**15**	**3 560**	**53 402**
RIA	1	13 311	13 311
IA	6	750	4 500
CSA	8	4 449	35 591
Until 2020	**6**	**28 090**	**168 542**
RIA	-	0	0
IA	2	13 460	26 920
CSA	4	35 406	141 622

Source: Portfolio analysis

In terms of the number of people trained, the portfolio analysis points to a total of 325 500, almost exclusively associated with the CSA projects. As in the case of jobs created, a few projects (3) reported 320 000 people trained. In one single market uptake project, expectation of a total of 200 000 people trained is reported but this mainly refers to people with increased capacity – but not formal training. In most other projects, the number of people trained reported was most often in the range of 100 to 1 000. Training for the period after the end of the project is much more limited since this is a type of activity that is not planned that far in advance and for which availability of funds is quite important.

Table 27: Expected number of total people trained from supported projects

	Number of projects reporting	Average (per project)	Total
Until end of the project	**61**	**5 336**	**325 500**
RIA	1	100	100
IA	1	400	400
CSA	59	5 508	325 000
Until 2020	**10**	**2 238**	**22 379**
RIA	-	0	0
IA	-	0	0
CSA	10	2 238	22 379

Source: Portfolio analysis. Numbers reported in project documents

The analysis of Annex I documents also provides information on the **level of investment triggered**, with a reported total of EUR 1.4 billion over the project timeframe and an average of EUR 39 million/yr per project, based on H2020 projects reporting reliable or acceptable KPIs. In the longer term, H2020

projects reporting reliable or acceptable KPIs are expected to trigger EUR 6.2 billion/yr of investment by 2020. The figures come primarily from CSA projects for which there was a requirement to provide an estimate of the expected level of investment triggered.

It is difficult to draw meaningful conclusions about the relative impacts of H2020 and IEE II projects as H2020 project impacts are based on reliable and acceptable data only, H2020 KPIs were not discussed and negotiated with project officers, and IEE II projects started earlier and so would be expected to deliver greater impacts by 2020. However, the data on short term impacts does suggest that IEE II projects were expected to trigger significantly greater investment per project than H2020 projects. As in all other socio-economic indicators considered judgment on this aspect should be deferred for a later stage of the programme.

Table 28: Expected investment triggered from supported projects, reliable and acceptable data only for H2020; all reported KPI data for IEE

	Number of projects reporting	Average (per project) **million Euro/ yr**	Total (**million Euro/yr)**
Short term (within project duration)			
All H2020	**37**	**39**	**1 442**
RIA	1	269	269
IA	2	13	27
CSA	34	34	1 146
IEE II (actual)	**52**	**660**	**34 332**
Long term (by 2020)			
All H2020	**9**	**691**	**6 221**
RIA	1	291	291
IA	1	5 000	5 000
CSA	7	133	929
IEE II (actual)	**55**	**2 675**	**147 135**

Source: Portfolio analysis

It is rather difficult to assess whether the reported/expected socio-economic impacts from the H2020 projects should be considered satisfactory or not since there were no specific targets set in relation to jobs created or investment triggered and benchmarks from other programmes are not available.

The only exceptions were the Project Development Assistance (PDA) projects where each project was required to secure a minimum of EUR 15 of investments for each euro of public support provided. Within the portfolio of 161 projects considered for this study there were four PDA projects reporting reliable or acceptable data on investment triggered. The reported total investment triggered was over EUR 160 million from a total EU contribution of EUR 5.2 million (see Table 29), or EUR 31 million investment triggered per EUR million of EU contribution. This is primarily a result of two projects (RESCOOP MECISE and SUNShINE).

There are no data for comparable projects under the IEE II programme (Mobilising Local Energy Investments (MLEI) in the portfolio. However, according to EASME data, a total of 22 MLEI projects supported under IEE II programme triggered investments of EUR 488 million (EASME, 2014), namely an average of EUR 22 million per million of EU contribution. Thus, if the PDA projects achieve their objectives and there are similar results from other PDA projects, an improvement in comparison to the achievement under the IEE II programme should be expected.

Table 29: Expected investment triggered from supported H2020 Project Development Assistance (PDA) projects during project lifetime (short term), reliable and acceptable data only

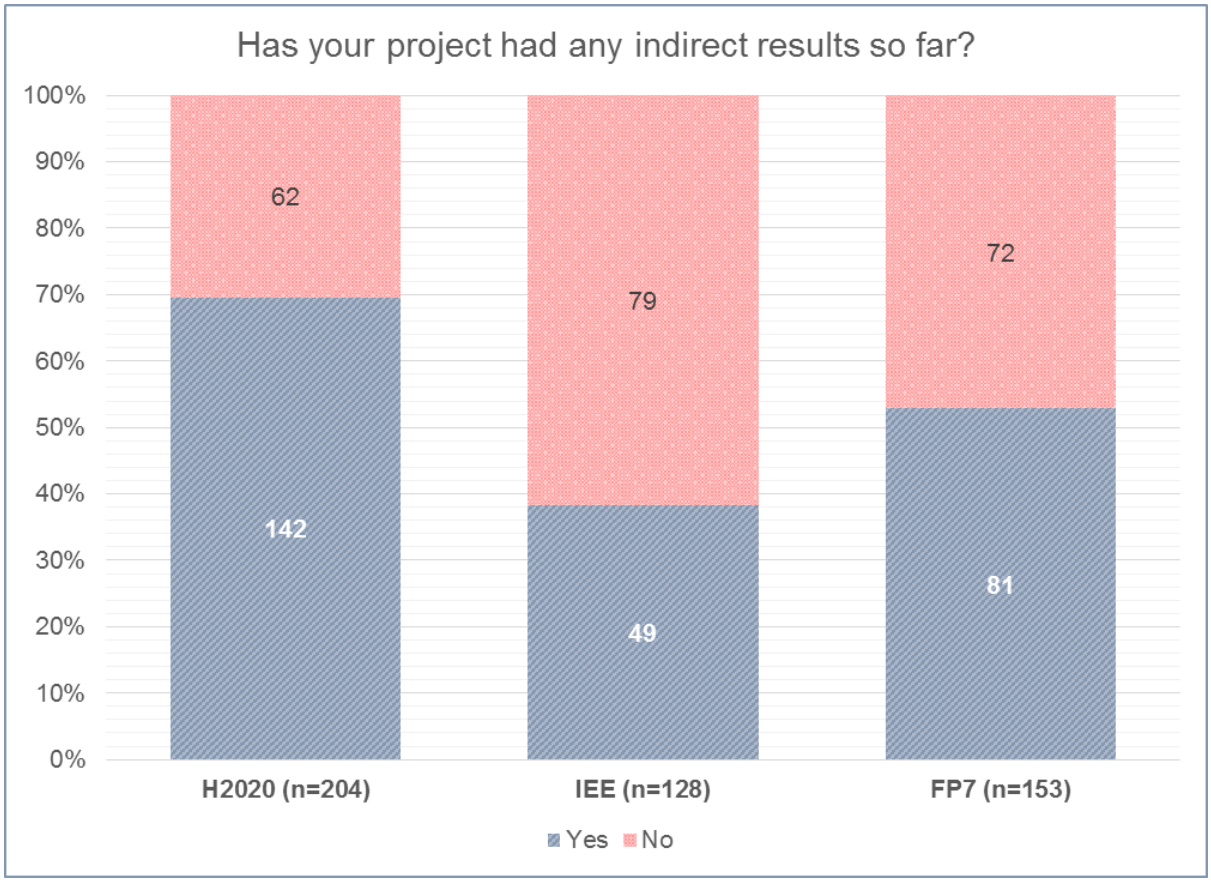
Name of project	Project description	Project budget (EUR million)	EU contribution (EUR million)	Investment triggered (EUR million)
RESCOOP MECISE (Mobilising European Citizens to Invest in Sustainable Energy)	Project focuses on developing renewable energy projects and use part of the revenues to initiate energy efficiency investments in private homes and public buildings.	2.2	2.2	111.0
SUNShINE	Investment scheme to support public and private Energy Service Companies by selling future cash flows	1.6	1.6	29.4
FESTA	Support energy investments on public buildings and to spread the PPP approach also through Energy Performance Contracts in convergence regions of Italy	0.5	0.5	7.5
EnerSHIFT	Use of financial schemes such as Energy Performance Contracting in Liguria (Italy) to support energy efficiency in social housing buildings through retrofitting.	1.0	0.9	14.6
Total		5.2	5.2	162.5

Source: Portfolio analysis

6.2.1.4 What are the indirect results (including unexpected/unintended effects) of the H2020 projects and the projects of its predecessor programmes? Where possible to ascertain, do these match objectives/expectations?

The survey participants made some reference to some indirect results from the H2020 projects. In total, less than one third of the H2020 survey participants that responded to the specific question indicated the presence of indirect results from their projects. This is in contrast with responses concerning the IEE and – less so - FP7 projects where a higher share identified the presence of indirect results. This is possibly due to the early stage of most of the H2020 projects and the difficulty of discerning indirect results at this stage.

Figure 14: Presence of indirect results in H2020 and predecessor projects



Source: Survey of H2020 programme participants

Among those that referred to the presence of indirect results, they covered a wide range of possible results. However, by far the most common (over two thirds of the cases) was the development of cooperation networks and partnerships – local or transnational and across sectors - along the same lines as those identified in the evaluation of the FP7 energy programme by Technopolis. This focus on the networking and cooperation aspects was also indicated as important by some NCPs.

Box 7: Case study - Supporting networking, cooperation and knowledge exchange

A multi-stakeholder Regional Action Network as a living structural base to effectively help define and implement deep energy efficient building renovation at local, national and European level (Build Upon) – Market uptake (CSA) – Budget: EUR 2.3 million

Programme: EE. Call: H2020-EE-2014-3-MarketUptake.

Project aiming in the development of 'Green Building Councils' (GBCs), in 14 countries (BG, CZ, ES, HR, IT, IE, FI, LV, RO, SE, SI, SK and TR). GBCs are multi-stakeholder platforms, formalising a 'Regional Action Network' of connected actors to ensure continuation of the activities beyond the project's duration. The project is expected to engage and empower a 'critical mass' of over 1,000 stakeholders in 14 countries (BG, CZ, ES, HR, IT, IE, FI, LV, RO, SE, SI, SK and TR) to define and implement their long-term national renovation strategy. The project is expected to facilitate learning from the participating countries through fast sharing of knowledge between the people participating in the network.

Other indirect effects of the projects, particularly at the participant level, were not possible to identify at this stage. The previous evaluation of FP7 referred to the impact on the income of participants and on their competitiveness[47] but it is too early in the project cycle to identify such impacts.

6.2.1.5 Do impacts differ between countries? If yes, how and why?

The limited information on actual impacts of projects – and consequently of the H2020 energy programme makes it difficult to examine the impacts of the programme by country at this stage. Nonetheless, the available data point to two main issues:

1. The high level of concentration of H2020 energy programmes in a few countries with particularly limited participation of new Member States
2. The different capacity of Member States to make use of the possible results and impacts of the H2020 programmes.

In relation to the first aspect, the portfolio analysis showed that participation in the H2020 energy programme is strongly dominated by EU15 countries (90.6 % of projects on the basis of the country of the lead partner; 96 % in terms of the budget allocated to participants). It is largely similar to what is observed for the whole of Horizon 2020 programme (European Commission, 2016d)). In comparison, when considering the countries where projects were expected to have an impact (on the basis of the information provided in Annex I documents), EU15 countries are indicated 70.7 % of the times, EU13, 21.4 %, while an EU-wide impact is identified 5.7 % of the time. 19 projects stated that their impacts would be "EU-wide", rather than country specific. (See Table 30 and Table 31)

Market uptake (CSA) type of projects are more broadly spread geographically while demonstration (IA) projects are more strongly concentrated in EU15 countries. Thus, impacts are expected to be more broadly spread geographically for CSA projects, although there is still a significant focus on EU15 countries.

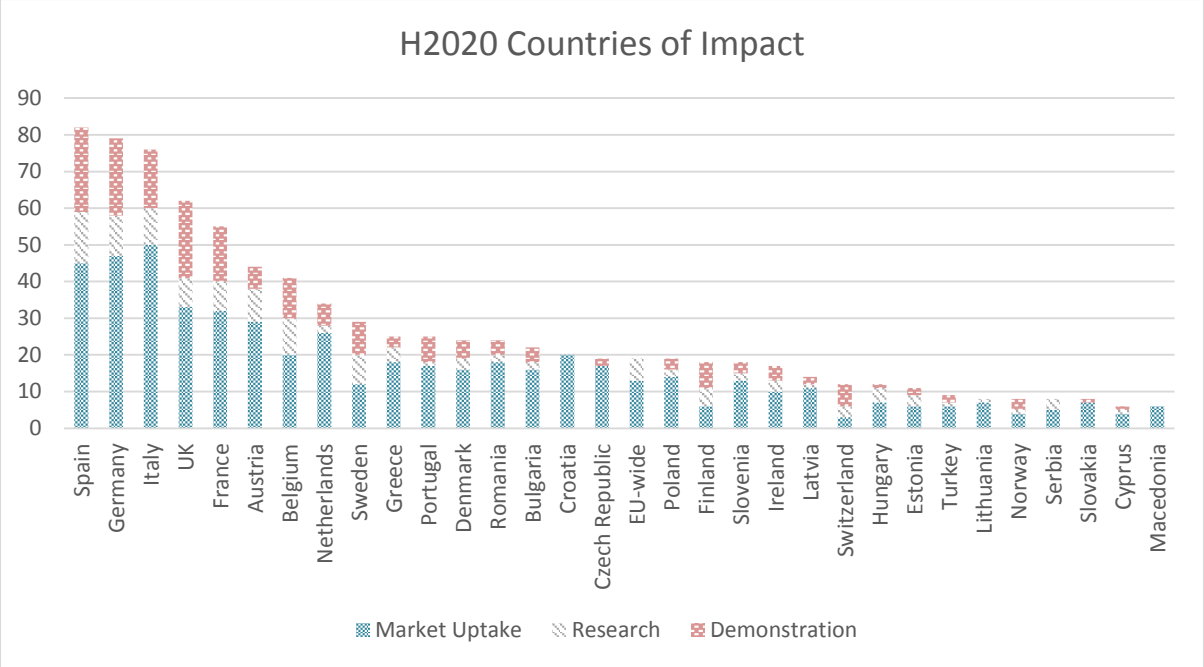
Table 30: Country where H2020 projects were expected to have an impact (frequency of reference)

	Total	CSA	RIA	IA
EU15	70.7 %	66.2 %	74.6 %	81.2 %
DE	*9.1 %*	*8.5 %*	*8.5 %*	*11.0 %*
ES	*9.4 %*	*8.2 %*	*10.8 %*	*12.0 %*
IT	*8.7 %*	*9.1 %*	*7.7 %*	*8.4 %*
UK	*7.1 %*	*6.0 %*	*6.2 %*	*11.0 %*
FR	*6.3 %*	*5.8 %*	*6.2 %*	*7.9 %*
EU13	21.2 %	26.0 %	13.8 %	12.6 %
EU-wide	2.2 %	2.4 %	4.6 %	0.0 %
Other country	5.9 %	5.5%	6.9 %	6.3 %

Source: Portfolio analysis of Annex I documents

[47] Around 42 % of participants indicated an effect of more than 5 % increase in research income while 6 % of participants in projects indicated that they have seen a large effect (>25 %) on their contract research income. Income from licenses also increased by more than 5 % for 9 % of participants. Furthermore, around 10 % of participants indicated that, as a result of the programme, they moved from the national leadership to the EU leadership position and around 3 % shifts from the EU leader position to World Leadership position

Figure 15: H2020 energy programme projects – impacts by country (number of projects)



Source: Portfolio analysis of Annex I documents

According to stakeholders interviewed (including Commission and Agency officials, evaluators and NCP representatives) the limited participation of EU13 countries in the H2020 projects is a reflection of the limited experience of relevant organisations (research organisations and business) in participating in EU projects and the resulting lower quality of the applications. More experience should lead to more and better proposals which, in turn, is translated to more funding secured and, eventually, greater impact.

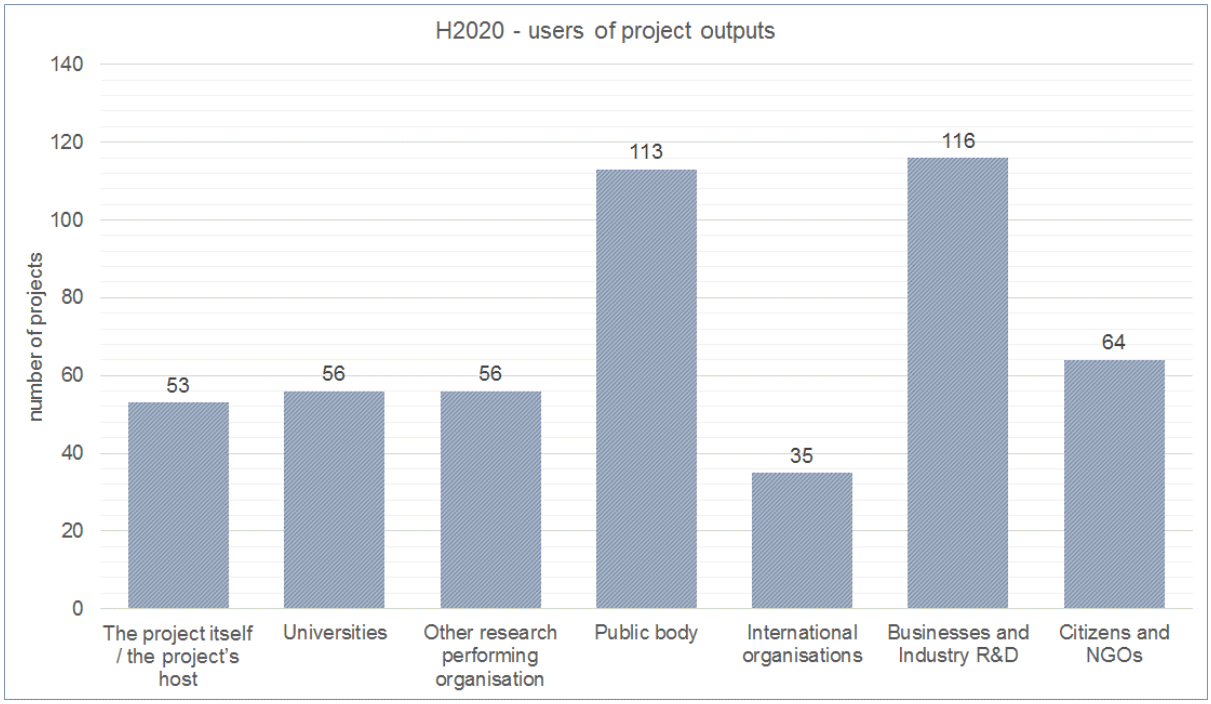
The interviewees also point to the important role that pre-existing capacity plays in making use of the results of the projects. Thus, higher impacts should be expected in the Member States with stronger technological and innovation capacity and with firms and research and technology organisations with the pre-existing knowledge and expertise. As suggested, countries with relevant support programmes (e.g. DE, FR) may also be able to make greater use of and see greater impact from H2020 projects. It is also the case that the H2020 programme has a significant impact in those EU15 MS with existing experience but where, due to budget cuts, H2020 programme represents the main source of innovation funding. Spain is a characteristic example in this respect and it was argued during interviews with project participants that H2020 programme contributed to stabilising research jobs rather than experts and their research teams potentially moving to more attractive places. Finally, the thematic focus of the programme also has a role to play. Thus, support for certain technology areas is only relevant to certain countries (e.g. solar energy technology for Southern Europe countries or geothermal for Germany, Italy and Norway).

The analysis of the participants' survey responses does not suggest specific patterns in terms of the expected direct or indirect results depending on the country of establishment of the participant.

6.2.1.6 Who is using the programme's outputs? To what extent?

The analysis of the portfolio of 161 H2020 energy programme projects indicates that public bodies, and business and industry groups are the most common target audiences for H2020 energy programme projects (Figure 16). This is unsurprising given the focus on market uptake projects who will be working with – or planning to work with – policy makers and industry to achieve project objectives.

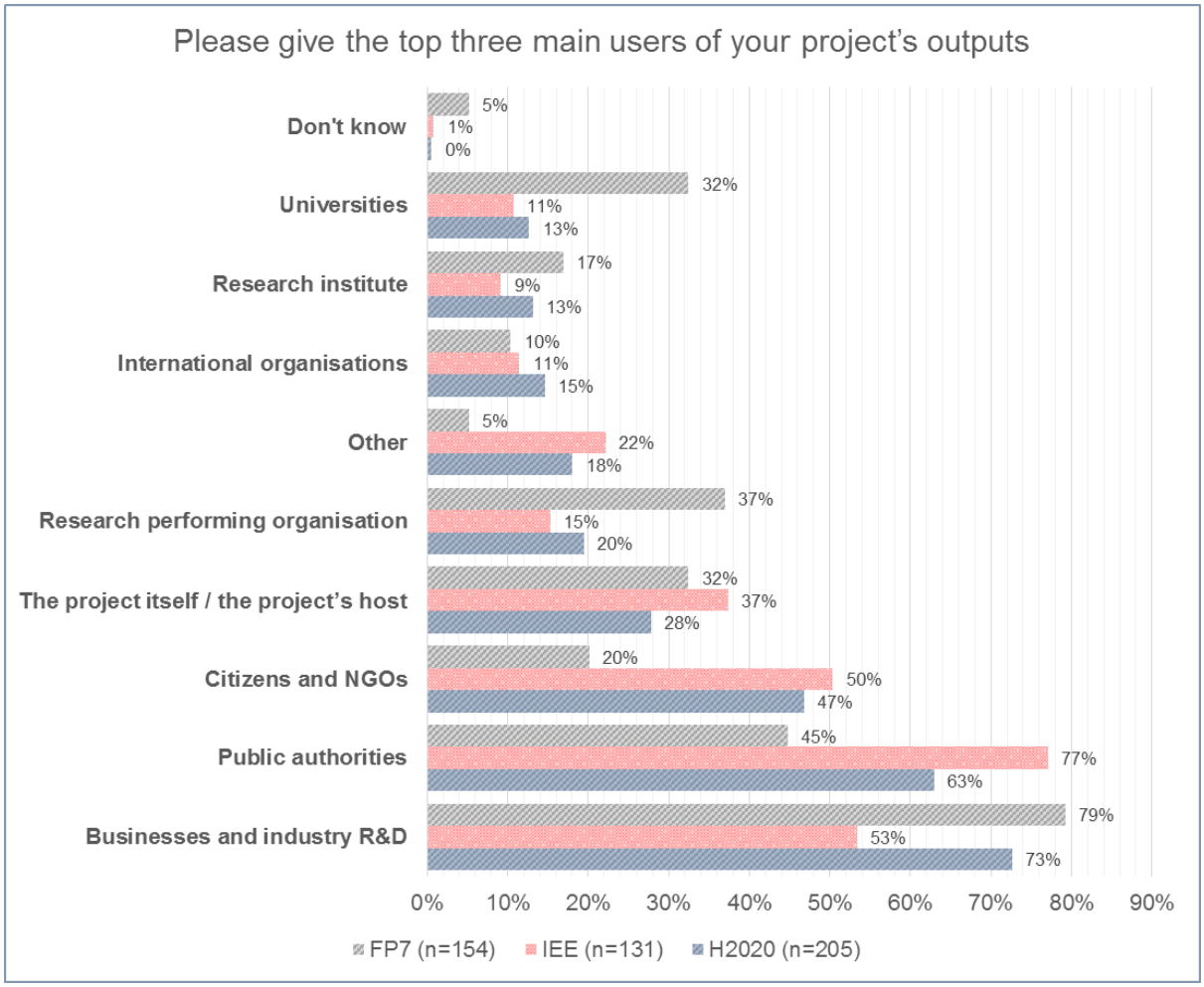
Figure 16: H2020 energy programme projects – users of project outputs (more than one answer possible)



Source: Portfolio analysis

The picture is also supported by the participants' survey which suggests that businesses and industry and public authorities are the main intended users of H2020 projects' outputs (72.7 % and 62.9 % respectively) while citizens and NGOs also appear to be significant potential users (46.8 %). On the other hand, Research organisations and universities are not identified as main users of outputs (less than 15 %) (see Figure 17). The picture for H2020 is not dissimilar to that for IEE and FP7 programmes – as indicated by the survey responses - although, public authorities are considered as the top main users in the case of IEE projects (77.1 % or respondents), followed by industry and citizens (53.4 % and 50.4 % respectively).

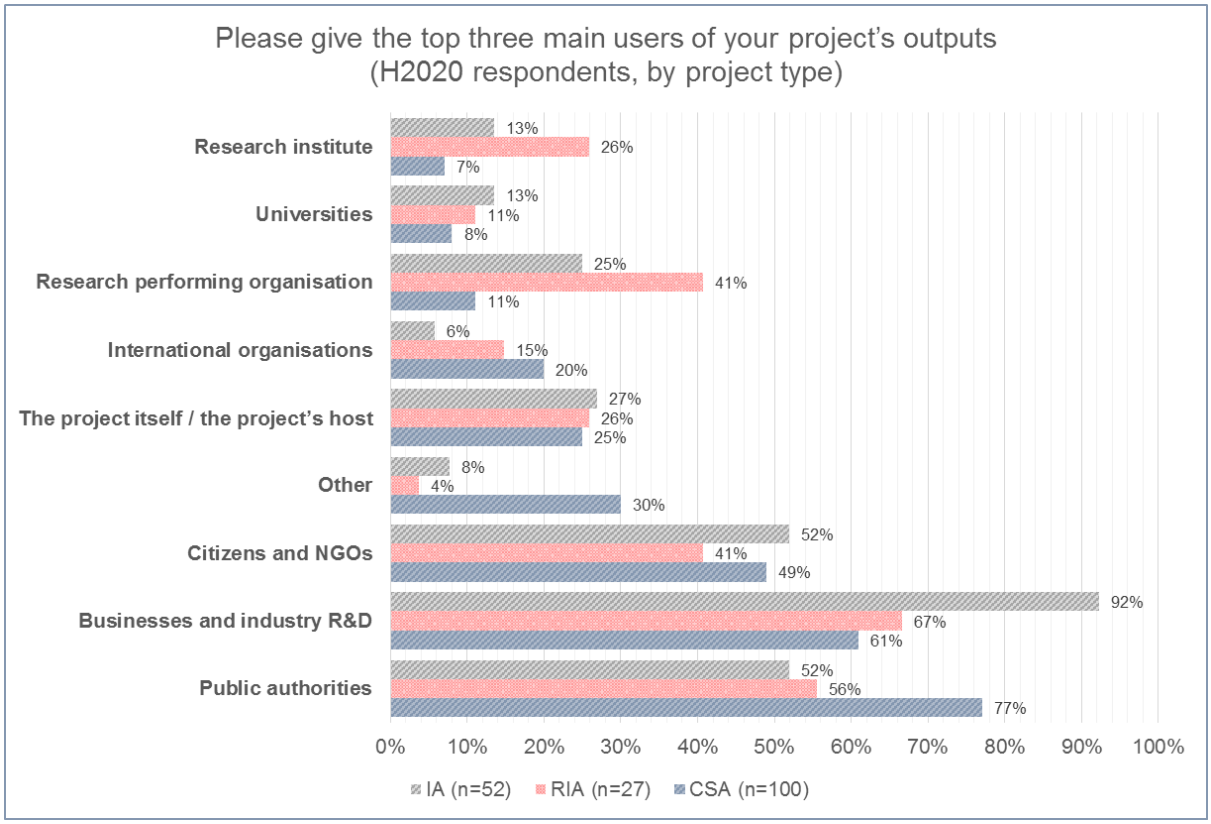
Figure 17: Top three main users of projects' outputs for H2020, IEE and FP7 projects (percentage of respondents indicating)



Source: Survey of H2020 programme participants

When comparing among the different types of H2020 projects (RIA, IA, CSA), the main users indicated are largely similar to those indicated for IEE and FP7 (see Figure 18). Business and industry was most often indicated (92.2 %) from IA participants while public authorities are the most common user of outputs from CSA type projects (77.8 %). Research organisations are not often identified as users of the outputs for all types of projects but, as expected, they are more often indicated in the case of RIA projects.

Figure 18: Top three main users of projects' outputs for H2020 by project type (percentage of respondents indicating)



Source: Questionnaire survey of successful H2020 participants

The same picture arises from the sample of 90 IEE projects for which we data-mined information in the portfolio analysis. There was a similar proportion of Public Bodies, International Organisations and Businesses and Industry R&D organisations using IEE project outputs as in the case of H2020 projects. However, there were more Citizens and NGOs, and fewer Universities and Other Research Organisations – which is to be expected given the more demonstrative nature of IEE projects.

It should be noted that the findings of this survey's findings are relatively different from those of the previous evaluations (e.g. FP7 evaluation by Technopolis) which found that project participants were the main users of the outputs of the predecessor programmes of H2020 (FP7 and IEE). This may reflect a change in the focus of the programme but also a greater level of awareness of the need for the project outputs to have an impact outside the consortium members.

The interviews with stakeholders at programme level (NCPs, evaluators, Agency staff) did not provide additional insights to the use of the project outputs since stakeholders asked this question had limited view on this topic. Among project coordinators interviewed, the responses varied greatly depending on the project type. Housing associations, public (national/local) authorities (national/local), investors and energy consultants but also organisations involved in the development of specific technologies or services (e.g. biomass trade centres) were the most commonly indicated.

The survey responses also provided some insights into the level of use of the project outputs, although these are only limited to the IEE and FP7 programmes. When asked to indicate whether there is evidence of the use of the project outputs by other stakeholders, 57 % of IEE participants and 46 % of FP7 provided a positive response but did not provide more detailed information.

