Council of the European Union

Brussels, 31 May 2017
(OR. en)

9787/17
ADD 14

RECH 211
COMPET 454
IND 142
MI 458
EDUC 272
TELECOM 148
ENER 255
ENV 551
REGIO 65
AGRI 289
TRANS 227
SAN 224

COVER NOTE

From:	Secretary-General of the European Commission, signed by Mr Jordi AYET PUIGARNAU, Director
date of receipt:	29 May 2017
To:	Mr Jeppe TRANHOLM-MIKKELSEN, Secretary-General of the Council of the European Union
No. Cion doc.:	SWD(2017) 221 final - PART 15/16
Subject:	COMMISSION STAFF WORKING DOCUMENT INTERIM EVALUATION of HORIZON 2020 ANNEX 2

Delegations will find attached document SWD(2017) 221 final - PART 15/16.

Encl.: SWD(2017) 221 final - PART 15/16

EUROPEAN
COMMISSION

Brussels, 29.5.2017
SWD(2017) 221 final

PART 15/16

COMMISSION STAFF WORKING DOCUMENT

INTERIM EVALUATION of HORIZON 2020

ANNEX 2

{SWD(2017) 220 final}
{SWD(2017) 222 final}

L. SECURE CLEAN AND EFFICIENT ENERGY

L.1. INTRODUCTION

L.1.1. Context

The EU's commitment to a clean energy transition is irreversible and non-negotiable[1] and the establishment of a 'resilient Energy Union with a forward-looking climate change policy' is **one of the 10 top priorities of the Commission**. At the global level, COP21 and the Paris Agreement have recently set ambitious targets which will stimulate huge investments in low-carbon energy solutions in the next decades and, at the same time, demand a fundamental shift in technology, energy, economics, finance and ultimately society as a whole. This transformation is taking place at global scale and represents a huge opportunity for European businesses. Research and innovation on clean energy technologies are crucial elements in this transformation. The Horizon 2020 **Societal Challenge *«Secure, clean and efficient energy»*** (in the following: Energy Challenge) is a **key funding instrument of the EU in the area of clean energy research and innovation (R&I)** providing up to EUR 5.68 billion over the period 2014-2020.

At the time of drafting this thematic assessment, the work programmes 2014-2015 and 2016-2017 have already been adopted and the call results for the calls launched in 2014, 2015 and 2016 are already known (for 2016 only partially). However, **only few projects have finished or progressed to a state from where it is possible to draw valid conclusions on the programme's effectiveness and impact**.

The main **sources of evidence** of this assessment have been grant-data available in the CORDA database[2], dedicated studies commissioned by the Energy Challenge or its predecessor programmes (FP7 Energy Theme; IEE) – more specifically the study 'First results of Horizon 2020 projects in the area of energy efficiency and system integration, completed in October 2016, and the 'FP6/7 Energy Mid-term Evaluation'[3], completed in May 2014 – as well as studies and reports from the JRC and various external organisations (e.g. International Energy Agency).

Activities on **fuel cells and hydrogen (FCH)** are not covered in depth in this assessment because FCH-related activities are supported and implemented by the Fuel Cells and Hydrogen Joint Undertaking (FCH JU)[4] which, in the context of the Horizon 2020 interim evaluation, is subject to a separate dedicated assessment. The budgetary contribution of the Energy Challenge to the FCH JU is stipulated in the Regulation establishing the JU and therefore not included in the Energy Challenge work programme.

---

[1] *See COM(2016) 110*

[2] *Unless otherwise specified, data presented in this report (especially section 3) is based on the evaluation results of topics contained in the work programmes 2014, 2015 and 2016 (for the latter, only calls which have already been evaluated by end of October 2016 are included) and linked to the Energy Challenge. This includes also a number of specifically energy-related topics supported by calls of the Fuel Cells and Hydrogen Joint Undertaking.*

[3] *http://ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/impact-of-energy-projects-fp6-fp7.pdf#view=fit&pagemode=none*

[4] *The EU contribution to the FCH JU (in total EUR 655 million) for the programme period 2014-2020 is provided by the Energy Challenge (EUR 425 million) and the Transport Challenge (EUR 230 million).*

L.1.2. Objectives and intervention logic

The **specific objective** of the Energy Challenge, as defined in the Horizon 2020 Regulation, is to make the transition to a reliable, affordable, publicly accepted, sustainable and competitive energy system, aiming at reducing fossil fuel dependency in the face of increasingly scarce resources, increasing energy needs and climate change.

An additional objective, stated in Article 4 ('Union added value') of the Horizon 2020 Regulation, which applies to the whole programme but has a particular relevance for the Energy Challenge, is to **improve the competitiveness of EU industry** – in the case of the Energy Challenge it is the clean energy industry, enabling it to benefit from the opportunities of the growing global clean-energy markets.

The specific objective of the Energy Challenge is expected to contribute to the **Horizon 2020 general objectives**[5] by leveraging additional research, development and innovation funding as well as by supporting the **Europe 2020 strategy and other Union policies**, notably the Energy Union. The Energy Challenge is also expected to contribute to the **development of a European Research Area** (ERA).

The objectives of the Energy Challenge are in line with the **UN Sustainable Development Goals (SDG)** for 2030, adopted in 2015[6], and in particular SDG 7 (Affordable and clean energy), SDG 9 (Industry, Innovation, Infrastructure), SDG 11 (Sustainable cities and communities) and SDG 13 (Climate Action).

The lines of activity of the Energy Challenge defined in the Horizon 2020 Council Decision are (objectives in italics):

1. **Reducing energy consumption and carbon footprint by smart and sustainable use**
   - 1.1. Bringing to mass market technologies and services for a smart and efficient energy use
   - 1.2. Unlocking the potential of efficient renewables heating and cooling systems
   - 1.3. Fostering European Smart Cities and Communities
2. **Low-cost, low-carbon electricity supply**
   - 2.1. Develop the full potential of wind energy (*objective: to reduce the cost of electricity production of onshore and offshore wind by up to about 20 % by 2020 compared to 2010*)
   - 2.2. Developing efficient, reliable and cost-competitive solar energy systems (*objective: the cost of solar energy (photovoltaics (PV) and concentrating solar power (CSP)), should be halved by 2020 compared to 2010*)
   - 2.3. Developing competitive environmentally safe technologies for CO2 capture, transport, storage and re-use (*objective: minimise the extra-cost of CCS in the power sector*)

---

[5] *According to Article 5 of the Horizon 2020 Regulation, the general objective of Horizon 2020 is "to contribute to building a society and an economy based on knowledge and innovation across the Union by leveraging additional research, development and innovation funding and by contributing to attaining research and development targets, including the target of 3 % of GDP for research and development across the Union by 2020. It shall thereby support the implementation of the Europe 2020 strategy and other Union policies, as well as the achievement and functioning of the European Research Area (ERA)".*

[6] *The SDG were preceded by the Millennium Development Goals for the year 2015 (adopted in 2000). Energy was mainly relevant for MDG 7 ("Ensure environmental sustainability"), but did not have the same level importance and visibility as under the SDGs.*

2.4. Developing geothermal, hydro, marine and other renewable energy options *(objective: further develop and bring to commercial maturity cost-effective and sustainable technologies, enabling large-scale deployment at an industrial scale including grid integration*)

3. **Alternative fuels and mobile energy sources**

3.1. Making bioenergy more competitive and sustainable *(objective: bring to commercial maturity the most promising technologies, to permit large-scale, sustainable production of advanced biofuels of different value chains in a bio-refinery approach for surface, maritime and air transport, and highly efficient combined heat and power and green gas from biomass and waste, including CCS)*

3.2. Reducing time to market for hydrogen and fuel cell technologies *(objective: the cost of fuel cell systems for transportation will have to be reduced by a factor of ten over the next 10 years)*

3.3. New alternative fuels

4. **A single, smart European electricity grid** *(objective: to transmit and distribute about 35% of electricity from dispersed and concentrated renewable energy sources by 2020)*

5. **New knowledge and technologies**

6. **Robust decision making and public engagement**

7. **Market uptake of energy innovation - building on Intelligent Energy Europe (IEE)**

The **priorities within the objectives have evolved** since the design of Horizon 2020 due to the significant advancement of many innovative energy technologies. The focus at policy level[7] and within the Energy Challenge has evolved from improving specific technologies and their components to their **smart integration in an efficient, consumer-centred energy system**.

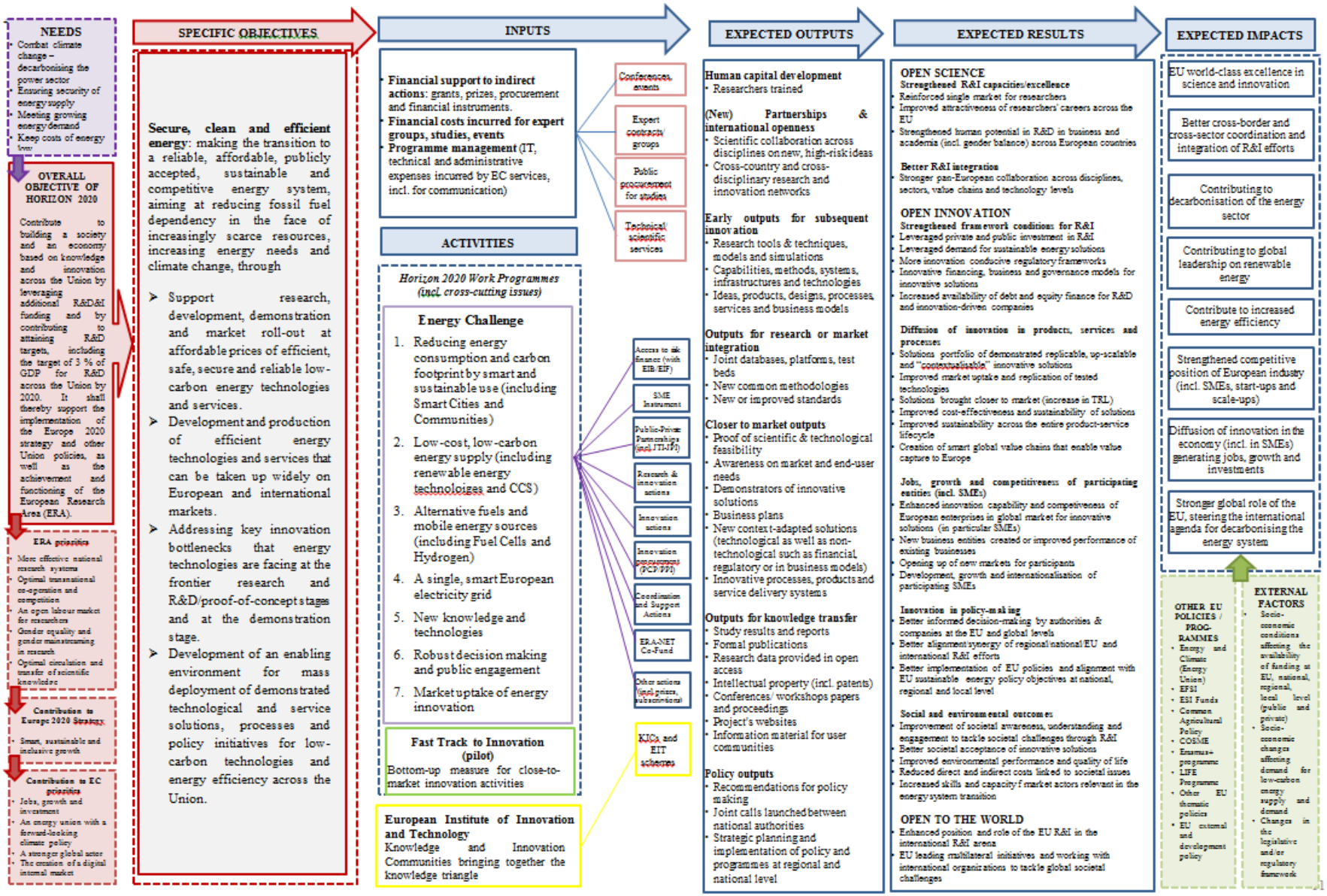
The comparison with the objectives of the Specific Programme *«Cooperation – Energy Theme»* in the Seventh Framework Programme for Research and Technological Development (FP7) shows a **high degree of continuity**: all main lines of activity of the FP7 Energy Theme are continued under the Horizon 2020 Energy Challenge.

The most significant new area in Horizon 2020 is **"market uptake of energy innovation"** which results from the **integration of the previous Competitiveness and Innovation Programme (CIP)**, and more specifically the energy-sector-related aspects of the Intelligent Energy for Europe (IEE) programme, into Horizon 2020 (IEE focussed mainly on removing non-technological barriers for the market-uptake of sustainable energy solutions). The transport-related aspects supported under the IEE programme are now supported under Societal Challenge 4.

To address the identified objectives, the thematic programme has adopted the following **intervention logic** (see Figure 209): the programme's objectives respond to specific needs by providing inputs which are used to support a set of activities which generate outputs, results and, at a later stage, lead to impacts which are however also influenced by factors beyond the scope of Horizon 2020.

[7] *See for example the Commission Communication "Towards an Integrated Strategic Energy Technology (SET) Plan: Accelerating the European Energy System Transformation", C(2015)6317, adopted in September 2015*

Figure 213 – Intervention logic of Horizon 2020 Energy Challenge



Source: European Commission.

This assessment focusses mainly on analysing:

- to what extent the needs and programme objectives are still relevant and whether the programme's objectives address the needs (section L.3, "Relevance"),
- how effective the programme has been in generating relevant outputs and results (section L.4, "Effectiveness"),
- how efficient it was in transforming inputs into outputs (section L.5, "Efficiency"),
- whether the programme is coherent as regards the interplay of different parts and as regards other funding programmes (section L.6, "Coherence"), and
- whether the programme's achievements could have been achieved also by national programmes without EU intervention (section L.7, "EU Added Value").

L.2. IMPLEMENTATION STATE OF PLAY

L.2.1. Overview of programme inputs and activities

As of 1 January 2017, the state of play is the following:

The Energy Challenge has opened:

- **37 topics in the 2014 calls** (17 topics in the Energy Efficiency call; 16 topics in the LCE call; 2 topics in the SCC call; 2 topics in the SME instrument call). In addition, 10 topics targeting energy projects have been opened by the FCH JU.
- **33 topics in the 2015 calls** (15 topics in the Energy Efficiency call; 14 topics in the LCE call; 2 topics in the SCC call; 2 topics in the SME instrument call). In addition, 8 topics targeting energy projects have been opened by the FCH JU

In 2016, in total 37 topics were open and in 2017, in total 42 topics (excluding the FCH JU).

The Horizon 2020 Energy Challenge has accomplished an **increased focus** in its funding priorities. The Energy Challenge doubled the available EU funding per topic from EUR 7 million (FP7 Energy Theme) to EUR 15 million, while the overall number of topics opened per year remains around 40 despite the integration of activities previously supported under the IEE programme. The increase in focus results from the **challenge-based approach under Horizon 2020** which is characterised by broader topics which define specific challenges but leave it to the applicants to propose the most appropriate approach for tackling the challenge.

The EU contribution allocated to the implementation of the calls included in Work Programmes 2014-2016 and which have been closed by the date of 5 April 2016[8] has been

[8] *By the time of drafting this report, all 2014 and 2015 calls are included, but only some of the 2016 calls are included (Horizon 2020-BG-2016-1, Horizon 2020-EE-2016-PPP, Horizon 2020-EE-2016-RIA-IA, Horizon 2020-JTI-FCH-2016-1, Horizon 2020-LCE-2016-ERA, Horizon 2020-LCE-2016-ETP, Horizon 2020-LCE-2016-RES-CCS-RIA, Horizon 2020-LCE-2016-SGS, Horizon 2020-SCC-2016, Horizon 2020-SMEINST-1-2016-2017, Horizon 2020-SMEINST-2-2016-2017 – some of them only partially), so the overall statistics for 2016 are not yet complete. 2017 calls are not yet closed. If reference is made to 2017, information is based on the work programme 2017, i.e. figures are only indicative.*

EUR 1 786.4 million, about 31.5% of total expected budget[9] allocated to the Energy Challenge in Horizon 2020 (which is EUR 5 688.1 million for the period 2014-2020[10]).

By 31 October 2016, in total **193 projects have finished** (of which 189 feasibility studies financed under the SME instrument, phase 1) representing EUR 11.34 million of EU contribution (corresponding to only **0.6% of the current project portfolio** in terms of EU contribution). 529 projects are ongoing, representing an EU contribution of EUR 1 775 million.

Each activity line of the Energy Challenge has been addressed through the Work Programmes 2014- 2017. Table 161 provides an overview of the budget allocation across activity lines[11].

Table 159 - Activities and allocated share of budget dedicated projects funded under the Horizon 2020 Energy Challenge for the programming period 2014-2017

Activities in the legal basis	Allocated share of thematic budget
EU 3.3.1. Reducing energy consumption and carbon footprint by smart and sustainable use (including Smart Cities and Communities)	**EUR 868.9 million – 30.6% of the total** Projects: 2014-2015: EUR 392.0 million 2016-2017: EUR 351.8 million 'Other Actions' (2014-2017): EUR 125.1 million
EU.3.3.2. Low-cost, low-carbon energy supply (including renewable energy technologies and CCS)	**EUR 879.3 million – 31.0% of the total** Projects: 2014-2015: EUR 394.7 million 2016-2017: EUR 395.3 million 'Other Actions' (2014-2017): EUR 89.3 million
EU.3.3.3. Alternative fuels and mobile energy sources (including Fuel Cells and Hydrogen[12])	**EUR 461.5 million – 16.3% of the total** Projects: 2014-2015: EUR 101.9 million 2016-2017: EUR 93.6 million Contribution to FCH JU (2014-2017): EUR 256 million 'Other Actions' (2014-2017): EUR 10 million
EU.3.3.4. A single, smart European electricity grid	**EUR 499.9 million – 17.6% of the total** Projects: 2014-2015: EUR 256.8 million 2016-2017: EUR 236.1 million 'Other Actions' (2014-2017): EUR 7 million

[9] The total expected budget, as stated in the legal base, also includes administrative budget, contributions of the Energy Challenge to horizontal activities, and activities funded by the Energy Challenge implemented without calls for proposals (e.g. procurements, contributions, financial instruments). The budget available for call-based grants is therefore lower than the total available budget of the Energy Challenge.

[10] The initial budget of the Energy Challenge, as stated in REGULATION (EU) No 1291/2013, was EUR 5 931,2 million. However, the Horizon 2020 budget has been modified in June 2015 through REGULATION (EU) 2015/1017 (contribution to the European Fund for Strategic Investments)..

[11] Data for 2014-2015 is complete. Data for 2016 is incomplete at this stage as some calls have not been evaluated yet. In this circumstances and with a view to ensure consistent figures, the budget included for 2016-2017 correspond to the budgets indicated in the work programme (in cases where topics cover more than one action line, a centre-of-gravity-approach is followed to account the budget in the table). The budget for the SME instrument for 2016-2017 has been allocated between the activity lines on a pro-rata basis.

[12] Activities in the area of Fuel Cells and Hydrogen are implemented by the Joint Undertaking on Fuel Cells and Hydrogen (FCH JU) which receives budget contributions from the Energy and Transport Challenge. The budget for projects of the FCH JU classified as 'energy' is lower than the Energy Challenge's contribution to the FCH JU. In the table, the contribution of the Energy Challenge to the FCH JU is included.

Activities in the legal basis	Allocated share of thematic budget
EU.3.3.5. New knowledge and technologies	**EUR 39.7million – 1.4% of the total** 2014-2015: EUR 18.2 million 2016-2017: EUR 21.5 million
EU.3.3.6. Robust decision making and public engagement	**EUR 86.5 million – 3.1% of the total** Projects: 2014-2015: EUR 33.1 million 2016-2017: EUR 23.7 million 'Other Actions' (2014-2017): EUR 29.7 million
EU.3.3.7. Market uptake of energy innovation[13]	***EUR 401.3 million – 12.8% of the total*** 2014-2015: EUR 161.1 million 2016-2017: EUR 112.0 million 'Other Actions' (2014-2017): EUR 128.2 million

Source: European Commission, based on CORDA data and Energy work programme 2016-2017.

The following tables provide key data regarding the implementation of the Energy Challenge. **A detailed discussion of the data is included in sections L.5.1 ("Budgetary resources") and L.5.2 ("Programme's attractiveness").**

Table 160 - Key data on proposals per type of action for the Horizon 2020 Energy Challenge: Number of eligible and retained proposals, EU contribution requested (in million Euros) and success rates (as % of proposals submitted, and as % of budget available)

Type Of Action	Nr of Eligible Proposals	Nr of high quality proposals	Nr of Retained Proposals	EU Contribution requested by Eligible Proposals (EUR million)	EU Contribution to Retained Proposals (EUR million)	Success Rate Proposals	Success Rate Funding
CSA	827	245	141	1 406.0	230.9	17.0%	16.4%
ERA-NET-Cofund	10	10	10	91.4	91.4	100%	100.0%
IA	534	156	72	4 946.8	839.3	13.5%	17.0%
RIA	933	332	132	3 539.3	562.4	14.1%	15.9%
SME-1	2 502	331	264	125.1	13.2	10.6%	10.6%
SME-2	1 018	441	64	1 580.2	100.4	6.3%	6.4%
Total	**5 824**	**1 515**	**683**	**11 688.8**	**1 837.5**	**11.7%**	**15.7%**

Source: CORDA data, 1 January 2017, Success Rates by Type of Action (General).

[13] *Projects and Other Actions funded under this activity have been accounted for under activities 3.3.1, 3.3.2 and/or 3.3.3 (this action line refers to a certain type of activity (market uptake) which is however an integral part of the 'thematic' action lines).*

Table 161 - Key data on signed grants per type of action for the Horizon 2020 Energy Challenge: number, EU contribution, time-to-grant, projects' total costs, % of EU contribution in projects

Type Of Action	Nr of Signed Grants	EU Contribution to Signed Grants (EUR million)	Share of EU Contribution to Signed Grants (in Programme Part)	Nr of Grants signed within 8 months (TTG)	Share of Grants Signed within TTG Benchmark (in all Signed Grants)	Project Total Cost in Signed Grants (EUR million)	Share of Total Costs (Signed Grants)	Share of EU co-funding
CSA	122	198.1	11.4%	109	89.3%	200.5	8.6%	98.8%
ERA-NET-Cofund	9	77.1	4.4%	6	66.7%	251.7	10.8%	30.6%
IA	70	768.6	44.3%	60	85.7%	1 089.9	46.7%	70.5%
RIA	140	588.9	33.9%	126	90.0%	644.8	27.6%	91.3%
SME-1	242	12.1	0.7%	242	100%	17.3	0.7%	69.9%
SME-2	57	90.5	5.2%	55	96.5%	129.4	5.5%	69.9%
Total	640	1 735.2	100%	598	93.4%	2 333.7	100%	74.4%

Source: CORDA data, 1 January 2017, Selected Projects and Signed Grants by Type of Action.

L.2.2. Participation patterns

L.2.2.1. Participation per type of organisation

The signed proposals involve in total **4179 participations**, mobilising **2692 distinct participants**.

Table 162 - Key data on participation per type of organisation for the Horizon 2020 Energy Challenge: number of participants, of project coordinators, of newcomers, of participations, and EU contribution to participations (in million Euros)

Legal entity type	Nr of Participants in Signed Grants	Nr of Projects Coordinators in Signed Grants	Nr of Newcomers in Signed Grants	Nr of Participations in Signed Grants	Average Participations per Participant	EU Contribution to Participations in Signed Grants (EUR million)
Higher Education (HES)	299	64	8	679	2.3	243.9
Other (OTH)	303	40	223	445	1.5	103.5
Private for profit (PRC)	1514	403	931	1860	1.2	850.8
Public bodies (PUB)	282	24	134	421	1.5	174.5
Research centres (REC)	294	109	47	774	2.6	362.5
Total	**2692**	**640**	**1343**	**4179**	1.6	**1735.2**

Source: CORDA data, 1 Janary 2017, Participants and Participations by Legal Entity.

A detailed discussion of the data is included in sections L.5.1 ("Budgetary resources") and L.5.2 ("Programme's attractiveness").

L.2.2.2. Attraction of new participants / newcomers

There are **1 343 newcomers** (not having participated in FP7, but probably having participated in the IEE programme) representing 49.9% of all participants in signed projects funded so far under the Energy Challenge (excluding the SME instrument and the FCH JU, the share of newcomers is 45.8%). More than 2/3 of all newcomers are from industry. Especially the SME topic attracted new participants, but also market uptake activities (previously supported under the IEE programme) and Smart Cities and Communities were above average (for more information, see section L.5.2.1).

L.2.2.3. Geographical participation patterns

All 28 EU Member States participate in projects funded under the Energy Challenge. A more detailed discussion of the data presented in table 165 is in sections L.5.1 ("Budgetary resources") and L.5.2 ("Programme's attractiveness").

Table 163 - Key data on participation per EU Member State for the Horizon 2020 Energy Challenge: number of participants, of project coordinators, of newcomers, of participations, and EU contribution to participations (in million Euros)

Country	Nr of Participants in Signed Grants	Nr of Projects Coordinators in Signed Grants	Nr of Newcomers in Signed Grants	Nr of Participations in Signed Grants	EU Contribution to Participations in Signed Grants (EUR million)	Success rate of applications
Austria	96	23	50	163	74.2	18.8%
Belgium	125	22	51	199	76.2	18.2%
Bulgaria	41	2	25	53	6.7	12.0%
Croatia	25	2	17	42	4.3	13.4%
Cyprus	12	1	4	25	3.9	12.5%
Czech Republic	39	2	17	56	11.6	15.6%
Denmark	75	23	45	135	59.1	16.8%
Estonia	23	2	13	31	11.4	13.0%
Finland	45	19	19	76	45.0	12.6%
France	174	39	80	264	128.4	17.7%
Germany	317	88	158	519	292.8	18.0%
Greece	61	17	25	116	32.7	10.1%
Hungary	23	5	9	32	6.5	6.9%
Ireland	48	17	18	67	28.1	16.6%
Italy	291	83	153	425	155.6	12.6%
Latvia	23	1	14	31	4.5	14.1%

Country	Nr of Participants in Signed Grants	Nr of Projects Coordinators in Signed Grants	Nr of Newcomers in Signed Grants	Nr of Participations in Signed Grants	EU Contribution to Participations in Signed Grants (EUR million)	Success rate of applications
Lithuania	13	2	8	19	2.2	10.1%
Luxembourg	10	1	7	12	2.0	23.1%
Malta	6		4	8	0.6	12.9%
Netherlands	138	25	70	237	118.1	18.4%
Poland	48	5	23	72	12.3	9.5%
Portugal	66	8	35	102	37.7	13.0%
Romania	42		27	61	10.5	14.3%
Slovakia	17	2	9	23	2.7	10.7%
Slovenia	35	8	19	60	19.4	11.9%
Spain	329	119	163	511	214.4	15.2%
Sweden	91	19	42	130	69.0	17.5%
United Kingdom	269	68	133	397	213.5	15.8%
Total	2 482	603	1 238	3 866	1 643.2	15.0%

Source: CORDA data, 1 January 2017, Participants and Participations by EU-28 Member State.

Table 164 - Key data on participation per Associated Country for the Horizon 2020 Energy Challenge: number of participants, of project coordinators, of participations, and EU contribution to participations (in million Euros)

Country	Nr of Participants in Signed Grants	Nr of Projects Coordinators in Signed Grants	Nr of Participations in Signed Grants	EU Contribution to Participations in Signed Grants (EUR million)
Bosnia and Herzegovina	2		2	0.2
Switzerland[14]	55	2	104	0.2
Faroe Islands	1		1	0.2
Israel	20	14	23	6.8
Iceland	13	6	18	16.1
Republic of Macedonia	6		6	0.4
Norway	49	14	84	48.4
Serbia	10		11	2.3
Turkey	23	1	30	11.9
Ukraine	7		9	0.9
Total	**186**	**37**	**288**	**87.4**

Source: CORDA data, 1 January 2017

[14] *Switzerland was classified as a 'third country' until 31.12.2016, but as of 1.1.2017 it has the status of an 'Associated country'. For this analysis, it is considered as an 'Associated country' as of the start of Horizon 2020.*

L.2.2.4. International cooperation

Signed projects (by 1.1.2017) funded under the Energy Challenge calls 2014-2016 include in total **25 participations** from **25 entities** established in third countries (i.e. not being EU Member State nor associated to Horizon 2020) which receive a total EU contribution of EUR 4.65 million (representing 0.27% of the total EU contribution so far). In terms of EU contribution, the most successful third countries were **South Africa** and **Morocco** (accounting for almost 80% of the total EU contribution to third countries); in terms of participations, Korea was the most active country (5 participations) followed by Morocco (4 participations), as well as the US and South Africa (both 3 participations). Participation of third countries was particularly high in the area of renewable energy and bioenergy.

15 out of 341 projects (excluding SME instrument calls) – **4.4% of all projects** - had at least one participation from a third country organisation.

L.2.3. Cross-cutting issues

Projects funded under the 2014, 2015 and 2016 calls of the Energy Challenge and with the grant agreement signed before 1.1.2017, contributed to the following cross-cutting issues (defined in the Horizon 2020 Regulation, Annex III):

- **Sustainable development**[15] (the target for Horizon 2020 is at least 60%): 628 out of the 640 funded projects contribute fully to climate change actions (representing 98.7% of the total budget), while 10 projects contribute 'partially' (representing 1.2% of the total budget) and 2 projects don't contribute. The overall 'weighted' contribution of projects funded under the Energy Challenge by 1.1.2017 is 98.8% (EUR 1.75 billion).
- **Climate-change related expenditure**[16] (should exceed 35% of the overall Horizon 2020 budget): 628 out of the 640 funded projects contribute fully to climate change actions (representing 98.7% of the total budget), while 10 projects contribute 'partially' (representing 1.2% of the total budget) and 2 projects don't contribute. The overall 'weighted' contribution of projects funded under the Energy Challenge by 1.1.2017 is 99.3%.
- **Digital Agenda**[17]: 58 projects contributed to the EU's Digital Agenda (20 contributing 'fully', 38 'partially'; accounting for 9.7% of all projects) representing a 'weighted' EU contribution of EUR 133.9 million (7.7% of the total EU contribution of the Energy Challenge). However, a separate analysis at *project level* showed that by 1.1.2017, a total of 73 projects (representing 23% of the total budget) feature a significant ICT component.
- **Integration of social-sciences and humanities (SSH)**[18]: As regards the promotion of social sciences and humanities (SSH) under the Energy Challenge, in the period 2014-

[15] The monitoring was done at topic level across Horizon 2020, i.e. topics in the work programme were flagged as either 'fully', 'partially' or 'not' contributing (following the logic of the 'Rio-Markers', projects 'fully participating were accounted for with 100%, projects 'partially' contributing were taken into with 40% of the EU contribution, projects not contributing were not taken into account). Projects were categorized according to the categorisation of the topic under which they have been funded.

[16] The same methodology as for 'Sustainable Development' was applied.

[17] The monitoring was done at topic level across Horizon 2020, i.e. topics in the work programme were flagged as either 'fully', 'partially' or 'not' contributing. Projects were categorized according to the categorisation of the topic under which they have been funded.

[18] This information is based on projects already financed under calls closed in 2014 and 2015. For 2016 and 2017, information will be only available respectively in 2017 and 2018. Data and details on the methodology used can be found in the monitoring reports on SSH projects in 2014 and 2015.

2017 there were 42 topics and one inducement prize which have been classified as being relevant for SSH researchers. It can be observed that within the projects selected under these topics in the 2014-2015 Energy Challenge calls, 19% of all participants indeed have an SSH background receiving 19% of the EC contribution dedicated to these topics. Projects funded under the 2016 calls have not yet been analysed in detail.

- **Industry participation** (including **SMEs**): 44.5% of all participants are from industry accounting for 49% of the total budget. As regards SMEs (which is a sub-category of industry), 27% of all participations were SMEs accounting for 25% of the total EU contribution (if the SME instrument is excluded, SME participations account for 21% and 21% of the EU contribution).
- **Pre-commercial procurement (PCP)** and **public procurement for innovation (PPI)**: One topic using the PPI instrument for supporting the public procurement of innovative solutions for energy efficiency is included in the 2017 energy efficiency call.
- **Gender balance** in the projects[19]: The share of women among the project's workforce was 32.2% (Horizon 2020 average).
- **Share of funding for non-fossil fuel[20] related activities** (commitment to not exceed 15% of the Energy Challenge budget): The budget share dedicated to non-fossil fuel related activities was 93% (or 93.6% in case the contribution to the FCH JU is taken into account).
- **Share of funding for market-uptake activities**[21] (commitment to dedicate at least 15% of the Energy Challenge budget): The budget share for dedicated market-uptake actions (grants and 'Other Actions') in the period 2014-2017[22] was 15.6% in case the budgetary contribution to the FCH JU is excluded and 14.2% in case it was included (see table 167).

[19] *Data on the gender of the project's workforce is gathered through the project's periodic reporting. By 1 January 2017, only 107 projects (funded under the 2014 calls) had already submitted their first periodic report. Therefore, the figures on gender of project work force are only based on a limited subset of projects.*

[20] *The Horizon 2020 Regulation states: "With a view to achieving the Union's long-term climate and energy objectives, it is appropriate to increase the share of the budget dedicated to renewable energy, end-user energy efficiency, smart grids and energy storage activities as compared to the Seventh Framework Programme, and increase the budget dedicated to market uptake of energy innovation activities undertaken under the Intelligent Energy Europe Programme within the Competitiveness and Innovation Framework Programme (2007 to 2013). The total allocation to these activities shall endeavour to reach at least 85 % of the budget under this societal challenge".*

[21] *The Declaration of the Commission annexed to the Horizon 2020 Regulation states: "The Commission will endeavour to ensure that at least 85 %, of the energy challenge budget of Horizon 2020 is spent in non-fossil fuels areas, within which at least 15 % of the overall energy challenge budget is spent on market up-take activities of existing renewable and energy efficiency technologies in the Intelligent Energy Europe III Programme".*

[22] *By the time this assessment was drafted, no projects or 'Other Actions' have been funded yet with 2017 budget. Therefore, for 2017, the indicative budgets included in the Energy work programme 2016-2017 have been used for the calculations.*

Table 165 - Share of the Energy Challenge budget for market-uptake actions, 2014-2017

	Project grants (Mio €)	Other Actions (Mio €)	Total (Mio €)	Share of total
Excluding contribution to FCH JU				
Market-uptake actions	273.1	128.2	401.3	**15.6%**
Non market-uptake actions	2 045.6	132.9	2 178.5	84.4%
Total	2 318.7	261.1	2 579.8	
Including contribution to FCH JU				
Market-uptake actions	273.1	128.2	401.3	**14.2%**
Non market-uptake actions	2 301.6	132.9	2 434.5	85.8%
Total	2 574.7	261.1	2 835.8	

Source: European Commission.

No project addressing **biodiversity** has been funded so far under the Energy Challenge.

For evaluating proposals submitted under the Energy Challenge calls 2014-2015, in total 863 **experts** (540 male (63%), 323 female (37%)) have been contracted. They participated 1 775 times (1 105 for male, 670 for female).

Figure 2: Organisational origin of expert evaluators, Energy Challenge

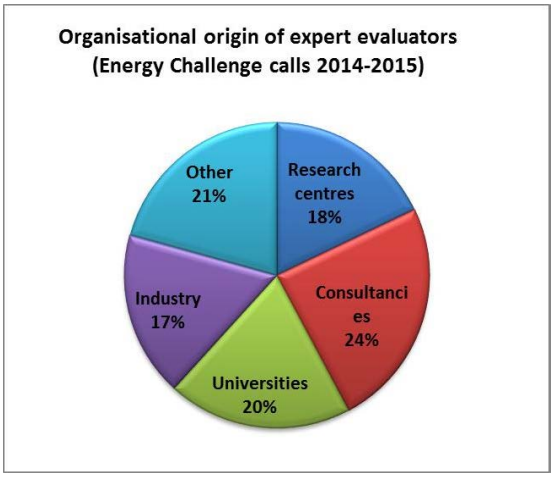
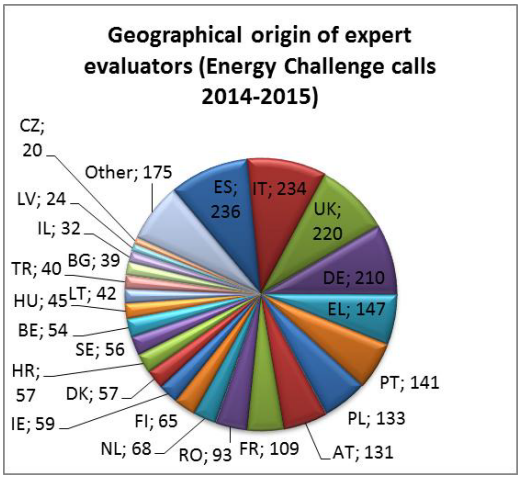


Figure 1: Geographical origin of expert evaluators, Energy Challenge 2014-2015



Source: CORDA (extracted 4.11.2016).