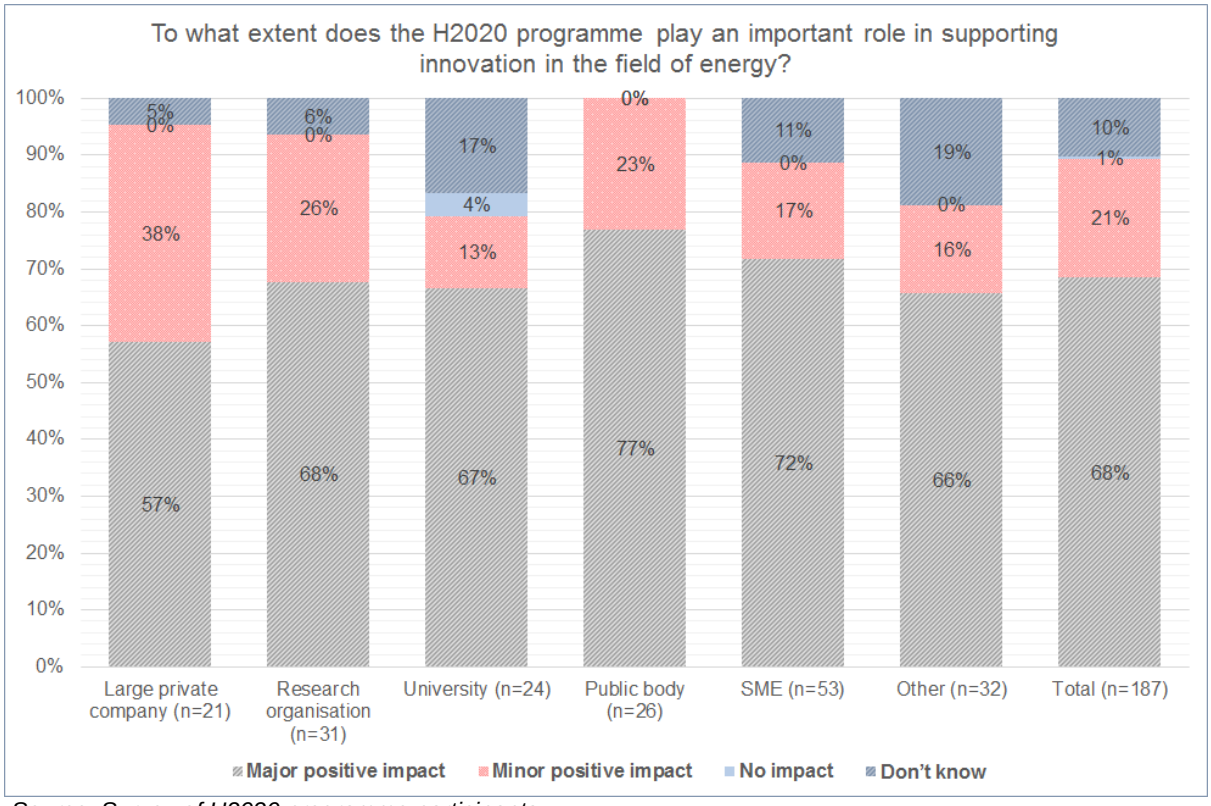
6.2.1.7 Does H2020 play an adequate role in supporting innovation in the considered field?

Another aspect of the programme effectiveness is its contribution to the development and uptake of innovation in the field of energy, namely the creation of new knowledge, development of new technologies and their eventual market uptake.

In that respect, survey respondents were particularly positive of the role of H2020 programme in supporting innovation in the energy field (see Figure 19). Only 1 % of respondents indicated that it

does not have an impact, while 68 % of respondents consider that it has major positive impact. This positive view is consistent independent of the type of respondent, (business, research organisation or public body) type of project or country.

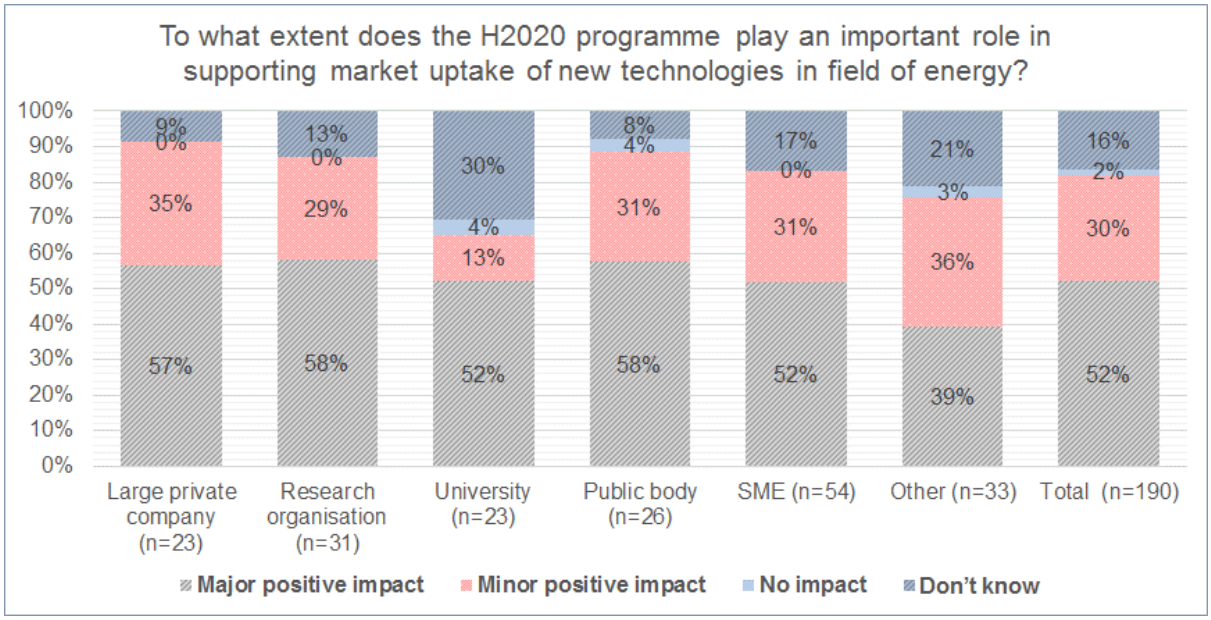
Figure 19: To what extent does the H2020 programme play an important role in supporting innovation in the field of energy?



Source: Survey of H2020 programme participants

There was also positive feedback provided on the role of the H2020 programme in market uptake of technologies in the field of energy. 52 % of the respondents to the specific question stated that the H2020 programme has a major positive impact and only 2 % indicated no impact. The positive view of the role of the H2020 is consistent across all types of participants and countries (see Figure 20).

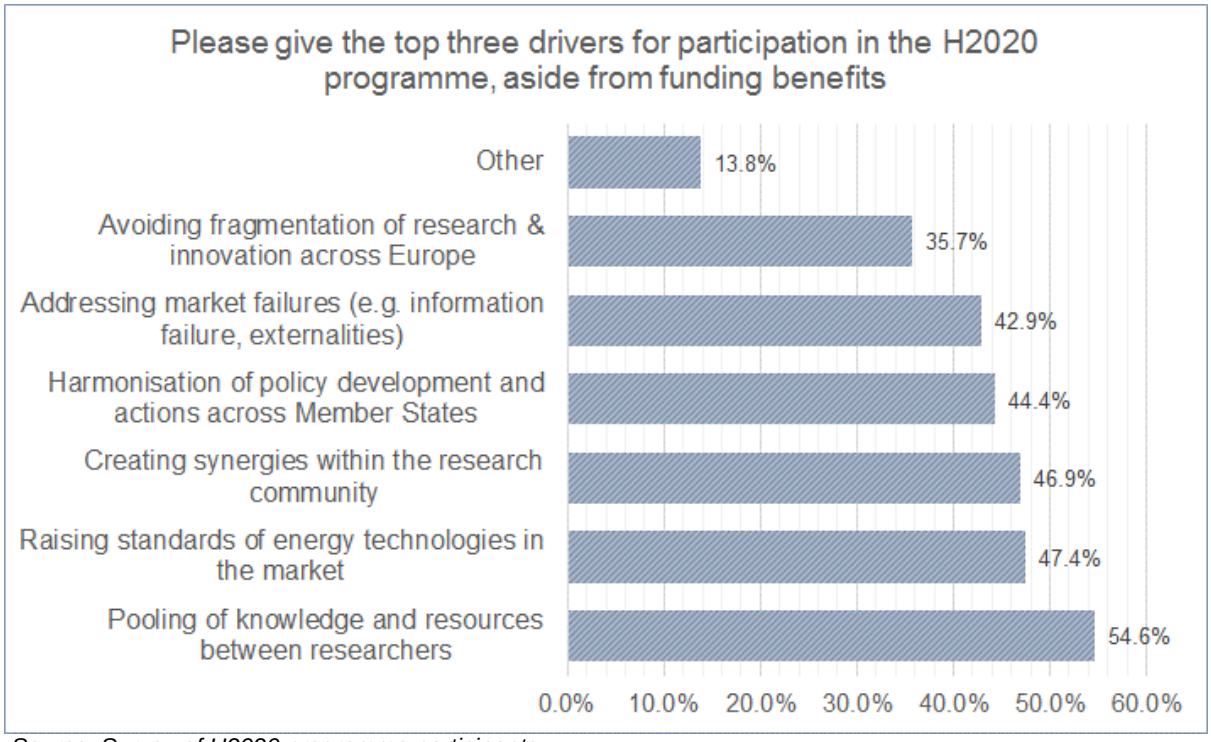
Figure 20: To what extent does the H2020 programme play an important role in supporting market uptake of new technologies in field of energy?



Source: Survey of H2020 programme participants

The survey responses also provide some indications of the mechanisms through which H2020 contributes to the development of innovation. When asked to indicate the top drivers for participation in the programme, besides funding, the respondents made reference to supporting knowledge creation through knowledge exchange and cooperation as well as to raising standards and addressing market failures, all of which are important aspects in terms of supporting innovation in the field.

Figure 21: Main drivers for participation in H2020 (percentage of respondents indicating)



Source: Survey of H2020 programme participants

Interviews with project participants confirmed this positive role of the programme in promoting innovation in the field. The most relevant point is the strong link with market demand and the focus on higher TRL levels has a positive role.

In terms of the capacity of the programme to follow developments of specific technologies in the energy field and the response to the evolving character of the energy field, the input from stakeholders is rather mixed. Most NCPs and evaluators suggested that the two-year work programme and the annual calls provide significant flexibility to revise main priorities and adapt to specific developments. At the same time, the work plan provides sufficient visibility of forthcoming calls for potential applicants. However, there is a similar number of stakeholders – including also Agency staff – that consider the two-year work programme rather rigid and limiting the capacity to respond to evolving needs. Reference was made, for example, to the SCC area, where technological developments are very fast and where the two-year work plan is not seen as appropriate.

Thus, the comments do not appear to fully confirm the initial expectations – as indicated in the Commission IA working document (European Commission, 2011) - that the H2020 programme has significant flexibility built in through the annual call system. At the same time though, there is no questioning of the presence of the appropriate links and mechanisms of the Commission services with the scientific community (through the consultation of Platforms, Associations and the Advisory Groups) and of the capacity to identify the relevant topics and respond within the framework of the programme through revisions of the work programme and the specific calls.

6.2.1.8 What has been the progress towards achieving an impact based, where applicable, on the performance indicator(s) of the specific objective(s)?

As has already been highlighted in previous sections, at this stage of the programme it is too early to assess specific impacts. Furthermore, for performance indicators linked to the specific objectives of H2020 there are no specific targets set that would allow assessment of progress to be made. In some cases, indicative targets were provided the work programme documents in relation to individual calls (e.g. 25 GWh savings per EUR 1 million of EU support was indicated in two Energy Efficiency calls (European Commission, 2015a).

In Table 31 we summarise the results for the few key performance indicators for which data is available. In terms of the share of funds allocated to non fossil fuel related activities, while this represented only 46 % of the total within the sub-set analysed in the study, the 2014-2015 monitoring report indicated a total of 94 %, well above the target. Similarly, while within the sub-set analysed the share of market uptake activities was less than the 15 % target set, it was 15.2 % for the overall SC3 project portfolio (European Commission, 2016d).

Table 31: Summary of performance by indicator

Indicator	Target	Total SC3	Data for sub-set used for this study	Comment
Output indicators				
Percentage of the overall Energy challenge funds allocated to renewable energy, end user energy efficiency, smart grids and energy storage activities	85 %	94 %	46 %	Based on total EC funds contributed to EE, LCE, SCC projects under the 2014-2015 H2020 Energy Programme, given the total available budget of the Energy Challenge for 2014-2015 was EUR 1 441 million
Percentage of the overall Energy Challenge funds allocated to market uptake	15 %	15.2 %	11.2 %	Based on total EC funds contributed to CSA projects in 2014-15 H2020 Energy Programme, given the total available budget of the Energy Challenge for 2014-2015 was EUR 1 441 million
Primary energy savings triggered by	No target set	No data	158 GWh per EUR million EUR (For projects where data	Based on the results of the portfolio analysis,

Indicator	Target	Total SC3	Data for sub-set used for this study	Comment
the market uptake project (GWh per EUR million)			are reliable or acceptable)	where figures are reported as expected impacts arising over the lifetime of CSA projects in scope for this study[#]
Total amount of money invested by the stakeholders in sustainable energy as direct or indirect result from the measures developed by the market uptake projects (EUR million)	No target set	No data	EUR 3 1232 (For projects where data are reliable or acceptable)	Based on the results of the portfolio analysis, where figures are reported as expected impacts arising over the lifetime of CSA projects in scope for this study[#]
Results indicators				
Total number of participations by EU-28 Member States (number)	No target set	2 935	1 909	Number of EU-28 Member State participations in the 2014-15 H2020 Energy Programme projects
Total amount of EU financial contribution by EU-28 Member State (EUR millions)	No target set	1 202	659.5	Requested EC contribution of EU-28 Member State participants in 2014-15 H2020 Energy Programme
Percentage of EU financial contribution going to SMEs	20 % (H2020 monitoring report)	22.25 %	16.4 %[48]	
Percentage of Horizon 2020 beneficiaries from the private for profit sector		44.85 %	40 %[49]	% of H2020 participants in 2014-15 H2020 Energy Programme from private for profit sector
Impact indicators				
Greater energy savings, renewable energy production and CO_2 emissions reduction (reliable and acceptable data only)	No target set	No data	Primary energy savings (GWh/yr): 4 774 CO_2 emissions reductions ($MtCO_2$/yr): 11.6 Renewable energy production (GWh/yr): 3 293	Based on the results of the portfolio analysis, where figures are reported as expected short term impacts arising **over the lifetime of the projects reporting reliable and acceptable KPIs**[#]
increasing share of renewables and increasing levels of energy efficiency	No target set	No data	Not available	
Completion of the European Research Area in the energy area	No target set	No data	Not available	

[48] 36.6 % for H2020 (European Commission, 2016d)
[49] 16 % for H2020. (European Commission, 2016d)

Indicator	Target	Total SC3	Data for sub-set used for this study	Comment
Private investments mobilised for sustainable energy	No target set	No data	Not available	

Source: Portfolio analysis, (European Commission, 2016e) (European Commission, 2016d)

**Data relates only to the 161 projects covered by this evaluation – See list at Appendix 3.*

[#] Note that in all cases these are data for the short term, not the long term (long-term is a lot more favourable for renewable energy generated and somewhat so for CO2 saved but less for the others)

Overall, we consider that the data available and the absence of specific targets for most performance indicators, it is not possible to reach specific conclusions concerning the progress made.

6.2.2 To what extent can the observed direct results, indirect results, unintended effects and socio-economic impacts be credited to the H2020 programme?

6.2.2.1 Introduction

We have already made some reference to the role that the H2020 structures and mechanisms have (or not) in achieving the identified outputs, results and impacts in the previous section. In this section we examine in some greater detail the extent to which the observed results and impacts identified can be credited to H2020. More specifically, we examine the following questions:

- The extent that those involved in the implementation of the programme consider that there are linkages between the observed results and impacts and the programme implementation
- The extent that the changes introduced in H2020 - in comparison to its predecessors (FP7 and IEE programme) – have contributed to a greater (or not) level of achievement of results and impacts.

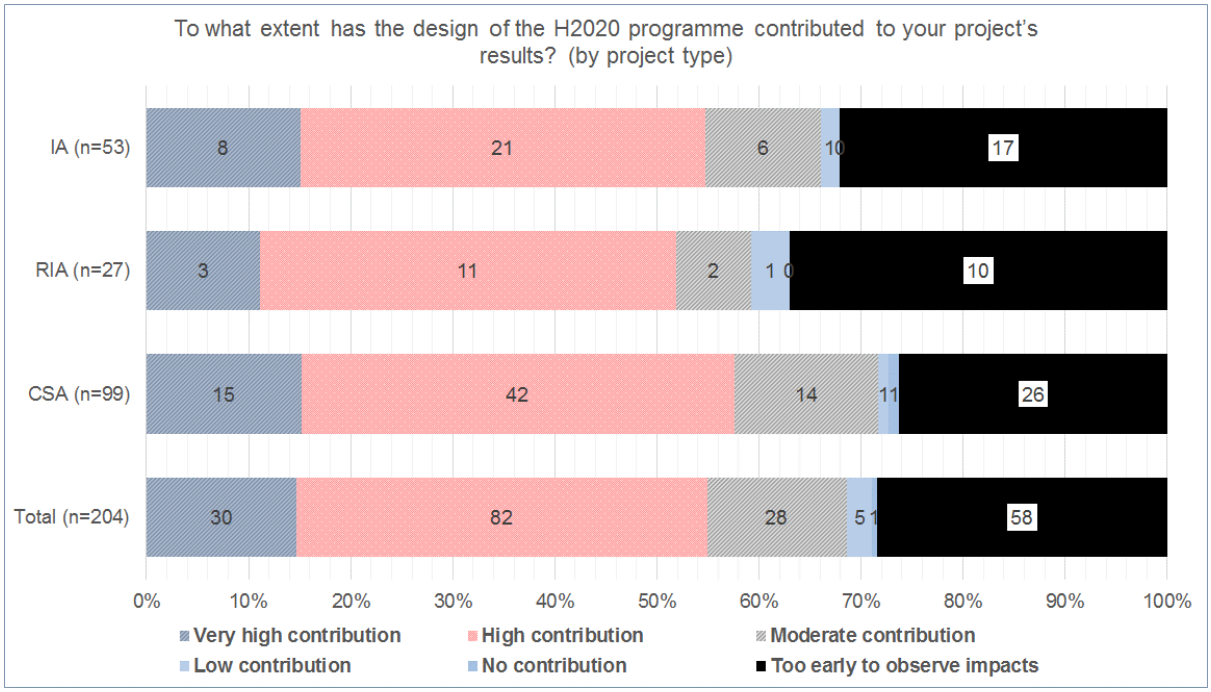
The analysis relies on the input from the surveys of the project participants and the more detailed input provided during the interviews with participants and other stakeholders involved in the implementation of the programme (NCPs, Evaluators, Commission and Agencies' staff)

6.2.2.2 The extent that those involved in the implementation of the programme consider that there are linkages between the observed results and impacts and the programme implementation

At the project level, the responses to the participants' survey provide a positive view of the role of the H2020 programme in the observed results, suggesting a high or very high contribution for the majority of the projects (55 % of respondents) with 28 % more indicating that it is too early to judge. The picture is largely the same in all types of projects (market uptake, research or demonstration). Only 3 % indicated low or no contribution (see Figure 22). The overall picture presented is also largely consistent independent of the type of respondents (project leader, participants or beneficiary), as well as in terms of the main type of output identified (product, process, service or business mode).

Further support of a positive role of the H2020 programme has already been provided in Section 6.2.1.2 in relation to the contribution to the TRL improvement. Out of 115 respondents to the specific question in the survey, 88 (77 %) stated that the H2020 project activities had a high or very high contribution to increasing the TRL. Only 5 % considered that there was no role of the H2020. Similarly, as indicated in section 6.2.1.7, the H2020 programme is seen as having a clear contribution to the development of innovation and market uptake in the energy field.

Figure 22: Role of the design of the H2020 programme to the projects results



Source: Survey of H2020 participants

Survey participants were asked to indicate what elements of the project design contributed to the project's results. Contribution to knowledge exchange, the access to funding and the fact that the objectives of the specific calls were in line with the objectives and the activities of the specific organisation were the most commonly indicated reasons.

Furthermore, project participants interviewed felt that the programme requirements for ensuring dissemination of the results and outreach were also beneficial, both for the projects and in terms of the H2020 programme more generally.

Box 8: Case study - Programme design contributing to increased results and leverage effects

Sustainable Regional Supply Chains for Woody Bioenergy (BioRES). Market uptake project (CSA). Budget: EUR 1.9 million

Programme: H2020. Call H2020-LCE-2014-3.

The project focuses on the development of Biomass Logistic and Trade Centres (BLTCs) in Serbia, Croatia, and Bulgaria on the basis of cooperation with technology leaders from Austria, Slovenia, Germany, and Finland. It intends to help increasing the demand for woody bioenergy products (processed fire wood, wood chips, wood pellets, and wood briquettes) in the focus countries and contribute to the achievement of EU targets set out in the RES Directive (2009/28/EC).

The significant leverage effects expected– in the form of bring along additional players in the focus countries - can be credited to the innovation programme design features, notably the focus on the establishment of community-based investor groups, the conduct of feasibility studies and sale agreements on supply and demand side made possibly by design of call. Findings from other projects very helpful.

6.2.2.3 The extent that the changes introduced in H2020 - in comparison to the FP7 and IEE programme - contributed to a greater (or not) level of achievement of results and impacts.

The changes introduced in H2020 in comparison to the FP7 and IEE programme aimed towards the adoption of a single framework integrating research, innovation, and market uptake actions acting on market environment of innovation. The H2020 should provide seamless support from scientific idea to marketable product with a more clearly stated link with policies. Operationally, the new programme's structure was expected to lead to greater outcomes on the basis of (European Commission, 2011):

- Critical mass at programme and project level.
- Enhanced knowledge triangle and broader horizontal policy coordination.
- Reduced administrative costs for applicants and participants, improving significantly accessibility, in particular for SMEs, and increasing levels of support for all types of stakeholders.
- Stronger output orientation, a better dissemination of research results, clearer technological objectives, enhanced industrial and SME participation and enhanced leverage

The input from participants and stakeholders provides a mixed picture of the extent that these changes have had the desired effect. In the case of demonstration and research projects, stakeholders (including both from the side of the Commission and the Agencies, NCPs and evaluator) consider that the integrated nature of the H2020 and, the need to consider market uptake and dissemination of results should be expected to have a positive contribution in terms of ensuring more tangible results and impacts from projects. They commented that the H2020 programme is both more targeted and more market oriented and this is seen as a rather positive element. Some H2020 project participants also referred to positive outcomes from the integrated approach. A coordinator of an H2020 EE participant indicated that, in comparison to the FP7 programme, there was much clearer ownership of the final outputs of the project and this made the final step to market uptake more effective. Another pointed to the opportunity to bring together participants with different roles in the innovation chain and that the market uptake focus brought in certain participants (such as service providers) that would otherwise have been excluded, as they are the delivery end.

Box 9: Case study - Example of the integrated approach from demonstration to market uptake

Triangulum: The Three Point Project / Demonstrate. Disseminate. Replicate. (TRIANGULUM). Demonstration project (IA) – Budget: EUR 29.9 million

Programme: H2020. Call: H2020-SCC-2014.

The three-point project Triangulum is one of the three European Smart Cities and Communities Lighthouse Projects, set to demonstrate, disseminate and replicate solutions and frameworks for Europe's future smart cites. The project aims to:

• Demonstrate working business models and social value models for smart cities.

• Transfer knowledge about smart city implementation.

• Develop and implement a smart city reference model.

• Sustainable transformation of existing buildings

• Contribute to and strengthen and the European Smart Cities Movement.

The flagships cities Manchester (UK), Eindhoven (NL) and Stavanger (NO) are intended to serve as a testbed for innovative projects focusing on sustainable mobility, energy, ICT and business opportunities. Three follower cities Leipzig (D), Prague (CZ) and Sabadell (ESP) are also involved creating a large network for dissemination and idea exchange.

Reported results already achieved include the installation of smart home installations in homes and flats for smart energy usage control in Stavanger and the development of a smart city district plan that will acts as a laboratory project for developing an operational plan for Leipzig.

On the other hand, there is much greater scepticism in relation to market uptake projects (CSA) when comparing with the IEE. Both Agency and Commission staff with relevant experience consider that the structure of H2020 calls and the overall application process is more demanding and less flexible than that of the IEE programme. This is seen as resulting in certain IEE participants not being able to participate (typically referring to public authorities and other users of technologies) with relevant impact on market uptake, dissemination and awareness raising activities which are at the core of these projects. Such views were supported by some national contact points and evaluators interviewed.

There were positive views expressed on the role of simplification of the application procedures although this is not directly linked with increased SME participation. Interviewees in general provided support for the efforts to reduce administrative costs and the feedback on the online portal was

positive. However, it was indicated that the level of paperwork remains too high to be practical for SMEs.

6.2.3 Summary - emerging conclusions

In this section we summarise the main results of the analysis presented so far.

It should be noted that it is still too early to provide a detailed and complete analysis of the actual results of the H2020 projects supported and assess performance against objectives. Thus the focus of the analysis has been primarily on the more qualitative objectives.

- Overall, we consider that, based on the input from stakeholders and the participants, there is a positive picture of the capacity of the H2020 programme to support the development of innovation that is relevant to the market and to contribute to the development of energy policy. More specifically, the analysis points to the following findings:
    - A significant share of H2020 projects are expected to lead to marketable outputs as a direct result of the H2020 projects
    - New business models and new services were the most commonly indicated (42.4 %) followed by new processes (36.4 % of respondents) and less so for new products (26.7 % of respondents).
- While our analysis is based on a subset of the H2020 energy programme that underrepresents low TRL level projects, we can still point to the fact that H2020 projects have, in general a higher initial and final TRL level (on average at TRL five: technology validated in relevant environment) when compared to FP7. This in line with the expectation that H2020 should be more closely linked with innovation development and closer to the market although there are stakeholders who are rather critical of this approach.
- An overall positive assessment of those involved concerning the role of H2020 programme in supporting innovation in the energy field.
- The greater linkage with and relevance to the market is also supported by the fact that businesses and industry, public authorities and citizens are identified as the main intended users of the H2020 projects' outputs.
- H2020 CSA and EE projects have a significant contribution to energy policy development at EU and national/local level. A significant number of projects in the portfolio (around 40 %) are expected to have a direct contribution to energy policy at national and local level even though among project participants only and 13 % of participants identified this as their prime objective. H while harmonisation of energy policy was one of the top three drivers for participation in H2020, at 43 % of project participants. Overall, the input provided is that the H2020 programme has – or is expected to have - a positive and significant impact on energy policy. The greater market orientation of the H2020 programme with an increased level of involvement of policy makers in H2020 projects – in comparison to FP7 – is identified as a key reason for this impact on energy policy.
- Cooperation networks and development of partnerships are seen as the main indirect results of the programme - along the same lines as those identified in the evaluation of the FP7 energy programme by Technopolis. (Technopolis, 2014)
- In terms of the distribution of impacts, the project portfolio analysis suggests a significant concentration of impacts in EU15 countries (identified in 70 % of the cases) in comparison to the new Member States (20 %). Nonetheless, this is still a more even distribution than that of the actual participation in the H2020 programme which suggests that many projects expect to have a broader impact beyond the countries where the project takes place through the eventual uptake of the technologies, if this indeed takes place.

The evidence available suggests the presence of a direct link between the programme design and structure and the expected results and impacts of the programme. The majority of H2020 programme participants (55 %) indicated that the design of the programme had (or is expected to have) a positive contribution to the project results and the TRL improvement achieved. This is particularly the case for research and demonstration projects (FP7 type) where the more holistic and integrated character of the programme, the need to consider market uptake and dissemination of results should be expected to have a positive contribution in terms of ensuring more tangible results and impacts from projects. It is less clear in the case of market uptake activities where, when compared to the predecessor (IEE II), there is greater scepticism as to the capacity to of the programme to fit to the characteristics and

needs of these activities. It is a concern raised by those involved in the implementation and a number of participants that – despite the changes – the FP7 R&D focused approach is still prevailing.

As a final point, we consider that in order for a proper assessment of the effectiveness of the programme to be made, there is need for a more comprehensive and systematic collection from project participants of key data on the outputs and results of the projects. More specifically, we consider that information requirements on key performance indicators should, in principle, not be limited to certain subcategories of projects. It is also reasonable to request for specific targets on key outputs to be set at the early stages of the project after grant agreement, possibly in the form of a separate document or as part of early reporting. We elaborate more on this topic in Section 7.

6.3 Evaluation of efficiency

The analysis of efficiency focuses on the following key headline questions:

- How efficiently have the observed impacts on Societal Challenge 3 of the programme been achieved?
- To what extent has H2020's common research and innovation framework improved the management and implementation of H2020 projects for applicants? What can be done to improve programme delivery?

The assessment of the first question focuses on the cost-effectiveness of the programme – namely looking into the operational and administrative costs in relation to the achieved direct and indirect outcomes. Comparison with the predecessor programmes (FP7 and IEE) and other programmes was used when relevant data were available. Furthermore, we examined in more detail the management structures and procedural aspects of the programme and their role in the success of the programme from the point of view of costs, participation, and broader stakeholder engagement.

The analysis is based on input from the surveys (participants in funded projects and coordinators of H2020 applications that were not funded), interviews with participants already involved in projects and other key stakeholders (NCPs, evaluators, etc.) and interviews with unsuccessful applicants.

6.3.1 How efficiently have the observed impacts on Societal Challenge 3 of the programme been achieved?

6.3.1.1 Introduction

The specific questions were considered to assess the efficiency with which impacts has been achieved were the following:

- Is the programme cost effective in relation to impacts?
- What were the observed and intended leverage effects, as part of the project programme objectives?
- What kinds of approaches could be considered to generate further efficiency gains?
- What are the parameters of the programme design and implementation that increase or decrease the cost-effectiveness of the projects?

6.3.1.2 Is the programme cost effective in relation to impacts?

According to the H2020 Impact Assessment the programme was expected to achieve greater cost-effectiveness as a result of the integration, simplification and harmonisation process (European Commission, 2011). Thus, per euro disbursed, implementation costs were expected to be lower in comparison to the predecessor while realised impacts were expected to be greater.

6.3.1.2.1 Overall costs of the programme - Direct financial outlays from the EU budget

A total of EUR 5 672.1 million (2011 prices) has been allocated to the non-nuclear energy research of H2020 for the period 2014-2020 under SC3. The amount earmarked for the first period (2014-15) was EUR 1 441 million, of which EUR 1 212 million was for 443 projects, EUR 99 million for other Actions and EUR 130 million was transferred to the Fuel Cells and Hydrogen Joint Undertaking (JU). According to the 2014 Monitoring report the total EC contribution to the 249 grants approved in 2014

calls was EUR 643.34 million. For the H2020 Energy Programme projects[50], which span 2014-15 calls, the total EC contribution is EUR 662.8 million (See Table 12).

On average in 2014, the amount of EC budget allocated per signed grant was EUR 2.58 million. SME instrument projects had an average size of EUR 0.32 million while other collaborative projects were significantly larger, on average EUR 4.34 million. For the 2014-15 Energy Programme projects, the average funding per project was EUR 4.11 million.

In comparison, in the case of FP7 a total of EUR 2 350 million was reserved for the sub-programme 'Energy' within the "Cooperation" programme of which EUR 1 029 million was allocated to demonstration projects and EUR 886 million to R&D projects. On average, in FP7 demonstration projects received EUR 7.6 million/project and R&D projects EUR 3.7 million/project[51] (Technopolis, 2014)(See Table 32) In the case of the IEE II programme, the total budget allocated to the implementation of IEE II for the period 2007-2013 was EUR 727.3 million. Average funding figures for IEE II projects are not available but, based on the 90 IEE II projects studied for the portfolio analysis, the average EC contribution was EUR 1.04 million per project. The 2011 Deloitte study found that the average funding contribution for promotion and dissemination projects was EUR 1.06 million. In comparison, under H2020, market uptake projects (CSA) had an average size of EUR 1.65 million.

Table 32: Average EU contribution by type of project – Comparison of Horizon 2020 Energy with predecessors (numbers in million euros)

	H2020 Energy (portfolio)			FP7		IEE II
	RIA	**IA**	**CSA**	**R&D**	**Demonstration**	**(Portfolio)**
Number of projects	30	33	98	135	240	80[52]
EU contribution (million)	106.1	394.7	162.0	886	1 029	83.2
Average project allocation (million)	3.53	11.96	1.65	3.70	7.60	1.04

6.3.1.2.2 Management costs of the programme

The administrative and management costs of the H2020 energy programme include the following:

- Personnel costs and relevant overhead for the Commission services and the Agency for the implementation of the programme and the relevant activities as described in section 5.2
- Budget for the evaluators involved in the selection of the projects
- Costs for the various communication and other supporting activities (meetings, information days, training of NCPs) to promote the programme
- Share of the costs associated with the management by DG RTD of common support services, including the Participant Portal website.

Data provided by the Commission services suggest that the total administrative costs for the SC3 related activities in 2014 were around EUR 26.5 million in 2014, increasing to EUR 29.7 in 2015 and expected to reach EUR 30.4 million in 2016. These costs cover staff costs, overhead and other activities of the two Directorate (DG ENER and DG RTD), the three agencies (EASME, INEA and REA) and the Common support services specifically related to SC3. (See Table 33). Project figures for the period 2017-2020 indicate that administrative costs will be in the range of EUR 31-32 million.

In total, administrative costs represented in 2015, 4.1 % of the operational budget, slightly lower than the total for H2020. Exact data on the costs of the evaluations of proposal are not available but DG RTD estimated that these represent around 1 % of the operational budget. This means that total administrative and evaluation costs in 2015 were 36.9 million, at 5.1 % of the operational budget of the programme.

[50] The 161 projects under the scope of the present study. Projects are listed in Appendix 3.
[51] For comparison, demonstration (IA) projects in the H2020 energy programme received EUR 12.0 million per project on average and R&D (RIA) projects received EUR 3.5 million/project on average.

[52] Budgets not published for all 90 projects considered

Table 33: Administrative and evaluation costs for the implementation of H2020 Societal challenge 3 activities (numbers in million euros)

	2014	2015	2016
Total operational budget for SC3	**677.3**	**721.7**	**742.8**
Total administrative costs for SC3	**26.5**	**29.7**	**30.4**
DG ENER	4.4	3.8	3.5
DG RTD	13.9	11.0	9.6
contribution to Common support services SC	-	4.2	4.6
subsidy to REA	2.0	2.1	2.0
subsidy to EASME	5.4	7.0	8.2
subsidy to INEA	0.8	1.6	2.5
% of administrative costs/operational for SC3	*3.9 %*	*4.1 %*	*4.1 %*
% of administrative costs/operational for H2020	*4.5 %*	*4.3 %*	*4.7 %*
Costs of evaluation (1 % of operational)	6.8	7.2	7.4
Administrative + evaluation costs	**33.3**	**36.9**	**37.8**
% of administrative + evaluation costs/operational for SC3	***4.9 %***	***5.1 %***	***5.1 %***

Source: DG RTD

In terms of human resources, according to the 2015 management plan a total of 29 FTE from DG ENER were involved in the implementation of the programme in 2015[53]. In the case of DG RTD, similar specific data on human resources allocated to the SC3 are not available. However, DG RTD admin costs were – on average - three times higher than DG ENER which could indicate a total of up 87 FTE. The discussions with DG RTD representative suggests that this is probably an overestimate and that, even though specific figures are not available, a more realistic figure would be closer to 50 staff.

For the Agencies, in EASME there were 25.7 FTE operational staff responsive for SC3 in 2016 and 4.7 FTE for the SME instrument related to SC3 (EASME, 2016). In addition, management and administrative support was 0.95 FTE for the SME instrument and 5.59 FTE for SC3. The total for EASME in 2016 was 37 FTE (9.4 % of the total EASME staff). The number of FTE for the previous year (2015) was largely similar (25.7 operational staff but no data on the share of administrative staff). In the case of INEA, according to the 2015 work programme[54] there were around 15 FTE occupied in SC3 related activities. The exact number of staff in the case of REA is not available, but, on the basis of the figures for the other Agencies and a budget of EUR 2.1 million in 2015, we can estimate a total of around 14 FTE[55]. The total number of human resources allocated is estimated around 145 FTE. This represents about 5 FTE per million EUR of administrative costs for SC3 in 2015.

[53] https://ec.europa.eu/info/sites/info/files/management-plan-2015-dg-ener_august2015_en.pdf
[54] https://ec.europa.eu/inea/sites/inea/files/wp_2015_3.pdf
[55] EASME : 29 FTE for EUR 8.2 million in 2016. INEA: 15 FTE for EUR 1.6 million. Average of 6.5FTE per million leading to 13.5 FTE for EUR 2.1 million in 2015.

Table 34: Human resources allocated to H2020 Energy programme (2015)

Organisations	Human resources in FTE (year)
Commission	
DG ENER	29 FTE (2015)
DG RTD	Estimated 50 FTE (2015)
DG CONNECT	n/a
Agency	
EASME	37 FTE (2016)
INEA	15 FTE (2015)
REA	Estimated 13.5 FTE (2015)
Total	Estimated 145 FTE

Source: DG ENER 2015 Management plan (DG ENER, 2015), DG RTD 2015 Annual activity report and H2020 budget (European Commission, 2016e), (EASME, 2016), (INEA, 2015), http://ec.europa.eu/rea/pdf/rea_aar_2015_final.pdf

Comparable data for the FP7 programme are not available. In the case of IEE II, the annual management costs increased from 4.3 million in 2007 to 5.9 million in 2011 with a total of 5.6 FTE Commission staff and around 40 FTE Agency staff occupied in 2011 (7.7 FTE per million EUR). In relation to the operational budget of IEE II programme, the management costs of the IEE II programme were around 6-7 % (Deloitte, 2011a). Thus, the new programme uses fewer human resources per million of administrative budget while the total management costs represent a smaller share to the total operational costs in comparison to IEE II.

Table 35: Efficiency indicators of H2020 Energy programme – Comparison with IEE II

	H2020 Energy (2015)	IEE II (2011)
Total management costs (million EUR)	29.7	5.9
% of management costs/total operational budget	4.1%	6-7%
Total staff (FTE)	145	45.6
FTE/million	4.9	7.7

While we consider that we should be cautious with such comparison, the input of the Commission and Agency officers also suggests there have been additional efficiency gains in H2020. The simplification of the project selection process (including the elimination of the negotiation stage) has had a cost-saving effect, even though some consider that it has had a negative effect on project quality and effectiveness. The fact that the size of H2020 projects of different types (RIA, IA, CSA) is, on average, larger than those of similar type under FP7 and IEE is also linked to the absence of any means for Agency staff to make changes to the budget of projects before signing the grant agreement. Even if the proposed budget appears to overestimate the costs of a selected project, there is no process through which an adjustment can take place.

The use of a common single IT tool is also considered as potentially cost saving although specific figures could not be provided.

Costs to participants

From the point of view of the costs to applicants and participants to the programme, a key measure was the commitment to reduce the time to grant to no more than eight months, something that was achieved for 90 % of SC3 project proposals according to the 2014 Monitoring Report (European Commission, 2016d).

Costs for participants include:

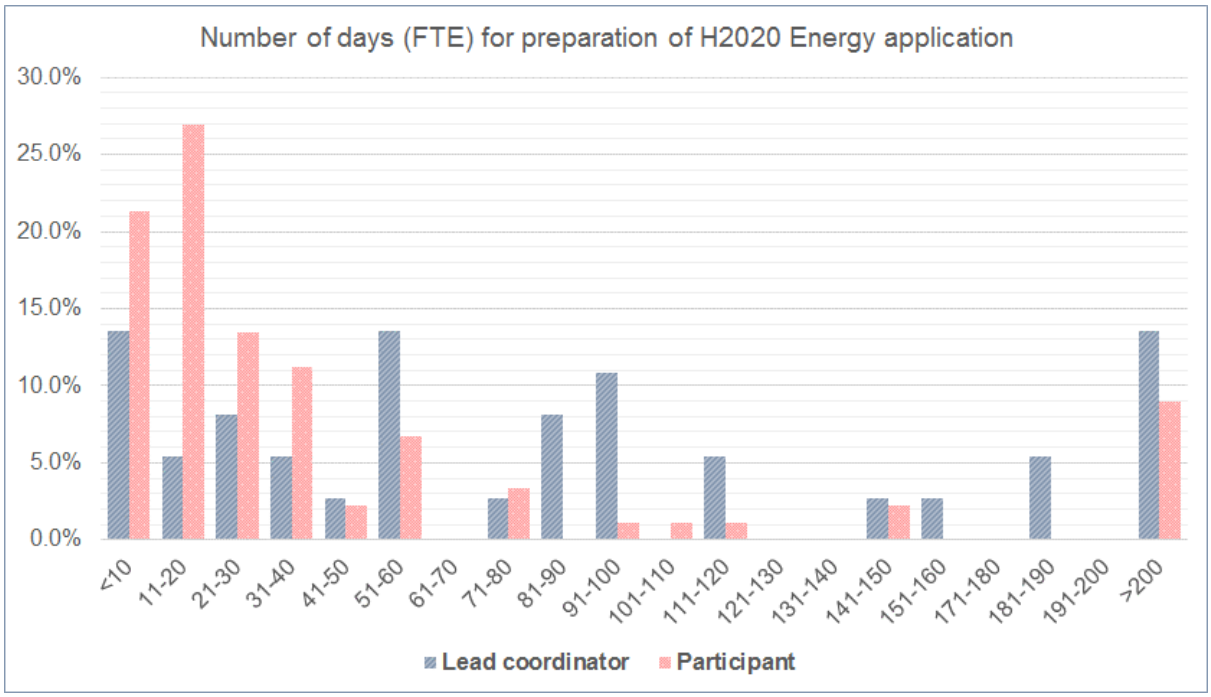
- Costs for preparation of application and all other activities until the contract signature

- Costs for project management activities

The first category of costs includes costs incurred by the participants without any reimbursement while the second category is largely – if not 100 % - part of the project budget.

In terms of the costs of application, we asked the survey participants to provide us an estimate of the time spent (in terms of total full-time working days) for application and, following success, the period to grant agreement. The average number of days indicated for application from a total of 121 respondents (lead coordinators and participants) was 110 with a median of 30 days (FTE). The responses of successful applicants suggest that for the application process the majority of successful applicants spent between 50-200 days (FTE) in the case of project leaders and 11-50 days FTE in the case of project participants (see Figure 23).

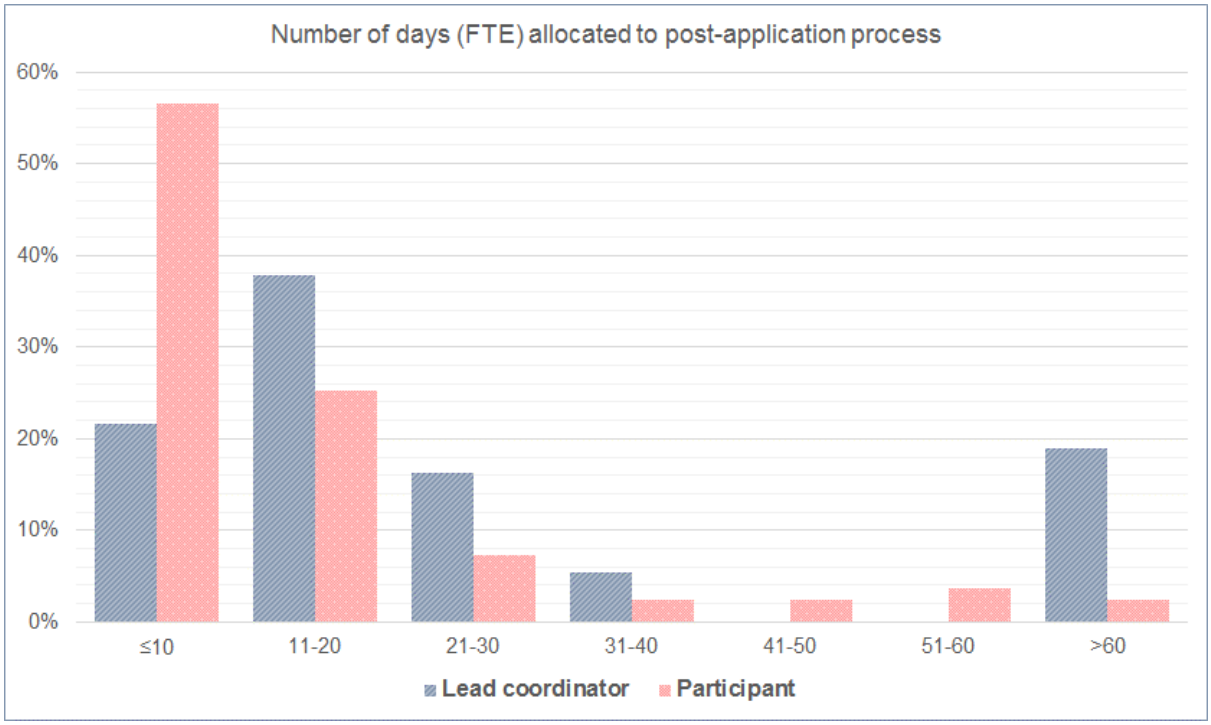
Figure 23: Resources spent per applicant for H2020 application process (% of respondents indicating by role)



Source: Survey of H2020 participants

Furthermore, in the post-application grant preparation period the average required investment of time was 81 days but with a median of 10 days. The majority of respondents indicated that they spent up to 20 days FTE – whether participants or lead coordinators (see Figure 24).

Figure 24: Resources required per participants for H2020 post-application (grant preparation) period (% of respondents indicating)



Source: Survey of H2020 participants

During interviews with applicants, it was often indicated that the time allocated to proposal preparation was significant and often exceeded what was originally expected. Furthermore, it was identified as one of the main barriers for participating in the programme. 36 % of H2020 participants referred to the costs for proposal preparation as the most important barrier for participation and 75 % of respondents identified it within the three most important barriers. (see Figure 38 in section 6.3.2.7)

Asked to compare with the predecessor programmes, project coordinators, evaluators and NCPs provided a very mixed picture as to the extent to which there has been tangible improvement in terms of the application costs. From their side, most of participants interviewed indicated that time to prepare application was still quite high particularly due to high quality required in order to be among the small number of projects funded. Many argued that the time taken to write an application has increased, especially given the financial crisis where national funding may have ceased so competition for H2020 funds is higher.

Furthermore, among most Agency and Commission staff - but also some evaluators and NCPs - there were strong doubts raised about the cost-effectiveness of the elimination of the negotiation process. While adding time prior to contract signature, negotiation is often seen as having played a positive effect on the quality of the projects and often helped avoid subsequent costs during the project implementation. Similar comments were not received from project participants.

Beyond the application process, administrative costs associated with project management are also seen as significant. According to the Impact Assessment working document the simplified rules of participation in the programme should lead to reduction of overall participation costs by 15-20 %. Specific figures for comparison have not been possible to collect. However, as can be seen in Figure 38 in section 6.3.2.7, administrative and reporting burden remain an important consideration. They are identified as the second and third most commonly identified barriers for participation in the programme (32.5 % and 10.4 % of respondents respectively). While the comparison with FP7 still tends to be favourable, there is more scepticism when comparisons with IEE projects.

Costs for integrating the Research, Innovation and Market Uptake activities

There was very limited input provided on the efforts require to integrate research, innovation and market uptake activities from the project participants. More general input on the integration of the different aspects within the same projects provided a rather mixed picture.

6.3.1.2.3 Cost effectiveness indicators

There are limited data available on the programmes results and outputs to be able to assess and develop cost-effectiveness indicators and compare it with its predecessors. The available figures for H2020 CSA projects suggest lower levels of cost-effectiveness (per project and per million of EU contribution) in comparison to the IEE. This may be explained in part by including only projects with reliable and acceptable KPI data for the H2020 projects while all IEE projects are included. Also H2020 project KPIs were not negotiated with project officers in the same way as IEE KPIs.

Table 36: Cost-effectiveness indicators of H2020 programme, reliable and acceptable data only

Indicator	Unit	CSA (portfolio analysis)			IEE (portfolio analysis)	
		Number of projects	Average per project	Average per 1m Euro EC Contribution	Average per project	Average per 1m Euro EC Contribution
Primary annual energy saved (reported) by the end of project	GWh/yr	53	88	54	38 034	29 431
Tonnes of Greenhouse gas emissions avoided (reported) by the end of project	$ktCO_2/yr$	18	644	447	1 665	1 370
Renewable energy produced (reported) by the end of project	GWh/yr	29	114	69	2 136	1 809

Source: Portfolio analysis

The comparison of the data of the few IA projects with the analysis by Technopolis of FP7 also suggests lower levels of cost effectiveness for the indicators available. However, given that that the data refer to only a few projects and these are expected results from a small number of projects, they will need to be treated with caution.

Table 37: Cost-effectiveness indicators of H2020 programme, reliable and acceptable data only for H2020 IA projects

Indicator	Unit	IA projects (portfolio analysis)			FP7 performance (Technopolis report)	
		Number of projects	Average per project	Average per 1m EUR EC Contribution	Average per project	Average per 1m Euro EC Contribution
Primary annual energy saved (reported) by the end of project	GWh/yr	3	7	0.4	4 - 18	1.4 – 6.3
Tonnes of Greenhouse gas emissions avoided (reported) by the end of project	$ktCO_2/yr$	4	3	0.2	105*	n/a
Renewable energy produced (reported) by the end of project	GWh/yr	0	n/a	n/a	2.2 – 7.4	0.8 – 2.5

** Based on survey response from 19 projects*
Source: Portfolio analysis, and (Technopolis, 2014)

6.3.1.3 What were the observed and intended leverage effects, as part of the project programme objectives?

In terms of the leverage effects, the EU level share of the total budget of the projects supported was 87 %, with almost 100 % of the budget of CSA projects covered by the EC (very limited own contribution) and 80 % of the IA projects.

However, besides the contribution to the budget a few projects triggered additional investment as already reported in Section 6.2.1.3. Project Development Assistance projects were, by design, projects triggering additional investment but there were other CSA projects that had similar results. Table 38 summarises the financial leverage from projects where the data are considered to be reliable or acceptable. This indicates an average leverage of EUR 40 per euro invested within the lifetime of the project and EUR 385 per euro invested by 2020.

Table 38: Potential leverage from support to H2020 energy projects as estimated in project documents

	RIA	IA	CSA	Total
Number of projects	30	33	98	161
Project budget (million EUR)	109.3	492.2	163.2	764.8
EU contribution (million EUR)	106.1	394.7	162.0	662.8
Average share of EU funding	0.97	0.80	0.99	0.87
Short term investment triggered (within projects)				
Projects reporting	1	2	34	37
Investment triggered (million EUR)	808	134	3 232	4 174
Leverage effect (additional EUR per EUR of EU investment)	404	3	57	40
Long term investment triggered (by 2020)				
Projects	1	1	7	9
Investment triggered (million EUR)	1 455	25 000	3 925	30 380
Leverage effect (additional EUR per EUR of EU investment)	728	5 492	328	385

Source. Portfolio analysis

6.3.1.4 What are the parameters of the programme design and implementation that increase or decrease the cost-effectiveness of the projects? What kinds of approaches could be considered to generate further efficiency gains?

The 2014 Monitoring report (European Commission, 2016d) on the first year of implementation pointed to positive developments in terms of simplifying the management of the programme in comparison to FP7, including:

- Use of a simplified funding model with a single reimbursement rate per project and a single flat rate for covering indirect costs;
- Use of simplified forms of grants with fully paperless proposal and grant management, with the Participant Portal as the single online entry point for all exchanges with applicants and beneficiaries
- Streamlining funding schemes from 11 to 4
- Reduced requirements for work time recording including the removal of the requirement to complete time sheets for staff working 100 % on the project and simplified time recording for other staff;

- Streamlined ex-ante checks, including fewer ex-ante financial capacity checks (only on private coordinators) and fewer certificates on financial statements (only one at the project end).
- Reduced audit burden: the period in which audits can be initiated was shortened from five to two years after the end of the project; a single audit service covering all implementing services was established and the audit strategy is focused on risks and fraud detection;

Our discussion with project participants supported most the points above. The significant reduction of the time to grant was generally seen as very positive. Many respondents considered that this had a positive role in reducing the overall costs associated with participation in H2020 and having a positive role in its effectiveness. At the same time though, as already indicated a number of interviewees – including both from the side of the Commission and the Agencies, but also the NCPs and the project participants - considered that the negotiation process did actually have a positive role to play in the overall quality of the projects and eventually contributing to their more efficient implementation.

The adoption of a web-based application and reporting system is also identified as very positive and contributing to cost savings and having a possible contribution to a more effective project management. In addition, the adoption of more simplified financial rules with simplified rates as well as the flexibility provided for certain changes to the budget (budget changes within the consortium) were also considered positively.

From the negative side, the standardised ethics procedures were considered as not appropriate for all types of projects and identified as a possible area were cost-efficiencies could be achieved. However, it should be noted that this procedure is applicable only to those projects where significant issues were identified.

In terms of approaches and changes to bring further efficiency gains there were only a few suggestions from project participants. At this stage, most project participants are focusing on adapting to the changes from FP7 to H2020 and not many had a clear view of things that could be further improved. Some suggestions made by individual participants included:

- Development of a simplified online platform for project management of H2020 projects (e.g. partner communication, timesheets) that will include all the essential elements and function as a one-stop-shop for the Horizon projects
- Simplify the guidance documents that are seen as rather complex to follow and time consuming and develop a version that would be possible for participants to print
- Simplify and potentially reduce the reporting requirements considering when certain aspects are not necessary
- Simplify the legal requirements
- Remove/limit procedures such as those related to ethics when not relevant to projects considered
- Promote the use and update of existing project websites in the case of projects that are continuations of previously funded EU projects.

6.3.2 To what extent has H2020's common research and innovation framework improved the management and implementation of H2020 projects for applicants? What can be done to improve Programme delivery?

6.3.2.1 Introduction

The common research and innovation framework was expected to bring a number of improvements in the management and implementation of H2020, including at the level of individual projects. In this section, we will examine those aspects focusing on the following set of questions:

- How is the H2020 programme currently delivered?
- How is the programme implemented?
- How effective has H2020 been in widening access and engaging stakeholders?
- Does the programme provide value for money for participants?
- What are the main drivers and barriers for participation in H2020 (project perspective)?
- Is there scope for further simplification measures to improve and measure programme performance?

6.3.2.2 How is the H2020 programme currently delivered?

The analysis of the delivery of the programme includes the key headline data and the governance structure, already presented in Section 5.

6.3.2.3 How well is the programme implemented?

6.3.2.3.1 Introduction

In this section we consider the implementation aspects of H2020, focusing on the following set of questions:

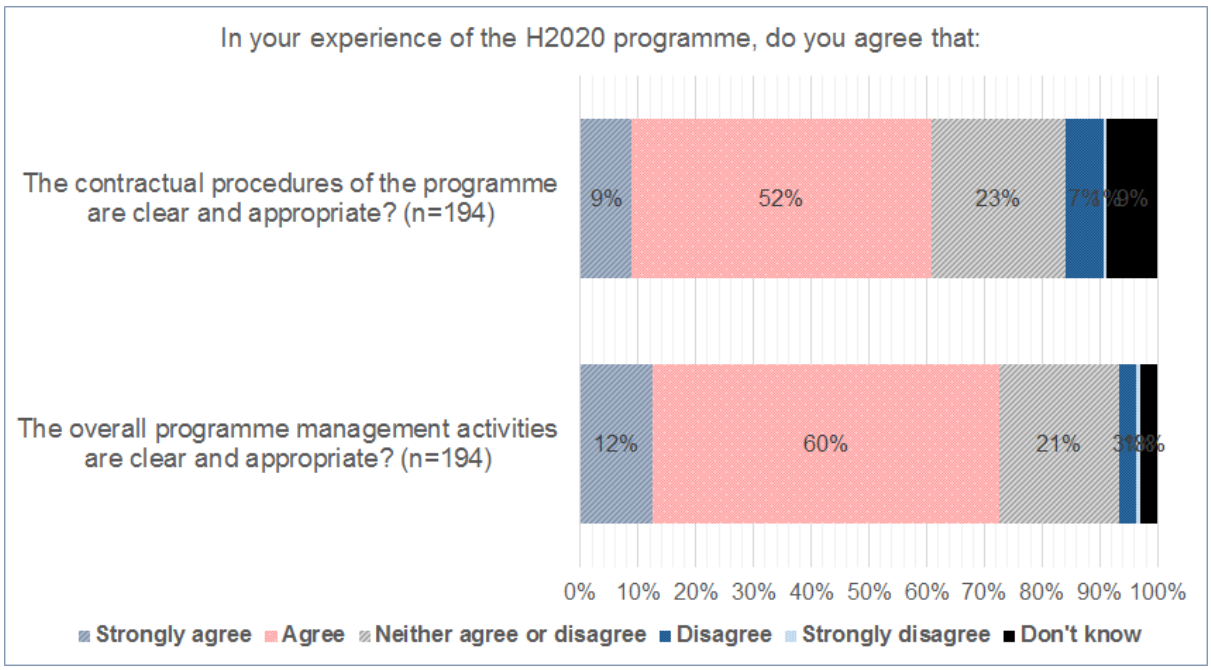
- Are the programme management activities (particularly with respect to overall cost of management against activities funded, contractual and legal procedures, communication and the support given by the Agencies and Commission) clear and appropriate?
- Is the overall legal framework (including rules for participation and contracts), clear, appropriate and effective?
- What are the challenges and bottlenecks of implementation at project and programme level?

The analysis is based on the input from the two surveys (participants and non-successful applicants), the interviews with the entities responsible for the implementation (Commission, Agencies) and those closely involved (evaluators, NCPs) and other stakeholders.

6.3.2.3.2 Assessment of adequacy of key programme management activities

As a first input to the analysis, the survey results provide a very positive view of the programme management activities. The responses (see Figure 25) suggest that overall, participants are satisfied by programme management activities and the contractual procedures, which are considered as clear and appropriate by the majority of them. Less than 10 % indicated that they consider them as unsatisfactory in that respect. The analysis by action type (CSA, RIA, IA) did not reveal any difference in the views of the respondents, nor were there deviations on the basis of type of participant or role.

Figure 25: View of participants on the clarity and appropriateness of the management activities?



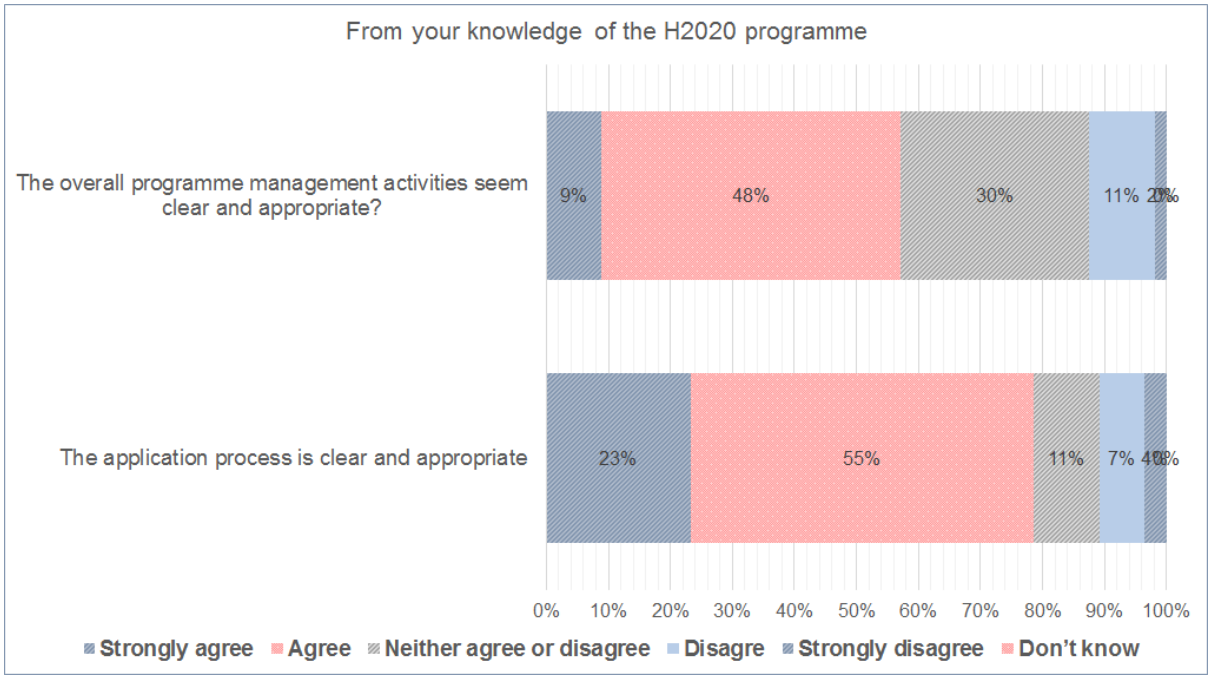
Source: Survey of H2020 participants

Among the survey participants, a few (42) made suggestions for possible improvement. The most common (8) included the streamlining of management activities and the reduction of administrative burden (8), raising a point already discussed in section 6.3.1.4.

Among unsuccessful applicants, the analysis of the survey suggests a more sceptical view in relation to the overall programme management, although still more than 50 % indicated that management

activities are clear and appropriate. Importantly, their views on the application process were even more positive, considered as appropriate for more than 75 % of respondents (see Figure 26).

Figure 26: View of unsuccessful applicants on the clarity and appropriateness of the management activities?



Source: Survey of unsuccessful H2020 applicants'

The interviews with project participants also provide an overall positive view, focusing mainly on what is considered to be a simpler and leaner application process but also being very positive concerning the role of the web-based and other programme management tools.

Time to grant

Time-to-grant has been identified as an important element in improving experience of participants and reducing costs. The Commission's target was to reduce the time to eight months, down from 12 months in FP7.

According to the 2014 Monitoring report (European Commission, 2016d) the first period of implementation of Horizon 2020 has shown a significant reduction compared to FP7 with respect to the time elapsing between the closure of a call and the signature of the Grant Agreement. By 1 December 2015, the percentage of projects signed within eight months was 89.40 % and the average time-to-grant being 229.04 days, 26.8 % less than the average time-to-grant for the whole of FP7 (313 days).

This appears also to be the case in relation to H2020 Energy projects with 89.96 % of projects signed within the eight month (245 days) period. The average period reported in 2015 was 216 days in the case of H2020 Energy calls managed by INEA (INEA, 2015b) and 228 days for the calls managed by EASME (EASME, 2015).