L.2.4. Other issues related to the state of implementation

The activities of the Energy Challenge are implemented by Executive Agencies (INEA, EASME), Commission services (RTD, ENER, CNECT) and the FCH JU[23]:

- INEA manages projects in the area of renewable energy, decarbonisation of fossil fuels, energy system (smart grids and energy storage), Smart Cities and Communities; socio-economic research; and energy-related projects in the Blue Growth calls;
- EASME manages projects in the area of energy efficiency as well as the SME instrument;

[23] *The number and projects and EU budget for projects managed by the FCH JU refers only to projects that have been flagged as contributing primarily to the Energy Challenge activity line (3.3.). The total number of projects implemented by the FCH JU is higher as it covers also transport-related activities.*

- The Commission services manage projects that are exempted from the Delegation Acts because of their specific policy-relevant content.
- The FCH JU manages all projects in the area of fuel cells and hydrogen.

So far, EASME implements almost 2/3 of all projects (including SME instrument), while INEA implements 2/3 of the total project budget (this is due to the relative average size of the projects in each Agency, with EASME being particularly focused on the SME, which have a relatively small size compared to the other instruments).

The **division of responsibilities between DG RTD and DG ENER** have changed at the start of Horizon 2020: whereas in the predecessor programmes DG RTD has focussed on research-oriented activities and DG ENER on demonstration activities, the new arrangement under Horizon 2020 is that:

- DG ENER finances the full R&I chain as regards the energy demand side (in particular energy efficiency, energy system (grids and storage) and Smart Cities and Communities); and
- DG RTD finances the full R&I chain as regards the energy supply side (in particular renewable energy and decarbonisation of fossil fuels).

Cross-cutting issues and the contribution to the FCH JU are financed by both services.

Given that the principle of equal budget split between the two DGs remained in place, this arrangement limits the flexibility of the programme to focus more resources on either the supply or the demand side (both are effectively capped at 50% of the overall budget).

L.3. RELEVANCE

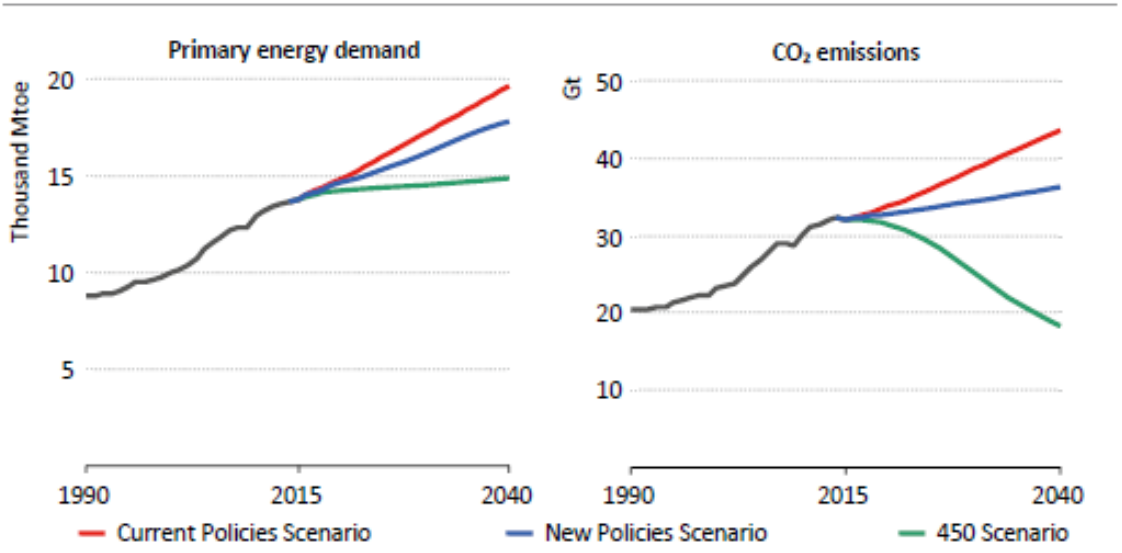
L.3.1. Is the Horizon 2020 Energy Challenge tackling the right issues?

L.3.1.1. The relevance of the Horizon 2020 Societal Challenge 'Secure, clean and efficient energy' given the challenges to address

The underlying rationale for the Energy Challenge has been the need to **decarbonise the energy system**, especially in the context of a **projected increase in global energy demand**[24] (see Figure 212), and ensuring at the same time a **secure provision of energy** and **competitive energy prices**. In addition, it targets the increase of **competitiveness of EU clean energy industry** enabling it to profit from the projected global market growth for clean energy technologies.

[24] *See for example 'World Energy Outlook 2012", published by the International Energy Agency. The rise in global energy demand has been confirmed in any new edition of the World Energy Outlook and by many other energy projections.*

Figure 216: Evolution of primary energy demand and CO2 emissions



Source: "World Energy Outlook 2012", IEA, 2012.[25]

According to the EU 'Roadmap for moving to a competitive low carbon economy in 2050', adopted in March 2011[26], and confirmed by many other studies[27], the **power sector has the biggest potential for decarbonisation** and will have to be fully decarbonised by 2050 if the 2ºC-target (i.e. limiting rise of global temperatures to well below 2ºC above pre-industrialisation levels) is to be achieved.

Given that the **energy mixes are different for all countries**, depending on their geographical, climatic, environmental and economic conditions as well as their endowment with natural resources, there has been a broad consensus, predating the time when Horizon 2020 was prepared, that **there is no 'silver bullet' that could solve the challenge of decarbonising the EU energy system**. Instead, there is a general agreement that a **portfolio approach**, including different technological options which can be adapted to the different circumstances, is the best way forward[28]. The most relevant technology options of such a portfolio are:

- Energy efficiency in end-use sectors such as in buildings and cities;
- Carbon Capture and Storage in the power and energy intensive industries;
- Renewable energy such as wind, solar, bio-energy, geothermal, hydropower and marine energy;
- Alternative transport drive-trains such as electric vehicles and fuel cells;
- Smart electricity grids, including utility-scale energy storage;
- Nuclear energy.

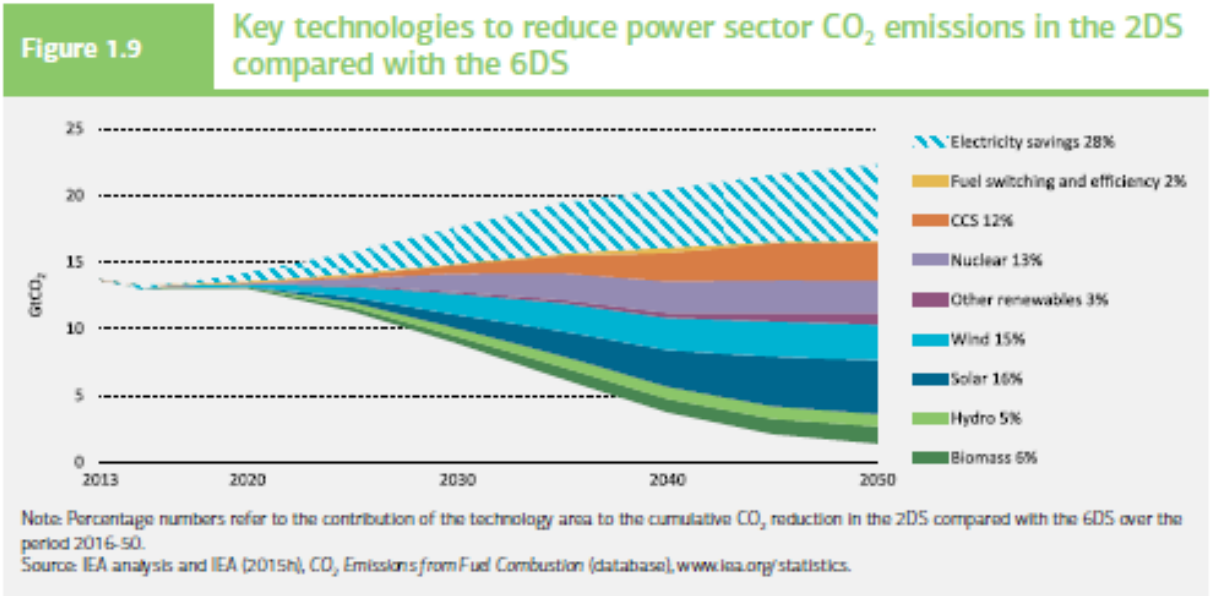
[25] *The '450 scenario' sets out an energy pathway consistent with the goal of limiting the global increase in temperature to 2°C by limiting concentration of greenhouse gases in the atmosphere to around 450 parts per million of CO2. The 2012 edition of the WEO has been chosen because it was relevant at the time when Horizon 2020 was prepared. However, also the current WEO edition (2016) confirms that the basic trends have remained unchanged.*

[26] *Commission Communication "A Roadmap for moving to a competitive low carbon economy in 2050", COM (2011) 112*

[27] *E.g. GECO 2016 - Global Energy and Climate Outlook, Road from Paris, JRC, 2016*

[28] *See for example: EU Energy Roadmap 2050 (COM/2011/885); "Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change", IPCC 2007; "World Energy Outlook Special Report – Energy and Climate Change", IEA 2015; or "Energy Technology Perspectives 2016", IEA 2016*

Figure 217: Key technologies to reduce power sector CO2 emisions in the 2DS compared with the 6DS



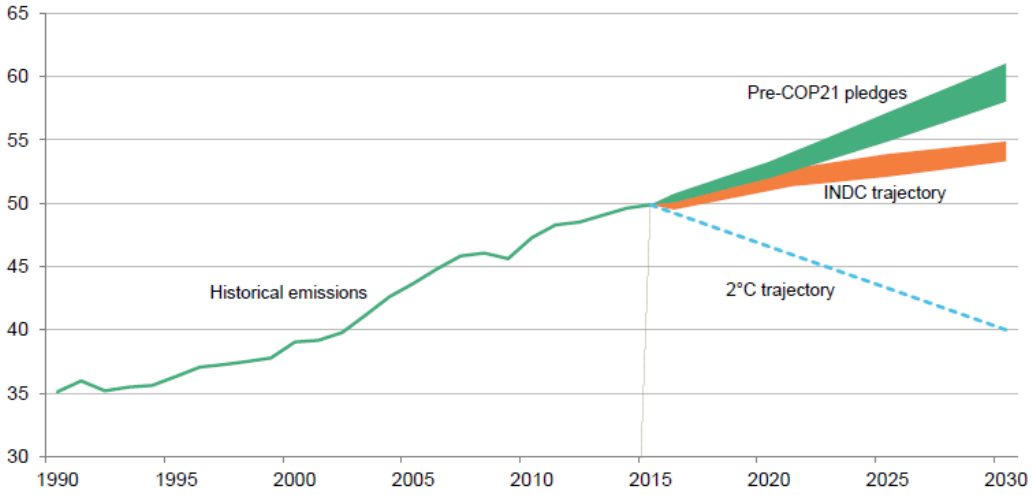
Source: "Energy Technology Perspectives 2016", IEA, 2016.

The basic assumptions as regards the contribution of low-carbon technologies to mitigating climate change have not changed since the time when Horizon 2020 was prepared. However, given that the progress in CO2 emission reductions since the preparation of Horizon 2020 was below the level required in the ambitious scenarios, **current projections foresee an even higher share for low-carbon energy technologies**, in particular renewables[29].

The scale of the **challenge of decarbonising the energy system is enormous** and current policy measures (as outlined in the 'Intended Nationally Determined Contributions' (INDC) submitted during COP 21) will fall short of achieving the required CO2 reductions. There is still a huge gap between the 'INDC trajectory' and the '2°C trajectory' (see Figure 214). According to estimations by BNEF[30], with current trends it would take 150 years to decarbonise the power generation and 332 years to fully decarbonise the global energy system.

[29] *The 450 scenario included in the "World Energy Outlook" of 2012 assumes a share of 37% for low-carbon energy technologies in world primary energy demand by 2040. In the 2016 edition, the assumed share of low-carbon energy technology is 42%. For renewable energy only, the share increases from 26.5% (2012 edition) to 31.3% (2016 edition).*
[30] *Bloomberg New Energy Finance; Keynote speech by Michael Liebreich at the 'Future of Energy' Summit 2016 (https://about.bnef.com/blog/liebreich-state-industry-keynote-emea-summit-2016/)*

Figure 218: Gap between pre-COP21 pledges, intended nationally determined contributions and the 2ºC trajectory



Source: UNFCCC, UNEP, Climate Action Tracker, Bloomberg New Energy Finance, 2016

An additional important element for justifying for public support for energy R&I is the **special nature of low-carbon energy innovations**[31]:

- Consumers can hardly differentiate between 'low carbon' and 'dirty' energy. Low-carbon innovations typically involve neither a more productive, more reliable, better looking, easily identifiable nor less expensive product that consumers are eager to adopt. The market risk for firms that invest in low-carbon R&D can be very large.
- Low-carbon innovations require not just incremental or even radical innovations, but paradigm shifts in several sectors and the transformation of the way economies, industries, cities and individuals produce or use energy.
- Energy-industry players have an extremely conservative approach to modifications, and any new equipment installed will define the nature of the system for typically 30 to 50 years. This has a direct impact on viable migration and evolution paths towards the newer systems envisaged for the future.

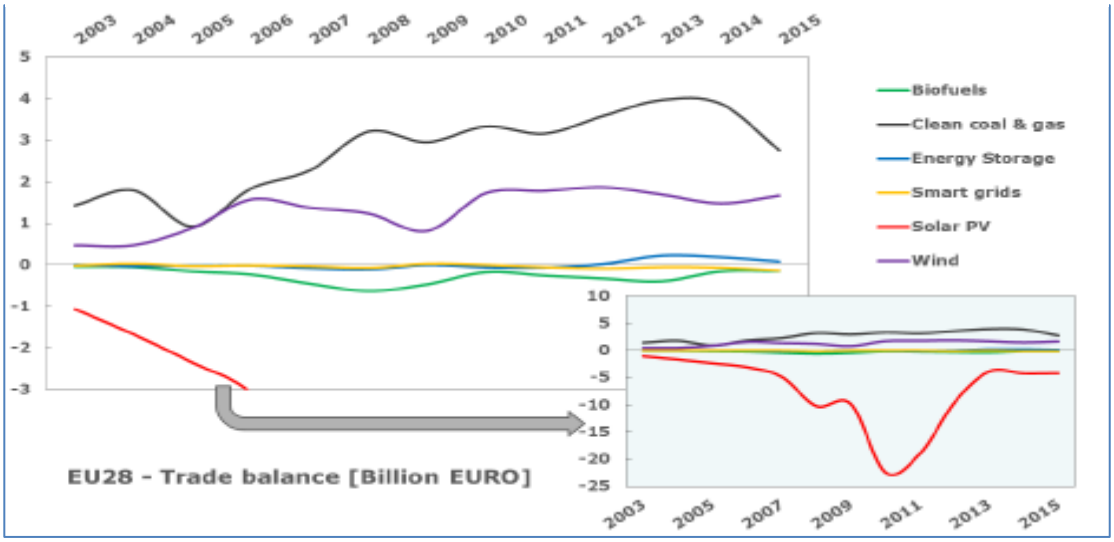
Increased public support for research and innovation in low-carbon energy is needed, for enlarging the portfolio of options available and, over time, bring down the cost of achieving global climate change mitigation goals. It is however clear that increased effort in research and innovation alone will not suffice. A supportive regulatory, market and financial framework is indispensable.

The Horizon 2020 **Energy Challenge addresses the most relevant technology options and issues for decarbonising the energy system** except transport (which is covered by the dedicated Horizon 2020 Transport Challenge) and nuclear energy (which is supported under the "Research and Training Programme of the European Atomic Energy Community (2014-2018) complementing the Horizon 2020 Framework Programme for Research and Innovation"). The activities of the Energy Challenge are expected to contribute to increasing the maturity of clean energy technologies and to pave the way for their large-scale uptake in the EU and globally.

[31] *Report of the FP7 Advisory Group on Energy (AGE) 2011: http://ec.europa.eu/research/fp7/pdf/advisory-groups/energy_report_2011.pdf#view=fit&pagemode=none*

The **global market for clean energy technologies is expected to grow enormously** in the coming decades. According to BNEF[32], nearly two-thirds of the global capacity additions by 2040 (6 091 GW out of 9 519 GW) will be **renewables** (mainly solar and wind energy) of which two-third will be installed in **non-OECD-countries** (mainly China and India) and one-third in OECD countries. In terms of investments, **roughly EUR 424 billion will be invested each year[33] in new power generation capacity** of which two-thirds will be targeted at renewable energy (the market for solar energy alone is estimated at EUR 3.13 trillion until China.

Figure 3: Trade balance of EU-28 as regards clean energy technologies



Source: Pasimeni, F., EU Energy Technology Trade, JRC, Science for Policy Report, Publications Office of the European Union, Luxembourg, 2017 (forthcoming).

The **global competition for capturing the clean energy growth markets is strong**. The trend in patents for Energy Union priorities shows that the EU productivity of **patents** was similar to that of South Korea and better than that of the USA. However, the EU has been lagging behind China and Japan[34].

The **trade balance** of EU-28 (see Figure 215) shows that the EU has a positive balance as regards 'clean coal & gas' and 'wind', whilst for solar PV and, to a lesser extent, biofuels it is negative. The balance for the other energy technologies is rather neutral.

L.3.1.2. The relevance of the Horizon 2020 Energy Challenge to address European objectives

Energy and Climate

The **main policy-reference points** for EU energy-related R&I at the time of preparing Horizon 2020 were the Commission Communication ***"Energy 2020** – A strategy for competitive, sustainable and secure energy"* (COM(2010) 639), adopted in November 2010, and the Communication ***"Energy Technologies and Innovation"*** (COM(2013)253), adopted in May 2013 and accompanied by a Commission Staff Working Document (SWD(2013)157).

[32] *'New Energy Outlook 2016', Bloomberg New Energy Finance, 2016*
[33] *The IEA estimates that the full implementation of the climate plans being part of the Paris Agreement reached at COP21 will lead to investments of USD 13.5 trillion in energy efficiency and low-carbon technologies from 2015 to 2030, an annual average of USD 840 billion.*
[34] *SWD(2017) 32*

These documents already acknowledged the important role of R&I in the transformation of the energy system and called for increased actions[35].

The **EU's energy and climate targets for 2020** (reduce greenhouse gas emissions by 20%; increase the share of renewable energy to 20% and to make a 20% improvement in energy efficiency), as well as the **long-term decarbonisation target** of 80-95% CO2 emission cuts by 2050, were adopted by the European Council in 2007 and set the scene for the objectives and ambitions of the Energy Challenge.

Since the start of Horizon 2020, the **profile of EU energy and climate policy has even increased**: since 2014, a **"Resilient Energy Union with a Forward-Looking Climate Change Policy"** is one of the Commission's top-priorities. The **Energy Union strategy**[36], adopted in 2015, identifies Research, Innovation and Competitiveness as one of five (mutually reinforcing) dimensions of EU energy and climate policy (for the other dimensions, see Figure 210) and the Communication **"Accelerating Clean Energy Innovation"**[37], adopted on 30 November 2016, lays out a comprehensive strategy for an EU policy on clean energy innovation.

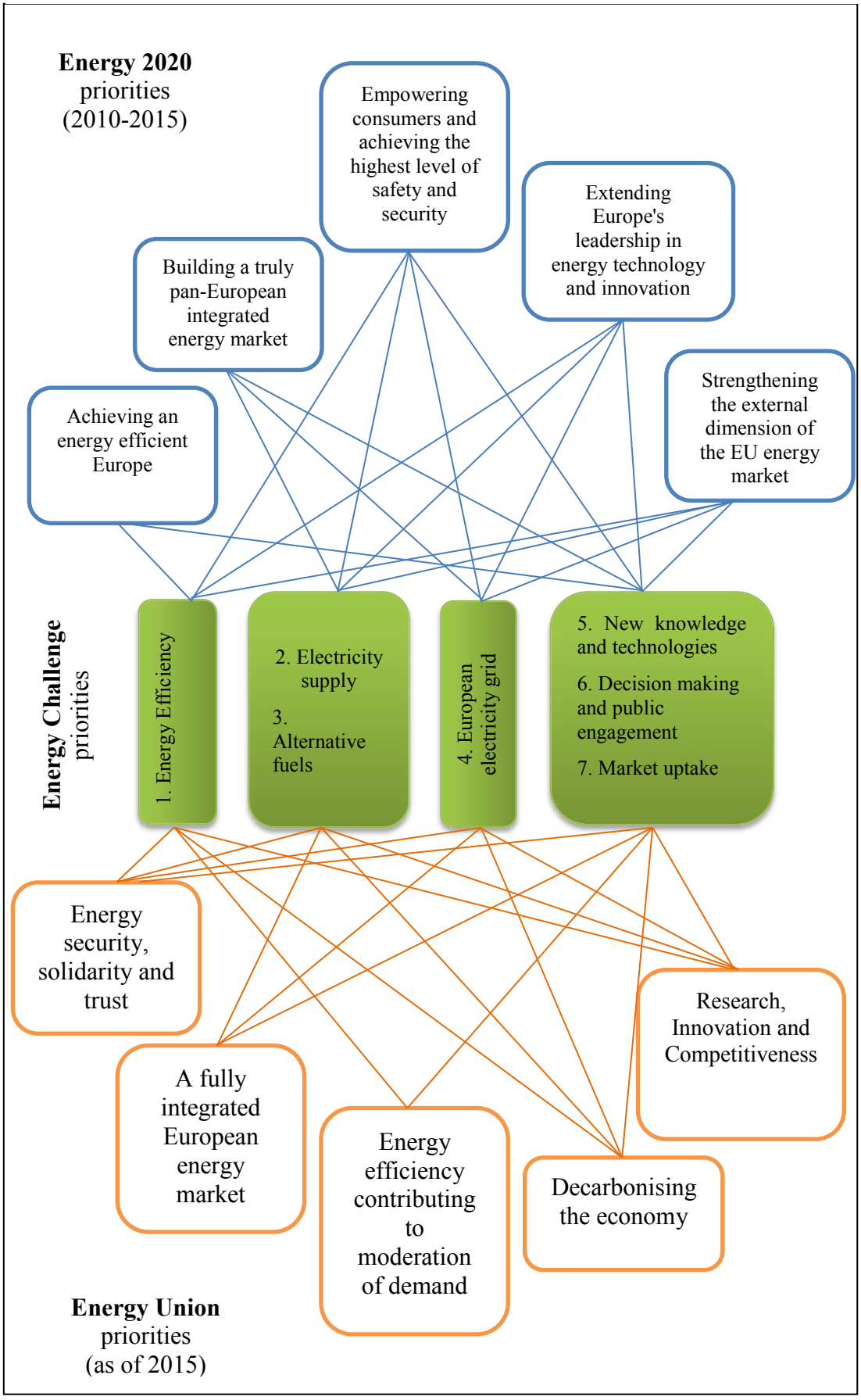
New **energy and climate targets for 2030** have been endorsed by the European Council in September 2014[38], calling for at least 40% domestic reduction in greenhouse gas emissions compared to 1990; at least 27% for the share of renewable energy consumed in the EU; at least 27% improvement of energy efficiency and an electricity interconnection target of 15%.

Activities of the Energy Challenge have been contributing to the objectives of EU energy and climate policy, as stated in the Energy 2020 Communication and in the 'Energy Union Strategy' (adopted by the Commission in February 2015) by:

- **Reducing energy consumption and carbon footprint**: R&I activities for improving energy efficiency and reducing energy consumption and wastage are expected to result in a lower energy demand which has positive effects on energy security (less energy imports necessary) and contributes to the decarbonisation of the economy. Reducing energy consumption is also closely linked to empowering consumers.
- **Low-cost, low-carbon electricity supply**: R&I activities on renewable energy technologies and the decarbonisation of the use of fossil fuel are expected to contribute to the decarbonisation of the energy system, to increased energy security (better use of indigenous energy sources; diversification of the energy mix) and to reduced energy prices (through lowering the costs of technologies). The integration of renewable energy in the energy system is closely linked to the energy grids and the integration of the European energy market.
- **Alternative fuels and mobile energy sources**: R&I on alternative fuels are expected to contribute to the decarbonisation of the transport system and to increased energy security (lower dependency on important fossil fuels).

[35] *The EU Energy 2020 Strategy states: "Without a technological shift, the EU will fail on its 2050 ambitions to decarbonise the electricity and transport sectors. Given the time scale for the development and dissemination of energy technology, the urgency of bringing new high performance low-carbon technologies to the European markets is more acute than ever".*
[36] *"A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy", COM(2015) 80*
[37] *COM (2016) 763*
[38] EUCO 169/14

Figure 4 - Links of the Energy Challenge activities to energy policy priorities



- **A single, smart European electricity grid**: R&I on grids is essential for building an integrated European energy market, for increasing flexibility, reliability and security of the energy system and for decarbonising the economy by enabling the integration of a high share of renewable energy.
- **New knowledge and technologies**: R&I activities on novel, more efficient energy solutions ensure that the innovation pipeline is constantly fed and new trends are taken up. Activities in this area are expected to contribute to all policy objectives, in particular as regards the decarbonisation of the economy, increasing energy efficiency, lowering energy prices and improving energy security.
- **Robust decision making and public engagement**: R&I activities in this area ensure that policy-making is based on the best evidence available and that the social, economic and political dimension of the energy transformation is taken into account. As a cross-cutting issue, activities in this area are expected to contribute to all policy objectives, especially as regards energy efficiency, the decarbonisation of the economy, the integration of the European energy market and energy security.
- **Market uptake of energy innovation**: Activities in this area aim at deploying and implementing sustainably and innovative energy solutions thereby contributing to all policy objectives, notably as regards energy efficiency, the decarbonisation of the economy, the integration of the European energy market and energy security.

The Energy Challenge addresses **three of the four R&I core priorities identified in the Energy Union Strategy**:

- Being the world leader in developing the next generation of **renewable energy technologies**, including environmentally-friendly production and use of biomass and biofuels, together with energy storage;
- Facilitating the participation of **consumers** in the energy transition through smart grids, smart home appliances, smart cities, and home automation systems;
- **Efficient energy systems**, and harnessing technology to make the building stock energy neutral;

In addition, the Energy Challenge also supports the Energy Union priority of **Carbon capture and storage (CCS)**[39] and carbon capture and use (CCU) for the power and industrial sectors.

The Horizon 2020 Energy Challenge is also expected to play a central role in the Commission's efforts to **follow-up the Paris Agreement**[40] (which underlined for the first time the crucial role of innovative technologies and solutions in ensuring an effective response to climate change), notably through its participation in "**Mission Innovation"**. The Mission Innovation initiative was launched by 20 major economies at the 21st Conference of Parties (COP21) of the UN Framework on Climate Change (UNFCCC) which was held in Paris in November 2015. The Commission joined the initiative on behalf of the EU in 2016. Members of Mission Innovation (including all major economies and GHG emitters) have committed to doubling their clean energy annual R&D budgets by 2020 thereby contributing

[39] *The Energy Union Strategy mentions CCS an 'additional priority' which merits a greater level of collaboration between the Commission and those Member States who want to use this technology.*

[40] *See Commission Communication "The Road from Paris: assessing the implications of the Paris Agreement and accompanying the proposal for a Council decision on the signing, on behalf of the European Union, of the Paris agreement adopted under the United Nations Framework Convention on Climate Change", COM(2016) 110*

to the advancement of more efficient and clean technologies which will be crucial for decarbonising the energy sector[41].

EU R&I policy

The main objectives of EU research and innovation policy, as defined in the Horizon 2020 Regulation, are to

- strengthen its **scientific and technological bases** by achieving a **European Research Area** ("ERA");
- encourage the Union to advance towards a **knowledge society** and to become a **more competitive and sustainable economy** in respect of its industry;
- ensure that the conditions necessary for the **competitiveness of Union industry** exist;
- **increase spending on research and development** in order to attract private investment of up to two thirds of total investments, thereby reaching an accumulative total of **3%** of gross domestic product (GDP) by 2020.

In 2015, these research-policy objectives have been complemented by the "**3 Os**", put forward by Commissioner Moedas, which call for open science, open innovation and openness to the world[42].

The **Energy Challenge contributes to EU R&I objectives** by:

- Supporting a great number of research performers in **increasing the knowledge base** as regards energy-related issues;
- In the context of the **SET-Plan**, identifying and defining **common thematic priorities for EU and national support programmes** which allow to better align EU and national programmes thus fostering a European Research Area in energy.
- Enhancing trans-national cooperation of leading research and innovation actors in the EU thereby contributing to the **creation of trans-European excellence clusters** and a European Research Area;
- Improving the **competitiveness of EU industry** in the low-carbon energy sector by involving industry in the identification of funding priorities and dedicating almost half of the total EU contribution to industry participants.
- **Leveraging additional funding** from national and private sources through joint actions (mainly in the context of the Strategic Energy Technology Plan – SET-Plan) and public-private partnerships (e.g. in the area of Fuel Cells and Hydrogen).
- **Fostering participation of non-EU countries** on the basis of mutual-interest and mutual-benefit through dedicated bilateral actions thereby enhancing scientific and engineering competences of the EU and partner countries; gaining access to unique sites and facilities; sharing costs and risks; accelerating the innovation of specific technologies; addressing global problems and establishing standards.

---

[41] *The mission statement of Mission Innovation reads as follows: "In support of economic growth, energy access and security, and an urgent and lasting global response to climate change, our mission is to accelerate the pace of clean energy innovation to achieve performance breakthroughs and cost reductions to provide widely affordable and reliable clean energy solutions that will revolutionize energy systems throughout the world over the next two decades and beyond". Additional information is available on the Mission Innovation website: http://mission-innovation.net/*

[42] *http://ec.europa.eu/research/openvision/index.cfm*

Other EU policy priorities

In addition to the Commission's Energy and Climate policy, the Horizon 2020 Energy Challenge is also in line with the following Commission priorities:

- ***Jobs, Growth and Investment***: by providing strong support for EU industry (half of the total Energy Challenge budget) to benefit from the (European and global) growth markets in clean energy technologies which is expected to translate into new manufacturing capacities and jobs in the EU.
- ***Digital Single Market***: by supporting Europe's economy, industry and citizens to take full advantage of what digitalisation offers for the energy sector in terms of efficiency and quality-of-life improvement.
- ***A Stronger Global Actor***: by cooperating with international partner countries on issues of common interest and benefit, e.g. in the context of Mission Innovation, thereby attracting foreign investment and knowledge; opening up to new markets; promoting economic growth and sustainable development as well as addressing global problems.

L.3.2. Flexibility to adapt to new scientific and socio-economic developments

While the objectives of the Horizon 2020 Energy Challenge remain valid, the **technological and socio-economic context has evolved** since the start of Horizon 2020. The following drivers have gained in importance and impact the development of the energy sector[43]:

- **The new role of consumers** and citizens will lead to new business models based on energy services, optimisation and sharing. This development is reflected in the EU energy policy framework (e.g. Energy Union Strategy, SET-Plan Technology Map, see above) by the more prominent role given to consumers. On the research side, the increased consumer-focus calls for a stronger role of Social Sciences and Humanities, in particular as regards a better understanding of consumer's behaviour and motivations.
- **Digitisation**: Based on the integration of ICTs, the energy sector is in the transition from an asset-centric sector to a more consumer-centric one enabling new business models, services and processes, and also new actors in a newly designed energy market. Big Data, Artificial Intelligence and the Internet of Things are key drivers for this transformation. This transformation is expected to increase the efficiency of the energy system and generate new profit streams and jobs. Furthermore, digitisation enhances the active participation of consumers/prosumers along the energy value chain.
- **Increased global competition**: European manufacturers increasingly compete on a level platform with international manufacturers emerging from economies with less strict environmental standards, lower production costs and quickly improving quality standards. In addition, emerging economies have a higher incentive than mature economies to develop and deploy renewable energy systems because they do not face the difficulties of transforming an old existing infrastructure. This may give national

[43] *See report of the Horizon 2020 Advisory Group on Energy (AGE) 2016:* *http://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetailDoc&id=25609&no=1*

industry a competitive advantage since the home market allows for learning and further improvement of technologies and solutions. Strong R&I capacities of industry are a crucial factor for competing successfully at European and global level.

The **Horizon 2020 Regulation provides sufficient flexibility** for the Energy Challenge to respond to these developments and measures have been taken to take them into account:

- The increased policy-focus on **consumers** is reflected by greater attention to socio-economic research and integration of **social sciences and humanities (SSH)**, compared to the time when Horizon 2020 was adopted. Such activities have been supported through dedicated stand-alone topics and through the integration of SSH-related aspects in technology-oriented topics (see also section L.4.4.5). The total funding for Energy Challenge projects with a significant SSH-dimension in 2014-2015 already exceeds the total amount for such activities in the FP7 Energy Theme (EUR 28 million compared to EUR 17.7 million). Consumer acceptance, their engagement and empowerment, is also the focus of market uptake actions which intend to help the consumer to find its way in the new energy market and system landscape in order to reap the tangible benefits from the transition to clean energy.
- The focus within the energy sector has moved since the start of Horizon 2020 from a vertical and technology-specific focus towards a more horizontally **integrated system approach** which pays more attention to enabling the intelligent integration of technologies into an overall smart system[44]. The funding share for energy systems and Smart Cities and Communities has increased from 20% under the FP7 Energy Challenge to 28% for the period 2014-2015.
- Topics targeting explicitly the **integration of ICTs** have been supported in the areas with the greatest potential for synergies, i.e. energy efficiency, energy systems and Smart Cities and Communities. These topics succeeded in bringing together the energy and ICT stakeholder community to work jointly on solutions. Within the project portfolio of the 2014 and 2015 Energy Challenge calls, projects with a strong ICT component account for 25% of the total EU contribution[45].
- **Bottom-up topics targeting new concepts** have been opened on a regular basis (e.g. in the case of renewable energy technologies by topic LCE-1-2014 and LCE-6-2017, for energy storage by topic LCE-10-2014). Such topics allow scouting for new developments which, in case they prove promising, can be further supported and matured.
- **Close cooperation with other relevant programme parts**, e.g. with the NMBP, ICT, Transport, Climate and Bio-economy part, when defining priorities and drafting topics, has been ensuring that important developments in other areas have been properly reflected in the Energy Challenge calls (see also section L.6.1.2. 'Internal coherence with other Horizon 2020 intervention areas').

[44] *See Commission Communication "Towards an Integrated Strategic Energy Technology (SET) Plan: Accelerating the European Energy System Transformation" (C(2015) 6317 final) adopted in September 2015.*
[45] *Based on a review of project abstracts and keywords.*

L.3.3. Addressing specific stakeholder needs

The process for defining priorities and drafting call texts is based on a **broad consultation of stakeholders** which ensures that call texts address the relevant issues and correspond to the needs of the stakeholder community.

At the level of overall priorities, several very comprehensive and systematic consultations have been carried out in the context of the **Strategic Energy Technology Plan (SET-Plan)**:

- During September 2013-October 2014, more than 150 key stakeholders representing the entire energy system – coming from the European energy technology platforms, sector associations, the research community, market actors and investors – were consulted on the **SET-Plan Integrated Roadmap**. The final outcome[46] of the consultation identified four key Energy System Challenges (Active consumer at the centre of the energy system, Demand focus - increasing energy efficiency across the energy system, Systems optimisation, and Secure, cost-effective, clean and competitive supply). For each Energy System Challenge a portfolio of key technological and non-technological solutions have been formulated by the stakeholders as specific R&I actions covering the whole innovation chain. The final document is the first comprehensive roadmap at EU level covering the whole energy system – it is a key reference document for Horizon 2020, but also for national funding programmes.
- Building on the Integrated Roadmap (see above) and the Energy Union, **10 Key Actions**[47] have been identified and a broad stakeholder consultation has been conducted between December 2015 and December 2016 with key stakeholders, including European Technology and Innovation Platforms (ETIPs), European Energy Research Alliance (EERA), research performers, and Member States to identify common targets (formalised in the form of 'Declaration of Intends') for each sector. In a second consultation round, expected to be completed during 2017, Member States / Associated Countries will lead the development of **Implementation Plans** with key stakeholder (research, industry) detailing a set of coordinated private, national and EU activities and the means of implementing them through national programmes, industry funds and, in case activities are of high EU Added Value, Horizon 2020.