Table 39: Average time to grant for H2020 Energy calls managed by INEA and EASME

	2014	2015
INEA	226	216
EASME	238	228

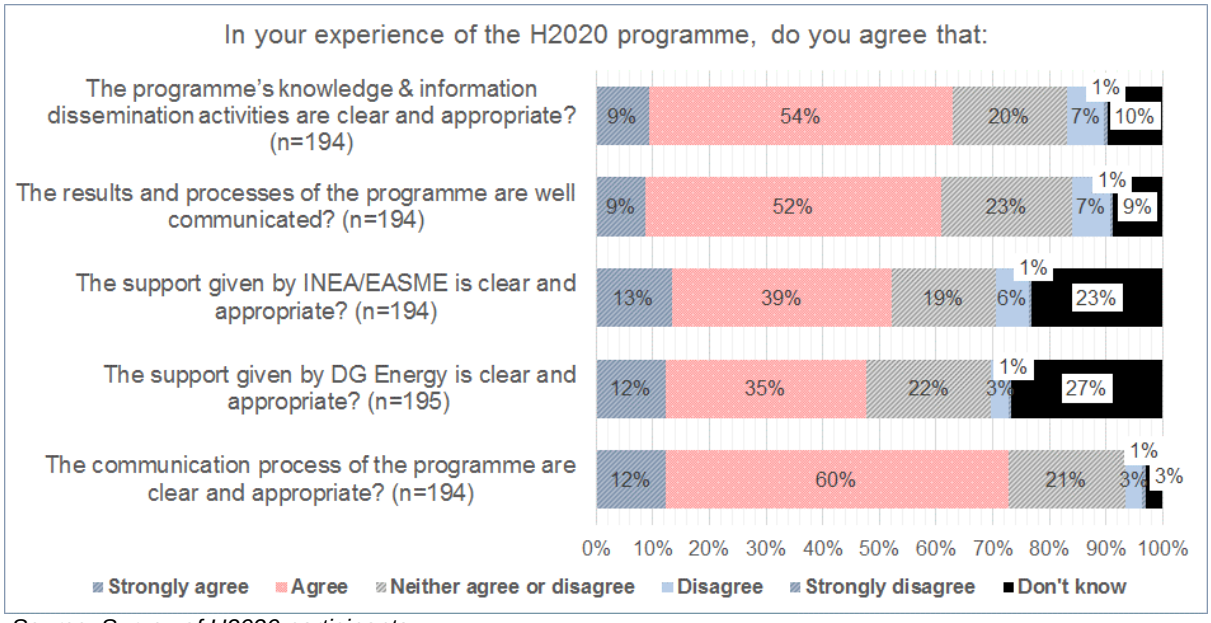
Source: INEA and EASME Annual activity reports 2014 and 2015

6.3.2.3.3 Communication and the support given by the Agencies and Commission

In terms of the communication, the majority of survey respondents from funded projects expressed positive views, with 60 % or more considering the knowledge and information dissemination, the communication of the results and processes and the overall communication process as clear and appropriate. Less than 10 % expressed negative views (see Figure 27).

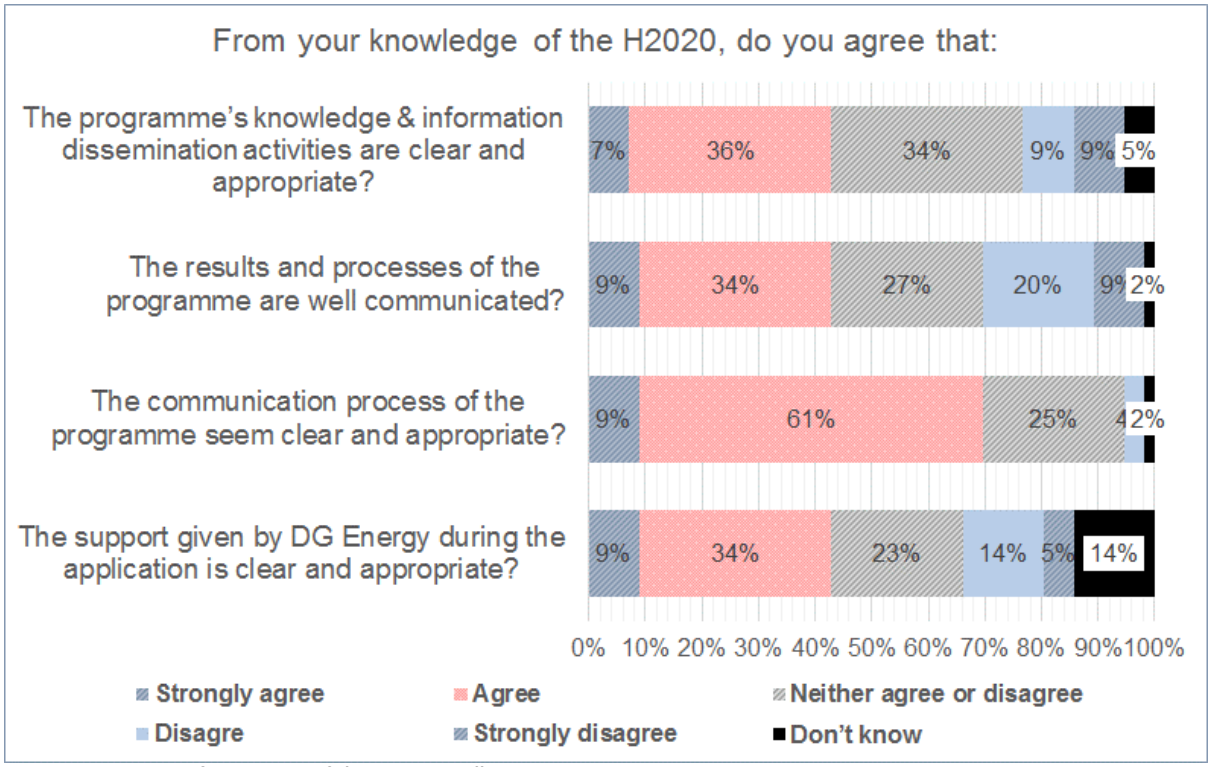
However, the feedback appears less positive regarding the support provided by DG ENER and the two Agencies, with around 25 % indicating no such experience and 52 % expressing a positive view for the support by the Agencies and 47 % for DG ENER. However, given the limited direct support that is provided by both DG ENER and the Agencies in the current programme, as explained in Section 5.1, an even higher share of "Don't know" responses would be expected. The responses from unsuccessful applicants are very similar to those who received funding with positive views on the communication activities and rather less supportive for the support activities (see Figure 28).

Figure 27: View of H2020 participants on the clarity and appropriateness of the communication and support activities?



Source: Survey of H2020 participants

Figure 28: View of unsuccessful applicants on the clarity and appropriateness of the communication and support activities



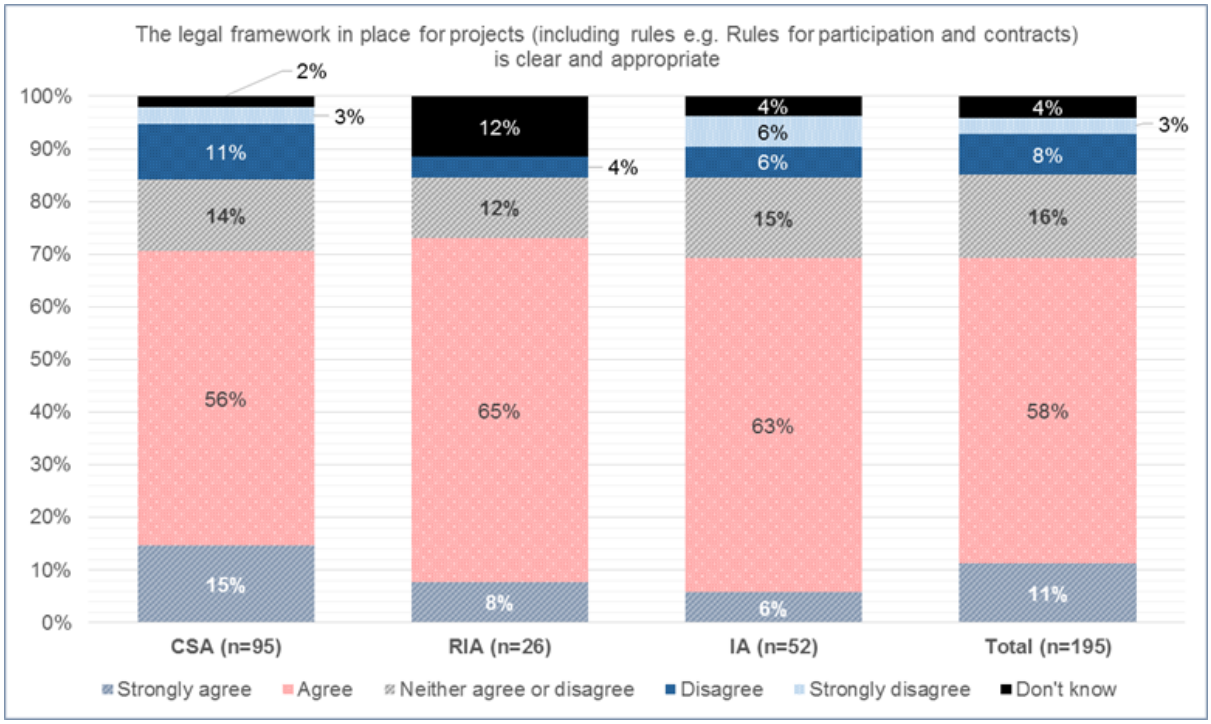
Source: Survey of unsuccessful H2020 applicants

From the point of view of National Contact points, the communication with the Commission services and the support provided (meetings, training) were also assessed rather positively.

6.3.2.3.4 Is the overall legal framework (including rules for participation and contracts), clear, appropriate and effective?

In relation to the legal framework, 69 % of participants to the H2020 energy programme consider it appropriate, with a similar share of positive views of around 70 % irrespective of the action type (CSA, RIA, IA) (see Figure 29). The views of unsuccessful applicants were also largely positive and, in general, the same feedback was provided during the interviews with project participants and NCPs. There were still comments from a few participants that considered the legal language used difficult to understand, the length of the legal documents excessive and indicated that legal advice was considered necessary.

Figure 29: Views of H2020 Energy programme participants on the clarity and appropriateness of the legal framework

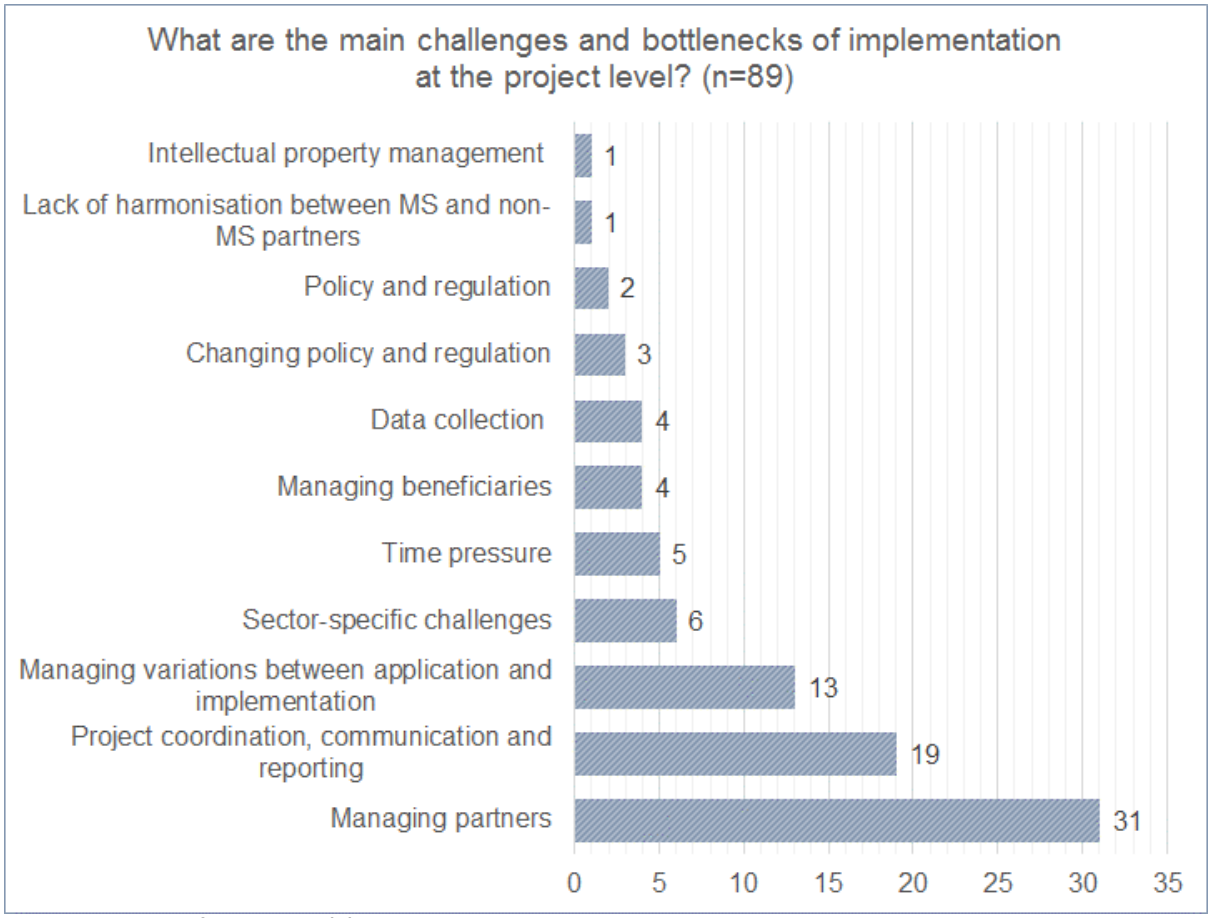


Source: Survey of H2020 participants

6.3.2.3.5 Challenges and bottlenecks of implementation at programme and project level

89 survey participants provided their views on the main challenges and bottlenecks at project level. Most focused on the project coordination issues, referring to issues related to the management of partners and beneficiaries as the main challenge and bottleneck (35 % of 89 respondents to this question), project coordination, communication and reporting (21 %) and ensuring that project implementation is close to the initial application (15 %). Other external aspects, such as sector specific challenges or changes in policy were much less frequently identified.

Figure 30: Identified challenges and bottlenecks of implementation at project level



Source: Survey of H2020 participants

At the programme level, the input from Agency staff and the Commission pointed to the increased number of applications – often of low quality – as posing a challenge to the programme implementation. Reduced national R&D budgets have contributed to this by making H2020 the only funding option available to some participants. There are low success rates and this is seen by NCPs and project participants alike as having a negative influence on the motivation of unsuccessful applicants and on ensuring that the programme does not end up being accessible only to a small club of experienced participants.

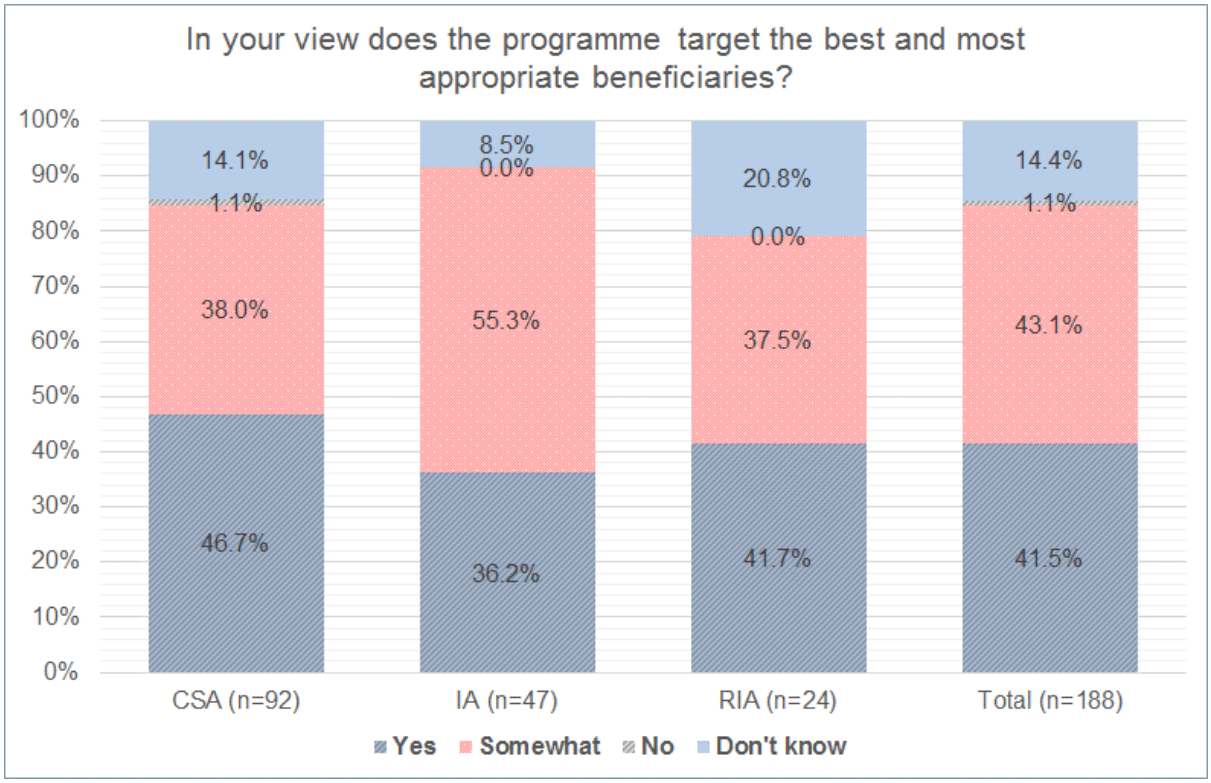
Within the Commission services, there is also questioning of the extent that the integration of the IEE and FP7 programmes has had a positive contribution. In contrast to FP7 calls which were often seen as too specific, the holistic approach aiming to capture the whole of the innovation chain is seen as leading to very generic – not focused – topics and makes it more difficult to identify specific and measurable impacts.

6.3.2.4 How effective has H2020 been in widening access and engaging stakeholders?

A key objective of the H2020 programme was to widen access and increase stakeholder engagement while ensuring that it still attract the most appropriate beneficiaries. In relation to the latter, the survey responses suggest that the programme only partly targets the best and most appropriate beneficiaries (41.5 % of total respondents said yes). Even among programme participants themselves there is significant scepticism – particularly among IA participants – with more than 55.3 % indicating that H2020 is only somewhat successful in that respect (see Figure 31).

The scepticism in relation to the targeting best and most appropriate participants is possible linked with the view expressed by some project participants that some H2020 calls support rather large consortia and that – in order to extend participation – they often promote participation of partners with limited relevant experience and capacity from countries with limited relevant activity. However, this was not a broadly shared view expressed among interviewees.

Figure 31: Targeting of the best and most appropriate beneficiaries

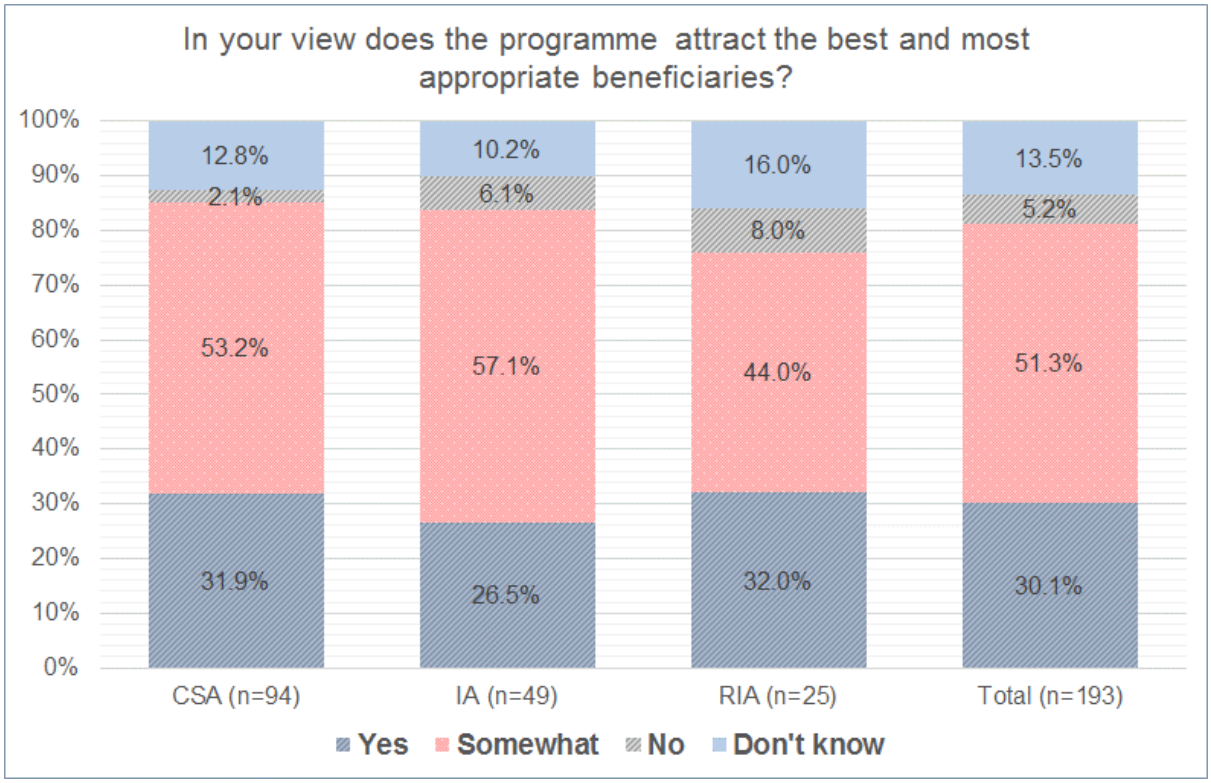


Source: Survey of H2020 participants. Note: Total number of respondents includes projects for which there is no information on the type of the project.

Scepticism of the success of the programme is even more evident when the respondents were asked if the programme has actually attracted the best and most appropriate beneficiaries (see Figure 32).

Only 30 % agreed while 51.3 % were less positive. In this case, it is participants in IA type projects that are more sceptical (57.1 % responded “somewhat” and 6.1 % “no”) rather than RSA or RIA.

Figure 32: Attracting of the best and most appropriate beneficiaries



Source: Survey of H2020 participants. Note: Total number of respondents includes projects for which there is no information on the type of the project.

When asked to indicate why the programme is not effective in attracting the most appropriate beneficiaries, the majority of survey respondents (20 of the 40 that contributed to this question) made reference to the administrative burden, 6 more referred to restrictive application requirements and 6 indicated that the evaluation criteria were not properly aligned with the project quality.

Beyond that, some project participants during the interviews suggested that the demanding application process means that the programme attracts professional application writers which are not necessarily the most appropriate targets from the point of view of technological and innovative capacity. However, this is not a point that is broadly shared among participants or among other stakeholders interviewed.

6.3.2.4.1 Did the programme manage to keep the same type of stakeholders as under the predecessor programmes? Is there a group/type of stakeholders from the predecessor programmes that have been 'lost'?

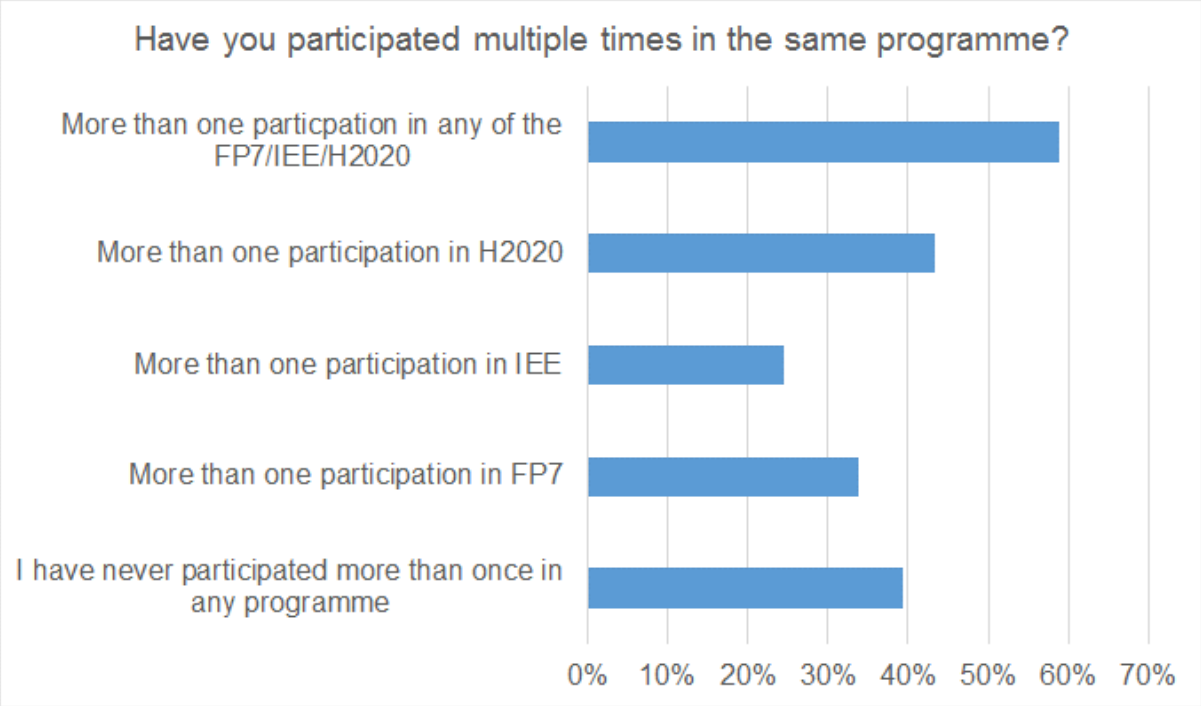
The data from the survey and the interviews provided an overall positive picture on the capacity of the programme to keep the same type of stakeholders. The responses from the survey suggest that close to 60 % have had experience in at least one further project in one of the FP7, IEE or H2020 programmes. Around 40 % of successful H2020 participants have not been involved in other programmes – in line with what was reported in the (2016) Commission internal document. The survey responses do not reveal significant differences depending on the country of the participant. From their side, NCPs also suggest a relatively positive view with NCPs from both EU15 and EU13 Member States providing relatively positive feedback on the accessibility of the H2020 programme when compared to FP7.

One respondent from an H2020 EE project, commenting on project sustainability, drew a comparison with the sustainability of IEE projects noting that:

"[IEE] projects were a good way to involve local authorities, national authorities and hence keep energy efficiency on the policy agenda. This is not part of H2020. Sometimes local authorities are scared to be involved, H2020 would put high demands on them in terms of providing data or match funding, so they are less likely to be involved. But then also less likely to gain the indirect benefits."

Nevertheless, the input from NCPs in relation to the predecessor programmes suggests that, in most cases, there has not been any specific group lost. Civil society organisations and local authorities were identified by a few NCPs as a possible group with a significant role in IEE that may have been lost. There is also some commenting that research organisations do not see the move towards higher TRL levels favourably. However, the data indicate that research organisations maintain a strong position in terms of overall participation in the programme.

Figure 33: Participation in other projects in H2020 or predecessors (share of H2020 project participants indicating)

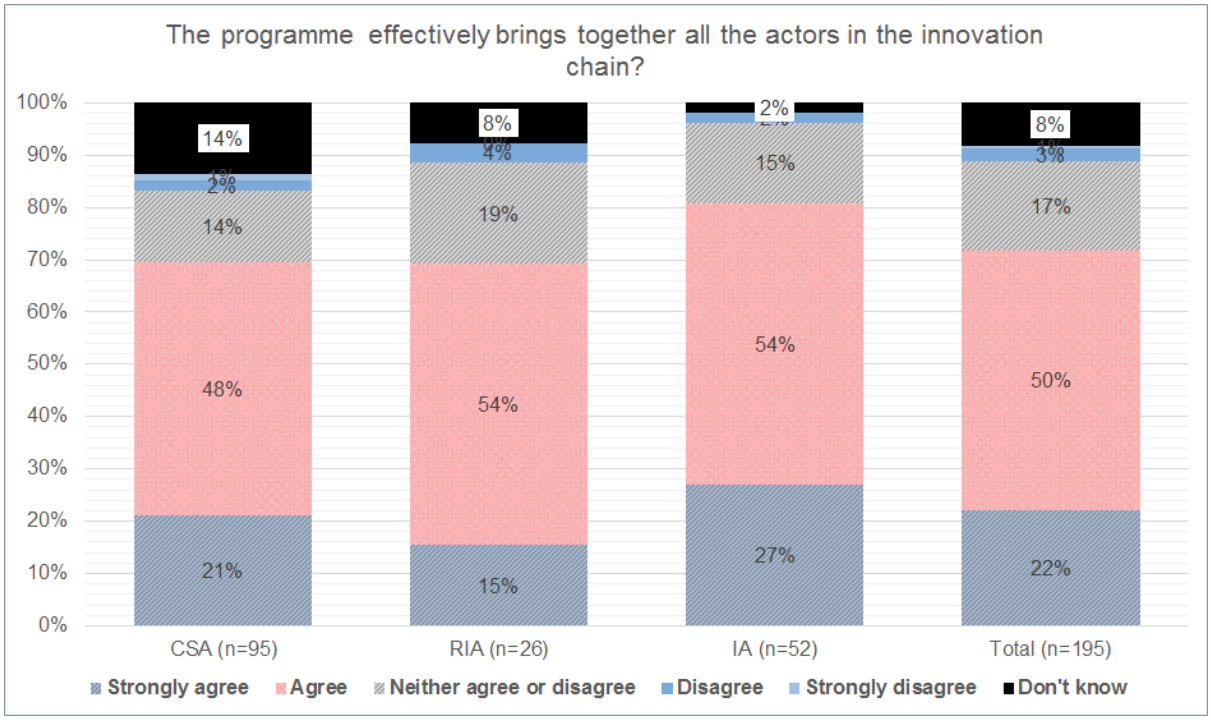


Source: Survey of H2020 participants

6.3.2.4.2 How effective has H2020 been in bringing together all the actors in the innovation chain so far?

In terms of the capacity of the programme to bring together all the actors in the innovation chain, the survey responses suggest that the programme is generally successful (see Figure 34). More than 70 % expressing a positive view (72 % agrees or strongly agrees) and with no deviation depending on the type of project (CSA, RIA, or IA). With the possible exception of universities (47 % indicated that they neither agreed or disagreed) which were rather less positive, the responses were also consistently positive across all types of stakeholders.

Figure 34: Success of H2020 in bringing together the actors in the innovation chain (share of H2020 participants indicating)

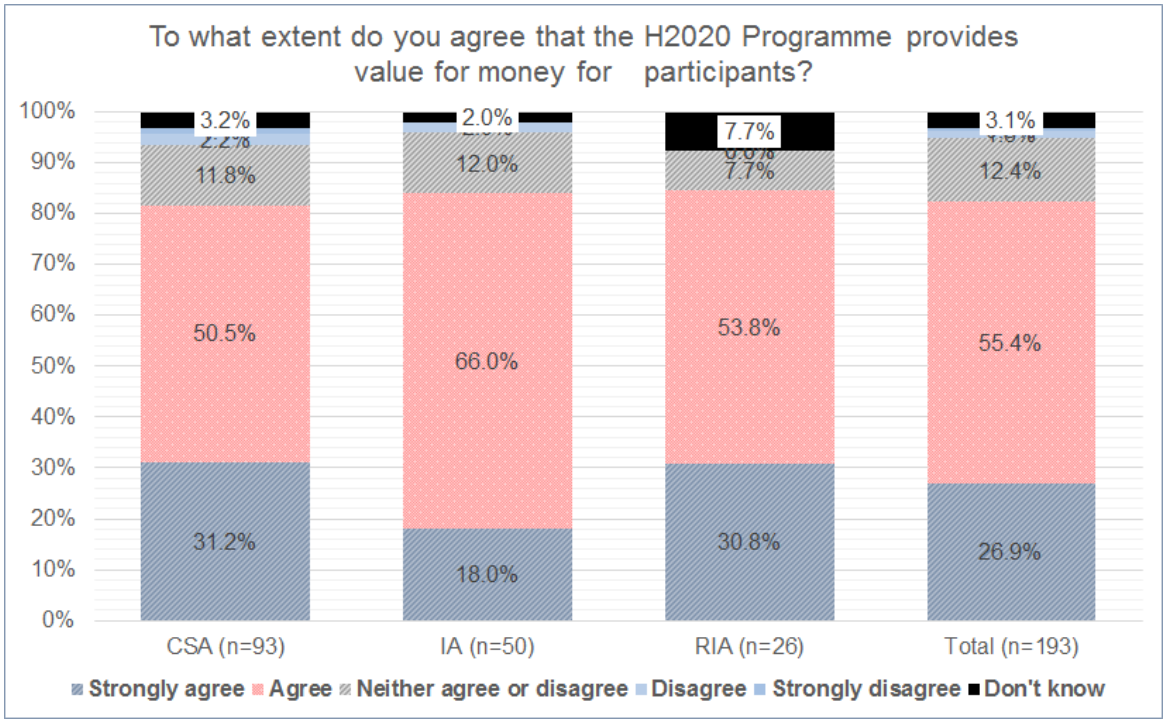


Source: Survey of H2020 participants

6.3.2.5 Does the programme provide value for money for participants?

Participants to the H2020 Energy programme generally think that it provides value for money. The great majority of survey respondents (over 80 %) provided positive or very positive views and less than 5 % had a negative view (see Figure 35). This is the same for all types of projects but was also consistent across different types of participants (large and small firms, universities and research centres, authorities), and across those with different roles (leader, participant, beneficiary). The interviews provided a similar positive view on the value for money with all respondents indicating that value for money arises both when referring to financial aspects (results versus costs of participation) but, more generally, when considering the more general benefits (access to knowledge, cooperation networks).