The outcomes of these consultations have informed the priority setting for the work programmes 2014-2015, 2016-2017 and will also provide valuable input for strategic approach of the work programme 2018-2020.

Besides the SET-Plan, Member States and Associated Countries also contribute to the identification of priorities through the Energy configuration of the **Horizon 2020 Programme Committee**. The Programme Committee has also a key role for translating the overall priorities into concrete call texts. In many cases, national delegations have established networks of national experts which help reviewing the draft work programmes and provide comments which are fed back to the Commission and, in many cases, included in the work programme.

[46] https://setis.ec.europa.eu/system/files/Towards%20an%20Integrated%20Roadmap_0.pdf
[47] *See Commission Communication "Towards an Integrated Strategic Energy Technology (SET) Plan: Accelerating the European Energy System Transformation" (C(2015) 6317)*

In addition, the Horizon 2020 **Advisory Group on Energy (AGE)** has provided strategic advice to the Commission as regards the priorities to be taken up in the work programmes 2014-2015, 2016-2017 and 2018-2020[48].

L.3.4. Lessons learned/ Areas for improvement

Providing secure, clean and efficient energy is a key challenge for Europe and at global level. Business-as-usual is not sufficient for decarbonising the energy system by 2050 (this was known when Horizon 2020 was prepared). Also, more ambitious policies, as agreed in COP21, will not deliver the necessary emission reductions (this is known since 2016). Increased R&I efforts are the best hope for closing the gap between the projected trends and the well below 2ºC target. Increased R&I efforts will also be crucial for enabling EU industry to profit from the projected growth of the global clean energy markets in the coming decades. Activities supported under the Energy Challenge are therefore more relevant than ever.

The Energy Challenge's objectives are also fully in line with EU policies, most notably in the area of energy and climate policy. The Energy Union Strategy identified Research, Innovation and Competitiveness as one of five dimensions of EU energy and climate policy providing important contributions also to the objectives of 'energy security, solidarity and trust', 'integrated European energy market', 'energy efficiency' and 'decarbonising the economy'. In addition, the Energy Challenge also contributes to EU R&I policy and other EU sectorial policies (e.g. Jobs, Growth and Investment; Digital Single Market; Stronger Global Actor).

Since the preparation of Horizon 2020, the socio-economic and political context of energy R&I has further evolved (most importantly as regards the role of consumer and digitisation). The relevance of the Energy Challenge activities is underpinned by an extensive consultation of the stakeholders community (including industry, Member States/Associated Countries, research community), mainly in the context of the SET-Plan. Based on the involvement of a broad and diverse stakeholder community, the Energy Challenge has been able to identify key challenges and address new developments.

L.4. EFFECTIVENESS

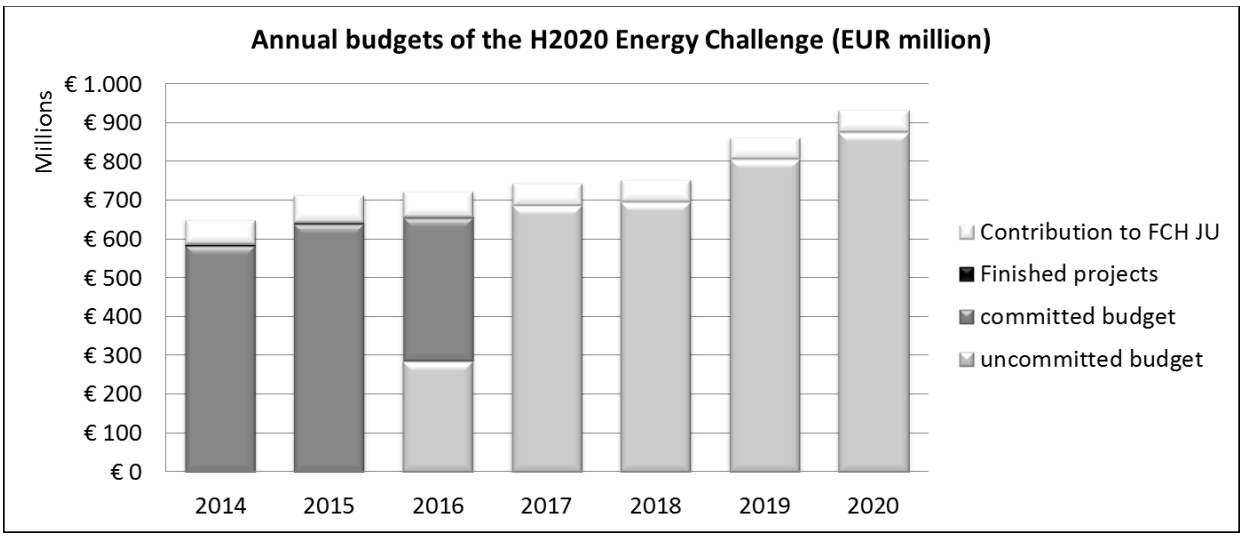
The assessment of the programme's effectiveness is **complicated** by the fact that:

- For most energy areas, the **Horizon 2020 legal base does not include specific targets or indicators** against which outputs and progress could be benchmarked.
- The programme's effectiveness, especially in the long-term, depends to a substantial extent on **external factors beyond the scope of Horizon 2020**, e.g. the regulatory framework including taxation and subsidy schemes, trade policy or market developments.
- By **1 January 2017**, **only 30% of the total available Energy Challenge budget has been committed** and, within this part, only a very small sub-set of projects are finished (representing 0.7% of the current project portfolio and 0.2% of the total Energy Challenge budget). By 1 January 2017, **214 projects have been completed** of which 210 projects were feasibility studies financed under the SME instrument, phase 1 (representing EUR 10.5 million of EU contribution) and 4 CSAs (3 supporting

[48] *For further information see* *http://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetail&groupID=2981*

specific events and one market-uptake action, representing in total EUR 2 million EU contribution). 426 projects are ongoing, representing an EU contribution of EUR 1 722.7 million, and projects for a value of EUR 3 353 million will still be signed until the end of the programme. It is clear that the measurable output at this stage of the programme implementation **can capture only a small portion of the *current* project portfolio** and an **even smaller share of the *final* project portfolio**. Furthermore, the **set of projects already finished or reporting intermediate results is not representative**.

Figure 5: State of implementation of the Energy Challenge as of 1 January 2017



Source: European Commission.

L.4.1. Short-term outputs from the programme

With the caveats mentioned above, the following **short-term outputs** for the 644 finished/running projects (total EU contribution: 1 607 million), generated through the EU contribution for projects, can already be identified (based on CORDA data extracted on 1 January 2017). **By 1 January 2017**:

- **2 569 participants** from 44 countries receive EU funding (in addition, 123 participants from 25 countries participate without receiving funding).
- Energy Challenge projects involve an estimated **28 500 persons**[49].
- The Energy Challenge is funding **70 innovation actions** (IA) which are expected to result in substantial improvements of technologies and solutions (representing 11% of all projects or 21% excluding SME instrument) accounting for an EU contribution of EUR 769 million (44% of the total EU contribution).
- Energy Challenge projects have **leveraged almost EUR 600 million** as own contributions from participants (the EU funding rate averaged 74%, ranging from 31% for ERA-NET Cofunds, 70% for SME instrument, 71% for Innovation Actions and 91% for Research and Innovation Actions). More than half of the leveraged budget

[49] *The number of staff involved in projects is reported during the periodic reporting. The presented figure is an estimate based on the extrapolation of the current available sample of 78 projects which indicates that 14.7 staff is involved per EUR million EU contribution.*

came from Innovation Actions (EUR 321 million) and ERA-NET Cofund Actions (EUR 175 million).

- **62 projects** funded under the **2014 calls** reported a total of **371 publications**[50] (given the very limited number of projects funded under the 2015 calls having reported publications so far, they are not reported in this assessment). These 62 projects account for a total EU contribution of EUR 299.7 million (representing around 50% of the EU contribution for projects funded under the 2014 calls) and started in the first half of 2015. Only one out of the 62 projects had finished by 1 January 2017 while 48 projects will finish after December 2017. Therefore, the **total number of publications** from this set of projects **will significantly increase until the end of the projects' lifetime**. Furthermore, as projects mature, many projects which haven't reported any publication so far will report publications.

Table 166 - Type and number of publications per instrument for 62 projects funded under the 2014 SC3 calls

	CSA	ERA-NET-Cofund	FCH2	IA	RIA	SME	Grand Total
Book chapter				1	2		**3**
Conference proceedings	24			99	36	14	**173**
Peer reviewed articles	44			16	66	1	**132**
Thesis or dissertation				5			**3**
Other	9	3		26	5	15	**58**
TOTAL	**35**	**3**		**124**	**50**	**21**	**371**

Source: CORDA data, extracted on 1 January 2017 (based on self-reporting of project coordinators).

- So far, projects funded under the Energy Challenge have applied for **35 patents** of which 2 have already been granted. All patent applications have been made by in total 7 projects funded under the SME instrument, phase 2 (one project applying for 12 patents which are not yet granted). 5 of the 7 projects are funded under the 2014 SME instrument call, the remaining 2 under the 2015 call. The **number of patent applications will increase in the coming years** when also RIA and IA projects will mature and progress in developing technologies.
- Regarding the **gender dimension** in research and innovation content, 5 projects with a total budget of EUR 16 million (4 RIAs addressing explicitly the social and societal dimension of energy, as well as 1 CSA aiming at establishing a stakeholder platform in the area of social sciences and humanities for energy) have included a gender analysis as part of their R&I activities.

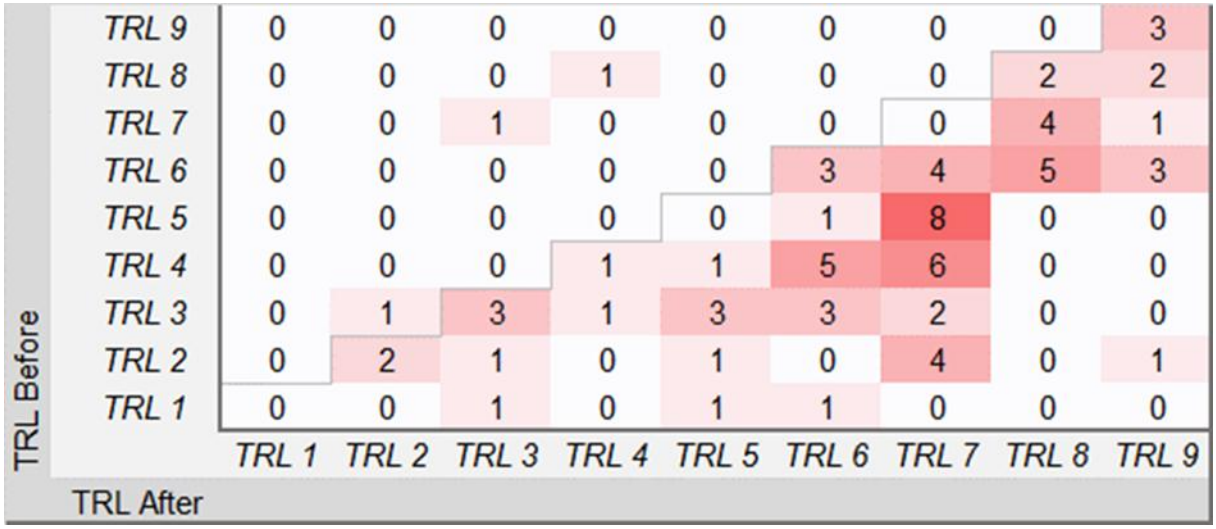
Since **only a small subset of funded projects submitted output-related data** through the regular reporting process, the Energy Challenge has launched a specific evaluation study for projects in the area of energy efficiency and energy system which comprised case studies and

[50] *In addition, 7 projects funded under the 2015 calls had reported publications by 1.1.2017. Given that these projects are not yet as advanced as those funded under the 2014 calls, they are not reported in this assessment.*

a survey among projects participants in the afore-mentioned areas[51]. In this survey respondents indicated that their project has led or will lead to the following outputs:

- 71.1% see a **concrete marketable outcome** as a result of the projects in which they participated. **New business models and new services** were the most commonly indicated (42.4% of respondents), followed by new processes (36.4% of respondents) and to a lesser extent new products (26.7% of respondents). Only 4.2% of participants indicate that they do not expect any results. It is worth noting that the share of projects planning to develop new business models and new services is significantly higher for the surveyed projects in Horizon 2020 than it was the case for FP7 or the Intelligent Energy Europe (IEE) programme.
- 62 projects (out of the 161 projects analysed) are expecting to lead to **new or modified policy frameworks**, of which 37 at national level and 25 at local level.
- For the great majority of projects the **Technology Readiness Level changes** during the course of the project. In most cases, the increase in TRL is credited to the participation in Horizon 2020 (77% of respondents stated that the project activities have a high or very high contribution to increasing the TRL; only 5% consider that the Horizon 2020 intervention has no impact on this).

Figure 222 - Change of Technology Readiness Level for Horizon 2020 projects in the area of energy efficiency and system integration



Source: "First results of Horizon 2020 projects on energy efficiency and system integration" (Ricardo, 2016); The two respondents in the upper part of the Figure seem to have misunderstood the question.

The survey results underline that the **surveyed projects conform to the Energy Challenge's objectives** of developing and maturing low-carbon energy technologies, improving the competitiveness of EU industry and providing information for policy making. Taking into account that objectives and outputs are different for research-oriented, innovation-oriented and market-uptake oriented projects, the results suggest that the **surveyed project portfolio performs well and in line with expectations**.

[51] *The survey included 233 participants from 161 Horizon 2020 projects funded under the 2014 and 2015 calls in the area of energy efficiency, energy system and market uptake actions in the area of renewable energy. Despite a low response rate, most projects were covered with at least one respondent.*

The 2014-2015 Energy Efficiency call included for many market-uptake activities the benchmark of achieving at least 25 GWh of energy savings and/or renewable energy production per year per million EUR of EU contribution.

A review of **information included in proposals** on expected impacts[52] for the **market-uptake projects** supported under the Energy Challenge calls 2014 and 2015 (mainly the Energy Efficiency calls) suggests the following impacts (see Table 169):

Table 167 - Aggregated expected impacts for Horizon 2020 market-uptake projects, Energy Challenge 2014-2015 calls

	Short-term impacts (within project life)
Primary Energy Savings	
Number of projects with reliable or acceptable impact indicators	53
Total energy savings from these projects (GWh/year)	4 690
Energy savings million EUR (GWh/year/EUR million EU contribution)	54
Renewable Energy Generated	
Number of projects with reliable or acceptable impact indicators	29
Total RE to be generated from these projects (GWh/year)	3 293
Renwable energy to be generated (GWh/year/EUR million EU contribution)	69
Investment Triggered	
Number of projects with reliable or acceptable KPIs	34
Total investment triggered by these projects (€ million/year)	1 146
Total investment triggered per million EUR EU contribution (EUR million)	20

Source: "Report on the first results of Horizon 2020 projects on energy efficiency and system integration", Ricardo, 2016.

The impacts that are expected to be generated by market uptake projects are substantial. However, they should be treated with caution as impacts figures were not checked and verified by project officers as had been done previously with IEE projects, and they include some outlier values that might have been reduced as a result of verification by the project officer.

These figures are in the order of magnitude of what was achieved in the last years of the IEE programme when the latter gained maturity. They are also in line with the objectives set out in the Horizon 2020 Monitoring Report 2015:

- **Primary energy savings** of 25 GWh per year per million EUR EU contribution, and
- EUR 850 million of **additional investments** by stakeholders as direct or indirect result of measures developed by the market uptake project.

[52] *For this purpose, information provided by the individual proposals was analysed by Ricardo. Proposal information which was considered as uncertain by Ricardo was not included in this analysis. For further information see "Report on the first results of Horizon 2020 projects on energy efficiency and system integration", Ricardo, 2016.*

L.4.2. Expected longer-term results from the programme

As explained before, it is **not possible at this stage to present evidence-based longer-term results of the programme**. Nevertheless, some indications on the results to be expected can be made based on the findings from predecessor programmes.

An evaluation study of the energy-related activities supported under the **energy-specific programme parts of FP6 and FP7**, contracted by the Commission in 2014, identified the following longer-term results of funded activities which can similarly be expected for Horizon 2020 Energy Challenge projects (this evaluation did not include market-uptake activities supported under the IEE programme)[53]:

- Participants indicated that their participation has led to substantial organisational impacts, especially in terms of **improved networks** and **knowledge position** (more than 50% of FP6/FP7 participants indicated that there was more than a small effect on their organization for these two aspects).
- In terms of **economic impact**, around 20-25% of participating companies saw a substantial improvement of more than 5% for turnover and profit.
- The large majority (76%) of companies indicated that there has been an **increase in their general competiveness** (however, for only around 2% of participants their participation has had very large effects of more than 25% increase in turnover, profit, employment or market share)

Table 168 - Overview of outputs of FP6/FP7 energy projects

Indicator	Average per project	Average per EUR million EU contribution
Total number of publications	±32	**±11.25**
Total number of publications in high/impact journals	±12	**±5**
Number of PhDs	±7.4	**±2.5**
Number of Patents[54]	±0.9	**±0.3**
Number of spin-outs		
Potential new innovations	±6.5	**±2.1**
Expected new innovations	±3.7	**±1.25**
Expected annual turnover (after innovation has reached the market)[55]	±€33 m – €138m	**±€11m – €45m**
Realised annual turnover	**±1.4m - ±4.6m**	**±0.47m - ±1.5m**

Source: FP6/7 Energy Mid-term Evaluation, Technopolis 2014.

As regards the **IEE programme**, an evaluation study was carried out in 2015 to assess the relevance and effectiveness of support provided to public authorities[56] which collectively represent around 20% of the EU population. Examining the evidence available the study indicates that the 34 projects had a positive influence on achieving increased levels of investment in sustainable energy, leading to greater use of renewable energy, energy savings and reductions in CO2 emissions:

[53] *See FP6/7 Energy Mid-term Evaluation, Technopolis 2014*
[54] *This is a minimum, as participants may have applied for multiple patents.*
[55] *This figure could take a long time to materialise, as some innovations will take at least until 2020 to enter the market.*
[56] *'Evaluation of Intelligent Energy Europe Projects Supporting Sustainable Energy Communities Final Report', European Commission, May 2015.*

- Cumulative investment made by European stakeholders in sustainable energy: EUR 8.3 billion (EUR 180 per EUR EU contribution);
- Renewable Energy production triggered: 0.9 million toe/year (20 toe/year per thousand EUR EU contribution);
- Primary energy savings compared to projections (toe/year): 1.9 million toe/year (42 toe/year per thousand EUR EU contribution);
- Reduction of greenhouse gas emissions: 7.7 million tCO2e /year (166 tCO2e/year per thousand EUR EU contribution).

Even with a conservative view on the scale of impacts attributable to the Initiative, the evidence suggests that it has had a **relatively high leverage effect on sustainable energy investment** (with a leverage factor of 9 based on the assumption that 5% of the investment reported was attributable to the Initiative).

L.4.3. Progress towards attaining the specific objectives

It is too early for assessing concrete progress, triggered by Energy Challenge activities, towards the specific objectives (see explanation above). At this stage it is **only possible to analyse the portfolio of running Horizon 2020 projects** (funded mainly under the 2014-2016 calls) and, **assuming that projects achieve their targets**, to presume the project portfolio's future contribution to the specific objectives. Furthermore, it should be kept in mind that the current project portfolio represents only 30% of the total available budget for the Energy Challenge – the remaining 70% of the budget will be translated into projects until the end of Horizon 2020. Therefore, the **current project portfolio is only a small sub-set of the final Energy Challenge project portfolio**.

Table 171 provides a global picture underpinned by relevant examples.

To summarise: All thematic areas specified in the legal base have been addressed through a portfolio of projects. The project portfolio covers a broad range of aspects within the area. The portfolio is in line with the area's scope and objectives specified in the legal base. The project portfolio can be expected to significantly contribute to the specific objectives of the Energy Challenge.

Table 169 - Current project portfolio of the Energy Challenge by areas

Area	Horizon 2020 project portfolio (2014-2015 calls)	Presumed contribution to specific objectives
EU 3.3.1. Reducing energy consumption and carbon footprint by smart and sustainable use		
EU.3.3.1.1. Bring to mass market technologies and services for a smart and efficient energy use	100 projects with a total EU contribution EUR 194.8 million (92 projects under the EE call, 8 projects under the SME instrument call)	Projects supported under this activity line address a broad range of issues, including – Buildings (9 RIA/IA projects): focus on renovations using innovative techniques of prefabrication; cost effective ways of constructing new Nearly Zero-Energy Buildings by using a variety of technologies including renewable energy sources, energy management and storage; demand response in blocks of buildings. The project *ZERO-PLUS* demonstrates cost-effective ways of designing and constructing new Nearly Zero-Energy Buildings at four pilot locations in France, Italy, the UK and Cyprus. The pilots will integrate a variety of technologies in a modular system to achieve Near Zero or Positive Energy Settlements. A strategy of mass customization is expected to achieve a 16% reduction in construction costs. – Consumers (9 RIA projects): focus on tapping the energy savings potential of behavioural change in buildings of public interest, offices and social housing with innovative ICT tools and systems; – Industry (4 RIA projects): develop and validate new technologies for waste heat recovery in large industrial facilities in the cement, steel, iron-steel casting and petrochemical sector. – Socio-economic research (5 RIA projects): focus on the multiple benefits of energy efficiency and the barriers to the uptake of energy efficient solutions; developing scenarios and policy recommendations Research (RIA) and innovation (IA) activities are complemented by coordination actions aiming at facilitating the market-uptake of sustainable energy solutions (further details under activity line 3.3.7)
EU.3.3.1.2. Unlock the potential of efficient and renewable heating-cooling systems	20 projects with a total EU contribution of EUR 52.2 million (10 projects under the EE call, 5 projects under the LCE call and 5 projects under the SME instrument)	Heating and cooling has been supported under the LCE call (focus on technology development) and the Energy Efficiency call (focus on integration and uptake aspects). Under the LCE all, five projects focussing on renewable (biomass or solar) heating-cooling systems have been supported. The main focus of the portfolio is, on the one hand, to develop novel and efficient technologies for heating or combined heating and power, and on the other, to widen its base of renewable primary energy sources. The *SOLPART* project aims at opening a new market for renewable energies in energy intensive industries. It will develop a high temperature solar process for supplying, totally or partially, the thermal energy requirements in the cement or lime industries, thus reducing the life cycle environmental impacts and increasing the attractiveness of renewable heating technologies in process industries. Under the Energy Efficiency call, seven projects aim at improving the operation and efficiency of district heating and cooling systems and maximising the uptake of locally available waste heat and renewable energy sources in district energy networks. Three additional CSA projects intend to accelerate the uptake of efficient heating and cooling solutions. The project *Heat Roadmap Europe 4*, building on the IEE STRATEGO project, develops comprehensive studies of the heating and cooling sectors in the 14 largest EU Member States. These studies also further refine a pan-European thermal atlas. The project directly supports the 14 Member States involved in meeting their obligations under the Energy Efficiency Directive by providing science-based evidence to policy development.
EU.3.3.1.3. Foster European Smart cities and Communities	10 projects with a total EU contribution of EUR 145.7 million (9 projects under the SCC call, 1 ERA-NET Cofund under the LCE call)	The Smart Cities Lighthouse call addresses the integration of solutions in buildings, mobility and infrastructure with ICT as a horizontal component. In addition, beneficiaries need to address the development of business models for the massive replication of these solutions. Seven projects are being supported under the 2014-2015 call. The most significant progress can be expected in the solutions that address the integration of the different domains, for instance the integration of Electric Vehicles for offering demand response solutions or the role of buildings to store energy provided by external RES power plants. The project *REMOURBAN* develops an integrated model for urban renovation which comprises: energy consumption reduction, strategies for a more sustainable and efficient mobility, integration of the existing infrastructures in cities, improvement of decision making processes, providing business models and financial schemes and the evaluation and knowledge sharing.
EU.3.3.2. Low-cost, low-carbon energy supply		

[57] *Of which 5 projects with a total EU contribution of EUR 5.1 million have already been accounted for under 3.3.1.1.*
[58] *All projects have already been accounted for under other headings.*

L.4.4. Progress towards the overall Horizon 2020 objectives

L.4.4.1. Fostering excellent science in scientific and technological research

Scientific excellence as an output can be measured through the number of publications, especially in high-impact journals, number of citations or patents. The excellence of technological research is assessed on the market in terms of profits and prices. However, at this stage of the programme implementation, it is **too early to assess credibly** to what extent funded projects could actually deliver excellent scientific and technological results.

Taking into account this context, reassurance as regards the scientific and technological quality of funded projects can be gained through an analysis of the **evaluation system selecting proposals** for funding as well as through an **analysis of project participants**.

A **high scientific quality of funded projects is ensured through a strict evaluation** by at least 3 (often 5 or more) independent external experts of all proposals according to their scientific and technological quality, impact and implementation mechanisms. Only if all evaluation criteria are considered to be at least 'good' (i.e. 3 points) and the overall score is at least 10 points (which requires that at least one criterion is even 'very good'), proposals can get funded. However, due to the often fierce competition, funded projects have in most cases very high marks (see table 172), e.g. the median value for scientific and technological (S&T) excellence for all instruments (except ERA-NETs) was around 4.5 (i.e. between 'very good' and 'excellent').

Table 170 - Evaluation scores by instrument for proposals submitted under topics included in the 2014-2016 calls and attributed to the Horizon 2020 Energy Challenge

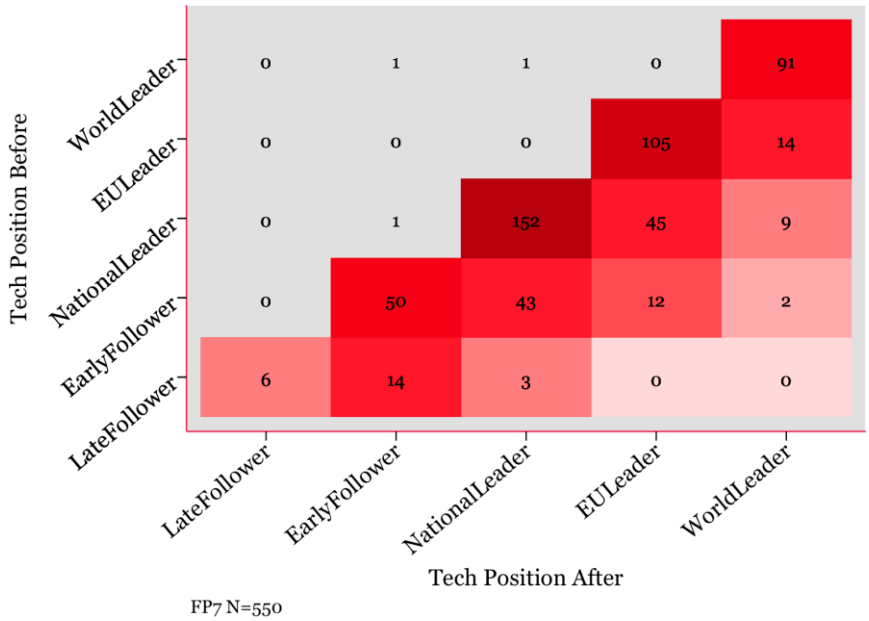
CSA	Instrument	S&T Excellence	Impact	Implementation	Total Score
	mean	4,2	3,9	3,9	12,1
	80th percentile	4	3,5	3,5	11,5
RIA	median	4,5	4,5	4	13
	mean	4,4	4,3	4,2	12,8
	80th percentile	3,5	4	4	11,5
IA	median	4,5	4,5	4	13
	mean	4,3	4,3	4,1	12,7
	80th percentile	3,5	4	4	12
ERA-NET	median	4	4	3,5	11
	mean	3,9	3,9	3,0	11,2
	80th percentile	3,5	3,5	3	10,5
SME	median	4,4	4,5	4,5	13,4
	mean	4,5	4,5	4,5	13,5
	80th percentile	4,3	4,4	4,4	13,2

Source: European Commission.

Participants in Energy Challenge projects are in many cases organisations with a high R&I profile. **Out of the top 100 research organisations in the EU**, according to the SCImago Institutions Ranking[59] (not restricted to energy-related activities), there are **58 organisations participating in Energy Challenge projects** (funded under the 2014-2016 SC3 calls). They account for 295 participations and represent 25% of participations from universities and 18% of participations from research centres.

The high scientific and technological level of participants has also been shown for the FP7 Energy Theme. Figure 219 summarises the results of a participant survey conducted by Technopolis for the FP6/FP7 Mid-term review: the majority of participants considered themselves national, EU or even world leader in their area and many participants improved their perceived technological position after having participated in the FP7 project.

Figure 223 - Technological position of participants in FP7 energy projects



Source: FP6/7 Energy Mid-term Evaluation, Technopolis 2014.

Given the high quality of the selected proposals as well as the high scientific and technological profile of project participants, it can be expected that Energy Challenge projects foster indeed excellent science in scientific and technological research. This assumption should be confirmed, at a later stage of programme implementation, through e.g. publications, citations, patents, successful products or processes.

[59] *The SCImago Institutions Rankings (SIR) is a classification of academic and research-related institutions ranked by a composite indicator that combines three different sets of indicators based on research performance, innovation outputs and societal impact measured by their web visibility. For further information see: http://www.scimagoir.com/index.php*

Box 19 - Contribution to the achievement and functioning of the ERA

Public-public partnerships launched under the Energy Challenge aim at developing and consolidating further a European Research Area in the field of energy.

Seven energy ERA-NET Co-fund networks have been launched since the start of Horizon 2020, with two more under preparation. As a result, at least sixteen joint calls for proposals will be launched in total by participating SET Plan countries, thereby extending the reach of EU and national research funding programmes, stimulating transnational collaboration, and avoiding duplication of efforts.

These networks represent over EUR 311 million in public funding commitments so far for the period 2015-2021, including an EU contribution of over EUR 96 million. In addition, and because of their focus on demonstration activities, ERA-NETs mobilise significant private funding for energy research and innovation: almost EUR 80 million for the joint calls concluded so far – exceeding by 10% the public funding contribution. Besides this, ERA-NETs create a collaborative environment for public funding organisations managing national and regional programmes in similar research areas.

These ERA-NET Cofund actions are a direct result of the SET-Plan and its Joint Actions Working Group which brings together countries interested in developing joint actions in areas of common interest.

It is too early to assess whether these ERA-NETs have been successful or not in terms of effectiveness and impact. So far, only results from the first co-funded calls for the three ERA-NETs launched in 2015 are available, and the projects being funded as a result are only starting now.

L.4.4.2. Boosting innovation, industrial leadership, growth, competitiveness and job creation

The enormous opportunities related to the global clean energy technology market for EU industry have been explained in section L.3.1.1.

Other sections of this assessment explained the **strong industrial focus** of the Energy Challenge as regards

- **priority setting** (mainly through the SET-Plan where common strategic research agendas were developed for all energy areas in a joint effort by national programme owners, industrial and scientific stakeholders informing EU funding priorities; see also section L.3.3);
- **type of actions** supported (60% of EU contribution has been dedicated to innovation and market-oriented activities, see also section L.5.1);
- **project participants** (industrial participants account for 49% of the EU contribution and 56% of all participants; for 63% of coordinators (31% when excluding the SME instrument) and, by 1 January 2017, for 69% of all newcomers; see also sections L.2 and L.5.2.1).

Considering that the funding priorities of the Energy Challenge have been informed by industrial needs, that more than half of the total budget has been dedicated to innovation activities and that projects feature a high share of industrial participants, often in a coordinating role, **Energy Challenge projects can be expected to in line do with the Horizon 2020 objective of boosting innovation, industrial leadership, growth, competitiveness and job creation**.

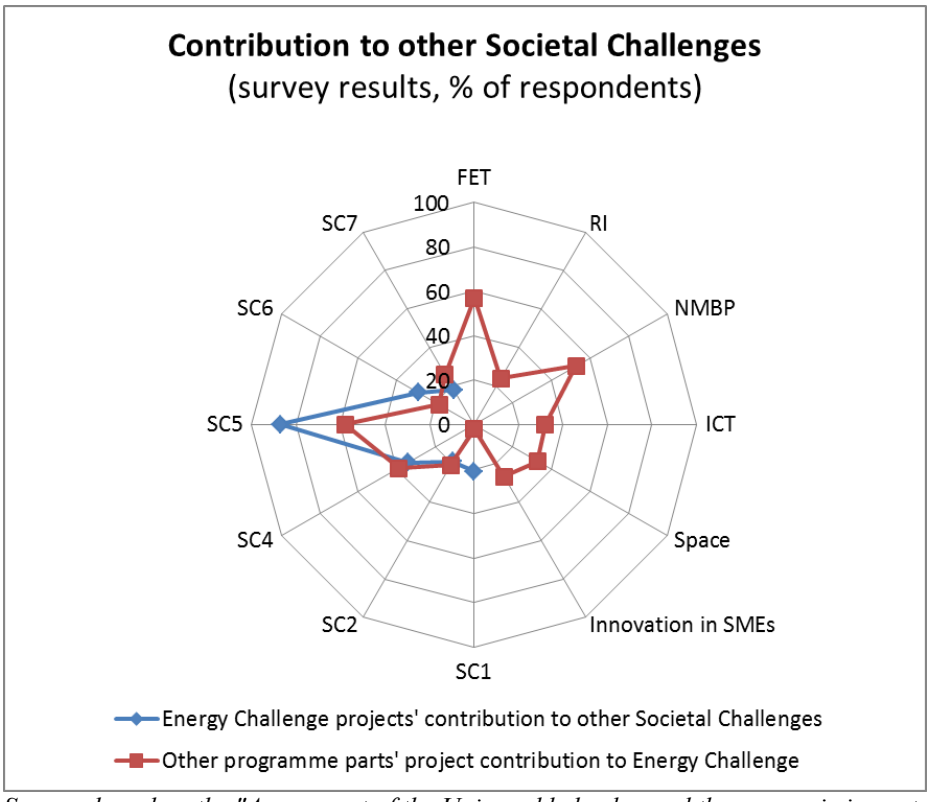
Also experiences from predecessor programmes indicate significant economic benefits for participants (see also section L.4.2) , but at this stage of the programme implementation it is **not yet possible to assess the actual economic contribution** of projects funded under the Energy Challenge.

L.4.4.3. Addressing the major societal challenges

As explained in detail in section L.6.1.2, activities funded under the Energy Challenge contribute explicitly and implicitly also to other Societal Challenges, e.g. Transport (SC4), Bioeconomy (SC2) or Climate (SC5).

This conclusion has been confirmed in a recent **survey among Horizon 2020 project coordinators**[60]. Figure 220 displays the survey results which indicate that coordinators of Energy Challenge projects consider that their project also contributes to objectives of the Climate Challenge (SC5), the Bioeconomy Challenge (SC2), the Reflective Societies Challenge (SC6), the Transport Challenge (SC4), the Health Challenge (SC1) as well as the Security Challenge (SC7).

Figure 224 - Survey results as regards contribution to societal challenges



Source: based on the "Assessment of the Union added value and the economic impact of the EU Framework Programmes (FP7, Horizon 2020)", 2016.

The survey results underline that **energy is a cross-cutting issue with significant impacts on (and from) many other programme parts**.

[60] *In the context of the study "Assessment of the Union added value and the economic impact of the EU Framework Programmes (FP7, Horizon 2020) ", to be finished xxx. The survey sample included 303 Horizon 2020 energy projects (out of 453 projects included in CORDIS at the time the survey was prepared). The response rate was 44% (134 project coordinators out of 303). This means that around 30% of all Energy Challenge projects, running at the time of launching the survey, are covered.*

L.4.4.4. Spreading excellence and widening participation

On a general level, the Energy Challenge successfully increased its outreach compared to the FP7 Energy Theme. By 1 January 2017 there are **already more participating organisations** funded under Energy Challenge calls 2014-2016 than under the entire FP7 Energy Theme (2007-2013) and almost **50% of all participants were newcomers** (i.e. have not participated in FP7).