Figure 35: Value for money of H2020 Programme according to survey participants



Source: Survey of H2020 participants

When asked to indicate ways to further improve the value for money, only a few survey participants (40) provided specific views. Among those, the most common suggestion (35 %) focused on the reduction of the costs (administrative burden), while all others focused on mechanisms to increase the value of the programme, including an increase in funding to increase the number of projects supported but also increases in communication and knowledge exchange.

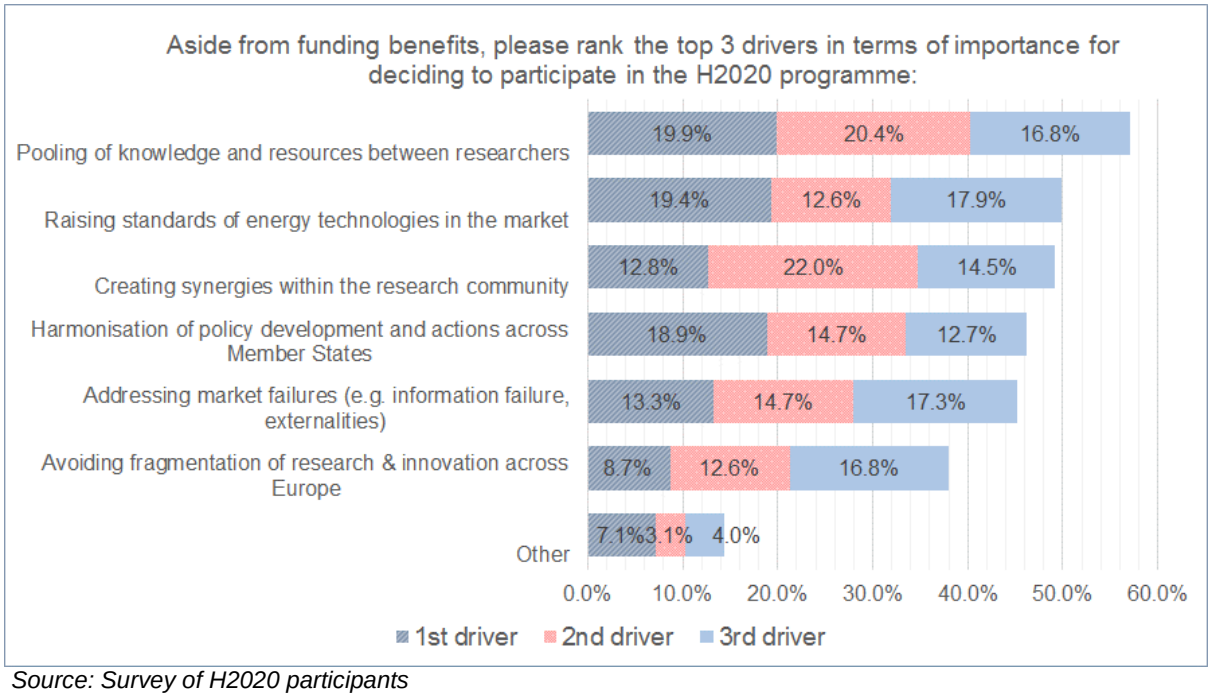
6.3.2.6 How effective are the activities of dissemination of the programme results and communication? Should they be improved?

As already indicated in section 6.3.2.3.2 (Figure 27) knowledge and information dissemination, the communication of the results and processes and the overall communication process are both clear and appropriate. Less than 10 % expressed negative views. At the same time though, the improvement of communication was the most commonly identified area where further improvement was considered necessary among the majority of project participants (10 out of 42 respondents to this question).

6.3.2.7 What are the main drivers and barriers for participation in H2020 (project perspective)?

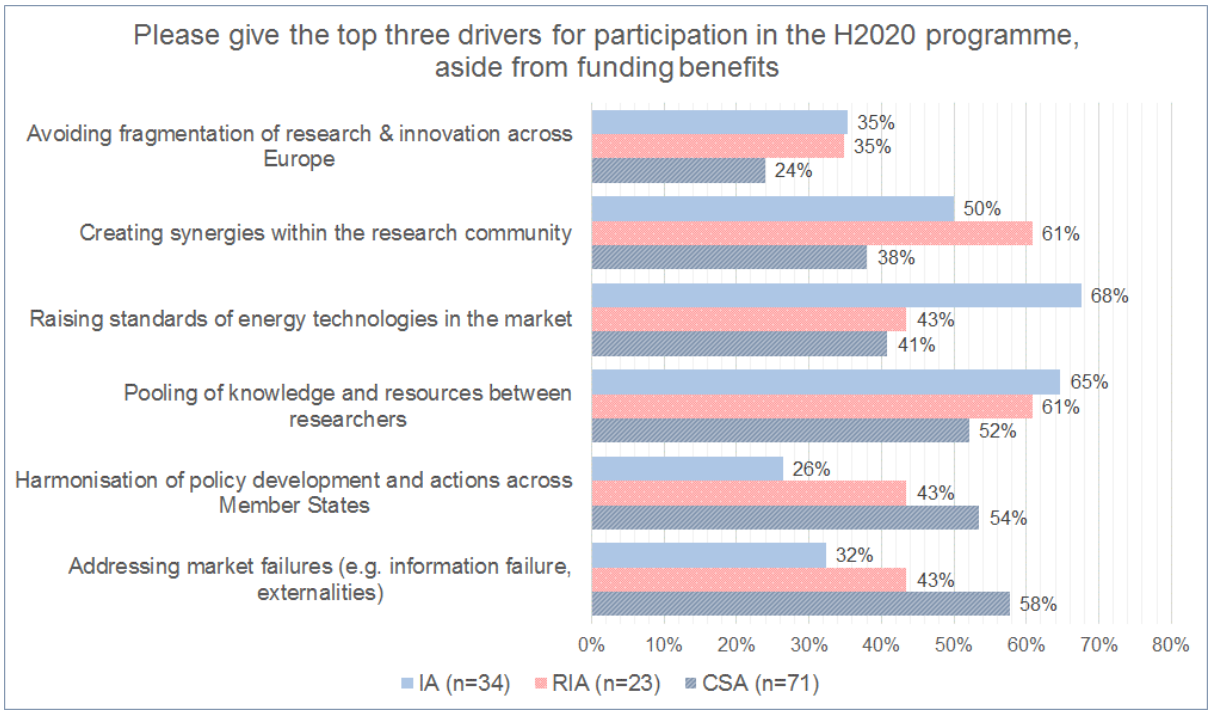
Survey participants were asked to indicate the main drivers for participation in H2020. A broad range of reasons was identified that also reflects the mix of CSA, RIA, IA projects in the sample. Aside from funding, the majority made reference to pooling of knowledge and resources (57.1 %), raising standards of energy technologies (49.9 %), creating synergies with the research community (49.2 %), harmonisation of policy development (46.3 %) and addressing market failures (45.3 %) (see Figure 36). As can be seen in Figure 37, depending on the project type (CSA, RIA, IA) the priority is given to different drivers. Largely the same results came from the survey of unsuccessful applicants.

Figure 36: Top three drivers in terms of importance for deciding to participate in the H2020 programme (% of respondents indicating)



Source: Survey of H2020 participants

Figure 37: Top three drivers in terms of importance for deciding to participate in the H2020 programme by project type (% of respondents indicating)

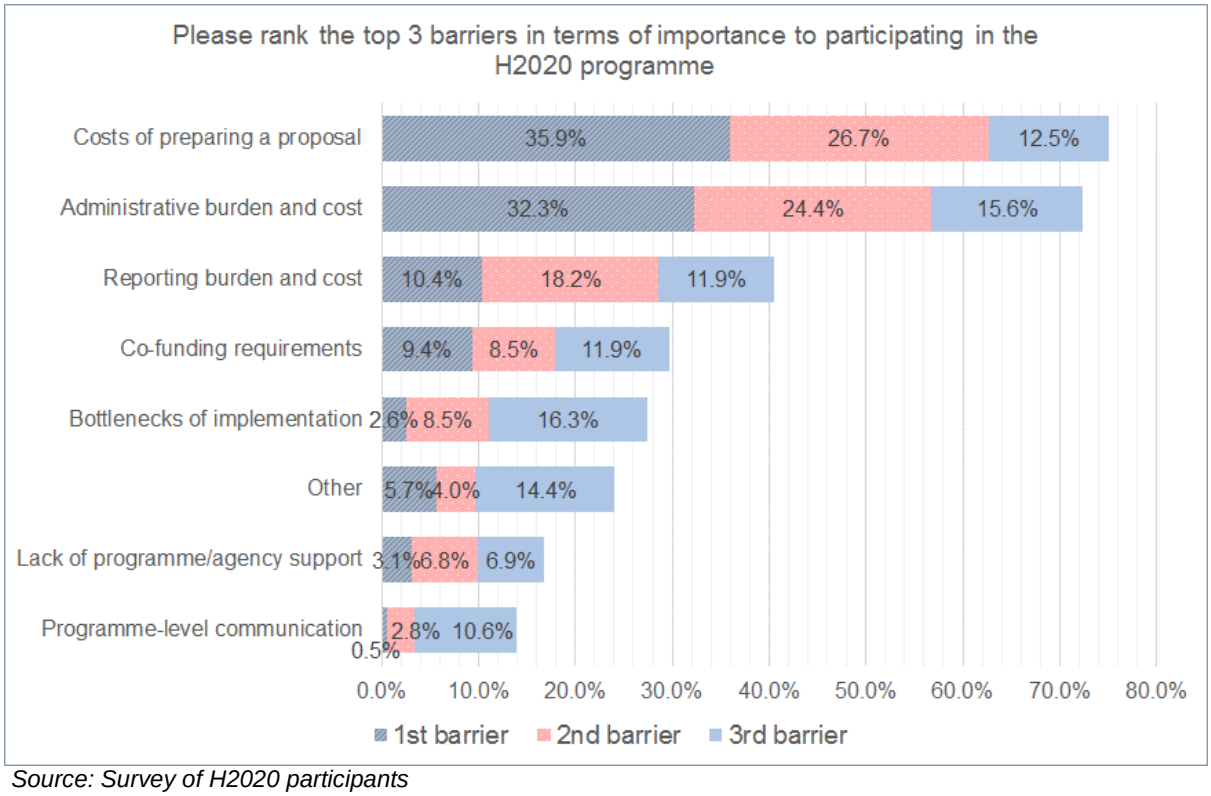


Source: Survey of H2020 participants

Among the interviewees the focus was primarily on networks and collaboration with many referring to the opportunity to work with partners in other countries to gain access to trans-national knowledge and experience.

In terms of the barriers to participation, the input from the survey focuses primarily on issues already raised earlier including cost for participation. Costs of proposal preparation are identified within the top three barriers (74 % of respondents) followed by overall administrative burden (72 % of respondents).

Figure 38: Top 3 barriers to participating in the H2020 programme (share of H2020 participants indicating)



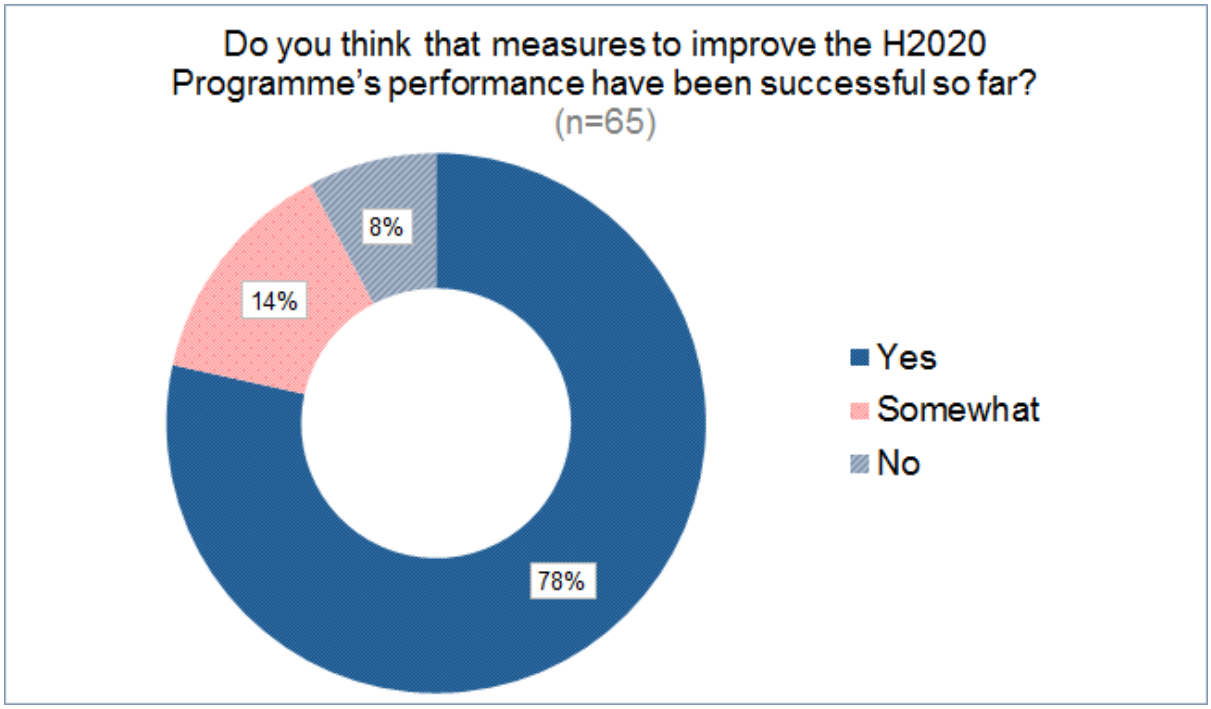
Source: Survey of H2020 participants

6.3.2.8 Is there scope for further simplification measures to improve and measure programme performance?

In terms of the awareness of existing simplification measures (in comparison to the predecessor programmes), around 37 % of H2020 participants indicated that they were aware of simplification measures to improve programme performance. Around half of them (51 %) mentioned the online reporting and communications via the online portal as an important simplification measure. The simplified funding rates were mentioned by 15 % of respondents.

The respondents provided a positive assessment of the role of these simplification measures. 78 % provided a positive assessment of the role of these measures in improving performance of the programme. This positive picture was consistent across different types of participants (firms, research organisations, public authorities), with different roles (leader, coordinator) and different types of projects (CSA, RIA, IA).

Figure 39: Success of H2020 programme improvement measures



Source: Survey of H2020 participants

Still, some (44) survey respondents referred to possible further simplifications focusing on measures to reduce administrative burden during the application and the project implementation stage (25 % and 16 % of respondents respectively), increasing flexibility in the requirements and improving the IT tool. The following table summarises the most common suggestions made under each main category.

Table 40: Simplification measures to application process suggested by survey respondents

General type of simplification proposed	Details of most common simplification measures identified
Reduce administrative costs during application	Shorten further the length of application documents Further cut of the time-to-grant
Reduce administrative costs during project	Simplify timesheets Reduce reporting requirement (frequency)
Increase project flexibility	Allow greater flexibility in the use of external sources and subcontractors for supporting activities without need for changes in the grant agreement
Improve IT tool	Improve participant portal in terms of user interface and access to information

Source: Survey of H2020 participants

6.3.3 Summary - emerging conclusions

While it is still too early to assess the cost-effectiveness of the programme (since most of the results and impacts are still not visible) the combination of the analysis presented in the effectiveness section - suggesting a positive view in terms of the capacity to deliver results – and the identified reduction in administrative and management costs provides positive indications. Nonetheless, the necessary cost-efficiency indicators are not currently available to allow for a more consistent and reliable assessment of the cost-effectiveness of the programme. These should be compared against the predecessor programmes (FP7 and IEE II) as a benchmark. At this point, meaningful comparison is not possible to

make. Similarly, the financial leverage analysis is limited by the data availability and the absence of comparable benchmarks.

Having said that, the input from the participants to the H2020 energy programme and other involved stakeholders point to positive aspects in relation to the efficiency of the programme but also certain areas where further improvement is needed:

- The basic structures of the programme appear to be operating largely satisfactory. Most participants to H2020 project expressed a positive view in relation to the overall H2020 programme management activities and contractual procedures, which are considered as clear and appropriate. Similarly, positive views were expressed in relation to the legal framework.
- The experience in relation to the application procedure is more mixed. On the one hand, total time to grant has decreased in comparison to the predecessor with the great majority of projects signed within the eight months period from the closing of the call. According to the input provided by most of those involved in the process (NCPs, Agencies and Commission) the overall process has become more efficient in comparison to the predecessors.
- On the other hand, while comparable data concerning the resources allocated by participants in the predecessor programmes are not available, the overall feedback is that the overall time and costs for application has not changed significantly and that the costs for application are still identified as an important barrier for applying to the project. The analysis points to a most typical time per applicant of around 30 days (FTE), with 50-100 being the most common among project leader and 11-25 among participants.
- Combined with the rather demanding standard and low success rates, the application process still appears to be an important disincentive for application. The costs of application together with an increase in the number of application due to cuts in national R&D budget lead to overall low success rates. This in turn is posing a danger of dissuading new actors with limited experience from future participation and contributing to the programme attracting the same participants. For the time being, there is no indication that the programme has been unsuccessful in attracting new participants; they still represent around 40 % of the participants according to the survey. Nor are there any strong indications of specific groups lost due to the programme structures and procedures.
- The Programme's communication and dissemination structures and activities – including knowledge and information dissemination, the communication of the results and processes and the overall communication processes – are also considered as appropriate and effective from most participants involved.
- Participants consider that there is scope for further improvement of the support provided by the Agencies and the Commission services. However, it should be noted that the current structure of the H2020 programme does not provide much scope for strengthening the support structures. The negotiation period prior to contract was the period where the Agency (EACI/EASME) could provide useful input to applicants helping adjust the budget of the projects to the scale and scope of the project contributing to their efficiency and the overall cost-effectiveness of the programme. Its elimination from the process has had a positive role in terms of reducing the time to grant with positive impacts on the attractiveness of the programme and the administrative costs. However, it has closed a very important feedback channel that does not appear to have been effectively replaced by alternative support structures, such as the National Contact Points.
- Despite these weaknesses, the great majority of participants (80 %) consider that it provides value for money. While a number of them pointed to the potential for reducing costs of participation, they still accepted that the costs of the H2020 are justified by the (expected) benefits. These include – above all other – the capacity to pool together knowledge and resources and creating synergies as well as the improving the level of energy technologies available. More policy related outcomes (harmonisation of policy across the EU, addressing market failures) are also identified by participants in market uptake (CSA) projects.
- Still, improvement and further simplification in a number of procedural aspects were identified. These include further improvement in the online/IT tools to support the management of the projects through the creation of a standard platform, reducing the length of application documents simplification of reporting requirements including possible elimination of certain requirements (such as the ethics procedures) when not relevant, simplification of timesheets.

6.4 Evaluation of relevance

The assessment of H2020 programme's relevance involves evaluating the programme in relation to its contribution to the EU policy goals and to those of its Member States. It also involves assessing relevance to the EU citizens. Specifically, we focus on the following evaluation topics:

- Relevance of H2020 to EU policy goals and policy development;
- Relevance of H2020 to the policy development and capacity of Member States;
- Relevance of H2020 to EU's citizens.

The research that underpins this analysis has focused on the following three primary evaluation questions:

- To what extent is the intervention expected to contribute to the stated priorities of the Commission regarding energy?
- What has been the impact of the programme on EU energy policy harmonised development and implementation across the EU?
- How could alignment with EU policy be strengthened to better support EU policy priorities, implementation and development?

The analysis in this section uses information from on a combination of sources: a literature review of relevant reports, programme documents, evaluations and other documents, interviews with stakeholders, portfolio analysis and case studies. The analysis presents short sections on the relevance of IEE II and FP7- to provide a benchmark for the evaluation of the relevance of H2020.

6.4.1 EU energy policy and broader policy context (tools and initiatives)

Before presenting our analysis we provide a description of the relevant policy initiatives and tools that provide the context against which the relevance of the programme is considered.

EU 2020 targets, 2030 and Energy Roadmap 2050

The EU recognises that sustainable, secure and competitive energy is the backbone of a smart, sustainable and inclusive EU economy. Energy is a pillar of the Europe 2020 strategy[56], which has the aim of delivering high levels of employment, productivity and social cohesion.
Correspondingly, amongst the headline targets of the Europe 2020 strategy are the -20-20-20- climate/energy targets (see below) as well as a "Resource efficient Europe" and "Innovation Union" flagship initiatives.

The "-20-20-20"- key targets are:

- A reduction in EU greenhouse gas emissions of at least 20 % below 1990 levels;
- 20 % of EU energy consumption originating from renewable resources;
- A reduction of 20 % in primary energy use compared with projected levels, to be achieved by improving energy efficiency.

The EU 2020 targets build on the ''energy action plan" for the 2007-2009 period to reduce emissions of greenhouse gases. The energy action plan is the first official EU policy action that includes a 20 % energy savings target for 2020 (COM(2006) 545 final). The 20-20-20 targets, mentioned above, were set by EU leaders in 2007 and enacted in legislation in 2009.

The EU has set itself a long-term goal of reducing greenhouse gas emissions by 80 % to 95 % when compared to 1990 levels by 2050. The energy roadmap 2050 explores the transition of the energy system in ways that would be compatible with this greenhouse gas reduction target while also increasing competitiveness and the security of supply.

The Commission's 2011 energy roadmap 2050 set out four main routes to a more sustainable, competitive and secure energy system in 2050: energy efficiency, renewable energy, nuclear energy and carbon capture and storage. It combined these routes in different ways to create and analyse seven possible scenarios for 2050.

In 2014, EU countries agreed on a new 2030 framework for climate and energy, including EU-wide targets and policy objectives for the period between 2020 and 2030. This builds on the 2020 climate

[56] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:EN:PDF

and energy package. These targets aim to help the EU achieve a more competitive, secure and sustainable energy system and to meet its long-term 2050 greenhouse gas reductions target. The targets for 2030 are:

- A 40 % cut in greenhouse gas emissions compared to 1990 levels
- At least a 27 % share of renewable energy consumption
- At least 27 % energy savings compared with the business-as-usual scenario

Innovation Union: A Europe 2020 flagship initiative

The innovation union was placed at the heart of the Europe 2020 strategy (Europe 2020 flagship initiative) in 2010 with the aim to foster the EU's capacity to innovate. The innovation union helps in achieving the EU's target of investing 3 % of EU GDP in R&D by 2020.

The launch of the new EU research and innovation framework programme, Horizon 2020, and the development of ERA measures are important stepping stones in the path to a more research and innovation friendly environment in the EU. Horizon 2020 is the financial instrument implementing the Innovation Union. It is the biggest EU research and innovation programme ever with nearly €80 billion of funding available over seven years (2014-2020) – in addition to the private investment that this money will attract.

Energy Efficiency Directive

The Energy Efficiency Directive (EED, 2012/27/EU) establishes a common framework of measures for the promotion of energy efficiency within the EU to ensure the achievement of the EU's 20-20-20 headline targets on energy efficiency and to pave the way for further energy efficiency improvements beyond that date.

The EED, approved in 2012, was the legislative result of the energy efficiency plan (EEP, COM(2011, 109)) that was published in March 2011. Following its approval, Member States had until 5 June 2014 to transpose it into national law. It covers all sectors except transport, and includes, for the first time measures for supply side efficiency. This was not included in the 2006 Energy Services Directive (2006/32/EC).[57] The EED repeals the Cogeneration Directive (2004/8/EC) and the Energy End-Use Efficiency and Energy Services Directive (2006/32/EC).

The EED is also linked to other EU energy efficiency directives in many areas. For instance, the EED sets ambition levels for building renovations and thus links to and complements the Energy Performance of Buildings Directive (2010/31/EU).

Renewable Energy Directive

The Renewable Energy Directive (RED, 2009/28/EC) was adopted in 2009 and amends and replaces directives 2001/77/EC and 2003/30/EC.

The RED sets binding targets for all Member States to contribute to the overall 20 % target for renewable energy in the EU final energy consumption by 2020, in line with the 'energy roadmap 2050' that shows that renewables will have to play a much greater role in all future scenarios beyond 2020. As well as putting in place legal obligations, the RED also makes recommendations for specific actions to be taken by the public and private sectors across the EU. However, in many areas, it fails to address the ways in which Member States may implement policies and support measures aiming to increase use of renewable energy at national, regional and local level.

Energy Performance of Buildings Directive

In December 2002 the EU adopted the 2002/91/EC Directive on the Energy Performance of Buildings (EPBD, 2010/31/EU), which set minimum efficiency standards for both residential and commercial buildings above a surface area of 1000 m^2.

In 2010, a recast of the EPBD (Directive 2010/31/EC) was adopted by the European Parliament and the Council of the European Union setting a more ambitious framework to improve the energy efficiency of EU buildings and to clarify and streamline some of the provisions from the 2002 Directive that it replaces. The objective of the EPBD is to promote the improvement of the energy performance of buildings within the EU, taking into account outdoor climatic and local conditions, as well as indoor climate requirements and cost-effectiveness. The recast proposal confirms the importance of effective

[57] European council for an energy efficient economy (2013). Understanding the Energy Efficient Directive.

implementation at the Member State level, the importance of EU-wide cooperation and the strong long-term commitment and role of the Commission itself to support such effective implementation.

The scope of the Directive has been extended to include almost all existing and new buildings. Energy performance standards for buildings are the key element of the Directive. Member States shall ensure that minimum energy performance requirements for buildings are set at cost-optimal levels. From 2019-2021 onwards, 'nearly zero energy standards' will be applied to new buildings.

The Strategic Energy Technology plan

The strategic energy technology plan (SET-plan, COM(2007, 723)) was established in 2008. The SET plan is the technology pillar of the EU's energy and climate policy and focused on joint strategic planning and more effective implementation of programmes to accelerate the development and deployment of cost-effective low carbon technologies. The SET-plan prioritised those technologies most relevant to the energy and climate policy objectives for 2020: wind, solar, electricity networks, carbon capture storage, bioenergy, nuclear, fuel cells and hydrogen and energy efficiency. With the SET-plan a more coordinated approach of energy research in the EU was strived for. In practice the focus on climate change goals became stronger. The SET-plan strongly affected the set up of FP7, among others by a number of roadmaps that were developed within the European Industrial Initiatives (EII's), and that influenced the topics for research under FP7.

Competitiveness and Innovation Framework Programme

The overarching competitiveness and innovation framework programme (CIP, 1639/2006/EC)) (2007-2013) was established to contribute to achieving the objectives of EU energy policy and to implementing the Lisbon agenda. The CIP programme was adopted on 24 October 2006 to contribute to the enhancement of competitiveness and innovation capacity in the EU, the advancement of the knowledge society and sustainable development based on balanced economic growth. The CIP programme promotes the increased use of renewable energy systems (RES) and energy efficiency (EE). Small and medium-sized enterprises (SMEs) were its main target group. The following three programmes constitute the CIP:

- The entrepreneurship and innovation programme (EIP)
- The information and communications technologies policy support programme (ICT-PSP)
- Intelligent energy europe II (IEE II)

European Institute of Innovation and Technology

The European institute of innovation and technology (EIT) is an independent EU body set up in 2008 to enhance the EU's ability to innovate by nurturing entrepreneurial talent and supporting new ideas. Together with its knowledge and innovation communities (KICs), the EIT aims to create favourable environments for creative thoughts to enable world-class innovation and entrepreneurship to thrive in the EU. It was established by the Regulation (EC) No 294/2008 of the European Parliament and of the Council of 11 March 2008. It became operational in 2010.

The EIT's first three KICs were launched in 2010:

- Climate-KIC: addressing climate change challenges
- EIT digital: generating world-class ICT
- KIC InnoEnergy: tackling sustainable energy.

The EIT aims to contribute strongly to the objectives set out in Horizon 2020, in particular by addressing societal challenges in a complementary way to other initiatives in these areas. Under Horizon 2020, the EIT was allocated a budget of € 2.7 billion of the total € 80 billion Horizon 2020 programme.

6.4.2 Relevance of H2020 to EU policy goals and policy development

6.4.2.1 Introduction

The analysis in this section focusses on the following set of questions:

- Were the overall programme objectives adequately specified, in relation to the policy priority for secured, sustainable energy for Europe and enhancing European competitiveness?
- To what extent is the Energy Challenge of the H2020 programme (still) aligned with the EU's political priorities on Energy?
- What has been the impact of H2020 on EU policy making?

6.4.2.2 Were the overall programme objectives adequately specified, in relation to the policy priority for secured, sustainable energy and enhancing EU competitiveness?

IEE II

The general objectives of IEE II were security of energy supply, competitiveness and environmental protection. According to several evaluations, these correspond to the EU's headline policy goals. The mid-term evaluation of IEE I and II (Deloitte, 2009) states that "The logical framework clearly demonstrated that the IEE II programme general and specific objectives directly respond to the general EU policy objectives in the field of energy." According to the final evaluation of IEE II (Deloitte, 2011a) the specific objectives were in line with EU energy goals. Not only were the actions and market replication projects in line with the EU energy policy objectives but the use of work programmes also made it possible to align with EU policy developments.

FP7

The general objectives of FP7 were described in the context and rationale of the FP7-programe: a mixture of research goals and energy policy goals. There was a mid-programme shift in line with the necessities of the global financial crisis towards innovation to foster the competitiveness of the EU-wide industry (Fresco, 2015).

The energy goals of FP7 are very similar to the energy policy priorities of the EU. There is almost complete overlap between these and the energy perspective goals of FP7 for "secure energy supply" and "enhanced competiveness of European energy industry." The FP7 goals are also in line with (some of) the EU2020 energy targets.

A criticism of the FP7 programme is that there was little interaction between funded projects and that this might have led to overlap and reduced synergies (European Commission, 2016a)

Horizon 2020

The general objectives of the Horizon 2020 Energy programme are as described in the context and rationale of the programme. Among them is achieving the 20-20-20 targets and the development of a reliable, affordable, publicly accepted, sustainable and competitive energy system that reduces fossil dependency (in particular part of Societal Challenge 3).

As shown by the Commission (European Commission, 2016d)) the objectives of the individual calls in the Horizon 2020 programme are in line with the objectives of the entire programme. Interviews with H2020 programme level stakeholders confirm that the programme is well aligned with EU policy.

Concerning flexibility of the programme, compared to its predecessors, H2020 has limited flexibility to be adapted in light of changing policy priorities. This is a consequence of the size of the programme, combining MU and D & R activities in a broad range of workprogrammes. The overall intervention logic of H2020[58] is not specified in more detail for SC3. The same "one size fits all" approach is evident in the support mechanisms and application procedures (e.g. call based application) for H2020. Moreover, the programme's management structure, involving different EU and national bodies in the design of the programme, does not allow for a swift adaptation in the light of changing policy priorities. Finally, the programme appears to be somewhat less agile than its predecessors because it issues calls every two years instead of annually.

Looking at coordination within the programme, EASME and INEA have organised a number of workshops and events that aim at synthesising results from different projects. This addresses the critique on FP7 that there was too little interaction between the projects. Examples are the Build Up Skills 8th EU exchange events, EPBD concerted action (IV) meetings, the contractors workshop "practical approaches to the building renovation challenge", contractor meetings on public procurement and public and contractor workshops on innovative financing for energy efficiency and renewables. Furthermore, a number of "cluster coordinator workshops" were organised to increase the interaction between projects and generate synergies. In the area of "energy system", a dedicated coordination action ("BRIDGE") is funded to increase synergies and cooperation of H2020 projects in the field of smart grids and storage. According to EC staff, this latter project is very successful.

[58] https://ec.europa.eu/research/evaluations/pdf/archive/h2020_evaluations/intervention_logic_h2020_052016.pdf

6.4.2.3 To what extent is the energy challenge of the H2020 programme (still) aligned with the EU's political priorities on energy

The energy challenge (Societal Challenge 3) is part of H2020's response to the recognition that coordinated research at a pan-EU level is still weak (European Commission, 2011). The energy challenge aims to ensure the transition to a reliable, sustainable and competitive energy system, in the face of increasing resource scarcity, increasing energy needs and climate change. The energy challenge 'Societal Challenge 3: secure, clean and efficient energy' (hereafter SC3) is structured around seven specific objectives and research areas[59]:

1. Reducing energy consumption and the carbon footprint
2. Low-cost, low-carbon electricity supply
3. Alternative fuels and mobile energy sources
4. A single, smart EU-wide electricity grid
5. New knowledge and technologies
6. Robust decision making and public engagement
7. Market uptake of energy and ICT innovation

Evidence from interviews shows that these objectives and areas are considered highly relevant to the EU's political priorities. For example, project participants (IEE, FP7 and H2020) indicate that the challenge is aligned with EU's political priorities, perhaps with the exception that cooling is less represented in the challenge vis-à-vis the latest EU strategy for heating and cooling. Evaluators in general feel that the programme is well aligned.

However, a number of unsuccessful applicants find that the challenge leads to short-sightedness: a tendency to over-value technologies that are close to market. Too little emphasis is put on next-generation technologies. Some members of Commission staff broadly agree with this vision. They state that with H2020, neither universities nor firms are happy. In essence, it seems that the holistic design of H2020, aimed to foster streamlining innovations to the market, comes with the downside that the programme does limited right to the specific characteristics of innovations in different stages of the innovation chain. This has the consequence that Commission staff mentions some topics that H2020 targets by its design as topics that are not targeted or not targeted effectively as compared to its predecessors. Examples are too little focus on research activities and less effective impact on policy as compared to IEE.

This view seems to be somewhat confirmed by an analysis of the budget spent within H2020 and its predecessors. Looking at the budget spread between activity types, the weight seems to be with demonstration projects as compared to market uptake and research projects. (See Table 41) Perhaps more importantly, compared to IEE/FP7, the budget allocated to demonstration has risen from 44% to 52% at the expense of budget allocated to research (fallen from 38% to 29%) and to market uptake (fallen from 18% to 13%).

[59] Horizon 2020, The EU framework programme for Research and Innovation. https://ec.europa.eu/programmes/horizon2020/en/h2020-section/secure-clean-and-efficient-energy

Table 41: Comparison of budget split by activity type: EC budget spent on IEE II/FP7 vs H2020

Activity type	EC budget per activity (M€)		EC budget per activity (share)	
	IEE II/ FP7	H2020 – full SC3 portfolio (2014 – 2015)	IEE II/ FP7	H2020 – full SC3 portfolio (2014 – 2015)
Market Uptake	418	161	18 %	13 %
Demonstration	1 000	655	44 %	52 %
Research	851	360	38 %	29 %
Other		76		6%
Total	2 269	1 252	100 %	100 %

Source: European Commission, March 2016, H2020 SC3 Data file (in confidence) and figures reported elsewhere in this study (see below)

Notes:

- *To obtain the IEE budget for a scope that is comparable to H2020, the following areas were included: market uptake projects on energy efficiency, renewable energy sources, and integrated initiatives, and also concerted actions. Background numbers are in footnote 27.*
- *FP7 budget and shares as mentioned in section 5.2.1 below Table 12*
- *IEE/FP7 figures are for the period 2007-2013, H2020 figures are for the period 2014 and 2015.*
- *H2020 Demonstration projects include IA and ERA-NET Cofund actions*
- *H2020 Other concerns the SME instrument and CSA's that are not considered to support market uptake.*

When interpreting the figures in the table, one should acknowledge that within H2020 pillar I (Excellent Science) a major share of research activities are funded. So the SC3-related budget spent on research should be seen against the background of what is spent in Pillar I.

Also, it should be noted that applied research activities related to energy are also included in the section of H2020 that focusses on Leadership in Enabling and Industrial Technologies (LEIT), such as EeB PPP- for EE in buildings and SPIRE PPP for EE in industry).

6.4.2.4 What has been the impact of H2020 on EU policy development?

H2020 has had a profound impact on EU policy development. In interviews, the INEA notes that it is the philosophy of H2020 to have this impact and that it is INEAs responsibility to feed back the results of H2020 projects to parent DGs. Next, EASME states that they are feeding back results of projects to DG Energy. There are recent examples of initiatives to put this into practice, like requests from DG Energy to organise a workshop and provide an overview of project results. Another example is that DG Energy has brought forward the deadline for a deliverable of a H2020 project to integrate its results in the RED II directive. In January 2016, DG Energy was preparing a chapter related to existing mechanisms for self-consumption of power generated by Solar PV. The H2020 project[60] generated a deliverable that addressed this topic. DG Energy requested to deliver this part a bit earlier and to organise the information in order to facilitate their work. The consortium accommodated the request[61].

From the survey on H2020 participants, respondents point out that their projects provide support to the implementation of the EED and EPBD. This finding has been confirmed with DG Energy staff. Another example is that the project AURES provides direct support to DG Energy on the policy development for the next stage of Renewables Auction[62]. More information can be found in the illustrative case study box on the AURES project (H2020 LCE RES Market Uptake) in Box 6 in section 6.2.1.2.3.

[60] This concerns the H2020 LCE project PV Financing
[61] This finding has been confirmed with staff members from DG Energy.
[62] This finding has been confirmed with staff members from DG Energy.

According to interviews with Commission staff and EASME, IEE had a more profound impact on EU policy. The merging of IEE programmes into H2020 has led to some loss of policy relevance. The liaison between the programme and DG Energy was faster in IEE according to EASME. It was easier to build and maintain a relationship and identify barriers. There was a spirit to identify important results and inform DG ENER and the other way around. H2020 is a mix of research and innovation. H2020, and notably the research part is seen as less policy targeted by EASME. Compared to IEE, there is less focus on the market uptake and legislative issues in H2020, according to members from Commission Staff and EASME.

6.4.3 Relevance of H2020 to policy development and capacity of Member States

This evaluation topic refers to whether Horizon 2020 impacted EU energy policy harmonized development and/or implementation across EU Member States.

IEE II

By its design the IEE II programme has an impact on national level policy development and implementation. According to the interim evaluation of the IEE II programme (Deloitte, 2009) this programme leads to harmonised development and implementation of EU energy policy because it '[…] reduces the institutional, behavioural and information barriers […]' and '[…] provides opportunity to bring different organisations together across different Member States thereby encouraging the exchange of information and best practice and the creation of networks.'

Within IEE, three concerted actions (CAs) were organised and supported: The CA EPBD, EED and RED. The CAs were supported by CA Fora and by a number of individual projects. For example, six projects have provided support to the EPBD concerted action. Also policy implementation of EU product policies has been supported as well as assisting governments of six Member States in setting RES heating/cooling targets (European Commission, 2012a). The CA Fora are multi-faceted, with specialist workshops combined with high level discussions, allied to networking opportunities and web resources. Activities centre on sharing —and inspiring— smart solutions for the professional tools, skills and systems in all fields addressed by the legislation. These solutions are picked up by 21 national bodies and applied across the EU, with the necessary tailoring to meet national requirements (European Commission, 2013c).

Two specific examples of IEE II projects that had an impact on national policy are "Energie Posit'if" (France) and "FRESH" (Italy). For Energies Posit'if the provision of finance is a cornerstone of its concept, but it faced major legal obstacles. For instance, according to the then prevailing French law, Energies Posit'If had to comply to the full prudential rules imposed on banks as they are making credit operations. The French Energy Transition law adopted in summer 2015 provides an exceptional regime for public third party financing companies, and enables Energies Posit'if to provide finance to homeowners with a specific status. As a result of the project FRESH, the regional legislation (law 24/2001) was modified in 2013 in order to make it easier to recoup energy savings from tenants when implementing energy performance contracts.

FP7

The high level expert group (HLEG) endorsed the conclusion that FP7 has fostered mutual learning and harmonisation in the EU and the strategic orientation of participants' research and innovation activities (Fresco, 2015). FP7 encouraged harmonisation of national research and innovation systems and policies. In most EU Member States, FP7 contributed to scientific excellence, focused on addressing societal challenges, and set standards for research funding mechanisms and selection processes. Through the sub-programme FP7-ERA-NET the cooperation and coordination of research activities carried out at national or regional level in the Member States and Associated States were intensified through networking of research activities, and activities to coordinate research programmes (Fresco, 2015).

The FP7 programme has interacted more with national programmes than its predecessors (Technopolis, 2014). The most direct impact of FP7 is related to the construction of the European Research Area (ERA). According to Technopolis (2014) 'as far as energy is concerned, the FPs have strongly contributed to the expansion of regional, national and trans-national existing networks.' According to the high level expert group (Fresco, 2015) FP7 has had a positive impact on 'the structure, working and performance of EU Member States' research and innovation systems'.

In conclusion, as also mentioned in (European Commission, 2016a) FP7 has had an influence on national and regional policies by joint-agenda setting in the direction of societal challenges.

Horizon 2020

Horizon 2020 is marked by a well-developed and transparent intervention logic, which reflects closely the breakdown of general objectives into specific and operational objectives. Horizon 2020 has the support of all types of stakeholders, who agree on the need to orient EU research and innovation funding towards the resolution of societal challenges and the achievement of ambitious EU policy objectives.

H2020 continues to fund the three concerted actions (CAs) initiated under IEE: CA EED, CA EPBD and CA RED. This will have a direct impact on Member State policy development.

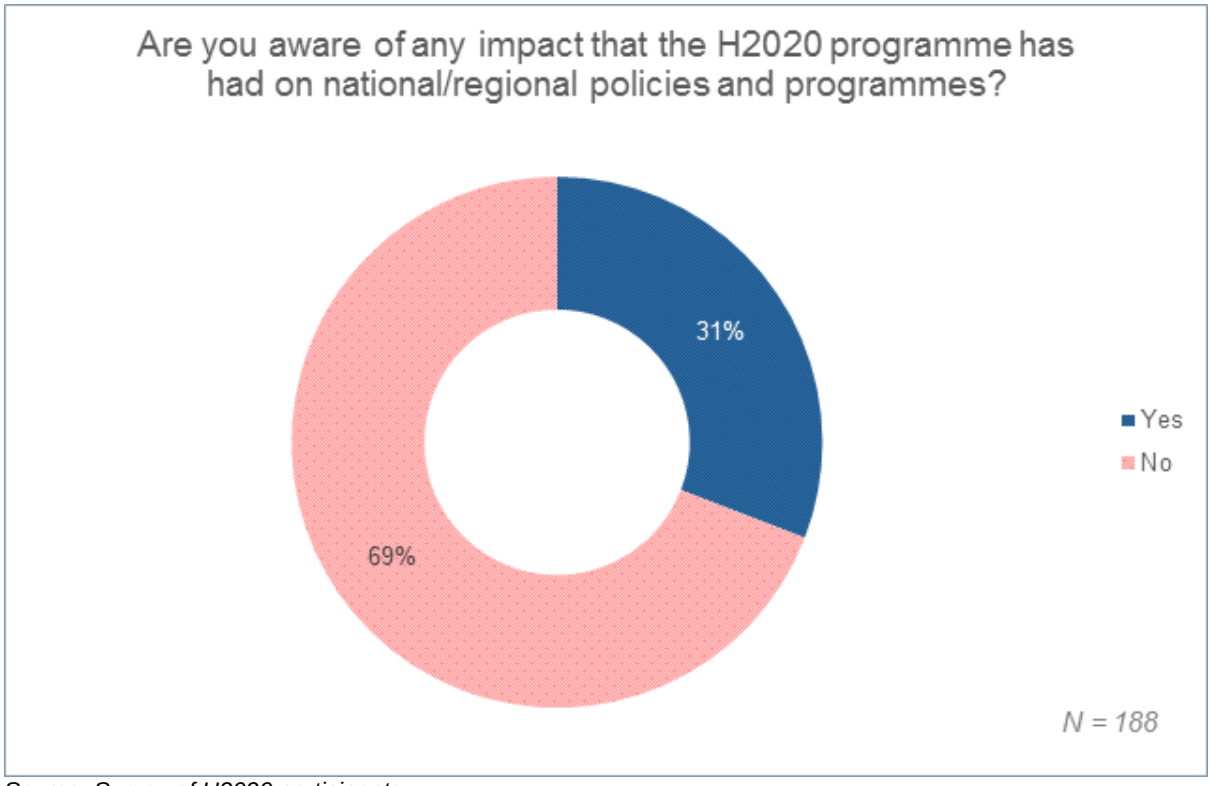
Moreover, H2020 funds coordination and support actions (CSAs), a continuation of capacity building and policy enabling actions funded under IEE. There are a number of calls aim to create resources that should make it easier for regional and national authorities to implement energy efficiency measures and increase the amount of renewable energy in regional and national grids. Good examples are: EE7-2014/2015, EE8-2014, EE9-2014/2015, EE15-2014/2015, EE20-2014/2015, EE05-2016, EE09-2016/2017, EE19-2017, EE21-2016, EE22-2016/2017, and LCE4-2014/2015 (European Commission, 2015a), (European Commission, 2016b). In interviews with Commission officers, they note that the CSAs are important in creating policy relevance. The CSAs complement technological innovation by creating positive institutions, like standardisation and policy dialogues. In practice working groups are established to give feedback to policy makers, and others (business, civil society organisations).

In Horizon 2020, an active attempt is made to link national funding with Horizon 2020 funding by means of joint programming initiatives. Partly in response to this, Member States have amended their research and innovation programmes to align with the Horizon 2020 research focus. For example, in Spain there is a partial focus on societal challenges (Georghiou, 2014), some of which overlap with Horizon 2020 societal challenges. Also in Denmark there is a coherence between the Horizon 2020 objectives and the Danish research and development objectives (Crasemenn, 2012).

Also incorporated in Horizon 2020 is the 'Seal of Excellence' for projects under Horizon 2020 that have been evaluated as being excellent but have not been funded. This makes it possible for Member States to support these 'ready to fund' projects (Gaczynshi, 2015). In case studies with unsuccessful applicants, most of them note that they have not heard about the seal of excellence. Those that have heard of it, are not familiar with it and/or have not used it.

Figure 40 shows results from a survey among participants in the IEE, FP7 and H2020 programmes, concerning the question: "Are you aware of any impact that the H2020 programme has had on national/regional policies and programmes?

Figure 40: Survey results on H2020 impact on national and regional policy



Source: Survey of H2020 participants

We observe that around 30 % of project participants have identified a policy impact of H2020 on the national or regional level[63].

Examples of policy impact given by people who have responded positively to the survey question typically refer to aligning national R&I programmes with H2020 (although in some Member States national R&I funding programmes stopped funding topics that are funded under H2020) and the development or adjustment of national or regional legislation. Examples of the latter are: sustainable energy action plans at the municipal level, REScoop friendly legislation, adoption of Bulgarian legislation to stimulate energy savings, and informing the French Article 173 of the energy transition for green growth act. The project AURES provides direct support to Member States for the policy development for Renewables Auction. More information can be found in the illustrative case study box on the AURES project (H2020 LCE RES Market Uptake) in Box 6 in section 6.2.1.2.3.

The impact of H2020 projects on national and regional policy and science funding is recognised in interviews with project participants and unsuccessful applicants. According to them, H2020 enhances diffusion of knowledge and economies of scale, leading to easy exchange of knowledge and knowledge workers. They give some examples of impacts that H2020 has had on regional policies. In Germany, the big funding agencies set up calls that complement EU funding. In Netherlands, France and Austria funds are aligned as well. In Italy, a special office is developed for understanding, transplanting and replicating the results of H2020 projects. In Austria, grid security issues are discussed with a H2020 project team.

Evaluators provide another example that indicates that H2020 projects have had an impact on national policy. In Belgium, energy exchange was not allowed between houses. In the context of a H2020 project, Belgium legislation has been amended so that specific research projects like the H2020 Story project[64] are allowed to experiment with this. Depending on the results and whether the project has an impact, the policy in Belgium may be changed.

[63] It is not evident how to put this figure into perspective. In the final evaluation of IEE II, we find that the survey among IEEC members and NCPs shows that 71% of the respondents indicate that the IEE II programme has had some impact on national and regional policies and programmes. Note that is to be expected that IEE II is perceived to have such an impact, as the IEE II programme's actions aim directly at enabling policy and strategies (CA's, promotion and dissemination projects with this priority).

[64] This project is funded under the area LCE, topic H2020-local/small scale storage

6.4.4 Relevance of H2020 to EU's citizens

In this section, we assess the relevance of H2020 to EU citizens.

IEE II

For EU's citizens, energy efficiency is the most noticeable element in the EU-wide energy policy. Improved energy efficiency has the potential to make the most decisive contributions to achieving sustainability, competitiveness and security of supply.

The IEE programme was relevant to EU citizens because it aimed to improve energy efficiency and the smart use of energy (IEE II, 2012), (European Commission, 2013c). Further, IEE II ensured increased awareness (Deloitte, 2011a) (Deloitte, 2011b) (European Commission, 2013c) (ICF International, 2015) and information among EU citizens on sustainable energy objectives and solutions, and addressed skills gaps to change the behaviour of energy users and suppliers. The IEE programme connected citizens and energy stakeholders at local, regional and national levels (e.g. during the sustainable energy week, conferences and networking activities were organised aimed at exchanging knowledge and building relations between these stakeholders) (European Commission, 2013c).

FP7

According to a survey, FP7 met the expectations of EU citizens, although some respondents indicated that certain changes in the priorities could be envisaged. Members of the high level expert group assessed the FP7 impacts on citizens and society and found that (Fresco, 2015):

- Citizens and civil society organisations were barely involved in relevant FP7 programming decision-making bodies e.g. evaluation boards or expert groups (European Commission, 2016a); (Fresco, 2015)
- Dissemination and outreach activities lacked in terms of the targeting and tailoring of these activities for different audiences with different purposes of communicating scientific outputs
- Civil society organisations' involvement as partners in research projects was limited (5 % of unique participating organisations), and
- The budget of the sub-programmes addressing issues of high importance for citizens and society (socio-economic sciences and humanities, SSH, and science in society, SiS) was comparatively small (European Commission, 2016a).

Horizon 2020

The H2020 programme on societal challenge 3 contains several elements to ensure relevance for EU citizens (European Commission, 2015). For instance, within the LCE sub-area "distribution grid and retail market", innovation actions should ensure that all consumers (industry and citizens) will benefit from cheaper prices, more secure, stable grids and low carbon electricity supply. Within EE, there is a strong focus on consumer-related issues under the sub-area 'Engaging consumers towards energy efficiency' (WP 2016-2017) and 'Buildings and consumers (WP 2014-2015). As a final example, the call "smart cities and communities" aims to result in district or city scale solutions with a high market potential in areas at the intersection of energy, transport and ICT. Among these, the call text specifically mentions smart digital services for better-informed citizens.

In interviews, the relevance of H2020 for EU citizens is broadly recognized. Commission staff emphasised the general relevance of the programme to EU citizens due to the policy goals to which it contributes (energy union, energy challenge). This view is shared by the EASME and INEA, as well as by unsuccessful applicants.

More specifically, Commission staff, the EASME and INEA mention that the role of social science in the projects should make the programme more relevant to citizens. The inclusion of social sciences into the innovation programme is a novelty. This had not been included in IEE II and FP7 (European Commission, 2016c). We find social sciences in several instances in the H2020 work program. For example, within the EE sub-area "socioeconomic research on energy efficiency", there is a specific focus on the role of consumer behaviour, the influence of institutional factors, and the implications of societal trends on the evolution of energy efficiency.

Next to this "passive" role of citizens in the research, Commission staff highlights that in some projects citizens play an active role. An example is the "save" project in which a competition is organized between citizens to save as much energy as possible. In general, the "living labs" approach that is

prominent in a number of projects under the "smart cities and communities" call puts target groups in a more active role.

Despite of the general relevance of the programme and the specific improvements aimed at making it more relevant to citizens, the EASME, INEA and NCP's note that most citizens are hardly aware of the programme. Communication to citizens can be made more effective, although some call topics already ask for dissemination towards citizens. Communication to citizens can be made more effective, although some call topics already ask for dissemination towards citizens.

6.4.5 Conclusions

This section presents the conclusions along the lines of the three research topics analysed.

6.4.5.1 Relevance of H2020 to EU policy goals and policy development

- The programme is, like its predecessors - in its design - well aligned with EU policy and well positioned to contribute to EU policy priorities, implementation and design. The energy goals of the H2020 programme reflect EU energy headline goals. The intervention logic clearly shows how the activities and outputs of H2020 contribute to reaching those goals.
- Compared to its predecessors, H2020 has limited flexibility to be adapted in light of changing policy priorities. This is a consequence of the size of the programme and the management structure involving a number of EU and national bodies in the design of the programme. Moreover, it issues calls every two years instead of annually as with its predecessors.
- At the EU level, there are recent examples of initiatives to feed H2020 project results into policy development, like integrating the results in the RED, the EED, EPBD and renewable auction policy.
- H2020's holistic approach seems to have some merits compared to FP7 and IEE being separate programmes. Its aim of seamless integration of the complete innovation cycle should move projects closer to the market and closer to addressing the direct needs of the community and citizens. However, we find some indications that that the holistic design of H2020 may come with the downside that it does not fully support the specific characteristics of R&I in different stages of the innovation chain. It is perceived to be less effective in delivering both basic research and policy uptake. This seems to be confirmed by an analysis of the share of budget allocated to the R&I activities (market uptake, demonstration and research). We see that demonstration projects appear to have received the bulk of the budget. Compared to its predecessors, the share of funding for this category has increased at the expense of the funding for the other two categories.
- We have found evidence that the criticism on FP7 concerning the limited interaction between separate research projects has been taken up and used to make Horizon 2020 more effective in supporting EU policy priorities.

6.4.5.2 Relevance of H2020 to policy development and capacity of Member States

- In general, as with its predecessors, Member States have amended their research and innovation programmes to align with the Horizon 2020 research focus, although the specific impacts vary between Member States.
- In the Horizon 2020 programme, there is a renewed focus on harmonised policy development compared to FP7. Like in IEE II, several CAs and other policy-enabling actions are supported to implement a number of directives in EU Member States.
- On the Member State level, we have identified the first examples of feedback into policy. More than 30 % of projects have an impact on policy at national or regional level. Among factors that contribute to the policy impacts are the focus on involvement of a wider circle of stakeholders, including policy makers. Another factor that promotes impact on Member State policy is the funding of several CSAs.
- With more focus on implementation and alignment with other EU-initiatives and funds as well as with Member State institutes, H2020 takes in some lessons learned from its predecessors. An active attempt is made to link national funding with Horizon 2020 funding by means of joint programming initiatives (European Commission, 2011), which seems to have resulted in alignment of national research funding with H2020. Also incorporated in Horizon 2020 is the 'Seal of Excellence' for projects under Horizon 2020 that have been evaluated as being excellent but have not been funded. This opens up possibilities for Member States to gear

funding from ESIF or other investment programmes to these highly relevant projects. However, most unsuccessful applicants indicate they have never heard about the 'seal of excellence', while those that have heard of it have not used it.

6.4.5.3 Relevance of H2020 to EU's citizens

- Looking at the programme from the perspective of relevance to its citizens, we conclude that the programme, like its predecessors, aims to increase EU citizens' trust in science and innovation, while fostering social acceptance for certain technologies by involving them in projects and decision-making. Moreover, the programme takes in lessons learned from its predecessors by including socio-economic research in the innovation programme. An example related to energy is socio-economic research on consumer behaviour in the context of (renewable and efficient) energy. Next, the H2020 holistic approach specifically aims to involve beneficiaries of science and R&D projects in the funded projects, a feature that was nearly lacking in FP7.
- It has been suggested that citizens are not or hardly aware of the programme or of its results. Communication to citizens can be made more effective, although some call topics already ask for dissemination towards citizens.

6.5 Evaluation of coherence

The assessment of the H2020 energy programme's coherence requires an examination of how well its constituent processes and activities have been working together and with other interventions. More specifically, this involves looking at:

- H2020's *external* coherence and the extent to which the H2020 energy programme is coherent with other interventions that have similar objectives and the manner in which its relations have manifested themselves (e.g. complementarities, synergies, overlaps, etc.)
- H2020's *internal* coherence and the manner in which its internal logic and work programme structure has manifested itself (e.g. through H2020's holistic approach).

The analysis in this section is based on a combination of a review of relevant reports, programme documents, evaluations, etc. and inputs provided by interviewed stakeholders. The analysis has made use of the IEE II and FP7-based literature and stakeholder inputs to provide a benchmark for H2020's performance on coherence.

Three primary evaluation questions have been used to examine coherence:

1. To what extent does the H2020 programme complement other EU level interventions that have similar objectives? (external coherence)
2. What synergies and interactions exist between the H2020 programme and the European Structural and Investment Funds (ESIF) and other research, innovation and competitiveness-related EU programmes? (external coherence)
3. To what extent does the overall logic, structure and activities of the work programme of the H2020 programme holistically support its purpose/objectives? (internal coherence).

6.5.1 External coherence

6.5.1.1 Introduction

In this section an analysis is presented of the H2020 energy programme's external coherence. The analysis is based on some key findings from the literature concerning H2020 and its predecessors and on the views of interviewed H2020, IEE and FP7 stakeholders in relation to the two primary evaluation questions for external coherence. These are: the extent to which the H2020 energy programme complements other EU level interventions that have similar objectives; and the synergies and interactions which exist between H2020 and the European Structural and Investment Funds (ESIF) and other research, innovation and competitiveness-related EU programmes.

6.5.1.2 Findings on extent to which extent the H2020 programme complements other EU level interventions that have similar objectives

In order to assess the extent to which the H2020 energy programme complements (and is coherent with) other EU level interventions with similar objectives it is instructive to first look back at the FP7 and IEE II programmes and review their interactions and synergies with other programmes and each other.

FP7

The coherence of FP7 with wider EU policies and international obligations (European Commission, 2016a) has been described under its contribution through its results to the development and implementation of EU policies and to important international commitments. Although, with this said, a strategic shift for FP7 was noted as being necessary in order to establish 'stronger and better' connections between research, innovation and education, i.e. the 'knowledge triangle'.

The Ex-Post Evaluation of the Seventh Framework Programme (European Commission, 2016a) stated that Competitiveness and Innovation Programme (CIP) linkages with other programmes could have been better 'exploited and institutionalised' and found that there were apparent signs of 'inconsistencies, competition, lack of coherence and overlap of elements of FP7 and R&I efforts in other Directorates'.

An accompanying High-Level Expert Group (HLEG) report, Commitment and Coherence – Ex-Post Evaluation of the 7th EU Framework Programme (2007-2013) (Fresco, 2015), found that there was some degree of fragmentation and the presence of 'silos' detrimental to the efficiency and coherence of FP7 (through a compartmentalisation and duplication of themes). The HLEG report stated that in order to increase FP7's efficiency and coherence, any potential for synergy should be assessed and implemented and that any duplication between the different specific programmes and sub-programmes should be avoided in the future.

An assessment within the Ex-Post Evaluation of the Seventh Framework Programme (European Commission, 2016a) found that, in some areas of the Competitiveness and Innovation Programme (CIP), research previously funded under research FPs was picked up and taken forward towards the market. A "clear progression was also commonly seen through each of the two Framework Programmes – from research through to applications on the ground". The ex-post evaluation reported that the European Institute of Innovation and Technology (EIT) has been acting as an 'innovation catalyst' by "accelerating the take-up and exploitation of technologies and research outcomes.

IEE II

The Interim Evaluation of the Intelligent Energy-Europe II Programme within the Competitiveness and Innovation Framework Programme (Deloitte, 2009) has noted that IEE II was designed with an underlying intention to be able to offer new possibilities for synergies with FP7 and the Structural Funds. Indeed, an earlier report in 2007 on Synergies between the EU 7th Research Framework Programme, the Competitiveness and Innovation Framework Programme and the Structural Funds 65 noted previously that while each of these three programmes have all shared the overall Lisbon objectives, they have had differing degrees of focus on the actors and phases of the innovation process.

The Final Evaluation of the Intelligent Energy-Europe II Programme (Deloitte, 2011a) found evidence to "support a number of interactions and synergies between IEE II and other EU initiatives in the field of sustainable energy development". Indeed, synergies were observed within and between IEE II programme management and a number of related EU initiatives and programmes and there was noted to be a sharing of knowledge through "inter-service consultations and joint communication to beneficiaries with other EU initiatives such as FP7 or the Structural Funds and Cohesion Fund". A number of such coherence and interactions between IEE II and other EU programmes was also confirmed by the Evaluation of Intelligent Energy Europe Projects Supporting Sustainable Energy Communities Final Report (ICF International, 2015).

The Final Evaluation of the Intelligent Energy-Europe II Programme (Deloitte, 2011a) also reported, however, that there was some degree of potential overlap between IEE II and the Structural Funds and Cohesion Fund, as well as with the LIFE programme. Given the almost impossible task of

[65] *Synergies between the EU 7th Research Framework Programme, the Competitiveness and Innovation Framework Programme and the Structural Funds*, 2007, ETEPS AISBL Network for European Techno-Economic Policy Support.

eliminating each-and-every overlap, the final evaluation noted that any apparent major overlaps should be focussed on in the first instance, at the level of programme objectives, and that any minor overlaps should be cost-effectively managed through the implementation of the programmes activities. It was found that IEE II could have been better connected with other EU programmes through improved knowledge sharing and a reduction of implementation barriers, e.g. relating to: EU regulation prohibiting overlaps in funding; the differing scale of EU initiatives; time lags between EU initiatives; and, the differing target groups and key stakeholders across EU initiatives.