Looking at the geographical outreach in more detail, section L.5.2.2 explained that, compared to the FP7 Energy Theme, **participation of EU-13 countries** (countries acceding to the EU as of 2004) **has significantly improved in the Energy Challenge**: as a group, the share of total participation increased by 5 percentage points with 9 individual EU-13 countries increasing their share. In terms of EU contribution, EU-13 countries increased their share by 2.5 percentage points with 9 individual EU-13 countries increasing their share. In absolute terms, EU-13 countries received already EUR 11.5 million more during the 2014-2015 Energy Challenge calls than they received during the whole FP7 Energy Theme (2007-2013). In addition, there were already 77 more participations for the group of EU-13 in the 2014-2016 Energy Challenge calls compared to the entire FP7 Energy Theme (2007-2013). A more detailed analysis of the performance of EU-13 countries is included in section L.5.2.2.

L.4.4.5. Science with and for society

Activities supported under the Energy Challenge have a **direct benefit for citizens and consumers** through more efficient and clean energy technologies and solutions; reduced energy prices; increased security, flexibility and resilience of the energy system; and less emissions for a healthier life.

Moreover a number of funded projects (e.g. Nobel Grid, Empower, Flexiciency, Flex4Grid) enable the **active participation of citizens in the energy system**, e.g. through the development and deployment of advanced ICT tools and services and promoting the role of prosumers (e.g. in smart grids).

Building on the activities supported under the Intelligent Energy Europe (IEE) programme (2007-2013) – which focussed on non-technological issues – the Energy Challenge supported under the 2014 and 2015 calls **16 projects[61] targeting explicitly citizens, consumers and/or local stakeholders** with the aim of raising awareness, building capacities and increasing their involvement for facilitating the uptake of innovative energy solutions.

L.4.4.6. Science for policy

The Energy Challenge has been supporting projects which influence policy making, notably related to energy issues, at local, national and EU level. Examples for projects influencing policy making at EU level are:

- The **project *AURES*** (CSA) aims at supporting policy makers at EU and Member States level in improving the effectiveness and cost-efficiency of financial support systems for electricity from renewable energy sources, notably through improving the design of auctions. AURES will develop best practices and

[61] *such as: FosterREG, TOPTEN ACT, SMART-UP, STEP_BY_STEP, DOMINO, Digi-Label, RESCOOP Plus and RESCOOP MECISE*

tailored policy recommendations for future auction designs, making it possible for policy makers and markets participant to make informed decisions when dealing with renewable support policies.

- The **project *ODYSEE-MURE*** (CSA, further information in section L.7.1) plays a key role in monitoring national policies, and their impact, in the area of energy efficiency, thus providing updated and centralized information required by each Member States and the Commission to assess, monitor and evaluate energy efficiency progress and the state of implementation of measures and their impact.

The "Clean Energy for All Europeans" package, adopted by the Commission on 30 November 2016, references many energy efficiency market-uptake projects, in particular in the evaluations and impact assessments related to the revision of the Energy Efficiency Directive and Energy Performance of Buildings Directive. Furthermore, the document "Good Practices in Energy Efficiency" (SWD(2016)404), included in the package, contains a number of good practices being developed by Horizon 2020 energy efficiency projects.

In addition, the participants' survey in the context of the Ricardo study indicated that 62 projects are expecting to lead to new or modified policy frameworks, of which 37 at national level and 25 at local level (most of these projects are non-technological market-uptake actions funded under the 2014-2015 Energy Efficiency calls). 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.

In addition to project-based activities, the Energy Challenge also financed more than 70 individual contracts (public procurement), 5 specific agreements with the EU Joint Research Centre (JRC), 2 Concerted Actions involving national authorities and facilitating the coherent implementation of EU policy, and 1 grant to a named beneficiary in 2014-2015 aiming at providing evidence for policy making and the implementation of EU policy (previously, most of these activities were financed under the IEE programme).

L.4.5. Early success stories

The following three projects are examples of promising stories which are currently being supported by the Energy Challenge:

The ***Peak-App***[62] ('*Personal Energy Administration Kiosk application: an ICT-ecosystem for Energy Savings through Behavioural Change, Flexible Tariffs and Fun*') project, a Research and Innovation Action (RIA) running from March 2016 until February 2019 and receiving a EU contribution of EUR 1.94 million, brings together a consortium consisting of electricity retailers, an association of distribution system operators, two software developers, as well as highly specialized R&I centres and universities. The project aims at developing and validating an innovative ICT-based system that connects end-users to the energy markets. The objective is to achieve energy savings through behavioural change. However, the ICT-based solution (relying on smart meters as the only hardware with respect to in-house equipment) will go further and enable households to increase their consumption of renewable energy and take advantage of low-priced electricity from the spot market through a dynamic electricity tariff. Validation under real

[62] *Project website: http://www.peakapp.eu/*

life conditions will be carried out in Austria, Estonia, Latvia and Sweden, and analyses of the collected data will allow for ground-breaking insights into consumer behaviour and inform regulatory practice to better support energy efficiency goals. More than 2500 households will be involved with the aim of reducing their electricity use by at least 24%, to connect them to social networks, and to motivate them through serious gaming, while boosting at the same time the efficacy of Smart Home building energy management systems.

The project ***STEELANOL***[63] (*'Production of sustainable, advanced bio-ethANOL through an innovative gas-fermentation process using exhaust gases emitted in the STEEL industry'*; IA; EU contribution: EUR 10.2 million; running from May 2015 until October 2018) demonstrates the production of bioethanol from emissions of the steelmaking process which has the potential to significantly reduce greenhouse gas emissions compared to oil-derived fuels. For this purpose, a demonstration plant of approximately 25,000 tons/ethanol per year will be built in Belgium; the first of its kind in Europe, and the largest facility built to date utilizing this technology globally. The project consortium comprises 5 partners from 4 countries. This high-risk/high-impact project is expected to contribute to achieving the targets of the Paris Agreement and advancing the circular economy.

The project ***REMOURBAN***[64] ('*REgeneration MOdel for accelerating the smart URBAN transformation*'; IA; EU contribution: EUR 21.5 million; running from January 2015 until December 2019) aims at developing and validating a sustainable urban regeneration model leveraging the convergence of energy, mobility and ICT to transform European cities into Smart Cities. The project combines innovations at technical level (on the three sectors of energy, mobility and ICTs) and non-technical level (on the main enablers for the Smart City concept: citizen engagement, policy and regulation, integrated planning, metrics and indicators and business models, procurement and funding). The concept will be implemented in three lighthouse cities (Valladolid-Spain, Nottingham-UK and Tepebasi/Eskisehir-Turkey) involving the retrofit of more than 1 000 dwellings, the deployment of more than 190 electric vehicles and the active engagement of some 11 000 citizens. The project is expected to lead to substantial reductions in energy consumption (>40%) and GHG emissions (>50%), improved business cases for deep city transformations, increased use of renewable energies (+50% for thermal energy and +30% for electricity), lower energy costs for citizens and public authorities and improved air quality. The replicability of the model at European level is facilitated by involving the cities of Seraing (Belgium) and Miskolc (Hungary) as 'follower cities' for which replicability potential of the model will be assessed.

L.4.6. Lessons learnt/Areas for improvement

It is too early to provide a fair assessment of the results and impacts of the Energy Challenge project portfolio at the current stage. However, by 1 January 2017, Energy Challenge projects have been supporting 2569 participating organisations and more than 28 500 persons, and leveraged more than EUR 600 million in own contributions from participants. A majority of participants expect from their projects concrete marketable outcomes (e.g. new business models and services), technology improvements, but also impacts on the policy framework.

[63] http://www.steelanol.eu/en
[64] http://www.remourban.eu/

Long-term impacts can only be estimated, at this stage, based on information provided in the proposals (which however often refers to potential impacts which may not materialise) and by comparison with previous programmes. Either way, the Energy Challenge project portfolio can be expected to generate significant impacts based on the current progress: research projects mainly in terms of publications, PhDs, patents or spin-outs; innovation actions mainly in terms of new innovations, business models, patents, increase in turnover, employment and competitiveness; and market-uptake actions mainly in terms of avoided CO2 emissions, renewable energy generated, kWh of energy saved, tonnes of CO2 avoided and millions EUR additionally invested.

Each activity line of the Energy Challenge is addressed with a portfolio of projects which will further grow until the end of the programme (so far, grants are signed for only 30% of the total budget).

Energy Challenge projects are so far on track to contribute to overall Horizon 2020 objectives, e.g. excellent sciences (by ensuring that only high quality proposals are funded and by involving many top EU research organisations); innovation, jobs and growth (by having a strong innovation focus and a high share of industry participants); addressing major societal challenges (by contributing also to a number of other Societal Challenges); Spreading excellence and widening participation (by attracting a high number of newcomers to the programme and by having a stronger participation of most post-2004 EU Member States); Science with and for Society (by generating direct economic benefits for citizens and facilitating the involvement and awareness raising of citizens); and Science for policy (by contributing to policy making at EU, national and regional level).

However, the scientific, technological and economic impact of the Energy Challenge project portfolio will be revealed only years after projects have finished and will heavily depend on factors beyond the reach of Horizon 2020. It is therefore important to continue monitoring closely the projects' performance, provide assistance for the exploitation of the projects' results and support for the market-uptake of innovative solutions.

L.5. EFFICIENCY

L.5.1. Budgetary resources

The overall budget of the Energy Challenge (EUR 5.69 billion for 2014-2020) represents 7.6% of the total Horizon 2020 budget. This is a **substantial increase compared to the FP7** Energy Theme which represented 4.65% of the programme's overall budget (if the budget of the IEE programme is included, the share would have been 6%). The average annual budget increased from EUR 464 million (FP7 Energy Theme, 2007-2013; if IEE programme is included the average annual budget was EUR 567 million) to EUR 810 million (Energy Challenge, 2014-2020) representing an increase of 75%.

However, despite this increase, the **budgetary resources seem to fall short of the**:

- **Demand for R&I funding at EU-level**: under the 2014-2016 Energy Challenge calls, around half of all high-quality proposals (i.e. passing all evaluation thresholds) could not be funded due to a lack of budget.
- **R&I investment needs for the decarbonisation of the energy system**: Although there is no precise estimation of the total R&I investment needs at EU and global level, the International Energy Agency (IEA), based on an analysis of

global R&I investments and trends[65], recommended in 2015 that governments should triple their current R&I investments for clean energy[66].

According to data from the International Energy Agency (IEA), European countries had almost doubled their clean energy R&I investments between 2007 and 2010 (from a total of EUR 2.57 billion in 2007 to EUR 4.76 billion in 2010), but **investments declined after 2010** (by 4% between 2010 and 2014). Mission Innovation, which a number of EU countries joined, seeks to reverse this trend – member countries committed to double their clean energy R&D investments between 2015 and 2020.

As explained in section L.6.2.2, the **Energy Challenge funding only represents around 4% of the overall public and private R&I funding** for Energy Union priorities (excluding transport and nuclear energy) in 2014 and between **15-20% of the total public R&I funding** for low-carbon energy in the EU.

The **funding share of the public sector for non-nuclear low-carbon energy is currently lower than in other areas**: According to Eurostat figures on total R&D expenditure (GERD) across all scientific and technological areas, government funding represents around 29% of the total R&D expenditures in the EU in 2014 (the business sector represented 55%, higher education 1%, private non-profit 1.6% and foreign funding 10%), whereas the share in the energy area (for the three Energy Union priorities covered by the Energy Challenge) was 21% in 2014.

Given the high demand for R&D funding on low-carbon energy, the huge investments needed for accelerating the energy transformation and the relatively low current share of public R&D investments in low-carbon energy, an **increase in public R&I funding (including at EU level) for low-carbon energy seems justified**.

For the budgetary years 2014-2017, the most significant part of the overall budget was implemented through **competitive calls for proposals** (total budget for competitive grants: EUR 2 318.7 million, representing 81.8% of the overall Energy Challenge budget). In addition, 9% (EUR 256 million) of the total Energy Challenge budget was contributed to the **Fuel Cells and Hydrogen Joint Undertaking (FCH JU)**. Furthermore, a total amount of EUR 261.1 million (representing 9.2% of the total budget) was implemented **outside calls for proposals** as 'Other Actions' (the majority of it was dedicated to financial instruments and support to the ELENA facility, followed by procurements). Compared to other programme parts and the FP7 Energy Theme, the number of actions and share of budget implemented through 'Other Actions' is very high which can be explained by the:

- integration of the IEE programme (which implemented more than 20% of its budget through 'Other Actions') in the Energy Challenge and continuation of many of its activities;
- greater focus on providing knowledge for policy development;
- piloting of energy-specific financial instruments.

As regards the budget allocated to the different **funding instruments**, the programme has so far been implemented mainly through Innovation Actions (IA) and Research & Innovation Actions (RIA), accounting together for more than 78% of the total EU contribution for grants. It is worth mentioning that the share of CSAs is very high compared to other Horizon 2020 programme parts and the FP7 Energy Theme. By 1 January 2017, around 36% of Energy Challenge projects (excluding SME instrument) are

[65] *"Energy Technology Perspectives 2015 – Mobilising Innovation to Accelerate Climate Action", IEA, 2015*
[66] https://www.iea.org/media/speeches/mvdh/150504_ETP.pdf

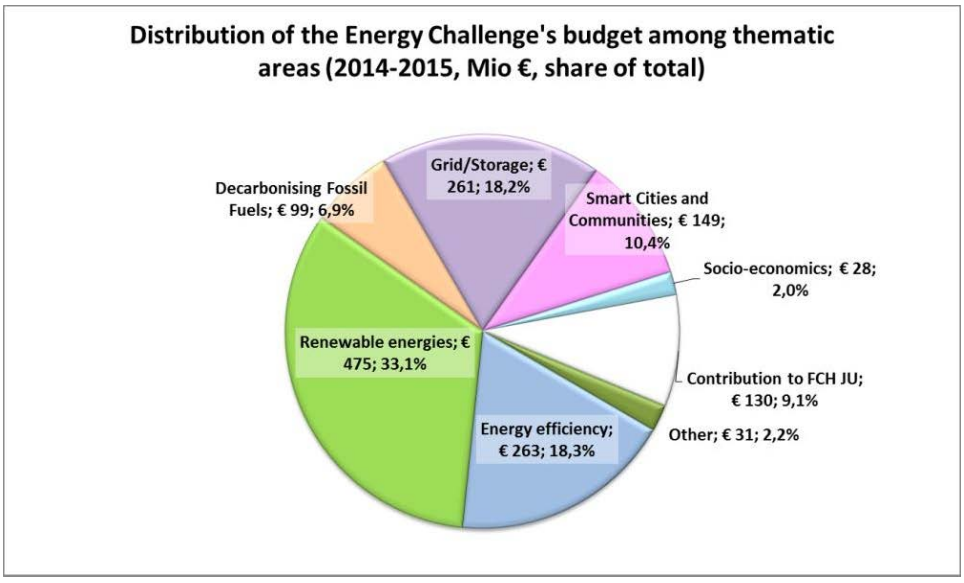
CSA actions targeting the market-uptake of sustainable energy solutions[67], representing however only 11.4% of the total budget.

The reason is that 117 out of 123 CSA actions target the market-uptake of sustainable energy solutions[68].

In terms of focus on the different parts of the innovation chain, the budget share for innovation-related activities is almost 50% (ca. 52% if projects funded by the FCH JU are excluded). An additional 14% of the total budget is dedicated to market-uptake actions, increasing the overall **budget share for innovation- and market-oriented issues above 60%**. The focus on innovation, which means on the other hand a lower budget share for research-oriented activities, is significantly stronger than under the FP7 Theme where demonstration and research activities each accounted for 50% of the overall budget (market-uptake activities were funded only under the IEE programme).

Not surprisingly, given the strong innovation focus, **industrial participants (including SMEs) account for almost 50% of the total grant-based EU contribution** whereas research centres received 21%, universities 14%, public bodies 10% and 'other types of organisations' 6% of the total EU contribution. Compared to the FP7 Energy Theme, the funding shares have dropped for research centres (22% in FP7) and universities (19% in FP7), but increased for public bodies (6% in FP7) and 'other' (3% in FP7). The increase for public bodies can be explained by the higher budget share for Smart Cities and Communities projects and ERA-NET Cofunds which are typically associated with significant public body involvement. The increase for 'other' (which includes e.g. regional energy agencies, consultancies, association, federations) is a result of the integration of the IEE programme in which these types of organisations were more represented. Despite these changes in the budget shares, **the average annual budget has increased substantially for all types of participants**.

Figure 225 - Distribution of the Energy Challenge's budget among thematic areas (2014, 2015)



Source: European Commission.

[67] *Market-uptake actions tackle non-technological obstacles and have previously supported under the Intelligent Energy Europe (IEE) programme. The Commission's declaration to the Horizon 2020 Regulation stipulates that the Commission will endeavour to dedicate at least 15% of the Energy Challenge's budget to such kind of activities.*

[68] *Market-uptake actions tackle non-technological obstacles and have previously supported under the Intelligent Energy Europe (IEE) programme. The Commission's declaration to the Horizon 2020 Regulation stipulates that the Commission will endeavour to dedicate at least 15% of the Energy Challenge's budget to such kind of activities.*

The **budget allocation among thematic** areas has also changed in comparison to the predecessor programmes. Whilst the **absolute average annual budget increased for all areas** (except New Knowledge and Technologies), some areas benefitted more than others: the highest absolute annual increases were for grids/storage (+ EUR 83.7 million), renewable energies (+ EUR 61.4 million), Smart Cities and Communities (+ EUR 57.4 million) and energy efficiency (+ EUR 45.5 million). In relative terms (expressed as difference of percentage points of the total budget share), the highest increase was in the area of grids/storage (+ 7 percentage points) and Smart Cities and Communities (+ 6 percentage points), while renewable technologies declined by 9 percentage points. The relative changes reflect the shift from a technology-centred approach to a more system-oriented approach and the change of responsibilities for implementing the Framework Programme (see section L.3.2).

L.5.2. Programme attractiveness

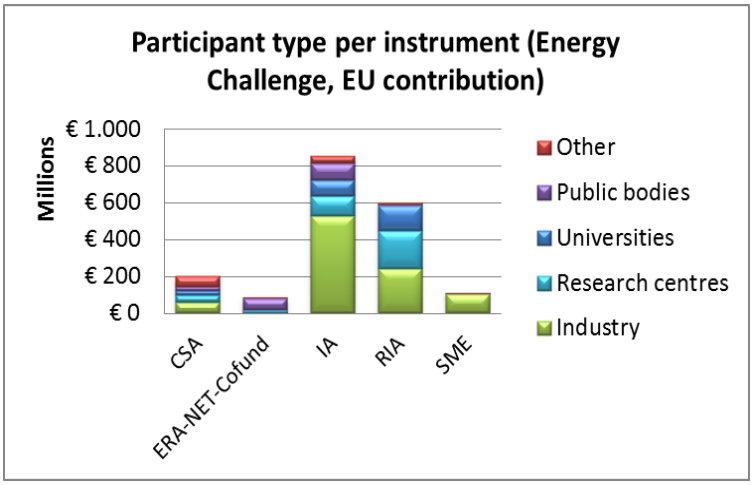
L.5.2.1. Mobilisation of stakeholders

The Energy Challenge has been **very successful in attracting participants** – the ratio of unique participants per EUR million EU contribution is 1.8 (it was 1.2 in the FP7 Energy Theme), while the ratio of participations per EUR million EU contribution is 2.4 (it was 2.3 in the FP7 Energy Theme). The higher ratio of unique participants is due to the introduction of the SME instrument which has attracted a great number of SMEs which receive a small lump-sum each (typically EUR 0.05 million) to carry out a feasibility study.

Almost half of the participants (45%) have been **newcomers**, i.e. they did not participate in FP7. The share of newcomers is very low for universities (2%) and research centres (15%), but very high for 'other' (69%), 'industry' (55%) and public bodies (44%). The reasons for the high share of newcomers within these categories (i.e. SME instrument; integration of IEE programme; increased funding for ERA-NETs and Smart Cities and Communities) have been explained in more detail above. However, the budget share for newcomers was significantly lower (30%) (due to the small grants of the SME instrument).

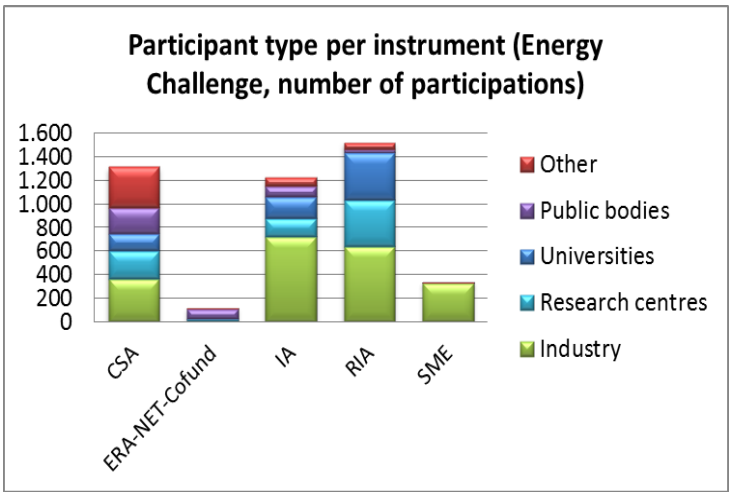
As regards the **participation per organisation type**, the picture is similar to the one representing the funding per organisation type.

Figure 226 - Participant type per instrument, EU contribution



Source: European Commission.

Figure 227 - Participant type per instrument, participations



Source: European Commission.

Apart from the SME instrument, industrial participation is strongest in innovation actions (IA), typically technology-oriented demonstrations (58% of the EU contribution and 62% of participations), and research actions (RIA; accounting for 42% of the EU contribution and 41% of the participations). Research centres and universities play an important role in research projects and, to a lesser extent, also in innovation actions. It is worth noting that for all types of collaborative actions (CSA, RIA, IA) there is a broad involvement of all types of actors (see Figures 212 and 213).

The **high scientific and technological profile of participants** has been shown in section L.4.4.1. Table 173 displays the top-15 organisations by organisation type in terms of participations in Energy Challenge projects. These organisations are **known as key players in European clean energy R&I** and **suggest a high quality of funded project and consortia**. It is worth noting that for research centres and universities, the top-15 organisations represent a rather high share of participations and EU contribution suggesting that top-organisations in these categories have developed important networks and capacities during the previous EU Framework Programmes which facilitate their participation in Horizon 2020. On the other side, the top-15 industrial participants represent a much lower share of participations and budget, indicating that industrial participants in general seem less focussed on the EU Framework Programme for bringing in public funding for their R&I activities.

Table 171 - Top-15 organisations in participations in Energy Challenge projects, as of 26 October 2016, by organisation type

Name	Country	Number of participations	EU contribution
Research centres ***(Top-15 represent 31% of all participations and 38% of total EU contribution for all research centres)***			
Fraunhofer Gesellschaft zur Foerderung der Angewandten Forschung e.V.	DE	38	€ 24.593.269
Fundacion Tecnalia Research & Innovation	ES	26	€ 14.567.277
Commissariat a l'Energie Atomique et aux Energies Alternatives	FR	23	€ 11.369.647
Teknologian Tutkimuskeskus VTT Oy	FI	21	€ 11.379.905
Agenzia Nazionale per le Nuove Tecnologie, l'Energia e lo Sviluppo Economico Sostenibile	IT	17	€ 3.564.396
Centre for Renewable Energy Sources and Saving	EL	16	€ 2.273.964

Fondation			
Centre National de la Recherche Scientifique CNRS	FR	16	€ 7.505.123
Stichting Energieonderzoek Centrum Nederland ECN	NL	14	€ 10.610.331
Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek TNO	NL	13	€ 7.368.203
Consiglio Nazionale delle Ricerche	IT	13	€ 4.974.983
Ethniko Kentro Erevnas Kai Technologikis Anaptyxis	EL	13	€ 5.524.316
Vlaamse Instelling Voor Technologisch Onderzoek n.v.	BE	13	€ 7.938.697
Fundacion Circe Centro de Investigacion de Recursos y Consumos Energeticos	ES	12	€ 3.719.996
AIT Austrian Institute Of Technology Gmbh	AT	12	€ 7.930.734
Deutsches Zentrum fuer Luft - und Raumfahrt e.V.	DE	11	€ 12.797.502
Universities ***(Top-15 represent 25% of all participations and 29% of total EU contribution for all universities)***			
Danmarks Tekniske Universitet	DK	24	€ 9.676.270
Politecnico di Milano	IT	17	€ 5.557.457
Aalborg Universitet	DK	16	€ 4.691.336
Karlsruher Institut fuer Technologie	DE	15	€ 6.325.483
Rheinisch-Westfaelische Technische Hochschule Aachen	DE	13	€ 8.451.979
Technische Universiteit Delft	NL	12	€ 5.961.105
Technische Universitaet Muenchen	DE	11	€ 5.297.685
Imperial College of Science Technology and Medicine	UK	11	€ 5.896.050
Ecole Polytechnique Federale de Lausanne	CH	10	€ 0
Politecnico di Torino	IT	9	€ 3.996.104
Technische universitaet Wien	AT	9	€ 2.839.108
Katholieke Universiteit Leuven	BE	9	€ 4.359.157
Universitaet Stuttgart	DE	9	€ 5.886.302
Eidgenoessische Technische Hochschule Zuerich	CH	8	€ 103.131
The University of Edinburgh	UK	8	€ 3.514.165
Industry ***(Top-15 represent 4% of all participations and 8% of total EU contribution for all industry)***			
Wirtschaft und Infrastruktur Gmbh & Co Planungs KG	DE	12	€ 3.378.896
Acciona Infraestructuras S.A.	ES	9	€ 9.222.501
D'appolonia SPA	IT	8	€ 2.287.437
Krajowa Agencja Poszanowania Energii SA	PL	7	€ 567.334
Siemens public limited company	UK	6	€ 7.418.883
Siemens Aktiengesellschaft	DE	6	€ 20.628.986
Diacheiristis Ellinikou Diktyou Dianomis Elektrikis Energeias AE	EL	6	€ 1.326.813
Geonardo Environmental Technologies Ltd	HU	5	€ 965.063
Ecopower	BE	5	€ 2.073.340
EDP Distribuicao Energia SA	PT	5	€ 4.710.939
Engineering - Ingegneria Informatica Spa	IT	5	€ 3.064.075
R2M Solution Srl	IT	5	€ 1.019.233
Solidpower SPA	IT	5	€ 12.679.819
Iberdrola Ingenieria y Construccion SA	ES	4	€ 2.051.381
Electricite De France	FR	4	€ 1.550.870
Enel Green Power	IT	4	€ 4.686.660
'Other' ***(Top-15 represent 18% of all participations and 21% of total EU contribution for all 'Other')***			
Osterreichische Energieagentur Austrian Energy Agency	AT	14	€ 4.632.441
Iclei European Secretariat GmbH (Iclei Europasekretariat Gmbh)*	DE	8	€ 2.478.351
Seven Stredisko pro Efektivni Vyuzivani Energie o.p.s.	CZ	8	€ 1.084.736
Planenergi Fond	DK	6	€ 1.533.764
Fachagentur Nachwachsende Rohstoffe e.V.	DE	6	€ 1.366.361

Energy Cities/Energie-Cites Association	FR	5	€ 932.803
The Energy Saving Trust Ltd by guarantee	UK	5	€ 1.059.816
Rescoop EU Asbl	BE	5	€ 1.462.971
Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ) GmbH	DE	5	€ 1.921.411
The Carbon Trust	UK	5	€ 1.482.906
Alliance Europeenne De Recherche Dans Le Domaine De L'energie	FR	4	€ 1.078.693
Eurocities Asbl	BE	4	€ 1.754.163
Legambiente Associazione Onlus	IT	4	€ 706.330
Comite Europeen de Coordination de l'habitat Social aisbl	BE	4	€ 175.413
European Council for an Energy Efficient Economy Forening - ECEEE	SE	4	€ 464.134

Source: European Commission, based on CORDA data extracted on 26 October 2016.

Despite the increase of budget, the success in attracting participants has led to **rather low success rates**, especially in the 2015 calls (see table 174). However, preliminary results for the 2016 calls suggest an increasing success rate. The success rate of the Energy Challenge is similar to the average success rates under the FP7 Energy Theme (which was 11.8%; ranging from 8% in 2008 to 22% in 2013).

Table 1 - Annual success rates of the Energy Challenge for proposals

	Including SME instrument	Excluding SME instrument
2014	12.2%	14.8%
2015	10.1%	12.7%
2016	12.2%	16.9%
TOTAL	**11.5%**	**14.6%**

Source: European Commission (based on CORDA data).

If only high-quality proposals (i.e. proposals passing all evaluation thresholds) are taken into account, the chances of proposals being funded improve dramatically: almost half of all proposals above thresholds are funded, and for the SME instrument even more. Around ¼ of the submitted eligible proposals passed all thresholds while ¾ of all proposals missed at least one threshold. However, there have been significant differences in success rates between:

- **Topics**: More than 23% of all topics have a success rate above 30%. However the huge majority of proposals has been submitted under topics with a success rate around 10%.
- **Funding instruments**: Among competitive topics, success rates have been highest for CSAs (18.1%), and RIAs (15%), and lowest for SME instrument (9%). However, there have been 6 RIA-topics which attracted 324 proposals in total of which only 13 could be funded (representing a combined success rate of only 4%). The low success rate was due to the limited budget dedicated to the topics in the work programme and the fact that some of these RIA topics competed unsuccessfully with Innovation Action (IA) topics for funding.
- **Organisation types**: In terms of success rates of unique organisations, research centres and universities have the highest success rates (38.4% and 35.4% respectively). However, in terms of applications (one unique organisation can account for several participations), the success rates for both organisation types

was only 18.4% and 14.5%, i.e. both types are often involved in multiple proposals of which at least one is finally successful.

- **Geographical origin**: Organisations from third countries have the highest success rate in terms of participations (22.4%; however, in terms of absolute numbers they represent only 0.7% of all applications), followed by countries associated to Horizon 2020 (18%; representing 6.9% of all applications), EU-15 countries (16.1%; representing 80.7% of all participations) and EU-13 countries (11.8%; representing 11.7% of all participations).
- **Submission mode**: success rates at 2nd stage of 2-stage submission have been almost double as high as for single-stage proposals[69]. On the other hand, the **'time penalty'** for 2-stage topics is significant: for the 2014-2015 calls, the time needed from the call publication to the signature of the grant was, on average, 6 months longer than in the case of single-stage proposals. For the 2-stage topics included in the 2017 calls, the time penalty will be even 7.5 months. Such a time penalty reduces the attractiveness for industry to participate (the budget share of industry participations in projects funded under 2-stage RIAs was significantly lower compared to single-stage RIAs – single-stage: 49% vs. 2-stage: 36%).

Given the rather low success rates of Energy Challenge calls in 2014 and 2015, the **significant efforts related to preparing a proposal** are an important consideration of potential applicants when participating in the programme. The survey conducted by Ricardo (2016)[70] found that the average time applicants (lead coordinators and participants) spent on preparing a proposal was 110 FTE days with a median of 30 days. The majority of successful applicants spent between 50-200 FTE days in the case of project leaders and 11-50 FTE days in the case of project participants.

The services implementing the Energy Challenge (see section L.2.4) **greatly improved as regards the time needed to prepare and sign grant agreements** (time-to-grant/TTG = number of days between call closure and grant signature). Whereas under FP7 the average time-to-grant was 350 days (median: 306 days; 75th percentile: 428 days), Article 20 of the Rules for Participation and Dissemination in Horizon 2020 has shortened TTG to a maximum of 245 calendar days. **92.8% of grant agreements** funded under the Energy Challenge **are within the 245 days limit**. There are however differences between the different funding instruments, with ERA-NET projects and Innovation Actions being typically the most complex grant agreements to prepare and consequently longer average TTG (267 and 241 days on average).

The reduction in time-to-grant was achieved through **more efficient, fully IT-based, administrative processes** and by a **'no-negotiation' approach** when preparing the grant agreement[71]. The no-negotiation approach has however **additional consequences** for the programme implementation:

---

[69] The Energy WP 2014-2015 included in total 9 topics following a two-stage submission procedure. These topics were included in the LCE call and targeted exclusively Research & Innovation Actions (RIA). Proposals funded under these 9 topics account for 28% of the LCE call budget and 34% of LCE call proposals. The success rate for 1-stage proposals was 12.9% (10.8% when including the SME instrument topic). For 2-stage proposals, the success rate is calculated on the basis of the number of proposals received only in stage 2 – therefore the rate was 24.3%. The success rate for proposals going form stage 1 to stage 2 was 31.8%, the rate of proposals received in the first stage in relation to the main-listed proposals was 7.7% and thus below the average success rate of 1-stage proposals.

[70] "First results of Horizon 2020 projects in the area of energy efficiency and system integration", 2016

[71] The predecessor programmes foresaw a 'negotiation phase' prior to the grant signature which allowed to fine-tune proposals, based on the recommendations of the evaluators, as regards the scope of the work packages, the composition of the consortium and the allocation of resources.

- Early feedback from the implementing services (Commission, Executive Agencies) suggests that, for a number of selected proposals, the **allocation of resources could have been improved** during a negotiation which could have resulted in a lower EU contribution and a more efficient use of the available budget[72].
- For complex industry-driven demonstration projects, depending on a multitude of factors beyond the reach of Horizon 2020, the absence of a negotiation phase leaves **no time for addressing and mitigating project risks** before the signature of the grant agreement (under the FP7 Energy Theme, when there was no maximum TTG stipulated, the average TTG for energy demonstration projects was almost 500 days, the 75th percentile was 582 days). This might result in a higher number of grant agreement amendments and a higher number of suspended or even terminated projects (see also section L.5.3).

Great efforts have been undertaken to **promote the programme** to new participants and to provide adequate information for helping applicants to submit high-quality proposals:

- Commission services and Executive Agencies organised jointly central **information events** in Brussels for the Energy Challenge calls
    - 2014-2015: 1 overarching event in 2013 and 3 area-specific events in 2014;
    - 2016-2017: 1 overarching event in 2015 and 4 area-specific events in 2016 (of which 1 was a virtual event).

    The (physical) events attracted each time more than 500 participants and were also broadcast online (videos and presentations were made available after the events).
- Commission services also supported a number of **national and regional information events** (physical and virtual events) throughout Europe by sending EC staff as speakers.
- The Commission supports the network of **National Contact Points (NCPs)** in providing professional support services for applicants as well as in spreading awareness, giving specialist advice, providing on-the-ground guidance and organising brokerage events. For this purpose, a dedicated CSA project is financed[73] and Commission staff has been participating in various training sessions organised for and by the NCPs.

L.5.2.2. Geographical dimension

Data on the geographical origin of participants was presented under section L.2.2.3 ("Geographical participation pattern").

The EU contribution for participations **correlates to a high extent with the total population** of the specific country (correlation coefficient = 0.88). It is therefore no surprise that the 5 Member States with the biggest populations (Germany, France, the UK, Italy and Spain; accounting for 63% of the total EU population) account for 63% of the total EU contribution. Correlation coefficients are similarly high for the relation

[72] *Implementing services report that evaluators often don't consider a slightly sub-optimal allocation of resources sufficient for failing a proposal during evaluation if the proposals scores well on all other criteria.*
[73] *The CSA project C-ENERGY 2020 receives an EU contribution of EUR 1.5 million.*

between population and participants or newcomers, and a bit lower (correlation coefficient = 0.72) for the relation between EU contribution and national public R&D investments for clean energy[74].

However, this general observation becomes **more nuanced** when looking at specific indicators which reveal **above-average performances of some smaller countries**, e.g.:

- Ireland, Finland and Spain have the highest share of coordinators among participants;
- Slovenia, Denmark, Ireland, Finland, Spain and Austria have the highest number of coordinators per capita;
- Croatia, Romania, Malta, Bulgaria and Lithuania have the highest share of newcomers among participants;
- Luxembourg, Slovenia, Estonia, Malta, Cyprus, Denmark and Latvia have the highest number of participants per capita;
- Compared to FP7, the countries with the highest increase of *percentage points* as regards their share of total participations are Spain (+3.6 pp), Austria, Romania, Italy, Croatia, Bulgaria and Slovenia. The highest *relative* increase of the participation share (expressed in %) apply to Romania (+332%), Croatia, Estonia, Luxemburg and Malta.
- As regards the EU contribution compared to FP7, the countries with the highest increase of *percentage points* are the UK (+ 4.7 pp), Spain, Germany, Austria and Slovenia. The highest *relative* increase of the budget share (expressed in %) apply to Estonia (+998%), Romania, Slovenia, Latvia, Bulgaria and Croatia.
- In the 2014-2015 Energy Challenge calls, the following countries received already a higher absolute EU contribution than during the whole FP7 Energy Theme: the UK, Estonia, Slovenia, Romania, Latvia, Bulgaria, Croatia, Portugal, Ireland, Malta and Czech Republic. Most of these countries also had already more participations than under the FP7 Energy Theme.

EU-13 countries (Member States joining the EU as of 2004) represent 19% of the EU's population, but they account for only 15% of the participations, 13% of the participants, 6% of the project coordinators and 6% of the EU contribution. The share of newcomers from EU-13 is 15% and thus higher than its share of participants. However, as mentioned above, **most EU-13 countries improved their level of performance**, in some cases spectacularly, compared to the FP7 Energy Theme. The lower per-capita average figures for EU-13 countries as a group are mainly due to the weaker performance of organisations established in the 2 biggest countries of this group: Poland and Romania (both countries account for 11.4% of EU population but only for 3.4% of all participations of the Energy Challenge). Excluding Poland and Romania, the remaining EU-(13-2) represent 9.2% of the EU population, 9.9% of participations and 4.7% of EU contribution. The fact that the share of EU contribution is only half the share of participations is put into perspective by the fact that around 70% of eligible costs of EU-funded energy projects are personnel costs[75] and that the average labour costs of EU-13

[74] *The correlation coefficient relates to the 19 EU Member States which provided data on national R&D investments in clean energy to the IEA (see Graph 11)*

[75] *Cost items are reported during the periodic reporting. For Horizon 2020, the number of projects having reported on personnel costs is too low and unrepresentative for drawing valid estimations. Under the FP7 Energy Theme, personnel costs represented 70% of the EU contribution (68% for EU-13 and 72% for EU-15 countries).*

countries are only around 1/3 of EU-15 countries labour costs[76]. In other words, for a typical project, the eligible costs of EU-13 participants for similar inputs represent on average only around half the costs of EU-15 countries (due to the lower personnel costs). EU-13 is therefore not an appropriate category for analysing the performance of countries as it is in itself a very heterogeneous group with many countries performing at EU average or even above.

To summarise: The most substantial part of the Energy Challenge funding is won by organisations with well-developed R&I capacities from countries with substantial national R&D programmes in clean energy. Nevertheless, the evidence presented above suggests that also new participants from countries with a less substantial track-record in EU energy R&D funding were able to join the programme.

However, for assessing the performance of specific countries in the Energy Challenge properly, the existence of alternative funding sources (e.g. national R&D programmes, Structural Funds) available to potential participants at national level has to be taken into account. Such analysis is yet to be carried out.

The **participation of entities from third countries** in the Energy Challenge is **significantly below the level of the FP7 Energy Theme** where 80 out of 376 projects (21.3%) included at least one third country participant. Also the share of EU contribution for third country participants was higher (1.4% of the total EU contribution, compared to 0.5% so far). This development might be due to the change in funding rules (contrary to FP7, organisations from China, Brazil, India, Russia and Mexico can receive EU funding only in exceptional and well justified cases) and/or to the perceived complexity of the EU programme. However, in addition to including organisations from third countries in EU-funded projects, the Energy Challenge **fostered international cooperation through coordinated calls** in which EU-funded projects cooperate closely with 'mirroring' projects from a third country and where EU funding is equally matched by the third country. This was the case in the 2016 call for **Mexico**, cooperating on geothermal energy (1 project, EU contribution: EUR 10 million), and **Brazil**, cooperating on 2nd generation biofuels (EUR 5 million earmarked). Another form of cooperation is the **twinning of projects**, funded by the EU and a third country, as it was the case in the 2016 topic on new generation high-efficiency capture processes where EU-funded projects will cooperate with projects funded by the Korean programme (3 projects have been selected for EU funding).

L.5.2.3. Cross-cutting issues

The systematic monitoring of cross-cutting issues, as defined in Annex 3 of the Horizon 2020 Decision, has started in Horizon 2020. It is therefore not possible, due to a lack of data, to quantify the difference in performance between the Horizon 2020 Energy Challenge and the FP7 Energy Theme.

However, based on a qualitative assessment of energy-related topics supported under both programmes it is clear that there are little changes as regards the Energy Challenge's contribution to climate actions and sustainable development. Also, a strong industry involvement was already the case in the FP7 Energy Theme. In contrast, the **integration of ICT and SSH-related issues** in Energy Challenge projects has gained in importance.

[76] *According to Eurostat data on labour costs levels in 2014, the average labour costs (EUR/hour) for EU-13 countries was 9.18 € (median 9.40 €), while for EU-15 countries the average labour cost was 29.72€ (median: 31.40 €).*

L.5.3. Cost-benefit analysis

Calls for proposals are an important interface between the Commission services in charge of managing and implementing the programme and the external stakeholder community. A key novelty of Horizon 2020 has been the promotion of a **challenge-based approach** which is characterised by fewer and broader topics which define specific challenges but leave the choice of the most appropriate approach for tackling the challenge to the applicants. As a result of this approach, the ratio of 'budget available / number of topics' has been doubled by the Energy Challenge compared to the FP7 Energy Theme. However, the practical application of the challenge-based approach raises a number of difficulties, e.g.

- Broad topics often attract a high number of proposals leading to low success rates.
- Few and broad topics make it difficult to ensure as an outcome a balanced project portfolio which addresses all relevant issues in an appropriate manner.
- Ensuring a level-playing field for all proposals submitted under a broad topic can be difficult if the topic addresses several areas which have each its distinct needs and challenges.
- The balance of expertise required for evaluating proposals submitted under a broad topic covering multiple areas can be difficult to predict which might impact negatively the quality of evaluations.

Another important interface between the programme and the stakeholder community – or between inputs and outputs – are the **services implementing the programme**. For the majority of Energy Challenge activities, these are the Executive Agencies INEA and EASME. While their performance has been instrumental in achieving the improved time-to-grant in Horizon 2020, the situation of splitting the implementation of the Energy Challenge between Commission services and two agencies raises challenges:

- While EU energy policy, and the Horizon 2020 Energy Challenge, has evolved since the start of the programme and are increasingly focused on integrating the whole energy system, the separation of energy efficiency (managed by EASME, together with the SME instrument) and the other energy areas (managed by INEA) makes it more difficult to fully exploit synergies between projects, particularly where they transcend energy efficiency and other areas. Examples of these areas are heating and cooling, social sciences and humanities, smart cities and communities. Nevertheless, both agencies regularly exchange information and cooperate on such cross-cutting issues, e.g. in the recent joint publication on projects on heating and cooling[77].
- Although Horizon 2020 features a common entry point for all applicants and participants (the Participant Portal), joint communication activities as well as common forms and conditions across the programme, the split in implementation can add to the stakeholders' perception that the implementation of the Energy Challenge is rather complex.
- Also for various services managing the Energy Challenge, the split adds additional administrative burden. This is the case for the two Agencies, which must coordinate with one another, and for the Parent DGs, which must also

[77] https://ec.europa.eu/energy/sites/ener/files/documents/overview_of_eu_support_activities_to_h-c_-_final.pdf

coordinate both within themselves (to have a common line on dealing with the two Agencies), between themselves – and with the two Agencies.

Commission services and agencies have been cooperating closely to ensure a coherent and efficient implementation on the programme. An evaluation of the Agencies will be carried out in 2017.

At the level of projects, inefficiencies can arise in case **projects**, especially complex and expensive demonstration projects, **face difficulties during their preparation phase** (e.g. changed conditions for testing an energy system in a given site). Due to the no-negotiation approach of Horizon 2020 (which results from the strict TTG requirements, see section L.5.2.1), adjustments to mitigate the risks of not delivering are de facto not feasible. This increases the number of Grant Agreement Amendments and/or suspensions of the projects (one Energy Challenge project (EU contribution: EUR 20.7 million) was terminated due to difficulties with securing financing and two projects (total EU contribution: EUR 37 million) were suspended due to technical problems and problems securing the financing). Therefore, more stringent requirements on key milestones and corresponding go/no-go decisions in the preparation phase of the action could be pursued[78].

L.5.4. Other issues related to efficiency

The **average project size** is rather similar to the FP7 Energy Theme. However, there are substantial differences among the funding instruments (see table 175) reflecting their different objectives and needs (e.g. Innovation Actions often include substantial hardware costs, while CSAs mostly involve personnel costs).

[78] *For example, one approach would be to have calls where all proposals have to be split into two stages. At least three projects would be selected and grant agreements signed for the full two stages; however, it would be made clear that there would be a go/ no-go decision at the end of stage 1, whereupon the 2 least promising projects would be terminated and only 1 allowed to continue. Budget would therefore only be needed to cover 3 first stages and one second stage. This is potentially more efficient (and introduces continued competition) in using budget than committing large sums of money to large demonstration projects which may have to be prematurely terminated (and the money is 'lost' for the Energy Challenge to the EU budget).*

Table 173 - Average number of participants per projects and average EU contribution per project and participation per instrument (Energy Challenge)

	Average number of participants per project	Average EU contribution per project (EUR million)	Average EU contribution per participation (EUR million)	Average project duration (months)
CSA	10.7	1.63	0.15	32.3
ERA-NET-Cofund	12.9	8.87	0.69	60.0
IA	16.8	11.17	0.67	45.6
RIA	10.9	4.21	0.39	40.3
SME instrument (phase 1)	1.1	0.05	0.04	5.2
SME instrument (phase 2)	1.4	1.57	1.15	24.1
Grand Total	**7.2**	**2.87**	**0.40**	**24.9**
Grand Total (excluding SME instrument)	**12.1**	**4.88**	**0.40**	**39.3**

Source: European Commission, based on CORDA data, extracted on 26 October 2016.

When delegating (part of) the Energy Challenge implementation to INEA (see section L.2.4), it was assumed[79] that the average EU contribution for RIAs/IAs/non-market-uptake CSAs will be EUR 8.6 million while for market-uptake actions it should be EUR 1.5 million (the same assumptions were later applied for the delegation to EASME). By end of October 2016, the average EU contribution for RIAs/IAs/CSAs managed by INEA was EUR 8.5 million, while for market-uptake actions it was EUR 1.77 million, thus very close to the assumed values.

L.5.5. Lessons learnt/Areas for improvement

The budget of the Energy Challenge has increased by 75% compared to the previous programme. However, it is still not adequate for addressing the challenges related to the decarbonisation of the energy system.

Around 82% of the overall Energy Challenge budget has been used for grant-based support which focussed strongly on innovation and market-oriented issues involving a high share (>50%) of industrial participants including SMEs. In terms of thematic priorities, the absolute budget increased for all areas compared to FP7. As regards the funding shares, the weight increased for energy-system related issues, but decreased for renewable energy technologies. The relative changes reflect the shift from a technology-centred approach to a more system-oriented approach and the change of responsibilities for implementing the Framework Programme (see also section L.3.2).

[79] *"Cost Benefit Analysis for the delegation of certain tasks regarding the implementation of Union Programmes 2014-2020 to the Executive Agencies", report submitted by ICF GHK in association with Technopolis, August 2013*

The Energy Challenge was very successful in attracting new participants, mainly from the industry sector. Evidence suggests that a substantial share of newcomers had however participated in the IEE programme. Success rates have been around 14%, with an increasing trend for 2016, but there are significant differences between topics, instruments, and submission type. The 2-stage submission increased success rates in the 2nd stage, but, due to the significant time penalty which discourages industry participation, seem most appropriate for broad research topics likely to attract a high number of proposals. Time-to-grant (TTG) for projects improved significantly compared to the FP7 Energy Theme with the large majority of projects meeting the 8-months limit. However, the improved TTG comes at a cost: feedback from the implementing services suggests that the 'no-negotiation approach' does not allow any more to improve the resource allocation which, in some cases, could have resulted in a lower EU contribution and a more efficient use of the available budget. The no-negotiation in the case of complex demonstration projects also does not allow to properly address and mitigate risks associated with the project which could have negative consequences during the course of the project an, in the worst case, can lead to the premature termination of the project.

The Energy Challenge attracts participants from all Member States and Associated countries. There are strong correlations between the EU contribution for a specific country and its population and/or its national clean energy R&D funding programme budget. However, there are a number of smaller countries, including countries accessing to the EU after 2004, which perform very well on a per-capita basis. The most substantial part of the Energy Challenge funding is won by organisations with well-developed R&I capacities from countries with substantial national R&D programmes in clean energy. Nevertheless, also new participants from countries with a less substantial track-record in EU energy R&D funding were also able to join the programme.

It was also shown that the group of EU-13 countries (i.e. countries acceding to the EU after 2004) is not an appropriate category for analysing country-specific performance due to its heterogeneity and the significant differences in labour costs.

The situation of splitting the implementation of the Energy Challenge between Commission services and two agencies raises a number of challenges (e.g. as regards the exploitation of synergies and the additional internal coordination efforts), but implementing services have been cooperating closely for ensuring a coherent and efficient implementation on the programme.

A small number of complex and costly demonstration projects have encountered difficulties in their preparation phase (e.g. securing additional financing; obtaining permits). Since the no-negotiation approach does not allow any more to introduce adjustments for mitigating the risks, Grant Agreements or more often amended and/or projects suspended. In this situation, more stringent requirements on key milestones and corresponding go/no-go decisions in the preparation phase of the action could be pursued.

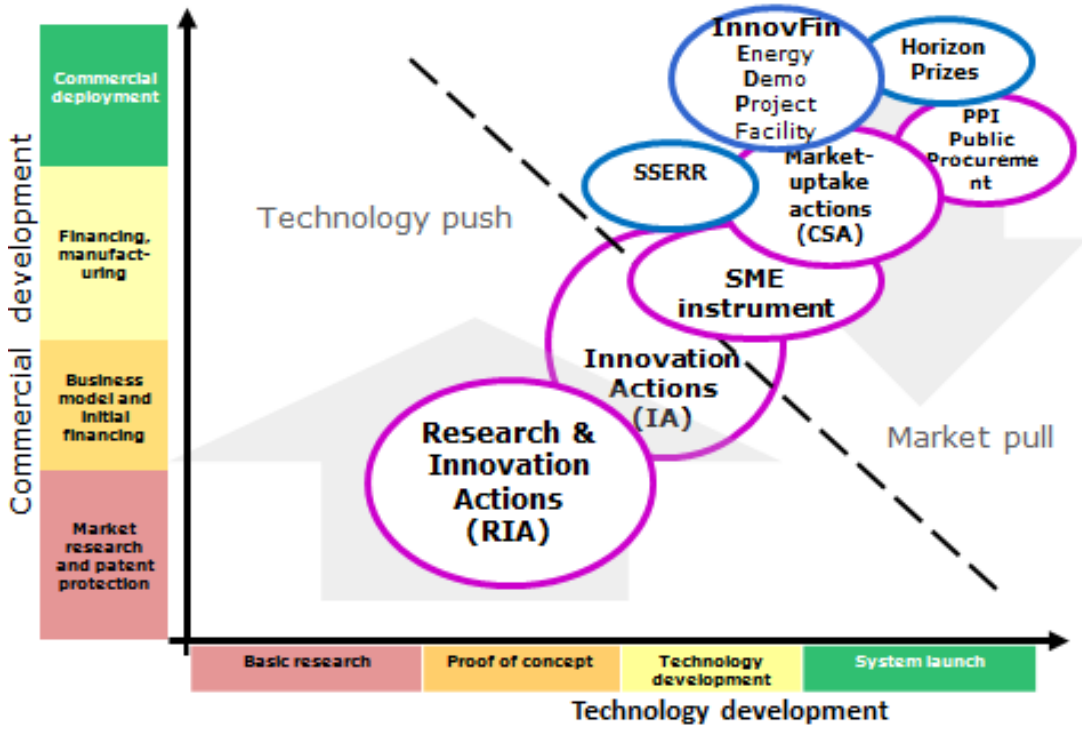
L.6. COHERENCE

L.6.1. Internal coherence

L.6.1.1. Internal coherence of the actions implemented for the Horizon 2020 Energy Challenge

The Energy Challenge supports the development of technologies along the innovation chain. To ensure internal coherence, the Energy Challenge uses **Technology Readiness Levels (TRLs)**[80] to specify the maturity of targeted technologies.

Figure 228 - Toolbox used by the Energy Challenge



Purple circle: implemented through calls for proposals; blue circle: implemented outside calls for proposals. Source: European Commission.

The Energy Challenge **covers the complete innovation cycle** by making use of the following instruments:

- **Research & Innovation Actions (RIA)**: accounting for around 1/3 of the Energy Challenge grant budget and typically addressing technologies in the range of TRL2/3 (formulation and proof of concept) to TRL 4/5 (testing and validation on a small-scale prototype in a laboratory or simulated environment);
- **Innovation Actions (IA)**: accounting for 45% of the Energy Challenge grant budget and typically addressing the validation/demonstration of technologies (TRL 5/6) up to the (successful) demonstration of a system prototype in operational environment (TRL 7/8).
- **SME instrument**: targeting innovative SMEs showing a strong ambition to develop, grow and internationalise and provides staged support covering the

[80] *See Horizon 2020 work programme, General Annex G*

whole innovation cycle (first stage is a feasibility study for single SMEs; second stage is an innovation action for single SMEs or a very small SME-led consortium);

- **Market-uptake actions (CSA)**: typically addressing non-technological bottlenecks (e.g. facilitating the energy policy implementation, preparing the ground for roll-out of the investments, supporting capacity-building, acting on public acceptance, and standardisation);
- **Public Procurement of Innovative Solutions (PPI)**: Enabling groups of procurers to share the risks of acting as early adopters of innovative solutions; provides EU funding for undertaking together one joint or several coordinated PPI procurements based on common tender specifications that are defined jointly by all procurers. So far, one PPI topic is included in the 2017 Energy work programme.
- **"Support Services for Exploitation of Research Results" (SSERR)**: A dedicated support service for projects financed under the FP7 Energy Theme or Horizon 2020 Energy Challenge, launched in 2016, providing expert assistance as regards identification of market potential and opportunities, evaluation of competing technologies, development of business plans, assessment of the costs for upscaling, and protection of IPR.
- **InnovFin Energy Demo Project (EDP)**: providing loans to first-of-a-kind commercial-scale industrial demonstration projects in the field of energy at TRL 7/8, i.e. demonstration in operational environment and systems complete and validated, or to extend guarantees to financial intermediaries who will make such loans. The EDP facility has so far been equipped with EUR 150 million (EUR 50 million from the Energy Challenge budget (split between 2015 and 2016) plus EUR 100 million as re-flow from the FP7 RSFF). By January 2017, InnovFin EDP received a total of 91 expressions of interest. Among these, a first project on wave energy was signed in July 2016 for a EUR 10 million loan, and a second project on offshore wind was approved by the European Investment Bank (EIB) Board of Directors in December 2016 for a EUR 25 million loan (the signature is expected during the second quarter of 2017). Six other projects have passed the initial eligibility check and are being subject to due diligence by the EIB for a total of around EUR 115 million (however, there is no guarantee they will be approved).
- **Horizon prizes**: financial contributions given as rewards following the publication of a contest specifying a target prior to the performance of the work; 3 prizes[81] included in the work programme 2016-2017 for a total budget of EUR 3.25 million.

The **current toolbox allows to appropriately address all issues** outlined in the Horizon 2020 legal base.

The following **example** illustrates the use of the toolbox for the area of biofuels[82]: In the 2014-2015 calls, new concepts for biofuels (TRL 2 – TRL 3/4) were addressed under

[81] *Horizon prizes for*
1. CO2 reuse;
2. a Combined Heat and Power (CHP) Installation in a hospital using 100% Renewable Energy Sources;
3. for Integrated Photovoltaic System in European Protected Historic Urban districts.

[82] *Due to the limited budget, not all areas could be supported with such a comprehensive 'package'.*

topic LCE-01; research on the next generation of biofuels (TRL 3/4 – TRL 4/5) was funded under topic LCE-11, demonstration of advanced biofuel technologies (TRL 5/6 – TRL6/7) was funded under topic LCE-12 and actions supporting the market uptake of bioenergy technologies were targeted under topic LCE-14. SMEs had the possibility to submit any innovative proposal in the area of biofuels for funding under the SME instrument. All projects could apply for support in exploiting their project results under SSERR.

Concrete examples for synergies between technology development Horizon 2020 projects (RIA or IA) and market-uptake-oriented CSAs are:

- The CSA "PV Financing" is researching business models and financing schemes for photovoltaics (PV), while the IA "PV Sites" has 6 different building-integrated PV demo sites across Europe and for each one the project is working out the business model that is best suited to the PV installation that will be demonstrated. Both projects have interacted – representatives from PVSITES have attended workshops organised by PV FINANCING, and this has possibly influenced the research done in PVSITES.
- The CSA "Bridge" brings together running RIAs and IAs in the area of grid/storage and is working on common deliverables in the fields of data protection, business models, customer acceptance and regulations. In principle this ensures that the new technical solutions and technologies developed (e.g. NAIADES (RIA) new sodium-ion battery as an alternative to Lithium ion batteries) complement the more mature solutions of the demonstration technologies (IAs).
- The CSA "SuperSmart" aims at speeding up the uptake of more energy-efficient refrigeration, heating and cooling solutions for the EU's food retail sector. The focus is on removing non-technological barriers by raising the expertise among technical and non-technical staff members and preparing the introduction of a new EU Ecolabel for food retail stores. The IA "MultiPACK" demonstrates the next generation of standardised integrated cooling and heating packages for commercial and public buildings. The MultiPACK consortium will cooperate closely with "SuperSmart" (CSA) to use existing networks via associations, consumer goods panels and forums within the supermarket sector.

Another example for synergies between different actions of the Energy Challenge is in the field of unconventional hydrocarbons: the Administrative Arrangement concluded with the Joint Research Centre (JRC) in 2014 includes a resource assessment of unconventional hydrocarbons; this particular task is outsourced to EuroGeoSurveys, the European Association for Geological Surveys. The cross-thematic ERA-Net on Applied Geosciences (to be funded under the topic LCE-26-2016), which brings together the European geological surveys, will strengthen the trans-national acquisition, interpretation and management of surface and subsurface date (which will include and build on the data gathered in the Administrative Agreement).

L.6.1.2. Internal coherence with other Horizon 2020 intervention areas

Energy is a cross-cutting issue par excellence - in Horizon 2020 it is explicitly addressed through the Energy Societal Challenge, but **other programme parts** also support actions which contribute to the EU's energy R&I objectives. In this assessment, a distinction is made between

- direct financial contributions from/to other programme parts for activities with a very clear contribution to the part's objective ('explicit linkages'), and
- activities which are funded by other programme parts with the aim of addressing their specific objectives but which have nevertheless an impact on energy issues ('implicit linkages'). For programmable actions, such activities have in many cases been discussed beforehand between the relevant Commission services and are, in case potential overlaps between activities could confuse applicants, cross-referenced in the work programme. For bottom-up actions (e.g. ERC, MSCA) such activities are not cross-referenced.

(a) Explicit linkages

To ensure the internal coherence of the programme, specific **inter-service working groups** ('Horizon Groups') have been set up which include representatives from all relevant programme parts. These groups discuss the strategic approach of the work programme as well as the draft work programmes. Thus, they facilitate the identification of potential synergies, gaps and overlaps between different programme parts. The **Horizon Group for the Energy Challenge** has met 8 times to discuss the Energy work programme 2014-2015 and 5 times for the work programme 2016-2017, providing all relevant services the opportunity to comment on all draft versions of the work programme.

Direct financial contribution of Energy Challenge to other programme parts

So far, the Energy Challenge has contributed with a dedicated budget to the following **calls** which are managed by other programme parts:

- 'Blue Growth' initiative: EUR 3 million in 2014 and EUR 2 million in 2016 financing support actions related to aspects of marine and off-shore energy.
- Fast-track-to-innovation pilot: EUR 13.7 million in both 2015 and 2016

In 2014-2015, the Energy Challenge sub-delegated in total EUR 71.5 million to DG CNECT (LEIT-ICT) given the absence of a budget line for DG CNECT in the Energy Challenge. This sub-delegated budget was used to finance the 'Smart Cities and Communities' call (EUR 30 million), the 'Energy Efficiency' call (EUR 18.5 million), the 'Low-carbon energy' call (EUR 22 million) and some 'Other Actions' (EUR 1 million).

The Energy Challenge also contributed to the following **Public-Private Partnerships**:

- Sustainable Process Industry through Resource and Energy Efficiency (SPIRE): in the 2014-2015 calls, 5 projects with a total EU contribution of EUR 20 million (additional EUR 21 million are foreseen in the work programme 2016-2017),
- Energy-efficient Buildings: in the 2014-2015 calls, 6 projects with a total EU contribution of 25.8 million (additional approximately EUR 16 million are foreseen in the work programme 2016-2017).

Direct financial contribution of other programme parts to the Energy Challenge

On the other hand, the following programme parts have contributed with a dedicated budget to calls managed by the Energy Challenge:

- ***Societal Challenge 4 (Transport):***
    - 2014-2015: EUR 40 million for the Smart Cities and Communities call targeting the integration of energy, transport and ICT in urban areas.

- 2016-2017: EUR 15 million for supporting the ELENA facility which provides support for public entities for investing in projects in the area of energy efficiency and transport.

- ***Societal Challenge 5 (Climate Action, Environment, Resource Efficiency and Raw Materials):***
  - 2014: EUR 5 million for energy efficiency in historic buildings
  - 2016: EUR 6 million for an ERA-NET on applied Geosciences.

(b) Implicit linkages

Contributions of the Energy Challenge to objectives of other programme parts

The Energy Challenge has supported projects that also contribute to the following other programme parts (list only includes the most relevant parts):

- ***LEIT-ICT***: The application of ICT and its integration in the energy sector is a crucial element in the Energy Challenge's activities in the areas of energy efficiency, energy systems and Smart Cities and Communities. As a result, under the 2014-2015 calls, 51 projects (representing 25% of the total EU contribution) had a very strong ICT component. These issues remain a priority also for the 2016-2017 calls.
- ***LEIT-NMBP*** – *Advanced manufacturing and processing*: Improved energy efficiency in industry was supported by the Energy Challenge under the 2014-2015 calls through 11 projects (total EU contribution: EUR 26 million; contributing also to the PPP SPIRE). Increasing the energy efficiency in building was supported through 7 projects (EUR 29.1 million; contributing also to the PPP on Energy-efficient Buildings). These issues remain priorities also under the 2016-2017 calls.
- ***Societal Challenge 2 (Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy):***
  - *Sustainable and competitive bio-based industries and supporting the development of a European bioeconomy*: Under the 2014-2015 calls, the Energy Challenge supported 23 projects (EU contribution: EUR 92.5 million) in the area of bioenergy thereby contributing to the creation of a European bio-economy. Bioenergy remains a priority also under the 2016-2017 calls.
  - *Cross-cutting marine and maritime research*: In addition to the contribution to the Blue Growth call (see above), the Energy Challenge supports a portfolio of marine- and off-shore energy technologies (e.g. wave energy, tidal energy, off-shore wind). Under the 2014-2015 calls, in total 9 projects targeting explicitly off-shore/marine technologies have been supported with a total EU contribution of EUR 99.6 million. Marine/off-shore energy remains a priority also under the 2016-2017 calls.
- ***Societal Challenge 4 (Transport):***
  - *Resource-efficient transport that respects the environment*: The Energy Challenge supports the development of renewable alternative fuel including biofuels which contribute to a more environmental-friendly transport system.

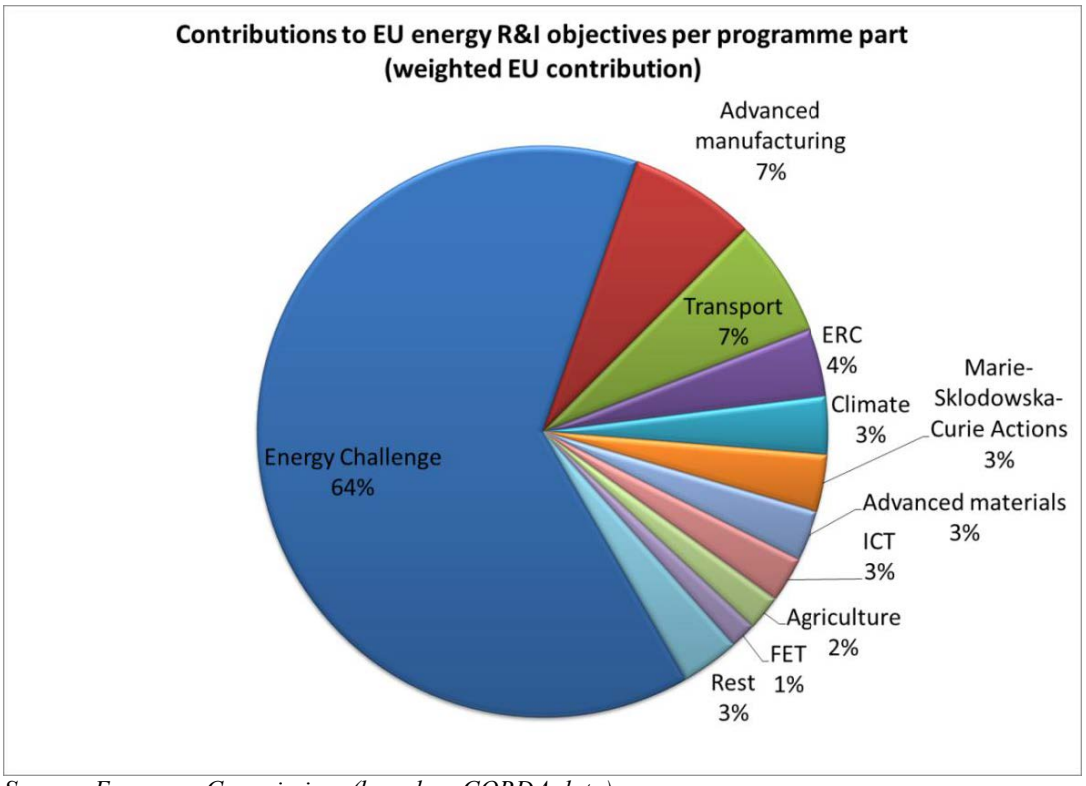
- *Better mobility, less congestion, more safety and security*: Smarter transport solutions in urban environments is supported under the Smart Cities and Communities calls 2014-2015 and 2016-2017.

- ***Societal Challenge 6 (Europe in a changing world)***: The Energy Challenge has been supporting the innovation capacities of societies by integrating socio-economic research into technology-oriented activities and by supporting dedicated socio-economic research.

Contributions from other programme parts to energy objectives

Based on an analysis[83] of the outcomes of the 2014 and 2015 calls, **20 programme parts** have been identified which supported, within their respective scope, actions contributing to EU energy R&I objectives. In terms of budget, the **additional 'weighted' funding** for energy-related projects outside the Energy Challenge under the 2014-2015 calls amounted to **EUR 783 million** (the budget for projects funded by the Energy Challenge in 2014-205 was EUR 1 331 million).

Figure 229: Energy-relevant projects funded by other programme parts under the 2014-2015 calls



Source: European Commission, (based on CORDA data).

In terms of **number of projects**, the programme parts with the highest number of 'fully' and 'partially' relevant projects were funded under Marie-Sklodowska-Curie Actions;

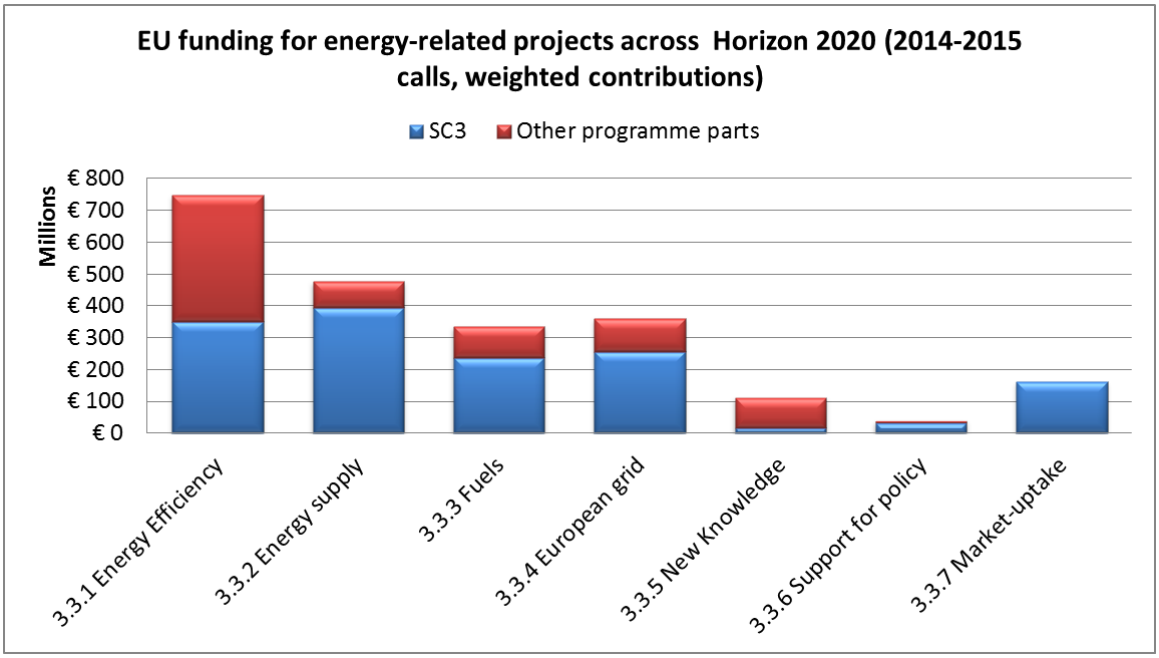
[83] *Data on all projects funded under the 2014 and 2015 Horizon 2020 calls has been extracted from CORDA in September 2016 (including JTIs). Only grants are considered (i.e. financial instruments and most 'other actions' are not considered). Projects have been filtered based on the appearance of energy-related keywords in their abstracts[83]. Pre-filtered projects have been reviewed individually and classified as 'fully', 'partially' or 'not' contributing to EU's energy R&I objectives. Following the logic of the Rio-Markers, projects contributing 'partially' were taken into account with only 40% of their EU funding ('fully' was considered 100%, 'not' with 0%). Projects have been classified according to the classification of the International Energy Agency (IEA) which is different from the structure of the Horizon 2020 Energy Challenge.*

European Research Council (ERC); Advanced manufacturing and processing; Smart, green and integrated transport; as well as Climate action, environment, resource efficiency and raw materials.

In terms of **thematic priorities**, the following areas have been receiving the most substantial support across the whole programme (list is not exhaustive – there are many other energy areas supported also by other programme parts):

- **Energy efficiency**: More than half of the energy-related funding outside the Energy Challenge was dedicated to energy efficiency. Relevant activities have been supported in 12 programme parts of which the most relevant in terms of budget were 'Advanced Manufacturing' (notably the PPPs on SPIRE, Energy-efficient Buildings and Factories of the Future) and the Transport Challenge (energy efficiency in transport including e-mobility as well as the PPP on Green Vehicles and Clean Sky).
- **Energy storage**: supported by 11 programme parts of which the most relevant in terms of budget were 'Advanced Materials' as regards new materials for energy storage, the ERC (on novel concepts for energy storage) and the Transport Challenge as regards electric vehicles.
- **Solar energy**: supported by 11 programme parts of which the most relevant in terms of budget were the ERC and Marie-Sklodowska Curie Actions on novel concepts for solar energy; Societal Challenge 5 and 'Advanced manufacturing and processing' on recycling of solar cells.

Figure 230: EU funding for energy-related projects across Horizon 2020, 2014-2015 calls, weighted contribution



Source: European Commission (based on CORDA data).

In terms of covering the full innovation cycle, projects supported in **other programme parts complement activities of the Energy Challenge**. While the Energy Challenge focusses mainly on applied research up to innovation and market-uptake, other programme parts cover upstream activities like basic or material research, e.g.

- The ERC funded 78 projects in 2014-2015 dealing with basic research that can be expected to have an impact on the energy sector,

- Under the 'Advanced Materials' part, 11 projects (in total EUR 87.5 million) have been funded in 2014-2015 targeting improved materials for application in the energy sector,
- The 'Future Emerging Technology' (FET) part funded 16 projects in 2014-2015 addressing cross-thematic, long-term oriented research with a clear link to the energy sector. In addition, the 2016 'FET Proactive' call includes a specific challenge on 'New technologies for energy and functional materials' (indicative budget: EUR 20 million) which is targeting ecosystem engineering and complex bottom-up construction.