The Ex-Ante Evaluation of a Successor of the "Intelligent Energy – Europe II" (2007-2013) (Deloitte, 2011b) highlighted that IEE II was placed under the Competitiveness and Innovation Programme (CIP) so as to "benefit from synergies in the implementation of the project management cycle, in communication, and in programme management".

Coherence of H2020 energy programme with other EU level interventions that have similar objectives

The Impact Assessment Accompanying the Communication from the Commission 'Horizon 2020 - The Framework Programme for Research and Innovation' (European Commission, 2011) has highlighted that the Horizon 2020 Programme clearly has links to other major EU programmes through 'multiple interfaces', e.g. to the programme for European Competitiveness and SMEs (COSME) where National Contact Points for SMEs would be built into the "Enterprise Europe Network and facilitate diffusion of information as well as collection of feedback from participants and stakeholders." Future Education programmes, e.g. mobility schemes, skills and competence development, life-long learning, universities, doctoral programmes, etc. were also referred to as having the potential to share 'implementation tasks' with H2020. Furthermore, an enhanced role within H2020 for the European Institute of Innovation and Technology (EIT) under its mission to integrate education, research and innovation was also noted.

Feedback from interviewed H2020, IEE and FP7-related Commission and Agencies staff on the extent to which the H2020 energy programme complements (and is coherent with) other EU level interventions with similar objectives indicates a general consensus that H2020 is broadly complementary to other EU level interventions (e.g. COSME, ESIF, LIFE). Several examples were provided on how H2020 (and IEE) influences other EU level interventions, e.g. LIFE by H2020 and INTERREG by IEE. The feedback also indicates that H2020 is more complementary than FP7, e.g. it is possible to continue a project at pilot scale within H2020 and bring it to the next level under CEF or ESIF.

It is interesting to note, though, that Commission and Agencies staff did highlight that while H2020 is complementary to other EU level interventions there are some instances of (complementary) overlap, e.g. activities in COSME tend to be more bottom-up calls for proposals and ideas, whereas H2020 takes more of a challenge-based approach. Indeed, in this regard the Ex-ante evaluation of a successor of the "Intelligent Energy – Europe II" (2007-2013) (Deloitte, 2011b) has previously noted the inevitability of some degree of overlap with other programmes due to the nature, size, and complexity of IEE II's activities and those of other programmes. The replication of particular projects (or perhaps rather, particular aspects of projects) was highlighted as a useful means to increase impact, e.g. a particular project, or aspect of it, might also work rather well in another city (although, it should be noted here that this might not always work out in practice given that every city has a unique blend of challenges and barriers due to their specific infrastructure, industry, regulatory framework, geography and cultural characteristics).

National Contact Points (NCP) for H2020, IEE and FP7 also indicated a general consensus that H2020 is broadly complementary to other EU level interventions, without any particular degree of apparent overlap or conflict. The complementarity of COSME and its innovation aspect to H2020 was highlighted in particular, in the sense of helping companies to understand the level of innovation and how to enhance (and make a correction if the focus is not in the appropriate place) where innovation is needed.

While NCPs thought it was difficult to directly compare the H2020 and IEE programmes, there was a perception that H2020 is more complementary to other EU interventions than IEE (one example highlighted was the overlap between IEE and the Cohesion Fund at regional level, e.g. improvement of energy performance in public buildings; which it should be said was not seen as necessarily negative since it promoted activity in certain topics that need to be developed to tackle the existing challenges). FP7 was highlighted in particular as not following a customer-centric and challenge-

based approach. While H2020 has improved on this, there is still some work to be done. For example, many H2020 project evaluators have an academic background and, typically, researchers do not have a profound knowledge of specific market needs. As a consequence, while projects can be selected that are 'good' science they may not be entirely in line with market needs.

Although, the Impact Assessment Accompanying the Communication from the Commission 'Horizon 2020 - The Framework Programme for Research and Innovation' (European Commission, 2011) has described how "industrial enterprises welcomed a policy option that would bridge research and innovation more strongly and focus stronger on the dissemination of results of research projects to allow for valorisation into new products, processes and services.".

Feedback from evaluators also appears to indicate a general consensus that H2020 is mostly complementary to other EU level interventions without any particular degree of overlap or conflict. The complementary objectives of the current Renewable Energy Directive and H2020 were given as one example, whereby H2020 promotes the development of wave energy projects and thereby moves in the direction of the 2020 renewables target under the Renewable Energy Directive. Some degree of overlap between H2020 and other programmes was highlighted as being inevitable, however, due to the broadness of the topics and areas covered by the H2020 energy programme (e.g. with LIFE). One example pointed out was that while interventions like INTERREG are indeed complementary to H2020, in the sense that they are focused on changing policies by identifying best practices, INTERREG does on the other hand duplicate projects in some H2020 challenge areas.

Evaluators also highlighted that while the European Commission would like project proposers to combine funds without there being a 'double/parallel-funding' of the same activities (e.g. through H2020, ESIF, INTERREG, LIFE, etc.) some participants were noted as having ultimately received such funding to some extent. It should be noted, though, that such instances are of course not widespread and that the Agencies are taking measures to avoid such double/parallel funding, e.g. through ISCs.

Commission and Agencies staff have also highlighted an issue regarding the absence of a clear and comprehensive overview of all existing EU programmes/funds, including which programmes are funding what projects. While this was noted as inevitably helping create the potential for incoherence, it was also seen as making the process more confusing for applicants/proposers to programmes/funds, i.e. they might not know which programme/fund to apply for, etc. This issue could perhaps be addressed by mapping all the different programmes/funds instead of merging different intervention logics. Indeed, the mapping of all EU programmes/funds would be an effective means of helping ensure a broader coherence.

Coherence of H2020 energy programme with national or regional level interventions that have similar objectives

The extent to which the H2020 programme complements (and is coherent with) national or regional level interventions with similar objectives has also been assessed through a series of interviews with H2020, IEE and FP7 stakeholders.

Feedback from H2020, IEE and FP7-related Commission and Agency staff shows a difference to the broad consensus seen on the complementarity of H2020 to other EU level interventions. This is to be expected given the broad array of national/ regional level interventions and their underlying objectives and that, in general, national level programmes do not support cross-border activities (which of course H2020 does). It was pointed out that MS control their own national and regional level interventions even though initiatives such as the European Strategic Energy Technology Plan (SET-Plan) seek, inter alia, to enhance synergy and cooperation amongst EU countries, companies, research institutions and the EU itself.

H2020 is seen as being better aligned than FP7 was with national interventions, though not fully aligned. Both the ERA-NET programme and the Concerted Actions (CAs) under IEE were highlighted as having had a good influence on the alignment of national interventions and policy (e.g. sharing best practices in the transposition of EU directives into national legislation). Since the Concerted Actions are continued under H2020 it is expected there will be same positive influence at national level as seen under IEE. France was seen in particular as being a good example of how EU funding can create synergy between national and regional funding. In general, though, project participants are encouraged to use both national and European level funding and to share their results with national policy makers as a part of the signed grant agreement, which can in turn influence national

programmes. It was highlighted, though, that sharing information about what happens within national funding programmes is important, and that this is something that does not exist at the moment but would be useful for NCP's and programme committee members.

It is worth noting that when unsuccessful H2020 proposers (who are, in effect, national representatives) were asked about the extent to which H2020 is coherent with the objectives of national level interventions with similar objectives, the overall answer was that national and regional programmes complement rather than contradict the H2020 energy programme. Indeed, EU funding influences what is funded at national level and in this regard the possibility to scale up 'good' projects from national to EU level through the energy H2020 programme was highlighted.

Feedback from interviewed NCPs for H2020, IEE and FP7 on the extent to which H2020 complements national or regional level interventions with similar objectives appeared to show that the influence of H2020 on national interventions can be significant. It was indicated, however, that national level interventions act on a different level than IEE and H2020, which focus more on the future (2030 and 2050).

Some NCPs felt that there does appear to be an issue with respect to EU and national calls occurring at the same time; although this would seem to mostly be a national level concern rather than an EU level one. Indeed, it was highlighted that the SET-Plan and Energy Union are helping to align MS with the current EU preferred direction of travel. NCPs also drew attention to the preference from the EU for the utilisation of several programmes by participants. In order to use several EU funds at the same time there is obviously a greater need for applicants/proposers to fully understand and act on various aspects of the funding opportunities that are available and the means to do this is, as yet, not fully coordinated or mapped.

Evaluators indicated that national or regional programmes with similar objectives are generally in line with H2020. In some countries, the persons involved in European and national interventions are the same which obviously assists with the alignment of national and European levels. Also, a national funding agency can coordinate H2020 applications and at the same time be responsible for national funding, which can in effect help ensure complementarity instead of contradiction (e.g. national funding in Finland focusses on research in the forest industry, which is a very important area for Finland that is not funded at an EU level; in Ireland the recent series of economic crises also indirectly caused national and regional policies to be more in line with the EU with regards to innovation since the R&D sector was strongly dependent on EU funds).

The utility of projects starting with H2020 funding and then continuing with national funding was also highlighted, and vice versa, e.g. national incentives supporting companies to cooperate locally and to bring research to a certain level, after which they can, as a consortium, apply for H2020 funding.

6.5.1.3 Findings on synergies and interactions between H2020 energy programme and the European Structural and Investment Funds (ESIF) and other research, innovation and competitiveness-related EU programmes

Looking back at IEE II, the Ex-Ante Evaluation of a Successor of the "Intelligent Energy – Europe II" (2007-2013) (Deloitte, 2011b) has stated that while IEE II was designed with an intention to offer an underlying synergy with other programmes and funds (e.g. FP7, Structural Funds and Cohesion Fund) the synergies appeared to be somewhat insufficient. The ex-ante evaluation noted that a successor to IEE II would need to better exploit synergies with the downstream Structural Funds and Cohesion Fund for mobilising investments and develop linkages 'within and beyond' the Competitiveness and Innovation Programme (CIP) within which it could be coherent (e.g. by developing sustainable energy eco-innovation).

More recently, the Horizon 2020 Work Programme 2014-2015: Secure, Clean and Efficient Energy (European Commission, 2015a), as adopted in December 2013, was notably structured so as to encourage synergies between H2020 and other EU funds, such as the **European Structural and Investment Funds (ESIF),** by expanding on 'scope and impact' in relation to scientific excellence and socio-economic development.

However, feedback from interviewed H2020, IEE and FP7-related Commission and Agency staff on synergies and interactions between H2020 and ESIF indicates that while the synergies and interactions may be well established in theory, they do not currently appear to be working that effectively in practice. This is seen as being due to their underlying processes and structures not being efficiently aligned with one another. There was also a lack of effective synergy and interaction

seen between FP7 and ESIF and while this has been improved slightly under H2020 it is still some way from being addressed fully. With this said, detailed guidance on this issue has been previously published in 2014 for policy makers and implementing bodies, namely: Enabling synergies between European Structural and Investment Funds, Horizon 2020 and other research, innovation and competitiveness-related Union programmes66. However, H2020 with its research & innovation focus and ESIF with its infrastructure focus are very complementary to one another: ESIF can make projects bankable as a step between H2020 and a self-supporting project. In order to do this, better linkages would need to be built between H2020 and ESIF, e.g. their processes, procedures and structures would need be better aligned to reduce the administrative burden, etc. However, Commission and Agency staff also emphasised how different H2020 and ESIF are in practice and how difficult it is to combine them effectively. Nonetheless, proposers are encouraged to combine H2020 and ESIF and there is still a lot of work to do before this can be done on a larger scale. Interactions are currently perceived to be somewhat informal, with any synergies being exploited and developed on an ad-hoc basis. In order to ensure a better achievement of complementarity between ESIF and H2020 and to avoid any potential duplication of funding, a systematic check across both programmes would need to be integrated into their underlying processes and procedures; which at present only occurs upon the initiative of the executive agency staff.

As part of the first Horizon 2020 Annual Monitoring Report (European Commission, 2016d), National Contact Points (NCPs) were asked to give their opinion on synergies between H2020 and ESIF: 22 % of NCPs surveyed had a 'high' or 'very high' perception of complementarity; a sizable component perceived it as 'low' or 'very low' (24 %); while the majority perceived it as 'average' (31 %) or had 'no opinion' (22 %). Similarly, NCPs were also asked to give their opinion on synergies between H2020 and EFSI: 22 % of NCPs surveyed rated it as 'high' or 'very high'; whereas almost 22 % rated it as 'low' or 'very low'; 26 % perceived it as 'average' and 29.5 % had 'no opinion'.

Further to the above findings, feedback from interviewed H2020 NCPs on the presence of synergies and interactions between H2020 and ESIF (including any apparent current ones or those which might be foreseen) appears to support the above findings that any such linkages are not effectively present (or visible). NCPs did note though that H2020 and ESIF are very comparable and complementary, in theory, and that overlap is inevitable. It was highlighted that as H2020 and ESIF have differing timescales (i.e. calls have different timelines) the establishment and development of synergies will be a very difficult and ongoing task. Also, ESIF is perceived to be more complicated for applicants/proposers, which often results in the two programmes not being combined at this stage of the process when perhaps they could be.

However, it should be noted that the IEE initiatives, ELENA and MLEI, which were related to ESIF are now continued and built upon in H2020[67]. This example (highlighted by some IEE NCPs) can be used as an indication that 'seeds' of collaboration and synergy which were planted under IEE are now being grown to some extent under H2020. It was noted that H2020 is better able to be focused on the potential effective use of ESIF, such as through, for example, the Innovative Financing Schemes topic on creating the conditions for the adequate supply of private finance for energy efficiency investments at regional or national level.

In line with the findings described above, feedback from interviewed H2020 evaluators also shows that the current linkages between H2020 and ESIF are perceived to be rather weak. It was noted that while synergies and interactions between the two programmes would help provide for bigger ultimate impacts, this would require additional and enhanced communication and alignment activities to be implemented. Indeed, a number of evaluators were unable to respond fully on this issue, which supports the observation that the communication aspect here is in need of attention. Further to this, it is interesting to note that interviewed FP7 evaluators highlighted that, whereas FP7 had no synergies with ESIF, H2020 is in fact starting to explore potential links to facilitate cooperation between both programmes and that the knowledge is there to identify and development the alignment opportunities. It was also noted that the current lack of synergy and interaction between H2020 and ESIF can be, in part, attributed to regional issues (e.g. co-funding of national authorities required) and not solely to an EU level.

[66] http://ec.europa.eu/regional_policy/sources/docgener/guides/synergy/synergies_en.pdf

[67] The Energy Challenge of H2020 includes more topics that are related to the effective use of the Structural and Investments Funds (ESIF). For example, this could be the topics related to point 5 (Innovative Financing for Energy Efficiency Investments) of the Energy Efficiency Area, more specifically topics EE 22 (Project Development Assistance-PDA) and EE 23 Innovative financing schemes. The PDA topic was the former MLEI priority within IEE.

In summary, while the overall theory of interaction and synergy between H2020 and ESIF may look good on paper, evidence for the translation of this into practice is not particularly apparent at present and further efforts are needed to enable the linkages to be effectively and efficiently realised.

6.5.2 Internal coherence

6.5.2.1 Introduction

In this section an analysis is presented on the H2020 energy programme's internal coherence. The analysis is based on some findings from the literature and on the views of interviewed H2020, IEE and FP7 stakeholders in relation to the primary evaluation question for internal coherence, namely: the extent to which the overall logic, structure and activities of the work programmes of the H2020 programme holistically support its purpose/objectives.

6.5.2.2 Findings on extent to which overall logic, structure and activities of the work programmes of the H2020 energy programme holistically support its purpose/objectives

Coherence of H2020 energy programme's logic, structure and activities

A brief assessment of the internal coherence of FP7 in the *Ex-Post Evaluation of the Seventh Framework Programme* (European Commission, 2016a) noted that an accompanying High-Level Expert Group (HLEG) report, *Commitment and Coherence – Ex-Post Evaluation of the 7th EU Framework Programme (2007-2013)* (Fresco, 2015), found that FP7 created compartmentalization and duplication of themes and that some successful elements of FP7 were provided through certain sub-programmes, even though they would be equally useful in other sub-programmes. It is not entirely clear what exactly the latter finding here relates to, but complementarity and synergies can obviously result from implementing research projects of common interest, but this could also indirectly target similar research topics, thereby doubling the effort and risking duplication.

Feedback from H2020, IEE and FP7-related Commission and Agency staff, NCPs and evaluators on the extent to which the overall logic, structure and activities of the work programmes of the H2020 energy programme holistically support its purpose/objectives appears to show that the various topics complement each other well but that in such a big and complex holistic programme as H2020 some degree of internal overlap is inevitable. It was noted that given IEE was managed by one agency, its internal coherence was more easy to realise than with such a complex programme as H2020, managed by different DGs and Agencies. In H2020 there is a risk of overlap between Societal Challenges and other areas (e.g. materials/ renewables: super conductors) and also within the Societal Challenges themselves. This could be minimised by sharing information and through better coordination between, e.g. the Agencies (indeed, in order to lower the chance of duplication, some Agency staff indicated that the 'silo-based' working structure should be taken down or opened up). There is an awareness though of the importance of making connections between responsible DGs when developing work programmes and between the different internal components and it was highlighted that while there are procedures to avoid overlap it is difficult to have a perfectly fail-safe check. The risk of overlap was also noted as providing a potential opportunity to cluster projects.

Unsuccessful H2020 proposers appear to have a generally positive view on H2020 and its focus on the whole value chain. It was noted from the perspective of some, however, that H2020 can be biased towards the higher end of the TRL scale. The presence of some apparent misalignment between DG RTD and DG ENER calls (e.g. on grid integration) was noted though. The two-year work programme is also perceived as rather rigid and therefore as a structural gap in the programme structure.

Responses from NCPs for H2020, IEE and FP7 also appear to show a general consensus that the internal structure of H2020 does not contradict itself. The inevitable potential for duplication was highlighted though, due to the various interactions between the different Societal Challenges. This overlap is not perceived to be counter-productive, rather helping create the basis for synergies to be identified and developed. It was noted, though, that towards the end of the IEE programme, the integration of energy efficiency actions with the building sector was seen as successful, while this was not the case for the transport sector. While a good level of communication is seen between the different H2020 areas, some confusion about which call to apply for within a certain subject was noted. In relation to FP7, which was smaller and more compact, comparable issues/topics in H2020 are located over several thematic programmes, which makes it somewhat easy for an ordinary proposer to lose themselves if they are interested in the development of a particular research issue/topic.

Feedback from evaluators on the extent to which the overall logic, structure and activities of the work programmes of the H2020 energy programme holistically support its purpose/objectives also shows that while there are some internal overlaps, the perception of overlap is not necessarily negative since funding several projects helps to increase the chances of achieving the desired impact.

Interestingly, there is a general perception that H2020 is more coherent internally than FP7, even though it is a considerably more complex programme. This is due to H2020's more practical focus as compared to FP7, i.e. basic research funding will always have more overlap due to the nature of research topics and the way in which they are implemented.

The need for more cross-cutting calls was noted as being helpful towards overcoming the existence of 'knowledge silos' within topics and confusion for proposers who might not be able to find their way among the various calls to the most appropriate opportunities. One example of a positive evolution seen under H2020 in this regard was that, e.g. ICT-focussed proposers can learn that interesting projects also appear under Energy, e.g. smart-based topics).

Integration of Research, Innovation and Market Uptake activities into single instrument

The extent to which the integration of research, innovation and market uptake activities in one single instrument is working effectively has been assessed through a series of interviews with H2020, IEE and FP7 stakeholders.

The general perception of H2020, IEE and FP7-related Commission and Agency staff, NCPs and evaluators on the integration of research, innovation and market uptake activities into one single instrument is broadly positive, but only just. The stakeholders interviewed did not present a unanimous view on whether IEE and FP7 have been integrated into one single programme efficiently and effectively, although many agreed that it is too early to tell whether the combined approach will lead to the achievement of a higher impact.

It was highlighted by some stakeholders that the market uptake dimension is not particularly well understood or exploited (it should be about taking down the market barriers and building capacity), making the integration less well executed than initially thought. It should however be stressed here that the market uptake dimension is not complete or optimised as yet. While the integration process has brought important insights in existing technologies, it seems that the market uptake part of H2020 is suffering from recognition, valorisation and communication problems. Some H2020-related Agencies staff and evaluators were of the view that the R&I-based projects suffer from a disadvantage by being compared with market uptake projects, which were seen as getting higher evaluation scores and hence funding. The reason for this viewpoint is not entirely clear, however, given that market uptake and R&I-based projects do not, in effect, compete for funding as they are on separate evaluation lists.

The lack of some degree of flexibility in the integrated approach has also been highlighted. One issue that has been encountered is that while IEE could allow the lowering of funds if the project is not achieving its pre-set objectives, this provision is not available under H2020. Another flexibility issue observed is the amount of resources that must be provided to satisfy the fixed procedural aspects, e.g. proposals, templates, grant agreements, etc. when clearly not always applicable to a certain project.

Responses from NCPs for H2020, IEE and FP7 appears to show a general consensus that the idea behind combining R&I and market uptake was a very good one; and that some parts are working well. However, it was highlighted that in a number of cases the integration has made the process more complex: some topics have become difficult to interpret ('they should be clearer, more to the point'), and different stakeholders have to be combined in bigger consortia. It is noted that NCPs definitely have a role to play here, i.e. putting these different stakeholders (who have not been used to working together in the past) into contact and facilitating the collaboration and proposal and implementation process. It was also highlighted that not enough attention is being paid to the lower TRLs. Clearly, the broad idea is that funding of basic research is crucial to feed the innovation value chain. If not enough basic research is done, the source of the innovation value chain might dry up risking that not enough valuable demonstration projects may come out of it anymore. It should also be stated here that the structure of the calls which allows projects to evolve from low to higher TRL's within one single programme is seen as a positive aspect.

Feedback from evaluators on the integration of R&I and market uptake into one single instrument appears to be generally positive but that the integration is not yet optimised. Bringing ideas or projects to the market is seen to work better within H2020 than before, especially for SMEs. There are however indications of some issues within the integration process, whereby the broad set of topics and issues presents some difficulty in that more communication is needed. Specifically, for evaluators, the integrated approach is seen to create challenges: impact evaluations are difficult (especially for projects with a TRL < 5) and developing business plans for new technologies is seen as very difficult. Too often, a well written and edited business plan will be evaluated higher, but in general it is too early to have meaningful business plans. In such cases it was suggested that the development of roadmaps in which the costs, scale of technology, next steps and potential early customers are depicted would be a better alternative for the business modes.

It was also pointed out that integrating the research 'community' and the private sector is a difficult process, not just because of the differing working cultures and practices but also because it takes time and considerable effort to build networks between (and within) academia and industry. On paper, the process may seem clear and straightforward, but it is easy to underestimate the different ways in which either academia or industry operates because there is often little day-to-day communication flow between them.

Unsuccessful H2020 proposers appear to understand the importance of and need for the integration but also see the difficulties in operationalising it. Translating scientific breakthroughs into jobs, new companies, and wealth through a consortium-based approach consisting of academic research teams and private sector entities from a multitude of countries is a difficult process. Indeed, for example, claims of 'ownership' for a particular concept or contribution from individual consortium members can become an ongoing issue.

It is seen as generally very good though that H2020 is focusing on the whole value chain. Although nonetheless, it was noted that H2020 can be a bit biased towards the higher end on the TRL scale for some would be applicants.

6.5.3 Conclusions

6.5.3.1 H2020 energy programme's external coherence

As mentioned elsewhere in this report, the goals of the H2020 energy programme are very similar to the energy policy priorities of EU and they are also in line with the EU2020 energy targets since the general objectives of the H2020 energy programme include "achieve the 20-20-20 targets". While the other general objectives of H2020 cannot be directly linked to EU energy priorities they are an operationalization towards reaching those goals.

The findings in relation to the extent to which the H2020 energy programme complements (and is coherent with) other EU level interventions with similar objectives indicate a general consensus among stakeholders that H2020 is broadly complementary to other EU level interventions (e.g. COSME, ESIF, LIFE). There was also some perception that H2020 is more complementary to other EU interventions than IEE[68]. While there is some degree of overlap between H2020 and other programmes, this was generally seen as inevitable due to the breadth of the topics and areas covered by H2020 (e.g. with LIFE). Indeed, the replication of particular projects (or perhaps rather, particular aspects of projects) is a useful means to increase impact.

A mapping of all EU programmes/funds could be a potentially useful and effective means of helping ensure a broader coherence. A clear and comprehensive overview of all existing EU programmes/funds is currently lacking, including which programmes are funding what projects.

The findings in relation to the extent to which the H2020 energy programme complements (and is coherent with) national or regional level interventions with similar objectives show a difference to the broad consensus seen on the complementarity of H2020 to other EU level interventions, which is to be expected given that countries control their own national and regional level interventions. However, national and regional programmes are often complementary to H2020. Having projects start with

[68] While NCPs are generally of the view that it is difficult to directly compare the H2020 and IEE programmes, there is a perception that H2020 is more complementary to other EU interventions than IEE (overlap between IEE and the Cohesion Fund at regional level was one example highlighted).

H2020 funding and then continue with national funding is also seen as being a positive aspect, and vice versa.

The findings in relation to synergies and interactions between H2020 and ESIF indicate that while the synergies and interactions may be well established in theory they do not currently appear to be working that effectively in practice. Current interactions are perceived to be somewhat informal. However, H2020 with its research & innovation focus and ESIF with its infrastructure focus are indeed very complementary to one another (even if there is overlap in some topics). In order to realise the potential synergies and interactions, better linkages will need to be developed and communicated between H2020 and ESIF (e.g. alignment of processes, procedures and structures and reduction of administrative burden, etc.)

6.5.3.2 H2020 energy programme's internal coherence

The overall logic, structure and activities of the work programmes of the H2020 energy programme are seen to holistically support its purpose/objectives and complement each other reasonably well. While internal overlaps are inevitable in such a big and complex holistic programme as H2020, such overlaps are not generally seen as negative or counter-productive, but rather helping to create the basis for synergies to be identified and developed towards the achievement of greater impacts.

H2020 can, for some applicants, be biased towards the higher end of the TRL scale (the two-year work programme is also seen as somewhat rigid by some). The use of more cross-cutting calls could be a useful means to facilitate wider participation and for overcoming 'knowledge silos'.

The integration of research, innovation and market uptake activities into one single instrument is seen by stakeholders as broadly positive, but only just. The successful integration of the market update dimension in particular is not that clear to some and it is not particularly well exploited. Although, it is noted that it is still too early to tell whether the combined approach will lead to the achievement of a higher impact. The principle behind combining R&I and market uptake is a good one though and, while parts of it are working well, it is not yet optimised.

6.6 Evaluation of EU added value

This section addresses the added value of intervention at the EU level. This requires an assessment of what action would have been taken at Member State level in the absence of any EU action. Clearly this cannot be measured directly, because the H2020 programme is well established and there have been predecessor EU programmes in the areas of energy efficiency and renewable energy for decades. These EU programmes are likely to have influenced the nature, scope and budgets of programmes undertaken at Member State level,

The evaluation therefore approached the assessment of EU added value by reviewing relevant literature and seeking stakeholder views on what might have happened without EU intervention, where and how EU intervention adds value and what might happen if EU intervention were to stop. The continued need for EU action in this area has also been addressed, i.e. whether EU intervention continues to add value. Finally, the evaluation has sought to establish the marginal EU added value of the H2020 programme compared to the predecessor IEE II and FP7 programmes. This was done by asking how EU added value related to the more holistic intervention of H2020, which proved to be a difficult question for interviewees to answer because of the intangible nature of EU added value and the relatively small differences between the scopes and modalities of H2020 and FP7/IEE.

The literature review conducted for the evaluation was inconclusive in terms of answering the research questions and establishing the EU added value associated with the H2020 programme, but it did highlight some ways in which EU intervention may add value, and this informed the design of the survey and interview programme that followed.

The main findings from the literature review of relevance to EU added value were as follows. Further information was presented in the interim report from this study.

- The Impact Assessment of the H2020 programme (European Commission, 2011) argued that Member States acting alone were unlikely to provide sufficient funding for research and innovation, given the context of the financial crisis, and that actions such as transnational collaborative research, researcher mobility and training, and stimulating market uptake of innovations can be more efficiently and effectively organised at European level.

- The Impact Assessment also identified potential EU added value in policy actions: bringing together knowledge and experience in different contexts, supporting cross-country comparisons, and spreading best practice.
- The evaluations of predecessor programmes and components of those programmes found evidence of EU added value in terms of transnational cooperation, improving the EU's research position, business competitiveness, transfer of knowledge to less advanced Member States, and market uptake of renewable energy.
- 68 % of National Contact Points (NCPs) surveyed in September 2015 indicated that the EU added value of H2020 was either 'high' or 'very high'.

The remainder of the evaluation used the survey and the interviews with project participants, unsuccessful applicants, Commission and agency staff, NCPs and evaluators to address the following three research questions relating to EU added value. The first of these questions also relates to the relevance of the H2020 programme.

- What would be the **effect of non-intervention**, e.g. what would be the impact of stopping the H2020 programme?
- What is the **additional value resulting from funding H2020 projects**, compared to what could be achieved by Member States at a national and/or regional levels? How does this relate to the new holistic intervention approach being taken? What are the main points of EU added value reported by the programme participants?
- To what extent do the issues addressed by the programme **continue to require action at an EU level**?

The results are described and discussed in the following sections, each addressing a separate question.

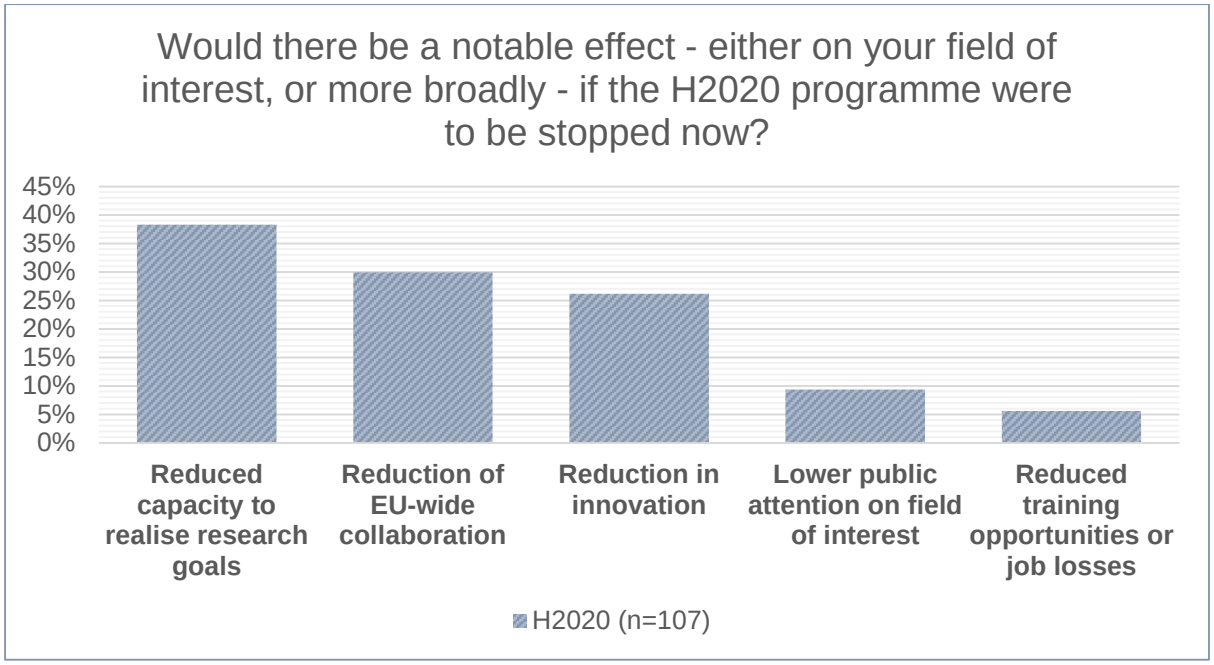
6.6.1 What would be the effect of non-intervention, e.g. what would be the impact of stopping the H2020 programme?