Whilst there are many complementary energy-related projects funded under different programme parts, there are currently very **little 'institutionalised' efforts for exploiting synergies** between complementary projects funded under different programme parts (e.g. common workshops; bringing together different stakeholder communities which work on the same issues but from different angles). In addition, due to the different implementation structures (projects are managed by different agencies and/or Commission services) it is difficult for implementing services to identify and monitor relevant projects across different programme parts and to create comprehensive project clusters. In particular, implementing services lack sophisticated data- and text-mining tools which would allow easy identification of relevant projects across Horizon 2020. Not exploiting potential synergies is, in the best case, a missed opportunity; in the worst case it could lead to wasteful duplications of efforts.

L.6.1.3. Ensuring that every euro spent counts twice

While activities supported under the Energy Challenge will contribute to energy objectives in the first place, a number of activities can be expected to **develop solutions that also benefit other sectors**. For example,

- In the area of **biofuels,** some projects (e.g. *WASTE2FUELS*, *2G BIOPIC*) will produce high added-value bio-materials that could be of use to other areas.
- In the **energy storage area**, the re-use of electric vehicles batteries for stationary applications may have a positive effect on improving the economics of those batteries (helping thereby the Transport Challenge and the Circular Economy). Similarly, the new types of batteries being developed are expected to have positive effects on the Transport and other Challenges too.
- The **technologies for capturing and utilising CO2**, supported under the Energy Challenge, will also benefit the process industry where waste can be used as resources in industrial symbiosis.

However, technological impacts on other areas are difficult to predict and can often only be verified after the projects finished. The evaluation of predecessor programmes indicates that indeed a significant share of FP6 and FP7 energy projects (39%) reported that they believed technology transfer to other areas has taken place[84].

[84] *See "FP6/FP7 Energy Mid-term Evaluation", Technopolis 2014 (http://ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/impact-of-energy-projects-fp6-fp7.pdf#view=fit&pagemode=none)*

L.6.2. External coherence

L.6.2.1. Coherence with other EU funding programmes

The relevance of the Horizon 2020 Energy Challenge to energy- and climate-related EU policy objectives has been tackled in part 4.1 (Relevance). In addition, a number of other EU funding initiatives exist which address (parts of) the energy area. The following overview is not exhaustive, but focusses on the most relevant EU initiatives.

EU Structural and Investment Funds (ESIF)

Around **EUR 40 billion** will be allocated by the **Structural and Investment Funds (ESIF) to objectives in the energy field** over the period 2014-2020, including interventions in energy efficiency, renewable energy, smart distribution grids and sustainable urban mobility, as well as R&I in these areas, in complementarity with Horizon 2020. To increase the impact of ESIF, beneficiary countries are required to establish **Smart Specialisation Strategies** that set priorities at national and regional level, building competitive advantage by developing and matching research and innovation own strengths with business needs. According to an analysis by the JRC[85], the Smart Specialisation Strategies indicate that the highest interest at regional or national level is in energy efficiency, smart grids, electric vehicles, bioenergy and wind energy. These areas are all addressed in the Horizon 2020 Energy Challenge.

The Commission supported the creation of **synergies between Horizon 2020 and the ESIF** by:

- Reviewing all national Operational Programmes submitted for the ESIF period 2014-2020 and including, where appropriate, references to the relevance of energy R&I, and the SET-Plan in particular.
- Encouraging applicants to benefit from the possible synergies between Horizon 2020 and the Structural Funds through specific references in the Energy work programmes.
- Raising awareness of NCPs and Programme Committee members through dedicated presentations.
- A Smart Specialisation Platform on Energy (S3PEnergy)[86] has been set up as an enabling tool for regions to coordinate, rationalise and plan their respective energy strategies, develop a shared vision on knowledge-based energy policy development, and set up a strategic agenda of collaborative work. The main objective is to support the optimal and effective uptake of the Cohesion Policy funds for energy, and to better align energy innovation activities at national, local and regional level through the identification of the technologies and innovative solutions that support in the most cost-effective way the EU energy policy priorities.

The Energy Challenge finances a number of **projects aiming at stimulating synergies** with ESIF, e.g.:

[85] *"Mapping regional energy interests for S3P-Energy", JRC 2016 (http://publications.jrc.ec.europa.eu/repository/bitstream/JRC100520/reqno_jrc100520_online%20version.pdf)*
[86] *http://s3platform.jrc.ec.europa.eu/s3p-energy*

- The project ***LEMON***[87] (*'Less Energy More OpportuNities*') focuses on the energy retrofit of 622 dwellings in the social housing sector of two regions of Emilia-Romagna to achieve 40% energy savings guaranteed by ESCOs (Energy Service Companies). The envisaged investment volume amounts to approximately EUR 15 million. The financing structure involves loans to be repaid, inter alia, within the framework of 'Energy Performance Tenancy Agreements' and combines different financing instruments available at National and Regional level (ERDF funds, National financing, National incentive 'Conto termico' and loans).
- The project ***SUNShINE***[88] (*'Save your bUildiNg by savINg Energy'*) addresses the poor conditions of the around 28 000 multi-family buildings in Latvia which have a huge untapped energy savings potential. To support owners in renovating, the project offers a solution by bundling the renovations in 'Energy Performance Contracts'. The project aims at boosting the ESCO market for deep retrofit by building a pipeline of 80 refurbished multifamily buildings and establishing a forfeiting fund in support of ESCOs cash flows. Projects are eligible for ERDF (European Regional Development Fund) support which reduces the payback time of the investment for deep refurbishment.
- The project ***Transition Zero***[89] aims at establishing the right market conditions for the wide-scale introduction of net zero energy homes across Europe. It builds on the success of Energiesprong in the Netherlands and intends to kick-start net-zero energy refurbishment markets in the UK and France, using the social housing sector as a catalyst. The Energiesprong initiative has also secured EUR 5.4 million of European funding through the Interreg Northwest Europe (NEW) programme, with a view to further spread concept. The grant will be used in the UK, France, Luxemburg and the Netherlands to stimulate the market for net-zero energy refurbishments.

As regards the synergies with ESIF, the Horizon 2020 Energy Challenge benefitted from the integration of the Intelligent Energy Europe (IEE) programme which has funded a number projects (some are still running) on synergies between the uptake of innovative energy efficiency solutions and ESIF.

European Fund for Strategic Investments (EFSI)

The ESIF, set up in 2015, intends to mobilise investments of at least EUR 315 billion in three years by focussing on removing obstacles to investment, providing visibility and technical assistance to investment projects and making smarter use of new and existing financial resources.

As of 30 June 2016, the 'Infrastructure and Innovation Window' (IIW) of EFSI approved 77 operations with an EFSI funding of EUR 11 billion. **21 of these projects were in the area of energy** accounting for 33% of the EFSI investment and **10 projects were in the area of research, development and innovation** (RDI) representing 9% of the total EFSI investments (one project, included in energy and RDI, focussed on energy RDI)[90].

The Energy Challenge supported 6 projects with a total EU contribution of EUR 6.8 million targeting **project development assistance (PDA)** under the 2014-2015 calls (for

[87] http://cordis.europa.eu/project/rcn/200000_en.html
[88] http://cordis.europa.eu/project/rcn/194599_en.html
[89] http://cordis.europa.eu/project/rcn/200167_en.html
[90] SWD(2016) 297 final

2016-2017 calls, additional EUR 16 million have been earmarked for such activities). These projects build on actions supported under the Intelligent Energy Europe (IEE) programme, e.g. MLEI POSIT'IF[91] and MLEI PSEE Alsace[92], and aim at developing innovative financing solution schemes (with a leverage ratio of at least 1:15) which could then be further supported by EFSI funds and/or guarantees.

By the time of 31 October 2016, when almost none of the Energy Challenge projects has finished yet, no project supported under the Energy Challenge has received support from the EFSI.

European Development Fund (EDF) and the Development Cooperation Instrument (DCI)

The budget of the European Development Fund (EDF) and the Development Cooperation Instrument (DCI) for energy-related issues in the period 2014-2020 is approximately **EUR 3.7 billion** (including allocations from some 30 National and Regional Indicative Programmes in all regions where energy is focal sector of cooperation, as well as thematic/global funds coming from the Global Public Goods and Challenges programme (2015 GPGC) and the Intra-ACP). For **Sub-Saharan Africa**, the total budget is around EUR 2.5 billion. The main instruments supported by these initiatives include policy dialogue, a large Technical Assistance Facility, the regional blending facilities (about EUR 500 million allocated for Sub-Saharan Africa, covering all infrastructure), the new electrification financing initiative Electrifi, the Covenant of Mayors for Sub-Saharan Africa and rural electrification.

Given the **significant potential for synergies**, Commission services managing the Energy Challenge of Horizon 2020 and the Development Cooperation instruments are discussing possible modes of cooperation, involving complementary financial support from both programmes, in the remaining years of Horizon 2020.

ETS New Entrants' Reserve (NER300)

NER 300 is funded from the sale of 300 million emission allowances from the New Entrants' Reserve (NER) set up for the third phase (2013–2020) of the EU emissions trading system. The revenues from the sales were allocated to projects selected through two calls for proposals awarded in December 2012 and in July 2014. The cumulative NER 300 funding was EUR 2.1 billion financing 38 projects covering different renewable energy areas (37 projects) and CCS (1 project). Almost 80% of the NER 300 grants went to highly innovative projects.

European Institute of Innovation & Technology (EIT)

The European Institute of Innovation & Technology (EIT) is an independent EU body aiming at enhancing Europe's ability to innovate by nurturing entrepreneurial talent and supporting new ideas. It brings together the 'knowledge triangle' of business, education

[91] The MLEI POSIT'IF project received EUR 100 million from the European Fund for Strategic Investment (EFSI) to upscale their MLEI pilot on deep retrofit in condominiums in France (for further information see: https://ec.europa.eu/easme/en/news/more-investments-energy-efficiency-bridging-gap-between-project-developers-and-finance).

[92] *MLEI PSEE Alsace is preparing the creation of a dedicated operator to finance the energy renovation of detached houses in the Alsace region (France). Discussions are on-going regarding the participation of EIB in the financing of this operator, which would be possible thanks to the guarantee provided by the European Fund for Strategic investments. (http://ec.europa.eu/energy/intelligent/projects/en/projects/mlei-psee-alsace).*

and research to form trans-national partnerships, so-called Knowledge and Innovation Communities (KICs).

In the area of energy, the KIC InnoEnergy[93] started in 2010 and comprises around 250 European partners from industry, research institutes, universities and business schools. It supports innovation-related activities in the areas of clean coal and gas technologies, energy storage, energy efficiency, renewable energies, smart and efficient buildings and cities as well as sustainable nuclear and renewable convergence. All areas, except nuclear energy[94], are also supported under the Horizon 2020 Energy Challenge.

The KIC InnoEnergy provides support to commercially mature concepts which have been developed under the EU R&I Framework Programmes, e.g.:

- In the context of the FP6 Energy project ***NightWind***[95], a project partner developed control algorithms for appliances in industrial/ large office buildings. After finalisation of the *NightWind* project, the project partner, together with other industry partners, successfully applied for support by the KIC InnoEnergy for developing a hardware/software control unit which controls the electrical energy demand of a freezing warehouse/cold store based on electricity pricing of the e-market, while respecting the temperature limits required by the refrigerated products. The project was completed successfully in 2015: the developed controller (hardware and software) is ready for the market, as is the data center of Cofely for the support. The emulator (software package) including testing procedure is finalized and transferred to Cofely. To further scale the product and ensure a larger market penetration, a startup was created ("ColdShift"), which is currently supported by the InnoEnergy Highway.
- In the FP7 project ***OMSOP***[96] ('*Optimised Microturbine Solar Power system*'), the Swedish Kungliga Tekniska Hoegskolan (KTH) created refined thermodynamic models for solar receivers which has been further developed and implemented in the *DYESOPT* software for the proper prediction of thermodynamic performance of solar receiver and associated cost functions. This software was then used to investigate solar power plant projects further. *DYESOPT* is the code used in the project *TesConSol* and it is continuously being expanded and updated.

Whilst there are regular exchanges between Commission services in charge of the Horizon 2020 Energy Challenge and the KIC InnoEnergy, activities facilitating the identification of promising concepts and the bridging from Horizon 2020 support to support by the KIC InnoEnergy **could be further developed and implemented**.

Connecting Europe Facility

Under the Connecting Europe Facility (CEF), **EUR 5.85 billion is available in 2014-2020** for trans-European energy infrastructure projects such as gas pipelines, transmission grids, liquefied natural gas terminals, gas storage, and smart grids. The European Commission has drawn up a list of 248 EU projects of common interest (PCIs) which may apply for CEF funding (the list of projects is renewed every two years).

---

[93] *See http://www.innoenergy.com/*
[94] *Nuclear energy is covered by the Research and Training Programme of the European Atomic Energy Community (2014-2018) complementing the Horizon 2020 Framework Programme for Research and Innovation*
[95] *http://cordis.europa.eu/result/rcn/46885_en.html*
[96] *https://omsop.serverdata.net/Pages/Home.aspx*

The thematic areas covered by CEF and the Horizon 2020 Energy Challenge overlap partially. However, CEF puts great emphasis on the geopolitical dimension of projects while Horizon 2020 focuses on the innovation dimension of projects. **Potential synergies** between CEF and the Horizon 2020 Energy Challenge are therefore **limited**.

Programme for the Environment and Climate Action (LIFE)

The LIFE programme[97] supports **environmental, nature conservation and climate action** projects throughout the EU. The overall budget for the period 2014-2020 is **EUR 3.4 billion**, of which EUR 0.86 billion are dedicated to the sub-programme for **climate action** which addresses, inter alia, energy-related activities, mainly renewable energy, energy efficiency, CCS and transport fuels, under its **'mitigation' chapter**. The LIFE Regulation mentions explicitly the need to develop synergies with Horizon 2020 and to ensure a coordination to prevent double funding. Moreover, it encourages the uptake of the results of environmental and climate-related research and innovation of Horizon 2020, e.g. by giving extra-points for proposals which take up results from Horizon 2020 projects. The **main differences** between LIFE and Horizon 2020 is that the LIFE programme follows a more bottom-up approach when calling for proposals (just defining priority areas instead of specific topics) and that mono-beneficiary projects without transnational cooperation are eligible. LIFE projects typically also receive a lower EU contribution (between EUR 0.5 – 3 million per project, but for most projects below EUR 1.5 million).

However, given that Horizon 2020 has a stronger focus on innovation compared to its predecessors and that the SME instrument also allows for mono-beneficiary support, there are indeed **some thematic overlaps between the LIFE programme and the Horizon 2020 Energy Challenge** which could potentially create confusion for applicants. For example, since 2014 a total of 12 energy-related projects have been funded by LIFE with a total EU contribution of EUR 17.1 million, mostly addressing energy efficiency and renewables, of which many could have been funded also under the SME instrument topic of the Energy Challenge. The LIFE programme is implemented by EASME which is facilitating the creation of links between LIFE and Horizon 2020 energy efficiency projects.

L.6.2.2. Coherence with other public support initiatives at regional, national and international level

At national level

All EU Member States have **national public support programmes for energy R&I**[98]. There are a number of estimates as regards the share of the EU funding compared to the total public funding in the EU:

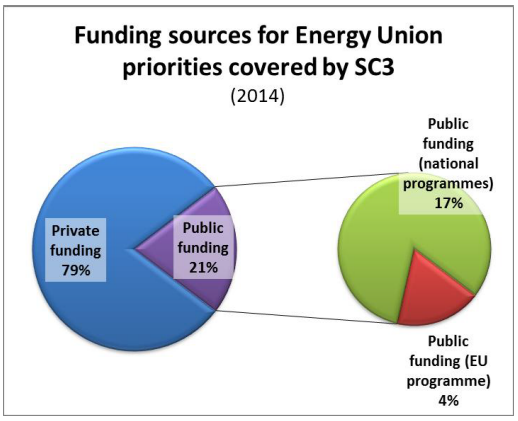
- The most recent estimations from the **JRC**[99] on the combined funding for the **Energy Union priorities covered by the Energy Challenge** (renewables, energy system, energy efficiency, CCS) was EUR 15.9 billion in **2014**, of which EUR 3.3 billion was provided by public funding programmes (EUR 0.6 billion from the Energy Challenge and EUR 2.7 billion from national programmes) and EUR 12.6 billion from private sources. This means that public funding represents

[97] http://ec.europa.eu/environment/life/
[98] *For an overview see* https://setis.ec.europa.eu/energy-research/sites/default/files/docs/CompediumERKC20131219.pdf
[99] *JRC, Science for Policy Report, EU innovation and R&I financing in energy – 2016 edition (forthcoming reference)*

around 21% of the total funding and that the EU funding represents around 4% of the total public and private funding and 18% of the total public funding.

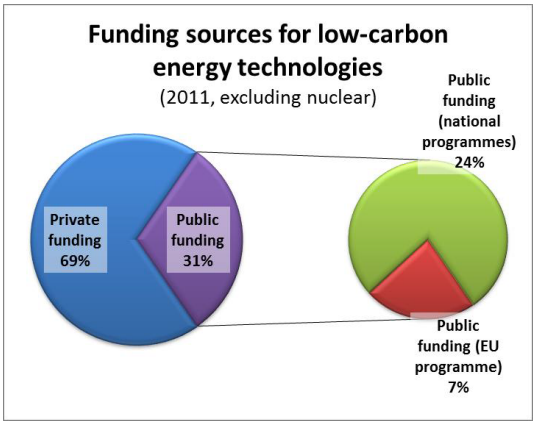
- The most recent data from the **International Energy Agency (IEA)** on public R&D spending for clean energy technologies in **2014** (excluding nuclear energy; see Figure 217) indicates that the EU funding represents around 16% of the total public funding for clean energy technologies in the EU.
- The **JRC Capacities Map from 2015**[100] which analysed private and public R&D funding for **SET-Plan technologies** (excluding nuclear energy) at national and EU level in **2011** found that EU funding (FP7 Energy Theme) represented 7% of the total public and private energy R&D funding in the EU (national public funding accounted for 24%, private funding for 69%) and 23% of the total national and EU public funding.

Figure 231 - Funding sources for Energy Union priorities covered by the Energy Challenge, 2014



Source: JRC, EU innovation and R&I financing in energy – 2016 edition.

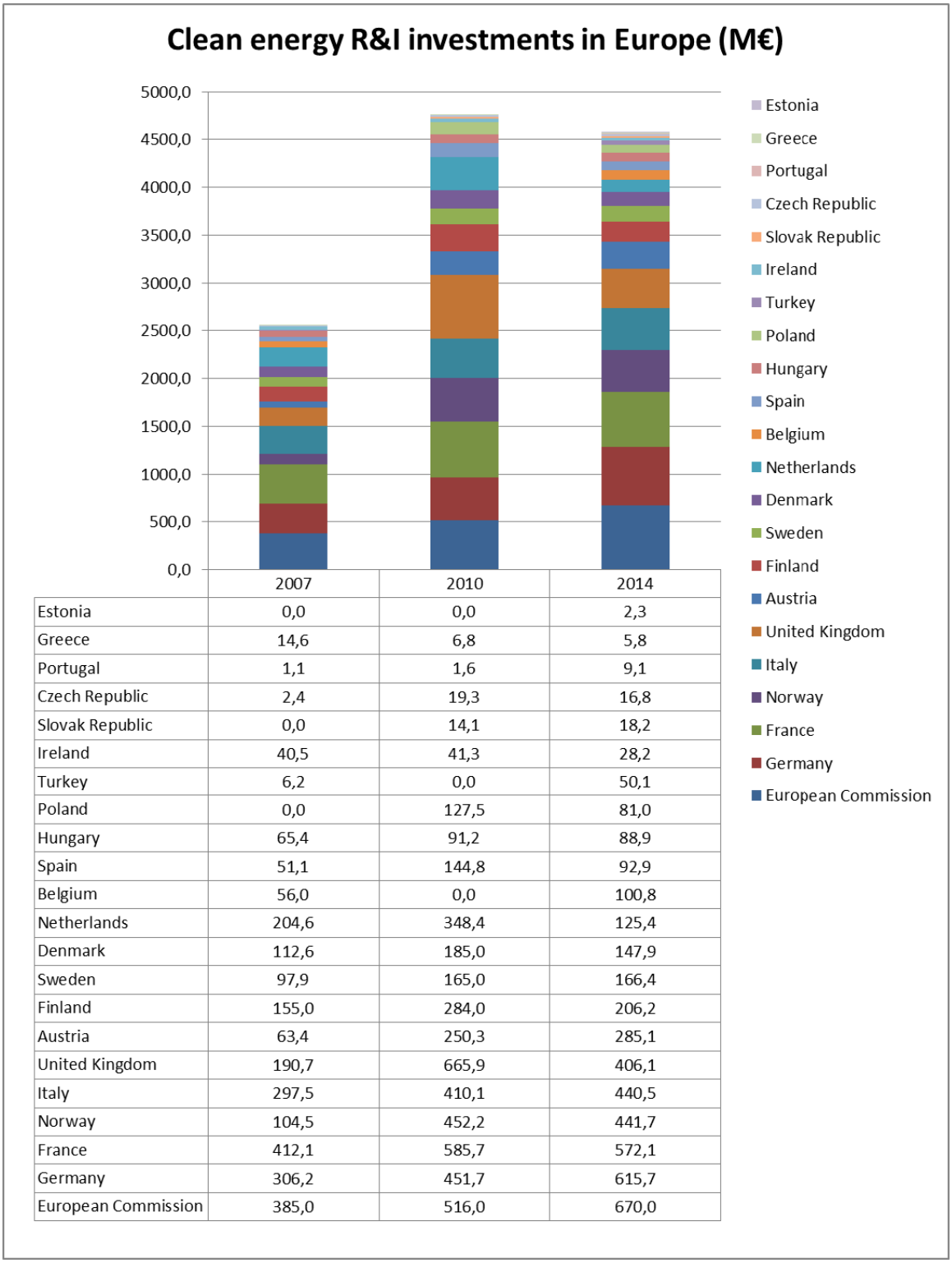
Figure 232 - Funding sources for low-carbon energy technologies, 2011, excluding nuclear energy



Source: JRC, Capacities Map 2015.

[100] *See https://setis.ec.europa.eu/system/files/Capacities-map-2015.pdf*

Figure 233: Clean energy R&I investments in Europe (2007, 2010 and 2014), million EUR



	2007	2010	2014
Estonia	0,0	0,0	2,3
Greece	14,6	6,8	5,8
Portugal	1,1	1,6	9,1
Czech Republic	2,4	19,3	16,8
Slovak Republic	0,0	14,1	18,2
Ireland	40,5	41,3	28,2
Turkey	6,2	0,0	50,1
Poland	0,0	127,5	81,0
Hungary	65,4	91,2	88,9
Spain	51,1	144,8	92,9
Belgium	56,0	0,0	100,8
Netherlands	204,6	348,4	125,4
Denmark	112,6	185,0	147,9
Sweden	97,9	165,0	166,4
Finland	155,0	284,0	206,2
Austria	63,4	250,3	285,1
United Kingdom	190,7	665,9	406,1
Italy	297,5	410,1	440,5
Norway	104,5	452,2	441,7
France	412,1	585,7	572,1
Germany	306,2	451,7	615,7
European Commission	385,0	516,0	670,0

Source: European Commission, based on IEA data; R&I on nuclear energy is not included; For Greece, due to lack of data, figures for 2007 have been replaced by 2006 figures, for 2014 with 2011 figures. For Ireland and Italy, 2014 figures are replaced by 2013 figures. For Hungary, 2014 figures are replaced by 2012.

To conclude: The **Energy Challenge budget is higher than the public low-carbon energy R&I budget of any individual Member States** and represents **between 15-20% of the total public R&I funding for low-carbon energy** (excluding nuclear). Taking **private funding into account, the EU budget represents some 4% of the total funding**.

Given the limited size of EU funding in the overall funding landscape, the increase in synergies between public programmes (at EU, national and regional level) as well as between public and private sources has been a central priority of the SET-Plan which was launched in 2007 and further developed ever since.

In the context of the SET-Plan an **Integrated Roadmap**[101] covering all priority areas of the Energy Challenge has been elaborated and serves as a main reference point for activities at EU and national level. Building on the Integrated Roadmap, the SET-Plan Steering Group (including representatives of Member States, countries associated to Horizon 2020 and the Commission) agreed on **common targets for priority areas** and is discussing **implementation plans** (targeting mainly industrial resources and national public programmes) for achieving these targets[102]. The objective is to increase the coherence of all actors' efforts for progressing towards the transformation of the energy system.

The Energy Challenge also supported (with targeted grants) the creation of **synergies between nationally-funded research organisations** through the SET-Plan **European Energy Research Alliance (EERA)**[103]. EERA currently has 175 members (including all major national research centres in the EU) which have established 17 Joint Programmes (JPs). JPs coordinate research based on the participating institutions own resources and define key priorities for the different research areas which are important reference points for the EU and national research priorities. Four JPs benefitted from EU-funded projects under the FP7 Energy Theme (Integrated Research Programmes – IRP).

At international level

To facilitate coherence at international level, the European Commission participates in 14 **Technology Collaboration Programmes** (TCP)[104] of the **International Energy Agency (IEA)** in the area of renewable energy, fossil fuels and electricity as well as in the 'Committee on Energy Research and Technology' (CERT) which looks at the overall coherence and strategic approach of the TCPs. This participation helps the Commission in following relevant activities in non-EU countries and ensuring that calls of the Energy Challenge appropriately reflect developments in other parts of the world.

The European Commission also joined the **'Mission Innovation' initiative** which was launched at the margins of the COP21 conference in Paris in November 2015. Members of 'Mission Innovation', representing 58% of the world population and over 80% of global clean energy research budgets, have already identified 7 key challenges which will be jointly addressed. In addition, Mission Innovation members also agreed to map

[101] *See https://setis.ec.europa.eu/set-plan-process/integrated-roadmap-and-action-plan*
[102] *For further information see the "SET-Plan Progress Report 2016 - Transforming the European Energy System Through INNOVATION", available under https://setis.ec.europa.eu/system/files/set-plan_brochure.pdf*
[103] *See http://www.eera-set.eu/*
[104] *Technology Collaboration Programmes (TCPs) are independent, international groups of experts that enable governments and industries from around the world to lead programmes and projects on a wide range of energy technologies and related issues. They are formally organised under the auspices of an 'Implementing Agreement'.*

existing and planned public and business activities onto identified needs in order to identify gaps and opportunities.

L.6.3. Lessons learnt/Areas for improvement

The Energy Challenge disposes of a large toolbox of funding instruments – including 'technology push' and 'market pull' instruments, grants and other forms of support – which allows supporting the whole innovation cycle. The systematic use of TRLs in the calls texts and proposal description has been facilitating internal coherence.

Energy is a cross-cutting issue addressed in various parts of Horizon 2020, either by direct financial contributions to the Energy Challenge or by projects which implicitly also contribute to energy objectives (the most significant parts are NMBP, ERC, MSCA and the Transport Challenge). In the area of energy efficiency or as regards long-term-oriented research, the funding in other programme parts even surpasses that of the Energy Challenge. To a lesser extent, the Energy Challenge contributes also to the objectives of other LEITs or Societal Challenges (mainly NMBP, ICT, SC2, SC4, and SC6). In order to ensure coherence in the calls (defining overlaps and avoiding duplications), dedicated inter-service groups have been created. Whilst there are many complementary energy-related projects funded under different programme parts, there are currently very little 'institutionalised' efforts for exploiting synergies between complementary projects funded under different programme parts (e.g. common workshops; bringing together different stakeholder communities which work on the same issues but from different angles). In particular, implementing services lack sophisticated data- and text-mining tools which would allow easy identification of relevant projects across Horizon 2020.

External coherence as regards the synergies with similar funding programmes at national and regional level has also been improved in Horizon 2020 thanks to the progress achieved in the SET-Plan which rallies national programme owners and managers around common priorities. In addition, the Commission's active role in Mission Innovation is expected to improve coherence with regard to similar initiatives of the main global actors outside the EU.

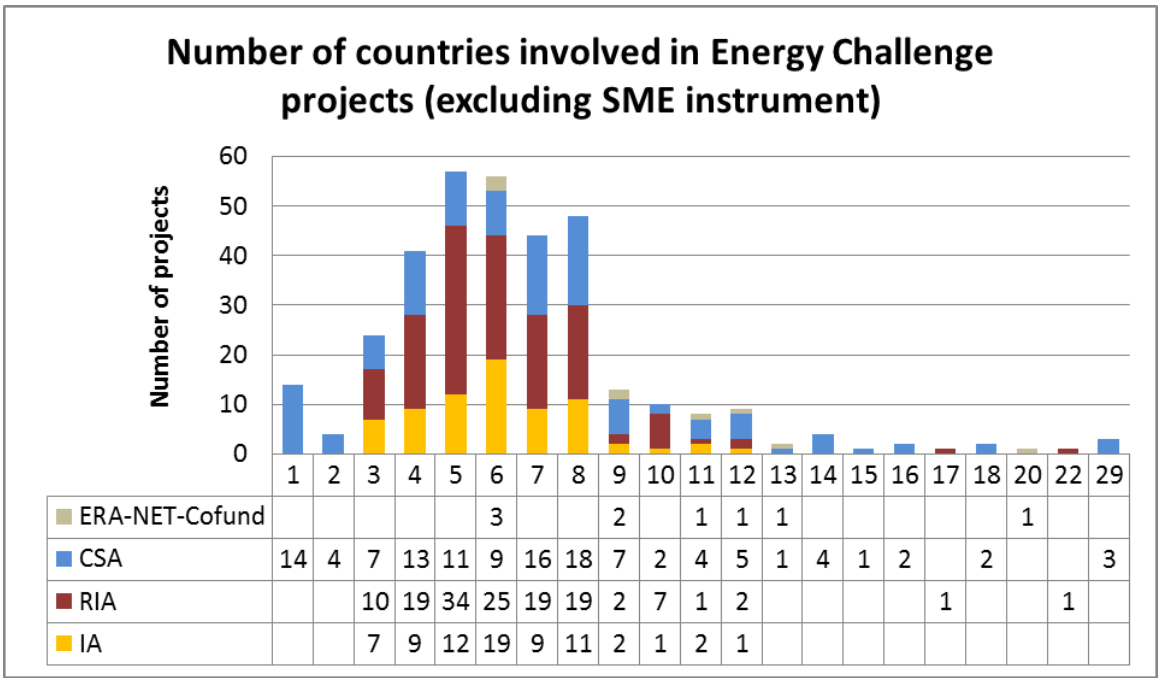
There are a number of other EU programmes disposing of substantial budgetary resources which link to certain aspects of the Energy Challenge. A number of Energy Challenge projects directly target the creation of synergies with such programmes by providing intelligence for better using and targeting the funds of these programmes. However, the impact of the Energy Challenge on energy R&I-related aspects in other programmes can be improved, especially as regards the Structural Funds for areas other than energy efficiency, the European Institute for Innovation & Technology (EIT) as well as the European Development Fund, in particular as regards the cooperation with developing countries which is of great importance for achieving global Sustainable Development Goals and emission reduction targets.

L.7. EU ADDED VALUE

Creating a European Research Area is one of the general objectives of Horizon 2020. Therefore, the Energy Challenge features distinct transnational requirements which distinguishes it from national/regional R&I funding programmes (e.g. for most collaborative actions there must at least be three distinct participants from at least 3 different countries).

Indeed, the majority of collaborative projects involve participants from between 4 to 8 countries (see Figure 220) – typically, the number of countries involved in a project is around half the number of participants, i.e. there are on average around 2 participants per country in a project – which pool their resources and knowledge to address societal challenges of European concern.

Figure 234: Number of countries involved in Energy Challenge projects (as of 26 October 2016, excluding SME instrument)



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20	22	29
ERA-NET-Cofund						3			2		1	1	1						1		
CSA	14	4	7	13	11	9	16	18	7	2	4	5	1	4	1	2		2			3
RIA			10	19	34	25	19	19	2	7	1	2					1			1	
IA			7	9	12	19	9	11	2	1	2	1									

Source: European Commission (based on CORDA data).

The **transnational nature** of Horizon 2020 can have positive and negative effects.

On the negative side are the substantial efforts required for preparing a proposal (see section L.5.2.1).

On the **positive** side, the transnational focus stimulates

- **Pooling a critical mass** of financial resources, research infrastructures and expertise from different countries, sectors and organisations allowing to support high-risk/high-impact projects;
- **Research policy coordination and agenda-setting activities** (for the Energy Challenge, these objectives are most prominently pursued through the SET-Plan);
- **Mobility of researchers**; and
- Improved **level of research excellence and capacities**.

These claims are backed by the findings of the survey conducted in the context of a study on European Added Value (PPMI, 2016) and the study on the first results of Horizon 2020 projects on energy efficiency and system integration (Ricardo, 2016). Asked about the differences between funding from Horizon 2020 and a national/regional programme,

respondents of the PPMI study replied[105] that in case of national/regional funding there would be a **decrease** in:

- **Research capacities**, mainly as regards understanding and knowledge in new (64% of respondents) and existing (53%) areas; planning and coordination of R&D to avoid duplication (51%) and access to infrastructures (48%);
- **Human resources**, in particular as regards relationship and networks (87%) and the ability to attract researchers and other staff (67%);
- **Commercial advantage**, in particular as regards competitive position internationally (79%) and access to new market (75%);
- **Scientific/research outputs**, in particular in as regards participations in scientific conferences, seminars or workshops (75%) and specific outputs targeting policy making (71%);
- **Research capacity outputs**, notably new collaborations partnerships with industry and business (77%); the transfer of technology and knowledge (72%), and new collaboration partnerships public administration and NGOs (66%);
- **Innovation outputs**, in particular as regards large-scale demonstration activities and prototypes/testing activities (no distinction was made for this aspect between the different programme parts, but given the strong innovation focus of the Energy Challenge, it can be expected that the findings will apply also to the Energy Challenge).

The same survey also showed that **more than half of the projects would not have gone ahead without EU funding**, while a third would have gone ahead with significant modifications (mainly as regards the project's timeframe, but also as regards the number and type of participants). For projects that would not have gone ahead, the reasons were mainly the lack of alternative sufficient funding sources at national/regional level, the difficulty of addressing pan-European challenges solely at national level and the lack of access to necessary knowledge, expertise and skills in other countries.

The PPMI study also included a bibliometric analysis investigating the difference in the **quality of the scientific output** produced by FP7 scientists (FP7 output versus all other output produced by the FP7 scientists during 2007-2013). For Energy projects[106] it could be shown that the average SCImago Journal Rank (SJR) value[107] for journals in which FP7 publications were published was significantly higher than the average SJR value of journals in which non-FP publications of the same author were published (2.2 vs. 1.4) – in short: **FP-publications were published in better journals than non-FP publications**.

The survey of the Ricardo study showed that more than **80% of respondents agreed** (or strongly agreed; less than 5% of respondents disagreed) that **Horizon 2020 adds value** over and above what could be achieved at national level as regards the

- Harmonisation of policy developments and actions across Member States;
- Avoiding fragmentation of R&I across Europe;
- Pooling of knowledge and resources between researchers (even 90% agreement);
- Creating synergies within the research community;

[105] *Findings are reported from the study "Assessment of the Union added value and the economic impact of the EU framework programmes (FP7, Horizon 2020), PPMI, 2016*
[106] *The output of scientists involved in 169 FP7 Energy Theme projects was included in the analysis.*
[107] *The SJR indicator is a measure of scientific influence of scholarly journals that accounts for both the number of citations received by a journal and the importance or prestige of the journals where such citations come from.*

- Raising standards of energy technologies in the market (slightly below 80% agreement);
- Addressing market failures (slightly above 70% agreement).

While there is clear evidence on the EU Added Value at programme and 'Energy Challenge' level, no detailed analysis is available on the specific Added Value for different technology areas. However, given the significant differences in the share the EU funding represents (for CCS and grids the FP represented at least 20% of the overall funding while for energy storage bioenergy the share was well below 5%[108]), the differences in national priorities and in the size of the sectors, it can be expected that the specific EU Added Value is different for the different areas, e.g.

- For areas with a small stakeholder community scattered across a few countries (e.g. geothermal energy), the EU programme is essential for pooling the available R&D expertise and capabilities. Often, the EU funding also represent a significant share of the funding.
- For areas with large stakeholder communities across many countries the specific added value of the EU programme could be more on research policy coordination, agenda-setting activities and sharing of best-practices.

Table 174 - Share of national, EU and corporate R&I funding per technology area (reference year 2011)

	Bioenergy	CCS	Grids	Storage	FCH	Ocean	Solar	Wind	Total
National (M€)	383	313	235	59	202	39	366	179	1776
National (share of total)	29%	40%	39%	4%	28%	36%	38%	13%	24%
EU (M€)	45	214	119	1	46	8	39	54	526
EU (share of total)	3%	28%	20%	0%	6%	7%	4%	4%	7%
Corporate (M€)	888	249	249	1576	463	60	548	1146	5179
Corporate (share of total)	67%	32%	41%	96%	65%	56%	58%	83%	69%
TOTAL	1316	776	603	1636	711	107	953	1379	7481

Source: "Capacity Mapping: R&D investment in SET-Plan technologies", JRC 2015.

L.7.1. Horizon 2020 projects demonstrating EU Added Value

The following Energy Challenge projects are outstanding examples of projects with a high EU-added value:

- Building on predecessor projects supported under the IEE programme, the project ***ODYSSEE-MURE***[109] (CSA; EU contribution: EUR 1.8 million) brings together 33 partners (typically national Efficiency Agencies) from 29 countries (EU-28

[108] *The reference year for these figures is 2011. Thematic funding priorities have changed under Horizon 2020: the budgetary envelope for energy storage projects funded under the 2014-2015 Energy Challenge calls was EUR 100 million, while the CCS project portfolio under the 2014-2015 calls was EUR 94 million. The funding for ocean energy projects under the 2014-2015 calls was EUR 60.5 million.*

[109] http://www.odyssee-mure.eu/

plus Norway) with the aim of supporting the monitoring of national policies, and their impact, in the area of energy efficiency. This is done by maintaining and updating two comprehensive databases covering each EU Member States: ODYSSEE (on energy consumption and energy efficiency indicators), and MURE (on energy efficiency measures). The project also provides new and innovative trainings and didactical documents to national, regional and local administrations to raise their capacity and expertise in the field of energy efficiency monitoring and impact evaluation. The **specific EU-added value** of the project is in addressing an issue of European relevance (i.e. the implementation of EU energy efficiency legislation), in bringing together relevant actors from all Member States, and in enabling transnational synergies through the exchange of best practices.

- The project ***PROMOTioN***[110] (*'Progress on Meshed HVDC Offshore Transmission Networks'*; IA, EU contribution: EUR 39.3 million) develops HVDC (high-voltage direct current) technologies that link off-shore wind parks in the North Sea and on-shore grids in different countries. It includes 34 partners from 11 countries, including all major HVDC manufacturers, Transmission System Operators (TSO's) linked to the North Sea, several wind turbine suppliers, offshore wind developers, leading academics, industry organisations and consulting companies. The project will also develop proposals for a regulatory and financial framework that support coordinated planning, construction and operation of integrated offshore infrastructures, including an offshore grid deployment plan (roadmap) for the future offshore grid system in Europe. The **specific EU-added value** of the project is that it addresses a trans-national challenge (i.e. linking off-shore wind parks to on-shore grids in different countries), involves leading players from different areas and EU countries and aims at generating significant impacts across many EU countries (it was shown that an EU-coordinated approach on this issue will result in significant lower overall infrastructure costs and CO2 emissions[111]).
- The project ***LEILAC***[112] ('*Low Emissions Intensity Lime and Cement*'; RIA; EU contribution: EUR 11.9 million) will pilot a breakthrough technology that will enable both Europe's cement and lime industries to reduce their emissions dramatically while retaining, or even increasing, international competitiveness. LEILAC will develop, build and operate a 240 tonne per day pilot plant demonstrating Direct Separation calcining technology which will capture over 95% of the process CO2 emissions from both industries without significant energy or capital penalty. The **specific EU added value** of the project is in
    - pooling a critical mass of financial resources, expertise and infrastructure expertise from different countries, sectors and organisations (using a technology initially developed in Australia and piloting it in an European Cement plant in the Netherlands);
    - stimulating research policy coordination and agenda-setting by developing a CCS roadmap for the Cement and Lime industry and organising workshops to provide policy makers with relevant project findings;

[110] https://www.promotion-offshore.net/
[111] *See 'Study of the benefits of a meshed offshore grid in Northern Seas region', TE, ECOFYS, PwC; 2014 (http://ec.europa.eu/energy/sites/ener/files/documents/2014_nsog_report.pdf)*
[112] http://www.project-leilac.eu/

- increasing mobility of researchers by exchanging researchers between Australia and Europe.

L.7.2. Lessons learnt/Areas for improvement

Transnational cooperation is a unique feature of the EU Framework Programme. While this may complicate the application process and administration of the project, it offers the possibility to pool a critical mass of financial resources, research infrastructures and expertise from different countries, sectors and organisations; improve research policy coordination and agenda-setting; and encourages the mobility of researchers.

Survey findings indicate that a majority of projects would not have been possible without EU funding. For many participants, the access to transnational networks and new markets are the most relevant benefits. There is also evidence that the scientific output of EU-funded R&I activities is of higher quality and published in better journals compared to outputs of the same researchers, but without EU funding.

For some areas, the EU programme represents a significant share of the overall public R&I support, while for other areas the Energy Challenge only represents a small fraction of the overall efforts.

L.8. SUCCESS STORIES FROM THE FP7 ENERGY THEME

The project ***EUROBIORF***[113] (*'EUROpean multilevel integrated BIOREFinery design for sustainable biomass processing'*) demonstrated a highly integrated and diversified concept for biorefineries including multiple feedstocks (non-edible), multiple processes (chemical, biochemical, thermochemical), and multiple products (aviation fuels and chemicals). The project involved 29 partners (industry, SMEs, academics) from 15 different countries, overcoming the fragmentation of the biofuels sector by including crop production, biomass pre-treatment, fermentation and enzymatic processes, catalytic processes, thermochemical processes, assessed by a life cycle analysis and an economic evaluation of the whole development chain. The project ran from 2010-2014 and received an EU contribution of EUR 23.1 million. *EUROBIOREF* tested new oil crops and lignocellulosics and established large test fields for feedstocks. It also worked towards a biomass supply logistics model and specifically applied it to four of the crops studied under the project. The project constructed a new, highly efficient pilot plant in Norway to process woody biomass rapidly. Project partners described and demonstrated five value chains — corresponding to five different process scenarios — for biorefineries, filed 33 new patents and published 33 articles.

The project ***REAPOWER***[114] (*'Reverse Electrodialysis Alternative Power Production'*), running from 2010 to 2014 and receiving an EU grant of EUR 2.7 million, investigated how to exploit the difference in salinity between two streams of water for generating electricity (this process is known as salinity gradient power - reverse electrodialysis, SGP-RE). Exploring a new path that had been so far been addressed only theoretically in scientific publications, the project developed the main materials, components and tools, and collected plenty of theoretical and practical information. The project has achieved to operate successfully the first system in the world to be producing power from brine in a real environment. As a result of the project, partners filed 10 patents, published 13

[113] http://www.eurobioref.org/
[114] http://www.reapower.eu/

articles in peer-reviewed journals and developed a R&D roadmap which outlines the future R&I actions needed for maturing the technology so it can enter the market in the next 5 to 10 years. The project consortium successfully applied for funding under the Horizon 2020 Energy Challenge where it will further develop the technology in the project *RED-Heat-to-Power*[115].

The project ***SOLARH2*** (*"European Solar-Fuel Initiative - Renewable Hydrogen from Sun and Water. Science Linking Molecular Biomimetics and Genetics"*; running from February 2008 until January 2012 and receiving a EU contribution of EUR 3.9 million) brought together 12 leading European laboratories carrying out integrated, basic research aimed at producing renewable hydrogen (H2) from environmentally safe resources. The vision was to develop novel routes for the production of a solar-fuel (H2) from solar energy and water. The SOLARH2 team was able to design synthetic compounds able to mimic biological molecules that convert energy from the sun into hydrogen fuel. Scientists also made progress investigating the use of bacteria and algae in bioreactors to perform the same conversion. Although large-scale H2 production by these methods is still distant, it has vast potential and could be of utmost importance for the European economy in the future. The project resulted in more than 380 articles of which many appeared in peer-reviewed scientific journals (168 articles are open access). The work initiated by SOLARH2, the networks it has created and the opportunities identified in developing biological and synthetic solutions should lead to larger, more high-impact hydrogen fuel projects in the future. The SOLARH2 project was also instrumental for the rapid development of 'solar fuels' as a scientific area: all project partners have become leaders in this new field and solar fuels, i.e. the conversion of sunlight into storable solar fuels and/or solar chemical products, has been chosen as one of seven Mission Innovation Challenges[116] to be cooperated on at global level.

L.9. LESSONS LEARNT/CONCLUSIONS/KEY FINDINGS

L.9.1. Relevance

Strengths:

- The objectives of the Energy Challenge (decarbonisation of the energy system, boosting competitiveness of EU clean energy industry) have been highly relevant at the start of Horizon 2020 and have become even more urgent.
- The Energy Challenge is a key building block of the EU energy and climate policy. It also contributes to EU R&I policy and other EU sectorial policies.
- Priorities of the Energy Challenge are based on extensive stakeholder consultations, mainly in the context of the SET-Plan, and reflect key challenges of industry, research community, national governments and the European Commission.

Bottlenecks/weaknesses:

- Evolutions of the socio-technological framework (e.g. digitisation, new role of consumers) are expected to profoundly change the energy system in the coming years. The Energy Challenge is trying to anticipate and pro-actively embrace

[115] http://www.red-heat-to-power.eu/
[116] http://mission-innovation.net/our-work/innovation-challenges/converting-sunlight-challenge/

these changes, but constant review of priorities and scouting of developments are necessary.

L.9.2. Effectiveness

Strengths:

- Energy Challenge projects mobilise a large number of organisations and workforce. 45% of participants have not participated in FP7.
- Activities have a strong focus on innovation and market-related issues and feature a high share of industrial participants.
- There are strong indications that projects will
    - advance the scientific and technological state-of-the-art in the different energy areas;
    - result in concrete marketable outcomes (e.g. new business models and services), technology improvements and impacts on the policy framework;
    - contribute to overall Horizon 2020 objectives, e.g. excellent sciences; innovation, jobs and growth; addressing major societal challenges; spreading excellence and widening participation; science with and for society; and science for policy.

Bottlenecks/weaknesses:

- It is not possible to proof concrete results and impacts of Energy Challenge projects at this stage (finished projects represent only 0.5% of the total budget; 2/3 of the total budget is not yet committed).
- The final impacts of funded projects depend on many factors beyond the scope of Horizon 2020, e.g. the regulatory framework and economic conditions. It is important to closely monitor the relevant framework conditions, try to make it more conducive and adapt activities when necessary.

L.9.3. Efficiency

Strengths:

- Energy Challenge's investments focus on activities which are expected to lead to real impacts in the market and society. Innovation and market-oriented actions account for 2/3 of the total budget and industry participants benefit from 50% of the budget.
- Participants in Energy Challenge projects have in general a high scientific and technological profile and include a large number of key players in the respective areas.
- Time-to-grant for projects improved significantly compared to the FP7 Energy Theme with the large majority of projects meeting the 8-months limit.
- Participants from many countries with a less substantial track-record in the EU Framework Programmes were able to improve their participation in the programme.

Bottlenecks/weaknesses:

- Despite the substantial increase of budget compared to the predecessor programme, more public investments (including at EU level) are required because of the high demand, the huge investments needed for accelerating the energy transformation and the relatively low current share of public R&D investments in low-carbon energy in the EU.
- In higher budget of the Energy Challenge is not commensurate with the investments needed for the transformation of the energy system.
- Success rates for proposals are rather low with around 14% (similar to the FP7 Energy Theme), however with an increasing trend for 2016. There are significant differences between topics, instruments, and submission type.
- The 2-stage proposal submission increases success rates for the 2nd stage, but has a significant time penalty which discourages industry participation. It should be applied only for broad research topics likely to attract a high number of proposals, and in case the time penalty is less than 5 months.
- Early evidence suggests that the 'no-negotiation' approach during the grant agreement preparation does not allow any more to improve the resource allocation which, in some cases, could have resulted in a lower EU contribution and a more efficient use of the available budget. In the case of complex demonstration projects, the absence of a negotiation phase does not allow to properly address and mitigate risks associated with the project which could have negative consequences during the course of the project.
- The participation of entities from third countries is significantly below the level of the FP7 Energy Theme. However, a number of targeted actions (e.g. coordinated calls, twinning of projects) fostered international cooperation (but without necessarily leading to higher funding for 3rd country participants).
- Although the participation of EU Member States accessing as of 2004 (EU-13) is below average it has been shown that EU-13 is a very heterogeneous group including many countries performing at EU average or even above.

L.9.4. Coherence

Strengths:

- The available toolbox allows supporting the whole innovation cycle. The systematic use of Technology Readiness Level (TRL) in call texts and proposals for specifying the targeted maturity of technology improves internal coherence.
- Projects with relevance for energy objectives are supported in 20 different programme parts. The additional weighted budget invested outside the Energy Challenge on energy-related projects in 2014-2015 corresponded to 59% of the Energy Challenge budget. Projects in other programme parts complement activities of the Energy Challenge, especially as regards long-term oriented research or materials.
- The Energy Challenge contributes to priorities of other Societal Challenges and programme parts, notably LEIT-ICT, LEIT-NMBP, Societal Challenge 2, Societal Challenge 4 and Societal Challenge 6.
- The Energy Challenge supports a number of activities leveraging resources of other EU programmes (e.g. Structural Funds) for achieving the Energy Challenge objectives.

- Coherence with activities at national/regional is targeted through the SET-Plan which developed a comprehensive integrated roadmap covering all priority areas of the Energy Challenge being used as a key reference point at EU and national level. Currently, Implementation Plans of the SET-Plan priority areas are being developed, led by national authorities and including the stakeholder community, which are expected to increase coherence of public and private, European and national efforts.
- Coherence of Energy Challenge activities with international efforts is facilitated through the Commission's participation in the International Energy Agency (IEA) and "Mission Innovation".

Bottlenecks/weaknesses:

- There are only little systematic, programme-wide efforts for exploiting synergies between complementary projects funded under different programme parts. In particular, there is a lack of sophisticated data- and text-mining tools which would allow easy identification of relevant energy projects across Horizon 2020.
- The leverage of the Energy Challenge for using resources of other EU funding programmes could be improved, especially as regards the Structural Funds (ESIF) or the European Fund for Strategic Investments (EFSI) for areas other than energy efficiency, and the European Development Fund. There is also potential for improving the transfer of solutions developed under the Energy Challenge to the European Institute for Innovation & Technology (EIT) for their further development.

L.9.5. EU Added Value

Strengths:

- The transnational character of the Energy Challenge offers opportunities which are not feasible for national funding programmes, e.g. to pool a critical mass of financial resources required for costly and high risk demonstration projects, research infrastructures and expertise from different countries, sectors and organisations; to improve research policy coordination and agenda-setting; and to encourage the mobility of researchers.
- A majority of projects would not have been possible without EU funding. For many participants, the access to transnational networks and new markets are the most relevant benefits of participating in the EU programme.
- There is evidence that the scientific quality of research outputs is higher for EU-funded projects compared to non-EU-funded projects carried out by the same team.

Bottlenecks/weaknesses:

- Transnational cooperation may complicate the application process and administration of the project.

M. SMART GREEN AND INTEGRATED TRANSPORTS

M.1. INTRODUCTION

M.1.1. Context

Transport is fundamental to European economy and society. Europeans depend on the transport sector for the distribution of goods, for jobs, or simply to enjoy their mobility. However transport is closely linked to some very pressing societal challenges: CO_2 emissions, extensive import and use of crude oil, external costs of transport, like those from congestion, noise and accidents. At the launch of Horizon 2020, advancing the electrification of mobility in Europe and introducing new, greener vehicles with higher energy efficiency were – and still are – high on the political agenda. Also, transport was on the brink of a new era of "smart mobility" where infrastructure, transport means, travellers and goods would be increasingly interconnected to achieve optimised door-to-door mobility, higher safety, less environmental impact and lower operations costs.

The Horizon 2020 Societal Challenge 'Smart, green and integrated transport' is a **key funding instrument of the EU in the area of transport research and innovation (R&I)** providing up to EUR 6,151 billion for the period 2014-2020.

At the time of drafting this thematic assessment, the work programmes 2014-2015 and 2016-2017 have already been adopted and the results for the calls launched in 2014, 2015 and 2016 are already known. However, with just one single project finalised as of 1/01/2017 (excluding activities carried out under the SME instrument) and given the specificities of the sector, with projects yielding results only in the medium to long term, it is premature to draw conclusions on the programme outputs at this stage.

The main **sources of evidence** of this assessment have been:

- The supporting study carried out by a Group of five Experts over the period May – November 2016. Experts relied on:
  - Two online surveys targeting (1) Horizon 2020 and FP7 Project coordinators and (2) Delegates in the Transport Programme Committee
  - Interviews with key stakeholders
  - A stakeholder hearing
  - The analysis of data, some of which provided by the Commission
- Commission analysis of Horizon 2020 Regulation, Joint Undertaking Regulations, and of relevant strategy and policy documents;
- Commission analysis of statistical data extracted from the Commission CORDA database (cut-off date: 1/01/2017);
- Commission analysis of Work Programmes, their implementation and the views expressed by stakeholders in the related consultation process;
- Relevant data from a survey of project coordinators performed within the study 'Assessment of the Union Added Value and the Economic Impact of the EU Framework Programmes (FP7, Horizon 2020)'.

Activities from the Joint Undertakings are subject to a separate dedicated assessment that is ongoing at the time this document is being drafted.

M.1.2. Objectives and intervention logic

The specific objective of the Transport Challenge 'Smart, green and integrated transport' is "to achieve a European transport system that is resource-efficient, climate and environmentally-friendly, safe and seamless for the benefit of all citizens, the economy and society".[117] The Specific Programme[118] is structured in four broad lines of activities aiming at:

a) Resource efficient transport that respects the environment.

The aim is to minimise transport systems' impact on climate and the environment (including noise and air pollution) by improving its efficiency in the use of natural resources, and by reducing its dependence on fossil fuels.

b) Better mobility, less congestion, more safety and security.

The aim is to reconcile the growing mobility needs with improved transport fluidity, through innovative solutions for seamless, inclusive, affordable, safe, secure and robust transport systems.

c) Global leadership for the European transport industry.

The aim is to reinforce the competitiveness and performance of European transport manufacturing industries and related services including logistic processes and retain areas of European leadership (e.g. such as aeronautics).

d) Socio-economic and behavioural research and forward looking activities for policy making.

The aim is to support improved policy making which is necessary to promote innovation and meet the challenges raised by transport and the societal needs related to it.

The Transport challenge strives for a balanced approach which takes into account the specifics of each mode (rail, road, waterborne and air transport) while remaining holistic; an approach which reconciles competitiveness with sustainability and which invests both in technology and in relevant socio-economic research.

In the Seventh Framework Programme for Research and Technological Development (FP7) (2007-2013) the Transport theme[119] took a holistic transport system approach in addressing the challenges and the innovation dimension, by considering the interactions of vehicles or vessels, networks or infrastructures and the use of transport services, and encompassing Aeronautics, Surface transport, and the European satellite navigation system (Galileo). FP6, on the other hand, (2002-2006) had addressed a specific 'Aeronautic and Space' theme (including Galileo) and 'Surface transport' as part of the 'Sustainable Development, Global Change and Ecosystems' theme. The main objectives of FP7 were: 'greener transport', which had received increasing support since FP5; and 'more competitive transport', which received the greatest share of EC contribution, especially in the case of aeronautics. A dedicated cross-

[117] *Regulation (EU) No 1291/2013 of the European Parliament and of the Council of 11 December 2013 establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) and repealing Decision No 1982/2006/EC*

[118] *Annex I, COUNCIL DECISION of 3 December 2013 establishing the specific programme implementing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) and repealing Decisions 2006/971/EC, 2006/972/EC, 2006/973/EC, 2006/974/EC and 2006/975/EC*

[119] *Decision 1982/2006/CE of the European Parliament and of the Council of 18/12/2006 concerning the 7th Framework Programme of the European Community for Research, Technological Development and Demonstration (2007 – 2013) and the Council Decision 971/2006/CE of 19/12/2006 adopting a Specific Programme for Research, Technological Development and Demonstration: 'Cooperation' (2007 – 2013).*

cutting sub-theme (TPT) addressed the objective of more integrated, cross-modal transport systems.[120]

In Horizon 2020, the EU funded transport research and innovation has evolved over time from technology push to a problem-solving and challenge-based approach, with increased emphasis on impact rather than on individual outputs from research projects and programmes. This translated in[121]:

- A thorough coverage of the whole research-and-innovation chain;
- Strong ambitions with regard to cross-modal and cross-cutting activities (an integrated, holistic and systemic approach highly relevant to the increasing challenges faced by transport);
- Further shift from project to programme level cooperation (systemic approach requiring a higher level of coordination in order to design the Work programme and support cross-fertilisation of results between projects);
- Renewed effort to reconcile policy requirements, societal challenges and industrial needs, with significant repercussions on architecture and priorities (in line with the policy orientations, a strong new emphasis on decarbonisation and the integration of advanced technologies towards an integrated transport system).

To address the identified objectives, the thematic programme has adopted the intervention logic depicted in Figure 235 below.

Research and innovation have been identified as essential to tackle the challenges of ensuring safe and seamless mobility and of cutting carbon emissions from transport, while boosting transport industries competitiveness. Smart, green and integrated transport addresses the full cycle of research, innovation and deployment in an integrated manner and, hence, aims to be a catalyst for devising new solutions supporting the shift to a resource-efficient and competitive transport system.

In order to accelerate further the development and market introduction processes, EU support to innovation is embedded within transport policy, serving its objectives. Therefore, this support is focussed on a set of priorities identified as key enablers to innovation and to growth, that have a strong replication potential and impact at EU level, and that cannot be provided by market forces only.

The four transport modes (air, rail, road and waterborne) have to be taken into account, both individually and through a systemic approach, as the integration of the four transport modes is fundamental for a safe and seamless mobility. In this regard, infrastructures, Intelligent Transport Systems (ITS) and logistics are essential. As large scale research programmes under public-private partnerships (PPPs), either JTIs/JUs or contractual PPPs, have successfully been conducted in FP7, demonstrating their value to maximise public and private commitment and improving the results of research, such set-ups have been continued in Horizon 2020.

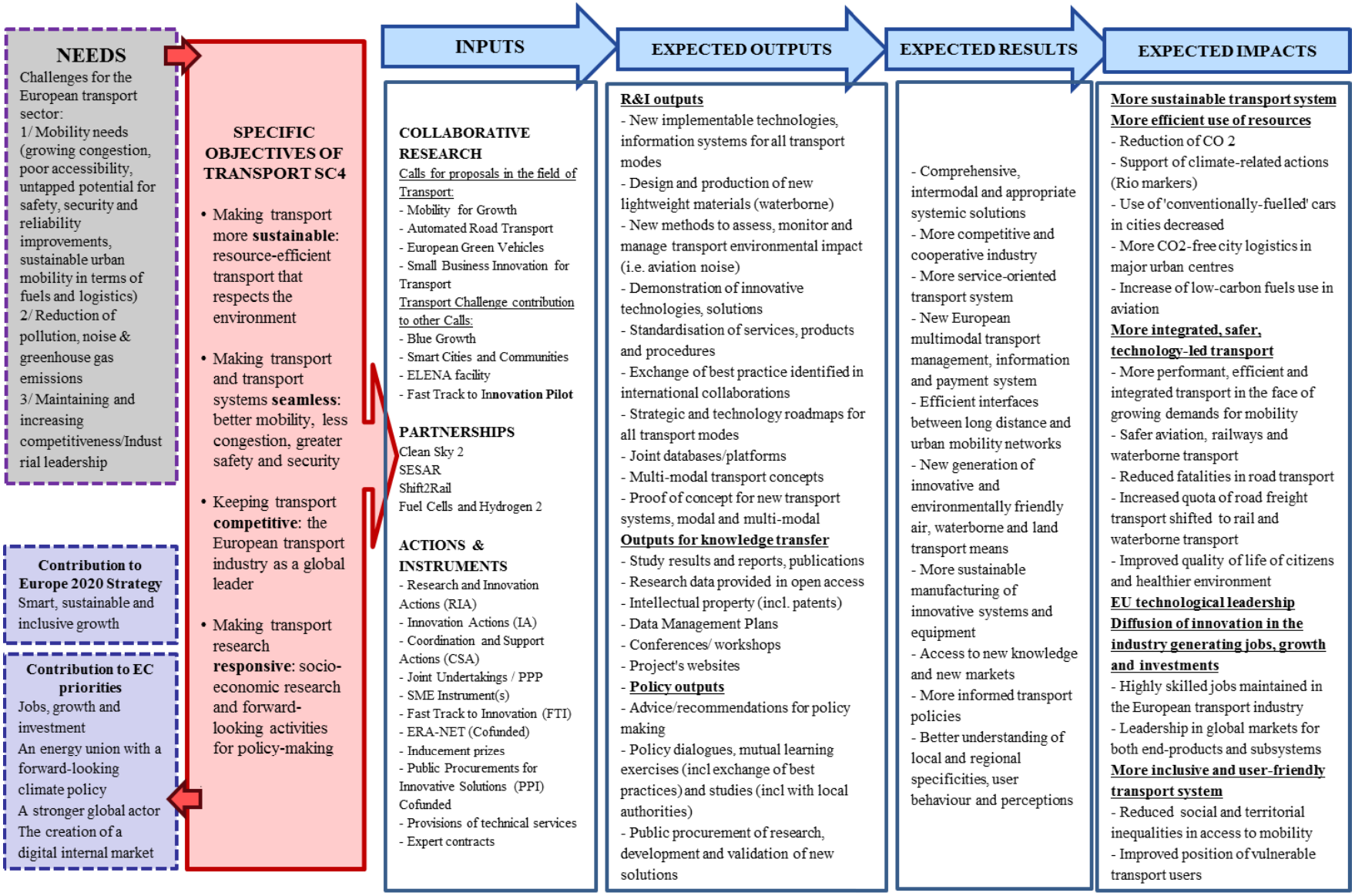
[120] *In addition, the FP7 Transport theme offered financial support to the Joint Technology Initiative (JTI) Clean Sky (Aeronautics); the Joint Undertaking SESAR (Air Transport); and the PPP European Green Cars Initiative (EGCI) that was launched in the context of the European Economic Recovery Plan. It also financially contributed to the JTI on Hydrogen and Fuel Cells (Energy) and to the Ocean of Tomorrow initiative (cross-cutting marine science and maritime industries). EUR 4.2 billon, representing 7.8% of the FP7 budget, was allocated to the Transport theme.*

[121] *Impact Assessment of Transport and Mobility Actions in the Common Strategic Framework for Research and Innovation, 28.4.2011*

With such a structure, expected results and impacts from Smart, green and integrated transport are:

- On pooling of resources and sharing of risks in research and innovation to develop new technologies, products and services which will contribute to facilitate the best mobility for people and goods while minimising the environmental impact of the European transport system on the environment, support European transport industry in taking worldwide leadership and allow the sector to achieve the highest levels of safety;
- On common problems and non-technological barriers, such as public acceptance and awareness of new technologies, to arrive at solutions with wide applicability;
- Allowing a better gathering and sharing of data and information to support sound policy making and guide investment decisions;
- Facilitating strategic planning at both the technology and transport system levels to ensure a common approach to problems that have a trans-national dimension, such as networks, as well as to optimise the transition towards the transport system of the future; and
- On coherence of actions and critical mass of joint efforts.

Figure 235 - Smart, green and integrated transport intervention logic



Source: Commission analysis based on review of relevant policy document.

M.2. IMPLEMENTATION STATE OF PLAY

M.2.1. Overview of programme inputs and activities

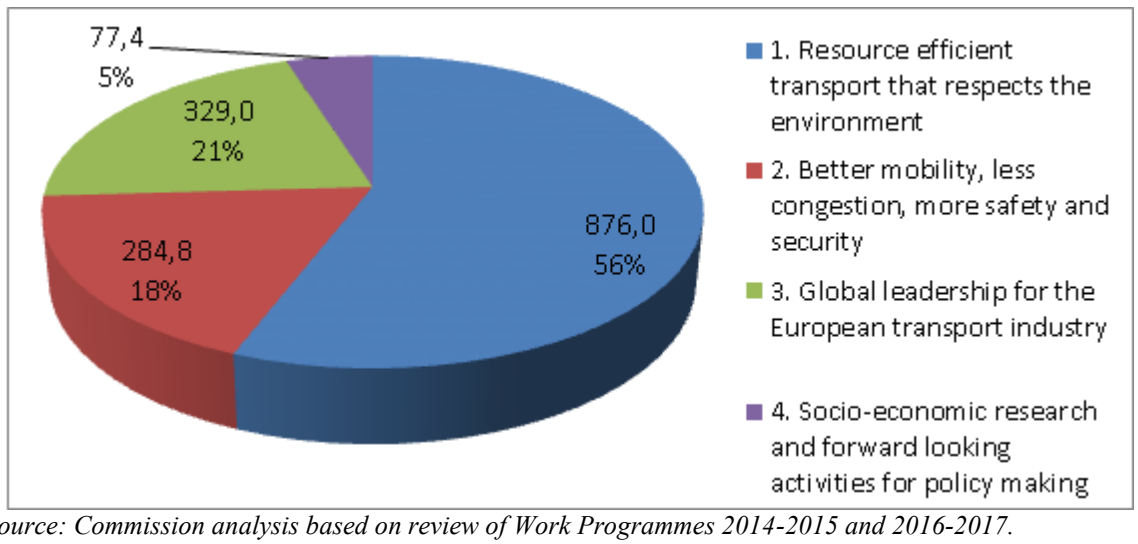
The EC contribution allocated to SC4 as of 1/01/2017 has been EUR 1,485 billion, about 24.1% of the total expected budget allocated to Smart, Green and Integrated Transport in Horizon 2020, which is EUR 6,151 billion for the period 2014-2020 (down from the original EUR 6,339 billion as laid down in the legal basis following the contribution to the European Fund for Strategic Investments) [122].

The above figures include contributions from Smart, green and integrated transport to the Joint Undertakings which are part of this Societal Challenge.[123] This document, however, does not include an in-depth analysis of research carried out in Joint Undertakings as these activities fall outside the scope of the Work Programmes and will be the subject of a dedicated evaluation. Nevertheless, it must be noted that these activities also contribute to the content coverage of the Specific Programme. The complementarity between activities carried out in the Joint Undertakings and under the Work Programmes of Smart, green and integrated transport is addressed in the section on coherence of this document (see section M.6.1).

Hence, unless indicated otherwise, figures presented throughout the document refer exclusively to activities carried out within the scope of the 2014-2015 and 2016-2017 Work Programmes.

Within the Horizon 2020 Work Programmes 2014-2017, each line of activity of Smart, green and integrated transport was allocated a share of the overall budget as indicated in the chart below.

Figure 236 - Activities and allocated share of budget (in EUR Mio and %) dedicated to Smart, green and integrated transport for the programming period 2014-2017



Source: Commission analysis based on review of Work Programmes 2014-2015 and 2016-2017.

[122] *Since the budget allocated to the Joint Undertakings is ring-fenced and cannot be revised, the EUR 188 million taxation affected only the budget allocated to the collaborative research open calls for proposals (approximately 9% reduction).*
[123] *A complete overview is presented in Chapter 7 of this report*

5% of the total funding, representing a 22% share in terms of number of topics, is allocated to "Socio-economic and behavioural research and forward looking activities for policy making" for research projects in social sciences that are usually less expensive than technological research.

The following tables show the budget breakdown per type of instrument, as well the contribution from Smart, green and integrated transport to current Joint Undertakings and contractual Public-Private Partnerships (cPPPs) supported by the Horizon 2020 Transport.

Table 175 - Allocated share of budget by type of instrument (signed grants on cut-off date 1st January 2017) for activities in the Work Programme

Type of Action	Nr of Signed Grants	EC Contribution to Signed Grants (EUR million)	Average Project EC Contribution to Signed Grants (EUR million)
CSA	32	50.4	1.6
ERA-NET-Cofund	1	9.5	9.5
IA	18	231.0	12.8
RIA	104	593.8	5.7
Sum	**155**	**884.6**	**5.7**

Source: CORDA data, 1 January 2017 Signed Grants by Type of Action.

Table 176 - Transport related JUs and contractual Public-Private Partnerships

Joint Undertakings and contractual Public-Private Partnerships (cPPPs) funded through the Horizon 2020 transport budget	EU Contribution (€ million)	Total Costs (€ million)	Crowding-in Effect
Single European Sky ATM Research (SESAR) 2020	585	1,585	271%
Clean Sky 2 (CS2)	1,755	3,949	225%
Shift2Rail (S2R)	450	920	204%
European Green Vehicles Initiative (EGVI)	750	1,500	200%
Fuel Cells and Hydrogen 2 (FCH2)	665 (of which 250 from Transport budget)[124]	1,330	200%
Total	***4,205***	***9,284***	***221%***
Other Joint Undertakings with direct applications to Horizon 2020 transport	***EC Contribution (€ million)***	***Total Costs (€ million)***	***Crowding-in Effect***
Electronic Components and Systems for European Leadership (ECSEL)	1,185[125]	4,695	396%
Total	***1,185***	***4,695***	***396%***

Sources: The respective Joint Undertaking Regulations.
Note: figures refer to the entire lifespan of the Programme (2014-2020).

In addition, Smart, green and integrated transport implements or contributes to the following activities:

[124] *EC contribution of c. EUR 415 million from Horizon 2020 Energy Challenge and the remainder from Smart, green and integrated transport*
[125] *Financed via the LEIT (Leadership in Enabling and Industrial Technologies) pillar of Horizon 2020*

- SME Instrument (contribution EUR 74.4 Mio)
- Fast Track to Innovation[126] (contribution EUR 29.3 Mio)
- Inducement prizes (EUR 5 Mio, of which EUR 1.5 Mio from the 2016-2017 Work Programme)
- Public Procurements for Innovative Solutions (PPI) Cofunded[127]
- Provisions of technical services
- Expert contracts

M.2.2. Participation patterns

M.2.2.1. Participation per type of organisation

The signed proposals involve in total 2,343 participations, mobilising 1,412 distinct participants.

Table 177 - Key data on participation per type of organisation for the Horizon 2020 Smart, green and integrated Transport Challenge: number of participants, of project coordinators, of newcomers, of participations, and EU contribution to participations (in million Euros)

Legal entity type	Nr of Participants in Signed Grants	Nr of Projects Coordinators in Signed Grants	Nr of NewComers in Signed Grants	Nr of Participations in Signed Grants	Average Participations per Participant	EC Contribution to Participations in Signed Grants (EUR million)
HES	193	26	8	415	2.2	141.6
OTH	94	11	36	156	1.7	38.9
PRC	808	57	332	1 139	1.4	467.7
PUB	150	7	57	195	1.3	63.6
REC	167	54	19	438	2.6	172.9
TOTAL	**1 412**	**155**	**452**	**2 343**	**1.7**	884.6

Source: CORDA data, 1 January 2017, Participants and Participations by Legal Entity.
Legend: (HES) Higher or secondary education
(PRC) Private for profit (excluding education)
(PUB) Public body (excluding research and education)
(REC) Research organisations
(OTH) Other

A discussion of the data is included in chapter M.5.