This research question was asked in the survey and in the interviews with project participants and unsuccessful applicants.

135 (85 %) of the 158 survey responses answered 'Yes' to the question 'would there be a notable effect, either on your field of interest or more broadly, if the H2020 programme were to be stopped now?'. All of the 23 respondents answering 'No' to this question, went on to agree or agree strongly that the H2020 programme adds value over and above what could be achieved at the national level in one or more ways (see next section), so there is an apparent contradiction here. One possible explanation is that these respondents thought that H2020 had delivered EU added value in the past but no longer does so – this is explored further through the third research question in this section. Another is that these respondents replied 'No' because they thought stopping the H2020 would have little impact on them or their organisations. This is plausible since most of them were participants rather than lead contractors in the programme, and most had been unsuccessful applicants to H2020 in the past.

Survey respondents that indicated there would be a notable effect were then asked to indicate what the effects would be, and given a list of possible effects to choose from. 107 respondents answered this follow up question and identified one or more effect of non-intervention. The results are shown in Figure 41.

Figure 41: Assessment of the effect of non-intervention at EU level, from survey



Source: Questionnaire survey of H2020 participants

The most popular answers from the survey were that stopping the H2020 programme would reduce capacity to realise research goals (38 % of respondents), reduce EU-wide collaboration (30 %) and reduce innovation (26 %). This was confirmed by interviews with H2020, FP7 and IEE programme participants, many of whom mentioned the importance of the programme in creating and sharing new ideas, in fostering collaboration and in encouraging the best research. Unsuccessful applicants to H2020 also stressed the programme's value in terms of innovation, international cooperation and strengthening research infrastructures. Several interviewees said that stopping H2020 would have a large negative impact, with words like disastrous, 'stifled'' and ''very bad', while others said that activities would go on, but on a smaller scale, with goals achieved more slowly and without the benefit of international cooperation.

6.6.2 What is the additional value resulting from funding H2020 projects, compared to what could be achieved by Member States at a national and/or regional levels?

Figure 42 shows results from the survey question 'In your experience do you agree that the H2020 programme adds value over and above what could be achieved at national level in the following areas?' The areas listed are shown under the bars on the figure, and can be summarised as: harmonisation across Member States, avoiding fragmentation of research and innovation, pooling of knowledge and resources, creating synergies, raising standards and addressing market failures.

The vast majority of respondents agreed or strongly agreed with each of these assertions, with the highest scores going to pooling of knowledge (89 %) and creating synergies within the research community (87 %). These two areas also had the highest proportion strongly agreeing with the assertion, with pooling knowledge at 35 % and creating synergies at 40 %. The lowest score was given to addressing market failures (73 % agreed or strongly agreed), but only 3 % disagreed with the assertion and no-one strongly disagreed, suggesting that respondents found it more difficult to judge whether H2020 adds value in this area.

Figure 42: Assessment of ways in which the H2020 programme adds value, from survey

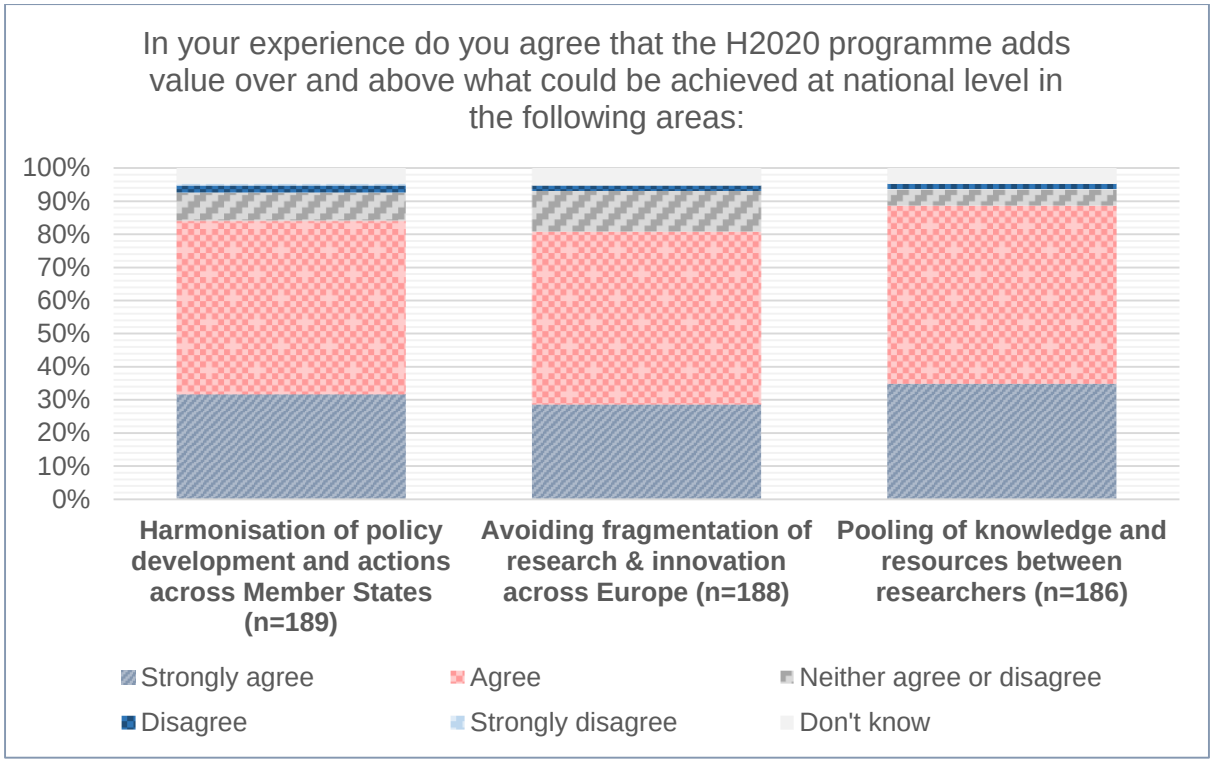
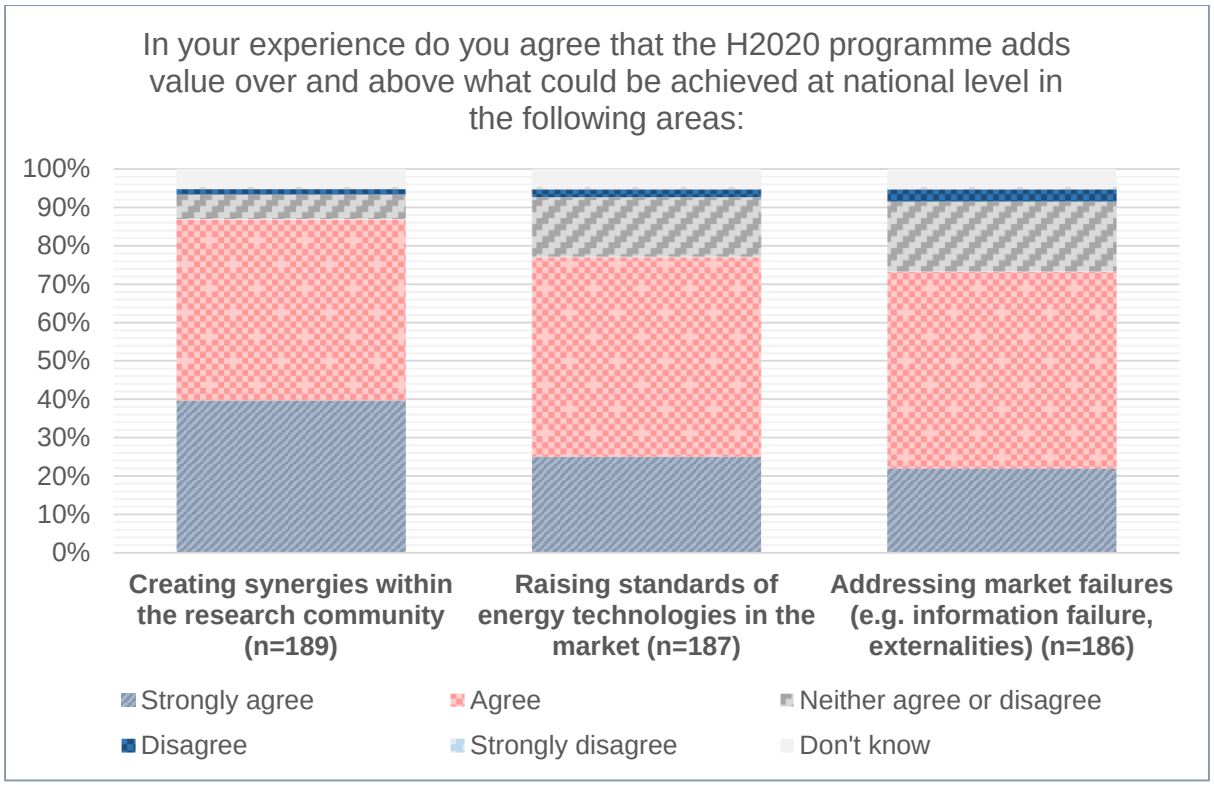


Figure 42 (cont.) Assessment of ways in which the H2020 programme adds value, from survey



Source: Questionnaire survey of H2020 participants

Interviews conducted with H2020 participants, FP7/IEE participants and unsuccessful H2020 applicants confirmed that H2020 and the predecessor programmes are widely believed to add value in all of these ways. Some interviewees also suggested other ways in which the programme(s) can add value, such as fostering cooperation between EU and non-EU members, benchmarking outputs, facilitating industry and academic cooperation and encouraging trade between countries. One

unsuccessful applicant noted that while EU funding is more competitive than national and regional funding, it is also less prone to nepotism and unfairness, and more open to outsiders to get their ideas funded.

Some of the programme participants and unsuccessful applicants were also asked how they thought EU added value of the H2020 programme related to the new holistic intervention approach being taken by H2020. This was not covered in every interview, and nearly all of those asked said that they did not know. As discussed above, EU added value is a difficult concept to grasp for many, and the marginal difference in EU added value between H2020 and its predecessor programmes is particularly difficult to judge. Moreover, only 36 % of survey respondents were aware of any simplification processes put in place for H2020 (as compared with IEE and the FP7), which suggests programme participants have a low level of awareness of differences between H2020 and its predecessor programmes more generally. One unsuccessful applicant commented that 'the holistic intervention was only making more complex what should be simpler'.

6.6.3 To what extent do the issues addressed by the programme continue to require action at an EU level?

This research question was addressed by asking unsuccessful applicants, NCPs, Commission officials, agency staff and evaluators, during interviews.

The question is pertinent because the other ways of approaching EU added value explored whether H2020 has added value in the past, and this one considers the present day and whether it continues to add value.

Of the fifteen unsuccessful applicants asked this question, twelve agreed that there is a continued need, with comments such as 'yes, obviously, because otherwise there would be a lot less innovation' and 'yes, far from all problems are solved'. Two unsuccessful applicants felt there was no ongoing need for EU level action on some issues, saying 'it is better to limit these actions' and 'depends on how relevant the topics are in the calls'. The other interviewee answered indirectly, stressing the importance of new and better policies to implement new energy technologies.

NCP interviewees mainly commented on the ongoing need for EU level and/or national level actions on market uptake and innovation. Most were in favour of action at both EU level and national level, but views differed as to the balance between funding sources, and also the balance between innovation and market uptake funding. One NCP took a contrary view, questioning whether funding at EU or national level was beneficial, saying 'companies are getting lazy and no longer want to innovate by themselves without external funding'.

Commission and agency staff provided a range of views on the ongoing need for EU action in the areas of innovation and market uptake. In most cases, those working on market uptake stated that it was important to continue action at EU level on market uptake, and those working on research and innovation stated that it was important to continue action at EU level on research and innovation. Those involved in research and innovation had differing views on the need for EU level action on market uptake, some strongly in favour and some against. This could be interpreted as vested interests, or as those closest to an issue being best placed to judge its ongoing importance.

Of the four evaluators asked this question, two agreed that there was an ongoing need for action at EU level and the other two answered indirectly, making comments about the lack of self-funded research in industry, and the lack of continuity in funding when consortia are unsuccessful in securing funding for follow-up projects.

6.6.4 Conclusions

- There is strong consensus from project participants, unsuccessful applicants and programme-level stakeholders that H2020 and its predecessor programmes add value at EU level, and that stopping the H2020 programme would disbenefit research and innovation and market uptake.
- Important aspects of EU added value from the H2020 programme include pooling of knowledge and resources between researchers, creating synergies within the research community and harmonising policy development and actions across Member States.

- It has not been possible to determine the marginal EU added value between H2020 and FP7/IEE as very few stakeholders are aware of the changes introduced for H2020 and how these relate to EU added value.
- Most stakeholders believe the issues addressed by H2020 continue to require action at EU level. There is near consensus on this for research and innovation issues and more divergent views on market uptake.

6.7 Evaluation of sustainability

The five evaluation areas covered in the previous sections are those highlighted by the Better Regulation Guidelines (European Commission, 2015b). In addition, there is interest in the extent to which the projects supported by the H2020 energy programme and its predecessors are sustainable. This has been addressed through consideration of the following question:

- To what extent are the observed effects replicated and lasting after the intervention finished?

6.7.1 To what extent are the observed effects replicated and lasting after the intervention finished?

Evidence of the sustainability of H2020 energy projects has been gathered from the portfolio analysis of IEE and H2020 projects that had not previously been evaluated (see section 4.1.2) and from a survey, interviews and case studies of participants in IEE, FP7 and H2020 energy projects and of unsuccessful applicants to H2020.

An initial assessment of sustainability was by review of project documents for IEE and H2020 energy projects that have not previously been evaluated (see Appendix 3 for list of projects).

Based on this subjective assessment, for most programme areas, the vast majority of projects did include plans for replication of a product, commercialisation of an activity, development of a business plan for future work or ongoing dissemination or impact via policy that would have a lasting effect. However, information on sustainability was not easy to discern in some cases, and it is not clear if this reflects lower longer term sustainability for the project, or that information of this type was not requested explicitly.

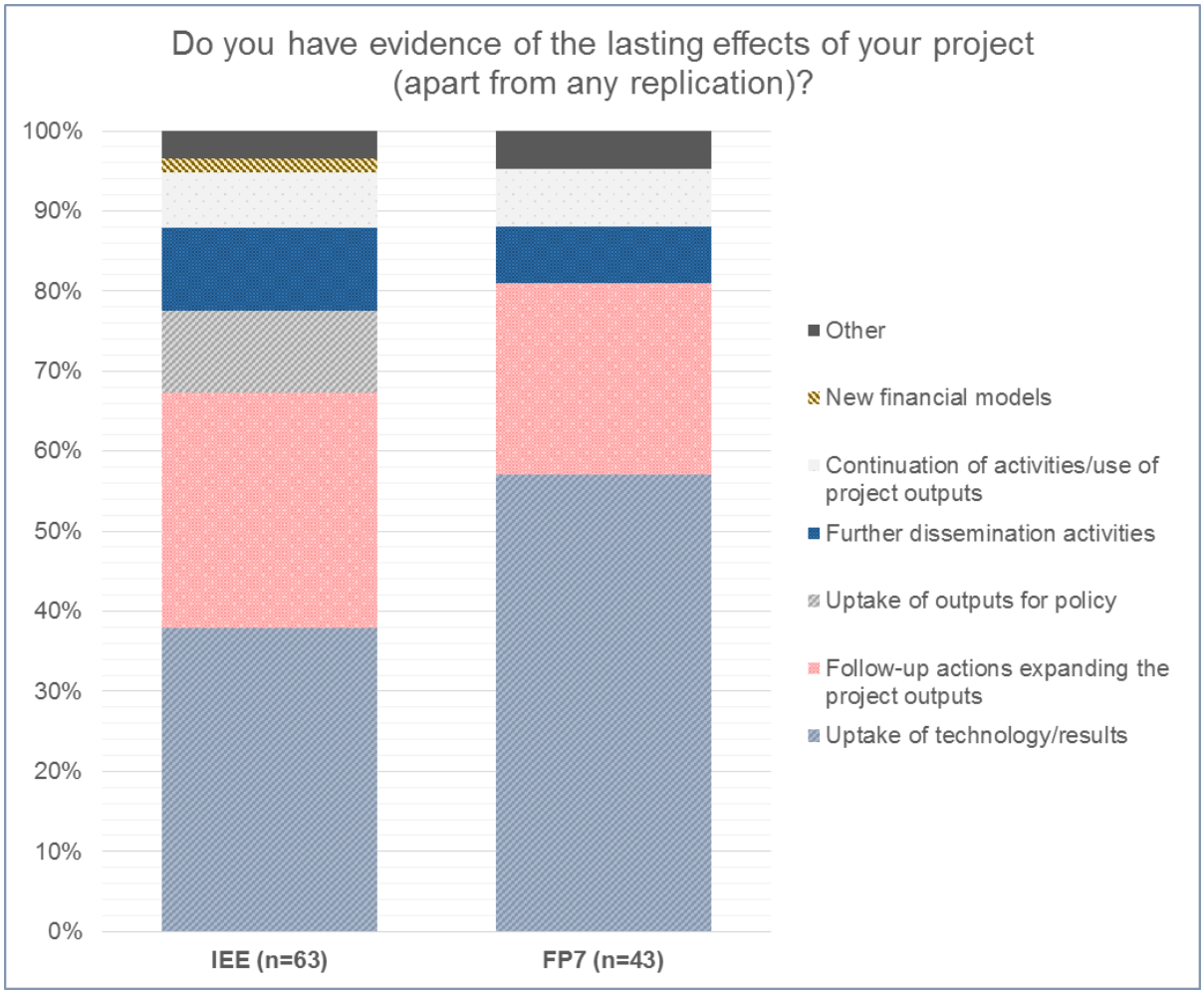
The survey used two approaches to seek further information on ways in which energy projects supported by IEE, FP7 or H2020 programmes might be sustainable.

In the first approach, participants in all three programmes selected one or more potential outcomes from the project (Figure 10 in the discussion of effectiveness – Section 6.2.1.2.1).

Less than 10 % of respondents replied that their project had led to no outcome indicated and this falls to less than 5 % for H2020 projects. Although H2020 could be considered a successor to both IEE and FP7, the anticipated outcomes are not always a balance between the outcomes of the other two programmes. There is a much stronger emphasis on the potential development of new business models from participants in H2020 projects than in IEE and FP7 projects. There is also a stronger emphasis on new services, though this is of the same order as for the IEE programme.

The second approach from the survey to developing information on sustainability was only for IEE and FP7 projects that had completed – this question was not put to respondents for H2020 projects as none have completed yet. In response to the question – do you have evidence of the lasting effects of your project (apart from replication), about one-half of FP7 respondents that answered the question (49 out of 99) and about two-thirds of IEE respondents (65 out of 98) said yes. Those answering yes provided brief explanations. These have been grouped as in Figure 43 and some examples of responses by programme for each kind of lasting effect are in Table 42.

Figure 43: Summary of free text responses for IEE and FP7 completed projects with evidence of lasting effects of the funded project (Based on 49 responses for IEE and 65 for FP7 projects)



Source: Questionnaire survey of project participants

Table 42: Examples of lasting effects quoted by survey respondents for completed IEE and FP7 energy projects

	IEE	FP7
Uptake of technology/ results	EPC project facilitation (supported by the project) is becoming more and more standard in EPC market development, even outside the EU	Companies have introduced innovations of this project into their products. A new start up has been created with the plasma technology and it has currently been implemented in several metal processing industries.
Follow up actions expanding the project results	Development of a 12 MW solar farm which will generate enough electricity for 3 000 homes. Procurement of a delivery partner for energy performance contracting, which will bring about energy and carbon reduction beyond the lifetime of the funding period. The set-up of a local authority fund to support the delivery of further energy projects.	The project has opened a new area of research in computer aided molecular design for carbon dioxide capture. The project advanced technology of crystalline silicon thin films on glass which is actively pursued by at least two leading laboratories.

	IEE	FP7
Further dissemination activities	Continuing broadcasting of the project audiovisual material, active youtube channel with project material	Number of visits from national and international organisations
Uptake of outputs by policy	The project results have been a basis for policy development in the EU (EU Heating and Cooling Strategy)	N/A
Continuation of activities/ use of project outputs	Pellet burners installed will continue to provide thermal energy in local community buildings.	Industrial partners involved in the project show interest to continue our collaboration in the field
New financial models	New financial models for geothermal projects	N/A

Source: Questionnaire survey of project participants

For over 50 % of FP7 cases, the evidence of lasting effects relates to uptake of technologies or project results. For the IEE respondents, uptake of technology/results applied to about one in three examples given. Some of the lasting effects, such as uptake of outputs by policy and use of new financial models are cited for IEE projects and not for FP7, reflecting the types of project supported.

Feedback from the interviews with project participants has broadly confirmed the findings from the portfolio analysis and the survey with references to lasting effects including through: development of networks; capacity building; knowledge sharing; dissemination; input to policy; input to models; and take up of new products and processes.

Coordinators of unsuccessful applications for H2020 EE project funding were broadly of the view that the impacts of the H2020 energy programme will be able to be replicated and sustainable. As well as mentioning the development of products or processes that can be replicated, respondents mentioned sustainable impacts through standards and policies that originate from a H2020 project and can then guide how a sector or process develops.

Unsuccessful applicants for H2020 LCE projects gave a range of views. One commented on the application process itself, considering that the costs incurred, allied with a low overall success rate, suggest that the overall investment necessary for applications is too high. Another commented on the technical scope, suggesting that, in the long run, funding may be better focussed on energy system approaches, than on individual energy technologies and their integration with the network. Other respondents commented positively on the involvement of investment facilities in H2020 programmes to seek to ensure sustainability of activities based on prototypes developed in H2020 programmes. Indeed, further support of this type would be welcomed. There was some concern however that the investment facilities may not be focussed on SMEs.

6.7.2 Conclusions

For the projects considered in the current portfolio analysis (90 IEE II projects that had not previously been evaluated and 161 H2020 projects funded from 2014 and 2015 calls), about 75 % included an indication of a route to longer term sustainability in their application documents. This could be plans for replication of a product, commercialisation of an activity, development of a business plan for future work or ongoing dissemination that would have a lasting effect. The proportion with an indication of sustainability was the same for the sets of IEE II and H2020 projects considered. However, this did vary between areas of each programme with IEE ALTENER, H2020 LCE and H2020 LCE RES MU only having indications of longer term sustainability in about 50 % of cases.

This may be a feature of the information requested or provided in the application documents as at least 90 % of respondents to the project participant survey, and over 95 % for H2020 respondents said that their project had led to or might lead to a new business model, service, process or product. Responses from H2020 respondents are highest for new business models and services and these are higher than for either the FP7 or IEE programmes.

Of those responding from IEE II and FP7 completed projects, about 2 of 3 respondents for IEE II projects and 1 of 2 from FP7 claimed that they have evidence of a lasting impact from their project.

There was a welcome from some unsuccessful applicants for the involvement of investment facilities in H2020 that may enhance impacts. There was both a request for further support of this type and some concern that it may not be focussed on SMEs.

7 Recommendations

Recommendations are based on evidence on the current state of play (Section 5.2) and on the evaluation of the H2020 energy programme in sections 6.2 to 6.7.

Current state of play

Of 198 respondents to the survey for the 161 projects in scope for the current study, 43% had not previously participated in either FP7 or IEE. This figure is encouraging in indicating a high degree of access to new participants. The comparable number for the FP7 programme had been 63 %, though it was lower for the IEE II programme. It may be appropriate to consider ways to increase further the participation by new participants.

> *Recommendation 1. That the European Union consider means of encouraging further participation in the H2020 energy programme by participants that have not participated in immediate predecessor programmes. This could involve: consideration of the nature of calls and of the application process to make them more accessible to new applicants; and consideration of the nature and extent of support provided by NCPs to support new applicants.*

Effectiveness

There is a gap in the availability of estimated and consistently calculated values at the time of Key Performance Indicators. These are requested for CSA projects but not for other types of project. It is appreciated that there will be significant uncertainties in developing such data and particularly for RIA projects. However, such data would give a further means of estimating potential impact of applications and would also provide a baseline for later review of impacts achieved.

> *Recommendation 2. That the European Union consider extending the requirement for provision of KPI data at application to IA, and possibly also to RIA projects.*

A high proportion of funding goes to EU15 states. In addition, though it is not quite as marked as for funding, a high proportion of the impacts are also in EU15 states. This may be an area for consideration, if the Commission wishes to rebalance this, at least to some extent.

> *Recommendation 3. That the European Union consider means of enhancing funding to and impacts in EU13 states. This could be by issuing more calls with themes that are particularly relevant to EU13 states. This may also be enhanced by additional support through NCPs in EU13 states.*

It is recognised that an aim of the H2020 programme has been to provide support to projects that are closer to market than typical FP7 projects through Innovation Actions. Evidence to date suggests that, indeed the average starting TRL for H2020 projects has increased from that for FP7 projects. There is however concern from some stakeholders, that if there is too little support for Research and Innovation Actions, this may suppress the next generation of innovative ideas. This comment also arose under consideration of relevance and of internal coherence of the programme. The Commission may be content with the current position for H2020 support.

> *Recommendation 4. That the European Union considers the current balance of IA, RIA and CSA support in the H2020 energy programme and considers whether a change in balance is required.*

Efficiency

One change in practice for H2020 is that there is no longer a negotiation with agencies about the work programme for each project. This has the merit of reducing the time to grant and a reduction has been seen. However, there is concern from some stakeholders that this eliminates an important support mechanism through which the quality of the project proposal and overall work plan could be significantly improved prior to contract and leads to a reduction in the overall support to applicants provided by the Commission and the Agencies and, eventually, to increased efficiency. Thus, re-

introduction of the negotiation process should be considered although, given the value of reducing time to grant for participants, it is important that this period is not prolonged. Another way this might be addressed, although less effective, would be by enhanced support from National Contact Points. (See also Recommendation 1, above)

> *Recommendation 5. That the European Union consider reintroduction of some form of negotiation stage for a certain, limited, period per project.*

Significant streamlining to application processes have been made since FP7 and IEE II. These changes have been broadly welcomed across all applicant types and for all action types. This is not universally welcomed and some, particularly those who are new to H2020 can find the process and the language unclear and vague. Building on this positive change, it may be a good time to consider further improvement to the process. This could consider, for instance: further improvement in the online/IT tools to support the management of the projects through the creation of a standard platform; reducing the length of application documents; and developing more tailored procedures and tools/documents adapted to the specific nature of a given action or challenge, keeping only the relevant and necessary elements.

> *Recommendation 6. That the European Union build on success in streamlining processes for H2020 energy projects and consider further tailoring through removal of non-essential aspects of the application and management processes, to the extent that these do not jeopardize the capacity to effectively monitor project implementation and assess progress against objectives.*

One significant barrier to participation is the low success rate for applications. This is the other side of the success story of a high level of interest in the H2020 energy programme and oversubscription which also includes a high number of low quality/ out of scope applications. This necessarily means that there is insufficient funding to support many high quality applications but also a need to reduce the number of low quality applications. Means to address this could be considered, if allowed under current H2020 rules.

> *Recommendation 7. That the European Union reconsider (lowering) the level of EU support provided to some types of projects in order to:*
>
> a. *Increase the availability of funds to support more projects in each call and address the issue of a large number of even good proposals being rejected. This can also be enhanced by providing clearer and more descriptive calls to ensure proposals address the challenges.*
> b. *Increase EU leverage*
> c. *Increase funding for calls supporting smaller projects.*

Relevance

The role of and relevance to citizens is strengthened in H2020, compared to its predecessors. H2020 has budget targeted at issues that are specifically relevant to citizens. H2020 introduced a role for social sciences in the funded energy projects. Moreover, as part of its integrated design, it specifically aims to involve beneficiaries of science and R&D co-creators in the funded projects, including citizens. An example of the latter are citizens that are actively involved in smart cities. Although H2020 has made some marked steps forward in improving relevance to citizens, citizens in general are still hardly aware of the programme or of its results, in spite of the fact that some call topics already ask for dissemination towards citizens.

> *Recommendation 8. That the European Union consider how to improve communication of the programme relevance towards EU citizens. One may consider for instance raising a campaign to generate crowd-funding as a co-finance source for H2020-projects at higher TRL-levels. An alternative to consider is the introduction of "news impact" as a criterion for evaluation of market uptake project proposals, perhaps also considering the inclusion of journalists in the commission of reviewers of proposals in some specific areas.*

Coherence

A clear and comprehensive overview of all existing EU programmes/funds is currently lacking, including which programmes are funding what projects.

Recommendation 9. That the European Union consider a mapping of all EU programmes/funds as a useful and effective means of helping ensure a broader coherence.

The findings in relation to synergies and interactions between H2020 and ESIF indicate that while the synergies and interactions may be well established in theory they do not currently appear to be working that effectively in practice. Current interactions are perceived to be on a somewhat case-by-case basis. However, H2020 with its research & innovation focus and ESIF with its infrastructure focus are indeed very complementary to one another (even if there is overlap in some topics). It is also noted, however, that there is a learning process here which is not yet complete and that, importantly, support from H2020 is allocated at EU level while ESIF implementation is under Member States' shared management rules.

Recommendation 10. That the European Union, in order to realise the potential synergies and interactions, develops and communicates better linkages between H2020 and ESIF (e.g. alignment of processes, procedures and structures and reduction of administrative burden, etc.)

EU added value

It has been noted several times in this evaluation that, although projects have started following the 2014 and 2015 calls, it is too early to quantify whether the actual, as opposed to the anticipated, outputs and impacts of projects.

Recommendation 11. That, once H2020 has been running for longer, the European Union undertake a specific evaluation of the outputs and impacts of holistic projects that would not have been eligible for support under FP7 or IEE, and to consider whether these could have been achieved through national funding alone.

Recommendation 12. That the European Union monitor the ongoing need for EU level action on these issues.

Sustainability

Evidence of potential sustainability of projects after project completion was not clear in documentation for about a significant minority of IEE and H2020 projects examined.

Recommendation 13. That the European Union consider strengthening the request for information on sustainable project impacts in project applications.

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Appendices

Appendices

Appendix 1 - Review of intervention logic

Appendix 2 - Evaluation matrix

Appendix 3 - Projects included in portfolio analysis

Appendix 4 - Portfolio analysis data fields

Appendix 5 - Survey scripts

Appendix 6 - Interview scripts

Appendices – Case studies

Appendix 7 - Case study plan

Appendix 8 – Case studies

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