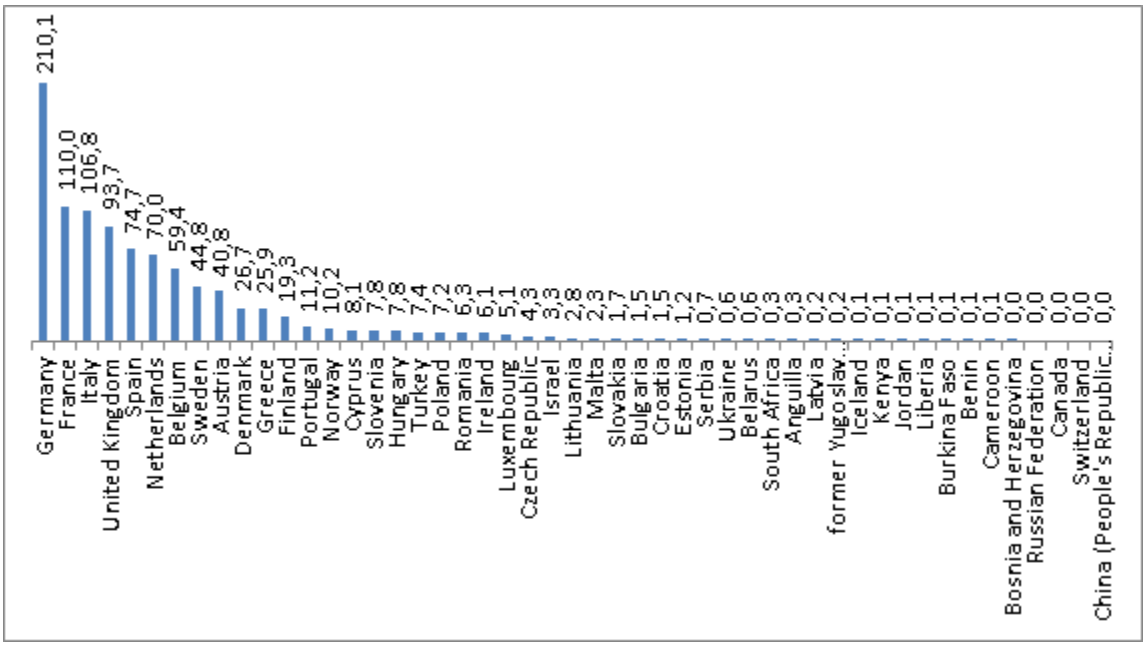
M.2.2.2. Attraction of new participants/newcomers

Among the 1,412 unique beneficiaries participating in Smart, green and integrated Transport projects, 452 – or about **one in three** – are newcomers, i.e. beneficiaries in Horizon 2020 that did not participate in FP7.

[126] https://ec.europa.eu/programmes/Horizon2020/en/Horizon 2020-section/fast-track-innovation-pilot
[127] http://ec.europa.eu/research/participants/data/ref/Horizon 2020/wp/2014_2015/annexes/Horizon 2020-wp1415-annex-e-inproc_en.pdf

M.2.2.3. Geographical participation patterns

Figure 237 - Total EC Contribution by Participant's Country (EUR million)



Source: CORDA data, 1 January 2017.

In terms of budget breakdown by the beneficiary's country of origin, activities funded in the 2014-2015 and 2016-2017 Work Programmes of Smart Green and Integrated Transport sees a concentration in funding absorbed by beneficiaries established in large industrialised Countries, in line with the industrial nature of the programme, with EU-13 Countries accounting for a small share of both funding received and participations, as well as in terms of successfulness in applications.

M.2.2.4. International cooperation

GROUP	Nr of Applicants in Eligible Proposals	Nr of Applicants in Retained Proposals	Success Rate of Applications
AC COUNTRIES	255	82	24.6%
EU-13	523	171	23.8%
EU-15	3 316	1 405	33.4%
THIRD COUNTRIES	105	26	21.5%
Total	4 199	1 684	31.9%

Source: CORDA data, 1 January 2017.

Projects funded under Smart, green and integrated transport with signature date until 1/01/2017 include in total 26 participations from entities established in third countries (i.e. not EU Member State and not associated to Horizon 2020), receiving a total EU contribution of EUR 1.6 million (representing 0.16% of the total EU contribution), a very substantial decrease compared to FP7, where the EU contribution to Third Countries beneficiaries in transport exceeded 1% of the total EU contribution.

M.2.3. Cross-cutting issues

In Smart, green and integrated transport, 81.5% of the budget (EUR 1.12 billion) has been so far allocated to Sustainable development topics (the target for Horizon 2020 is at least 60%), 56.2% of the budget (EUR 777 million) to Climate related topics (it should exceed 35% of the overall Horizon 2020 budget) and 0.3% of the budget (EUR 3.5 Mio) has been so far allocated to biodiversity. 16.6% of the EC contribution (EUR 228.3 Mio) is ICT Research and Innovation related.

As regards the promotion of social sciences and humanities (SSH) under Smart, green and integrated transport in Horizon 2020, in the period 2014-2017 60 topics and other actions have been classified as being relevant for SSH researchers. It can be observed that within the projects selected under these topics, 18% of partners indeed have an SSH background, receiving 16% of the EC contribution for these topics.[128,129]

For Smart, green and integrated transport as a whole (including JUs and projects funded SME instrument) 30.6% (1419) of women are researchers. Amongst project coordinators, 20.8% (256) are women. These shares are in line with those observed in FP7. 50% (15) of the members of the Transport Advisory Group are women.

Within projects in Smart, green and integrated transport, 27.1% of EC contribution (EUR 372.4 Mio) is allocated to innovation actions. Within innovation actions, 53.4% of EU financial contribution (EUR 198.9 Mio) focusses on demonstration and first-of-a-kind activities.

M.3. RELEVANCE

M.3.1. Is the Horizon 2020 intervention for Smart, Green and Integrated transport tackling the right issues?

M.3.1.1. The relevance of the intervention given the challenges to address

Transport is fundamental to European economy and society. Europeans depend on the transport sector for the distribution of goods, for jobs, or simply to enjoy their mobility. However, the ever increasing demand for transport has a downside: transport contributes to climate change, may cause accidents and noise, and raises concerns about pollution and energy dependency.

These concerns are reflected in the following figures:

Based on information from the Statistical pocketbook 2016[130], transport accounted in 2014 for 23% of all EU greenhouse gases (GHG) emissions (excluding international maritime) and for 33% of the final energy consumption at EU level. Despite greater levels of efficiency achieved and the uptake of renewable energy, transport emission levels grew by 20% between

[128] *This information is based on projects already financed under calls closed in 2014 and 2015. For 2016 and 2017, information will be only available respectively in 2017 and 2018*
[129] *Data and details on the methodology used can be found in the monitoring reports on SSH projects in 2014 and 2015*
[130] *Statistical pocketbook 2016 (http://ec.europa.eu/transport/facts-fundings/statistics/pocketbook-2016_en)*

1990 and 2014.[131] The almost exclusive dependence of transport on oil products for its energy needs is one of the main reasons (in 2015 only 6.7% of the transport energy needs were covered through renewable sources[132]). Due to this dependence, increases in traffic demand result in a nearly exclusive increase in fossil fuel consumption and relative emissions.[133]

The Commission Communication *A Roadmap for moving to a competitive low carbon economy in 2050*[134] showed that while deeper cuts could be achieved in other sectors of the economy, a reduction of at least 60% of GHGs by 2050 with respect to 1990 was required from the transport sector, which was a significant and still growing source of GHGs emissions. The goal for transport would be to reduce, by 2030, GHG emissions to around 20% below the 2008 level.[135]

The greening and efficiency of transport and mobility was identified, therefore, as an imperative for meeting the EU's climate goals, reducing the dependency on external energy markets and increasing the performance of the European economy. It was acknowledged that, at the same time, the greening of transport offered a big opportunity to increase the global competitiveness of the European transport industry and promote growth and jobs. Transport as a whole represented 5.1 % of total value added (figures 2014) and 5.1 % of the EU labour force (figures 2014).[136]

New technologies for vehicles and traffic management were recognised as key to lower transport emissions in the EU as in the rest of the world, making it crucial that European transport continued to develop and invest to maintain the competitive position of many European companies world leaders in infrastructure, logistics, traffic management systems and manufacturing of transport equipment.

Decarbonisation and modernisation of the transport sector, thereby contributing to increased competitiveness, had been identified as challenges also within the priority Sustainable Growth and specifically as part of the flagship initiatives Innovation Union and Resource Efficient Europe of the Europe 2020 strategy.[137]

At the same time, congestion, costing the EU every year 1% of its GDP[138] and compromising accessibility, was and still is seen as a major concern, in particular on the roads and in the sky.

---

[131] *Transport greenhouse gas emissions, including from international aviation and maritime transport, increased by around 34% between 1990 and 2008. Over the same period, energy industries reduced their emissions by about 9%. Following the emission decline between 2008 and 2013 transport emission level in 2013 are 19,4% above 1990 levels (Source: EEA, http://www.eea.europa.eu/data-and-maps/indicators/transport-emissions-of-greenhouse-gases/transport-emissions-of-greenhouse-gases-6).*

[132] *Share of renewable energy in fuel consumption of transport (Source: EUROSTAT, http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tsdcc340&plugin=1)*

[133] *This strong bond can be empirically observed: in 2007 the decreased energy demand, registered in conjunction with the global economic downturn, led to a downwards trend in transport GHG emissions. As soon as transport demand and energy consumptions were reported to increase in the most carbon intensive modes in 2014, the transport overall GHG emissions were reported the rise as well. Eurostat: increased emissions by transport (Source: EUROSTAT, http://ec.europa.eu/eurostat/statistics-explained/index.php/Consumption_of_energy)*

[134] *Communication from the Commission 'A roadmap for moving to a competitive low carbon economy in 2050', COM(2011) 112 final, 8/3/2011*

[135] *White Paper 'Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system', COM(2011) 144 final, 28.3.2011; and Communication "A European Strategy for Low-Emission Mobility", COM(2016) 501 final, 20.7.2016*

[136] *Statistical Pocketbook 2016, (http://ec.europa.eu/transport/facts-fundings/statistics/pocketbook-2016_en)*

[137] *Communication from the Commission EUROPE 2020 'A strategy for smart, sustainable and inclusive growth', COM(2010) 2020 final, 3.3.2010*

[138] *Transport White Paper IA (link).*

In addition, transport infrastructure was unequally developed in the eastern and western parts of the EU, which needed to be brought together.

Road fatalities are declining but still high at 25,500 per year in the Union in 2015[139]; citizens and businesses expected a transport system accessible to all, safe and secure. The urban context posed specific challenges and provided opportunities to the sustainability of transport and for a better quality of life.

In a business as usual scenario, these problems would continue to grow, costing the EU economy hundreds of billions each year and affecting increasingly the citizens' health and well-being.[140]

At the launch of Horizon 2020, transport was on the brink of a new era of "smart mobility" where infrastructure, transport means, travellers and goods would be increasingly interconnected to achieve optimised door-to-door mobility, higher safety, less environmental impact and lower operations costs.[141]

In order to achieve efficiency at system-level, it was agreed that targeted efforts were needed to develop and validate new solutions that could be rapidly deployed, notably on trans-European corridors and in urban areas. They would address transport means and infrastructure and integrate them into a user friendly European transport system of smart connected mobility and logistics. R&I on equipment and systems for vehicles, aircraft and vessels would make them smarter, more automated, cleaner and quieter, while reducing the use of fossil fuels and improving air quality.[142,143] R&I on smart infrastructure solutions, based also on GNSS[144] applications, was considered necessary to deploy innovative traffic management and information systems, advanced traveller services, efficient logistics, construction and maintenance technologies.

Smart, green and integrated transport was designed to[145]:

- Support R&I to turn towards more resource efficient transport and mobility;
- Promote complementarities between transport and mobility stakeholders in setting research priorities (the scale of the R&I needed required the establishment of a common scientific base, an integrated approach, and the best gathering of complementary competencies, allowing higher ambition than what would be affordable at national programmes and industry level);
- Encourage collaboration among transport researchers and research capacities (to integrate the highly fragmented transport research capability in Europe and exploit synergies between nationally-based and European-wide projects as well as promote cross-fertilisation of transport R&I undertaken at national and regional levels);

---

[139] *http://europa.eu/rapid/press-release_IP-17-674_en.htm*
[140] *White Paper 'Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system', COM(2011) 144*
[141] *Commission Communication ' Research and innovation for Europe's future mobility - Developing a European transport-technology strategy', COM/2012/0501 final, 13.9.2012*
[142] *Commission Communication 'Thematic Strategy on air pollution', COM(2005) 446 final, 21.9.2005*
[143] *Commission Communication 'A Roadmap for moving to a competitive low carbon economy in 2050', COM(2011) 112 final, 8.3.2011*
[144] *Global navigation satellite system (GNSS)*
[145] *Impact Assessment of Transport and Mobility Actions in the Common Strategic Framework for Research and Innovation, 28.4.2011*

- Contribute to the competitiveness of the transport industry (supporting high risk R&I and supporting the introduction of EU-wide standards to facilitate the deployment of innovations).

Compared to FP7, Smart, green and integrated transport, in line with the Horizon 2020 objectives, has focused more on innovation by strengthening close-to-market activities. A preliminary analysis of the 2014-2015 and 2016-2017 Transport Work Programmes performed by the Expert Group concludes that particular reference to pilots and demonstrations are included in topics representing 17.5% of the budget of the Collaborative Research calls excluding Joint Undertakings. Based on the analysis of the budget per topic conducted for this evaluation, the budget allocated to Innovation Actions in the 2014-2015 and 2016-2017 Work Programmes reaches 25.9% for Smart, green and integrated transport, about twice as much as the 12.65% figure for Horizon 2020 as a whole.

According to the Expert Group, the objectives set in the Transport Specific programme still correspond to the challenges to be addressed at EU and international level, although the period 2012-2016 saw a number of global developments, which have impacted the policy and R&I landscapes. These include a number of new, important international political agreements such as the UN's Sustainable Development Goals[146] and the Paris Climate Change Agreement (COP21)[147] as well as an increase in the threat of terrorism, with major incidents occurring in several Member States and potential threats to transport, notably at the level of infrastructures, the increase of sharing economy and bottom up citizen centred innovative solutions such as Uber, and huge step-change progress in some areas of technological developments (examples include 3D printing, smart phone applications, 5G).

M.3.1.2. The relevance of Smart, green and integrated transport to address European objectives

At the launch of Horizon 2020, Smart, green and integrated transport addressed the challenges identified in the priorities of the Europe 2020 strategy[148] and the 2011 Transport White Paper.[149] As of 2016 the strategic programming of the transport R&I activities[150] took into consideration also the evolving political context, namely the 'Strategic agenda for the Union in times of change'[151] and the political guidelines of the Juncker's Commission 'A New Start for Europe: My Agenda for Jobs, Growth, Fairness and Democratic Change[152] (see Table 178).

[146] *http://www.un.org/sustainabledevelopment/sustainable-development-goals/*
[147] *http://unfccc.int/paris_agreement/items/9485.php*
[148] *Communication from the Commission EUROPE 2020 'A strategy for smart, sustainable and inclusive growth', COM(2010) 2020 final, 3.3.2010*
[149] *Commission White Paper "Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system" (COM(2011)0144)*
[150] *Scoping Paper for Horizon 2020 Societal Challenge 'Smart, green and integrated transport' Work Programme 2016-2017, https://ec.europa.eu/programmes/horizon2020/en/smart-green-and-integrated-transport-%E2%80%93-work-programme-2016-2017*
[151] *Agreed at the European Council of 26-27/06/2014*
[152] *https://ec.europa.eu/priorities/publications/president-junckers-political-guidelines_en*

Table 178 - Main top-level European priorities relevant to Smart, green and integrated transport

Year 2010 Europe 2020	Year 2013 Horizon 2020 – Smart, green and integrated transport	Year 2014 President Juncker's priorities	Examples of R&I topics/activities funded to achieve priorities
Smart growth ○ **Digital Agenda for Europe** ○ **Innovation Union** ○ **Youth on the move**	Competitiveness of the European Transport industries	Jobs, Growth and Investment EU as a Global Actor Internal Market Digital Single Market	• New&improved waterborne transport concepts • Innovative ICT solutions for future logistics operations • International cooperation in aeronautics with Japan, Canada, China
Sustainable growth ○ **Resource Efficient Europe** ○ **An industrial policy for the globalisation era**	A European transport system that is resource efficient, climate- and environmentally-friendly	Energy Union and Climate	• Technologies for low emission powertrains • Optimisation of heavy duty vehicles for alternative fuels use • Reducing aviation noise
Inclusive growth ○ **An agenda for new skills and jobs** ○ **European platform against poverty**	A European transport system that is safe and seamless for the benefit of all citizens, the economy and society	Internal Market Digital Single Market	• Smart mobility systems • Interface standards for communication between vehicles and infrastructure (ITS) • Intelligent infrastructure • Integrated transport management and information systems

Sources: Europe 2020 strategy COM(2010) 2020; Regulation (EU) No 1291/2013 establishing Horizon 2020; President Juncker's priorities (https://ec.europa.eu/priorities/publications/president-junckers-political-guidelines_en); Horizon 2020 work programme 2014-2015, Annex 11, Commission Decision C(2014)4995 and work programme 2016-2017, Annex 11, Commission Decision C(2016)4614.

From the Europe 2020 strategy of 2010, seven flagship initiatives are relevant to Smart, green and integrated transport[153], as shown in Table 178 above. Transport clearly is a major contributor to the first two initiatives under the Smart Growth pillar. In particular, Smart, green and integrated transport contributes to the Digital Agenda for Europe and the Digital Single Market strategy[154] through the deployment of smart mobility systems, standards for communication between vehicles and infrastructure, and integrated transport management and information systems, and more in general through connected and automated driving. The 2011 Transport White Paper[155], a key document for designing the Transport R&I actions, is one of the initiatives planned to deliver on the Resource Efficient Europe flagship.[156]

Transport has a specific relevance to deliver on economic growth and jobs (interpreting competitiveness in its widest sense), which is reflected in the following facts and figures:

[153] *http://ec.europa.eu/europe2020/europe-2020-in-a-nutshell/flagship-initiatives/index_en.htm*
[154] *http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52015DC0192&from=EN*
[155] *See footnote 149*
[156] *http://ec.europa.eu/resource-efficient-europe/pdf/resource_efficient_europe_en.pdf*

- In 2013[157] the transport sector directly represented 6.95% of the Union's Gross Domestic Product (GDP). The whole industry accounted for 7.03% of total employment in the EU, corresponding to more than 14 million jobs in absolute terms. Sectors such as aviation and automotive are considered to be high-tech sectors, employing highly qualified people and leading technologies in line with Europe's ambition to be a global leader. In addition there are technology spill overs from the work in these areas that can be successfully transferred to other industrial sectors.[158]
- Freight transport and logistics keeps much of Europe's economy moving. In 2014 (EU28) freight transport was responsible to close to 3.5 trillion tonne-kilometres.[159]

With reference to the Energy Union priority, of particular relevance is the link between transport R&I and climate. More specifically, in the low carbon and climate change areas, Smart, green and integrated transport represents a necessary contribution[160] towards the objectives set in the European Commission Communication *A Roadmap for moving to a competitive low carbon economy in 2050*[161], as well as in the *Energy Union Package.*[162]

In preparation of the International Climate Change conference (COP 21) held in Paris in December 2015, the European Union committed to reducing greenhouse gas emissions while increasing the share of renewable energy consumption and the energy savings compared with the business-as-usual scenario. Such commitments are economy-wide. The Communication *State of the Energy Union 2015*[163] envisaged the development of a Strategic Transport Research and Innovation Agenda[164], currently under preparation, addressing the role transport R&I will play in order for transport to address the above goals.[165]

The link between Transport R&I and climate is clearly seen in the climate-related EU financial contribution to Horizon 2020 transport projects[166]: 56.63% of the EU contribution to projects in Smart, green and integrated transport goes to projects addressing climate change issues, compared to 24% in Horizon 2020 as a whole. In other words, tackling climate change is one of the key objectives of R&I transport projects. A similar analysis can be offered in the case of the share of EU contribution to the UN's Sustainable Development Goals[167]. In Smart,

---

[157] *Commission Staff Working Document ' The implementation of the 2011 White Paper on Transport "Roadmap to a Single European Transport Area – towards a competitive and resource-efficient transport system" five years after its publication: achievements and challenges', SWD(2016) 226 final, 1.7.2016 – Section 4*
http://ec.europa.eu/transport/themes/strategies/doc/2011_white_paper/swd(2016)226.pdf
[158] *https://ec.europa.eu/research/participants/data/ref/Horizon 2020/wp/2014_2015/main/Horizon 2020-wp1415-transport_en.pdf*
[159] *Statistical pocketbook 2016 (http://ec.europa.eu/transport/facts-fundings/statistics/pocketbook-2016_en)*
[160] *'Energy Union Package, A Framework Strategy for a resilient Energy Union with a Forward-Looking Climate Change Policy', COM(2015)80 final, 25.2.2015, section "Towards an energy-efficient, decarbonised transport sector" under chapter 2.3*
[161] *Commission Communication 'A Roadmap for moving to a competitive low carbon economy in 2050', COM(2011) 112 final, 8.3.2011*
[162] *See footnote 160*
[163] *Communication from the Commission 'State of the Energy Union 2015', COM(2015)572 final*
[164] *http://ec.europa.eu/programmes/horizon2020/en/news/towards-strategic-transport-research-innovation-agenda-stria*
[165] *COP21 initiatives include e.g. electrifying sustainable transport, low carbon rail transport challenge, airport carbon accreditation, global green freight action plan, etc. See http://newsroom.unfccc.int/lpaa/transport/*
[166] *In order to contribute to building a low-carbon, resource efficient and climate resilient economy, climate action objectives and relevant performance measures have been included in the Commission's Multiannual Financial Framework. Building upon these provisions, a common tracking methodology for climate related expenditure has been integrated in the existing methodology for measuring performance used for EU programmes. The climate tracking methodology has been largely based on an existing OECD methodology ('Rio markers'), adapted to provide for quantified financial data. Expenditures have been marked in one of the three categories: climate related only (100 %); significantly climate related (40 %); and not climate related (0 %).*
[167] *https://sustainabledevelopment.un.org/topics/sustainabletransport*

green and integrated transport, 81.6% of the EU contribution supports those goals[168], compared to 45% for the entire Horizon 2020.[169]

Such an engagement towards sustainable transport and reducing climate-impacts is well illustrated by the European Green Vehicles Initiative.[170]

The European Green Vehicles Initiative PPP: Use of new energies in road transport

The quick introduction of new, greener vehicles with higher energy efficiency and alternative powertrains is pivotal for the ongoing success of the European automotive sector, the wider economy and Europe's environment. Meeting these challenges requires innovation and a joint effort coming from several technological areas and EU industries. As a response, the European Green Vehicles Initiative (EGVI) is a contractual public-private partnership (cPPP) aiming at accelerating research, development and demonstration of technologies allowing the efficient use of clean energies in road transport. The EGVI cPPP specifically focuses on the energy efficiency of vehicles and alternative powertrains and covers additional vehicle types. The technologies developed under the EGVI will help in reaching the targets set under the EU's climate, energy and transport policies, notably the 20-20-20 targets[171] on reducing greenhouse gas emissions, increasing use of renewable energy and more energy efficiency.

The Horizon 2020 Transport Work Programme 2014-2015 makes an explicit reference to the Commissioner Moedas' priority of Open Science: "a novelty in Horizon 2020 is the Open Research Data Pilot which aims to improve and maximize access to and re-use of research data generated by projects"[172] and which was implemented in transport on a voluntary basis. However, open access to project results can negatively affect competitiveness, for instance with regards to Intellectual Property Rights (IPRs) and patents. On the contrary, Open Innovation in terms of data openness and sharing as well as standards is at the basis of cooperative Intelligent Transport Systems (ITS), real time ITS services, automated transport, traffic management, open global logistics networks, novel urban mobility services, mobility as a service.

Smart, green and integrated transport has an important international dimension, linking to Commissioner Moedas' 'Open to the World' priority. Indeed, building on previous Framework Programmes, Transport R&I in Horizon 2020 reinforces a tradition of international cooperation activities in aviation, renewable fuels, smart mobility and safety, although provisions introduced under Horizon 2020 restricting the automatic eligibility for funding to Third Countries beneficiaries have meant a drop in participations of such beneficiaries.

International cooperation has a key role to play in shaping global solutions to global challenges such as CO_2 and polluting emissions, oil dependency, transport safety and security, and standardisation of many services, products and procedures. Other aspects that are more local in nature such as traffic congestion, land use planning, behavioural issues also profit from the exchange of best practice identified in effective international collaborations. Activities at the international level are important to enhance the competitiveness of world

[168] *Particularly goal n. 11, "Sustainable cities and communities" and goal n. 13 "climate action"*
[169] *Source: CORDA data, 1 October 2016*
[170] *http://www.egvi.eu/*
[171] *2011 Transport White Paper's three key targets to be achieved by 2020: 20% cut in greenhouse gas emissions; 20% of EU energy from renewables and; 20% improvement in energy efficiency.*
[172] *https://ec.europa.eu/research/participants/data/ref/Horizon 2020/wp/2014_2015/main/Horizon 2020-wp1415-transport_en.pdf*

leading European industries by promoting the take-up and trade of novel technologies. Demand for European produced vehicles as well as for European know-how is very strong in the emerging markets. With most of future transport growth occurring outside Europe, access to knowledge and to new markets is increasingly important. Cooperation as well as exchanges on transport R&I strategies and investment priorities with major partner countries such as the US, Canada, Japan and China are pursued under Smart, green and integrated transport.[173,174]

It the 2014-2015 and 2016-2017 Work Programmes, several topics were flagged as being particularly suitable for international cooperation. In these cases, consortia were encouraged to include third country partners. Aviation is benefitting so far from 11 fully coordinated research projects with Japan, Canada and China, started in 2016 and leveraging additional resources in topics of mutual benefit. Twinning activities were planned for selected projects entailing a collaboration in which an EU-funded project and a project funded by the US Department of Transport (DoT) are paired and coordinate specific research activities of mutual interest.

The relevance of international cooperation in transport is clearly visible in the share of EU contribution to International Cooperation topics (topics in the Work Programme mentioning at least one third country or region), which is 29% for topics in Smart, green and integrated transport versus 23.3% for the entire Horizon 2020.

M.3.2. Flexibility to adapt to new scientific and socio-economic developments

In the framework of the preparation of the next 2018-2020 Work Programme, the Transport Advisory Group (TAG) pointed out the relevance of the previous Work Programmes content and stressed the need to continue with a disruptive rather than incremental approach to R&I in order to respond rapidly to shifting transport paradigms with new revolutionary technologies, business environment and mobility patterns.

A targeted consultation with key stakeholders took place in 2016 as part of the preparatory work for the drafting of the Work Programme 2018-2020.[175] Feedback received from stakeholders expressed a broad support for the objectives of the European transport and transport R&I policy, such as decarbonising, improving sustainability, innovating, making transport safer, deploying Intelligent Transport Systems and preserving the competitiveness of the European transport industries. Among the new areas stakeholders proposed to include in the next work programme, the following were mentioned: automated transport (not only road vehicles, but including drones, vessels, infrastructure for automated transport and covering new terms such as big data, drones, etc.); transport and health (emissions, obesity and active transport); circular economy and its relation to transport; new nanotechnology materials with self-reporting and self-healing capabilities, for instance for infrastructure; hyper-connected transport (including 5G systems for rail communications), physical Internet, disruptive

[173] *Report of the Horizon 2020 Transport Advisory Group, May 2016, https://www.nks-schifffahrt-meerestechnik.de/lw_resource/datapool/_items/item_71/tag_final_report_23_may_2016_.pdf*
[174] *Scoping Paper for Horizon 2020 Societal Challenge 'Smart, green and integrated transport' Work Programme 2016-2017*
[175] *Approximately 40 organisations from all transport modes and including research organisations, industry associations, public bodies and users of transport as well as citizens associations participated in the stakeholder consultation from 23/3 to 11/5/2016. A number also prepared position papers to not only lay down their priority areas, but also to voice concerns on present calls, processes and programmes.*

technologies; vulnerabilities and new security threats (including cyber-security and personal data protection).

Newly emerging issues, like the new socioeconomic challenges identified in the implementation report of the Transport White Paper[176], can be embraced by the existing goals of Smart, green and integrated transport. Examples are shown in the table below.

Table 179 - Smart, green and integrated transport objectives in relation to new challenges

Transport SC pre-existing goals	New socioeconomic challenges identified in the implementation report of the Transport White Paper	How new challenges are tackled in Smart, green and integrated transport (examples)
To boost competitiveness of the European Transport industries	• Increased complexity of business and new Circular Economy approaches • Unexpected growth in the collaborative and sharing economy (cloud funding, bottom up solutions and sharing rather than owning concepts) • Deep changes in supply and value chains with the growing importance of software, globalisation, ICT and 3D printing • Growth of digitalisation and mobility as a service • Unexpected interest and technology readiness levels in new concepts such as drones	• New call on *Automation in road transport* • Enhancing the performances of electric vehicles • Topic on *Maintaining industrial leadership in aeronautics*[177]
To achieve a European transport system that is resource efficient, climate- and environmentally -friendly	• Increasing importance of role of active modes in the urban transport mix (especially in response to growing concerns on transport related impacts on health) • Fragmented and incomplete framework conditions for "smart transport" in areas such as standardisation, interoperability and data exchange.	• The European Green Vehicles Initiative, focussing on alternative powertrains for energy efficiency and less emissions • Topic on *Reducing energy consumption and environmental impact on aviation*[178]
To achieve a European transport system that is safe and seamless for the benefit of all citizens, the economy and society	• Demographic and urbanisation trends differing to those predicted in published literature as guidance for development. • Automation and connected vehicles challenges beyond technology (human factors). • Growing dissatisfaction of European citizens of contentious negative externalities of transport (air quality, safety of vulnerable users, noise, congestion, land take etc).	• More emphasis on socio-economic aspects, behavioural research and forward-looking activities • New call on *Automation in road transport* • Two inducement prizes for the '*Cleanest engine*' • Activities on alternative fuels and energy efficiency for transport

Source: Commission Staff Working Document 'The implementation of the 2011 White Paper on Transport "Roadmap to a Single European Transport Area – towards a competitive and resource-efficient transport system" five years after its publication: achievements and challenges', SWD(2016) 226 final.

[176] *SWD(2016) 226 final*
[177] *Topic MG-1.3-2017*
[178] *Topic MG-1.1-2016*

From a survey carried out as part of this evaluation[179], project coordinators pointed to the capability of Smart, green and integrated transport to adapt to emerging developments. Results show that the majority agreed that the Transport Work Programmes take the latest developments into account: 92% of the respondents agreed (score 3 to 5 in the table below) that Work Programmes are able to capture latest development of a scientific nature, followed by the socio-economic and the political dimensions (82% and 61% agreement respectively).

Table 180 - Ability of Smart, green and integrated transport to capture latest developments (survey)

Are latest developments taken into account?	0 (not at all)	1 (margi-nally)	2 (partly)	3 (satisfac-torily)	4 (largely)	5 (fully)	I don't know
Scientific	0%	0%	4%	9%	61%	22%	4%
Socio-economic	0%	0%	4%	13%	52%	17%	13%
Political	0%	0%	4%	9%	39%	13%	35%

Source: N=54, survey of Horizon 2020 Transport Project Coordinators carried out over August-September 2016, question "Do you think that the overarching Horizon 2020 Transport programme objectives take into account the latest scientific, socio-economic, political or any other nature developments in the field of transport research and innovation at the national/European and international level?".

Despite the stakeholders' general agreement to pursue the Transport R&I high-level objectives, some concerns were expressed regarding the flexibility and responsiveness of the calls for proposals: stakeholders mentioned during the interviews and the hearing[180] that a higher flexibility and responsiveness of calls to integrate newly emerging needs into topics would be beneficial and have an impact on relevance to some extent. According to them, while bi-annual programming allows applicants to prepare their proposals well in time, Horizon 2020 should include mechanisms to swiftly integrate new and "urgent" topics in already approved Work Programmes, to better respond to the take up and success of disruptive and counter-intuitive technologies and business models which cannot be anticipated over any length of time. Such reasoning also applies in Aviation Safety, for instance in case new hazards are detected following an incident or accident. The need for more flexibility is also recurrently expressed by EASA (European Aviation Safety Agency).

The Expert Group[181], supported by comments in several interviews and the hearing, found it difficult to establish clear links between high-level policy objectives and the related quantitative targets and the specific contribution expected from some topics (for instance, what will be the contribution to "an 80-95% decrease in greenhouse gas emissions by 2050" that will be provided by a certain project concentrating of improving powertrain efficiency). Topics do correspond to the general objectives but quantifying their impact towards them is more complex. The future Strategic Transport Research and Innovation Agenda (STRIA) should fill this gap by producing roadmaps and looking more precisely to what can be performed in research to achieve the overarching objectives. STRIA is considered a key component designed to streamline the R&I efforts and focus them on the most pressing challenges and the most beneficial actions for transport.

[179] *Survey of Horizon 2020 Transport Project Coordinators carried out over August-September 2016.*
[180] *Interviews (N=24) and hearing (N=12) among stakeholders carried out over the period July – September 2016*
[181] *A pool of five experts was appointed to support the Commission Services in the evaluation of the Smart, green and integrated transport Societal Challenge*

M.3.3. Addressing specific stakeholder needs

Work Programmes in Smart, green and integrated transport are based on comprehensive consultation mechanisms, which are designed to help the programme take stakeholders' needs into consideration and adapt to new scientific and socio-economic developments. Such mechanisms include a more formal consultation with Member States through the Transport Programme Committee (Comitology procedure[182]), the consultation of the Transport Advisory Group, as well as consultations with key stakeholders (industry groups, research associations, technology platforms, Joint Undertakings, industry associations, modal representative associations, large or key participants in projects).

The overall consultation process and collection of inputs from the stakeholders is generally well accepted and considered sound. However, a minority of stakeholders, mainly from Technology Platforms, voiced their opinion on a lack of transparency or information in connection with the preparation of the Work Programmes, specifically on how the individual and collective inputs to this process are treated. The Expert Group suggests additional communication along the work programme drafting process, and particularly on how the received inputs are translated into the call topics, for instance with a dedicated section included in the Work Programmes, although this might turn out to be a particularly demanding and time consuming task.

The limited involvement of representatives from the softer transport modes is also considered an issue. It is recognised that this may partially be due to the fact that stakeholders such as civil society organisations representing citizens at large, pedestrians, passengers of all transport modes and unions are not constituted in well-defined groups, as the majority of other more traditional transport modes are. This low involvement is also confirmed by the 3.6% share of Responsible Research and Innovation (RRI) relevant projects under Smart, green and integrated transport, compared to the 6.9% for the overall Horizon 2020.[183]

Smart, green and integrated transport has been designed to cover the whole range of the stakeholders' needs from research to innovation and deployment/commercialisation of solutions. For instance, project participants consider new tools such as the Common Exploitation Booster, supported through the Horizon 2020 Common Support Centre as valuable tools in the path towards commercialization of project results.

M.3.4. Lessons learnt/Areas for improvement

Transport R&I is highly relevant for EU environmental sustainability, society at large, competitiveness and boosting the European economy. It becomes increasingly relevant to tackle international challenges such as security, reducing carbon emissions and the fight against climate change. The objectives of Smart, green and integrated transport are clear to stakeholders: namely to improve competitiveness of the European transport industry and to provide to European citizens the transport system of the future which is green, efficient and safe.

[182] http://eur-lex.europa.eu/summary/glossary/comitology.html
[183] *Commission's internal data on cross-cutting Key Performance Indicators on Responsible Research and Innovation (RRI) projects where citizens, Civil Society Organisations (CSOs) and other societal actors are involved.*

Compared to Transport R&I in previous Framework Programmes, Smart, green and integrated transport is more focused on innovation, demonstration and the introduction of new financial instruments. This approach is overall supported by the stakeholders, who appreciate efforts to direct research towards concrete results, deployment and thus to increasing the impact on solving the transport societal challenges, in addition to promoting excellence in science. However, it was noted that R&I programmes must strike the right balance between innovation and fundamental research, avoiding that the accent on impact and deployment (direct economic objectives) overshadows the breakthrough potential of the latter.

Relevance of the work programmes is assured by a wide stakeholder consultation process and by a sound preparation of the call topics. Although the objectives set in the Transport Specific Programme still correspond to the challenges to be addressed at EU and international level, new mechanisms should be developed to tackle emerging and urgent needs by introducing rapidly new R&I topics in the incoming calls for proposals.

International cooperation in Horizon 2020 is seen as being more restricted but more strategic when compared to FP7, yet Smart, green and integrated transport in particular is seen as being highly relevant internationally. It is recognised that the free flow of information is essential within projects, but this is not yet always seen as being optimal. Too much openness reinforces doubts about conflict of interests. This was especially noted in relation to international exchanges, as EU and national industrial interests and competitiveness on technology-oriented research in transport has a direct relevance on competition within the European market and outside (for instance, new companies entering the transport manufacturing sector).

M.4. EFFECTIVENESS

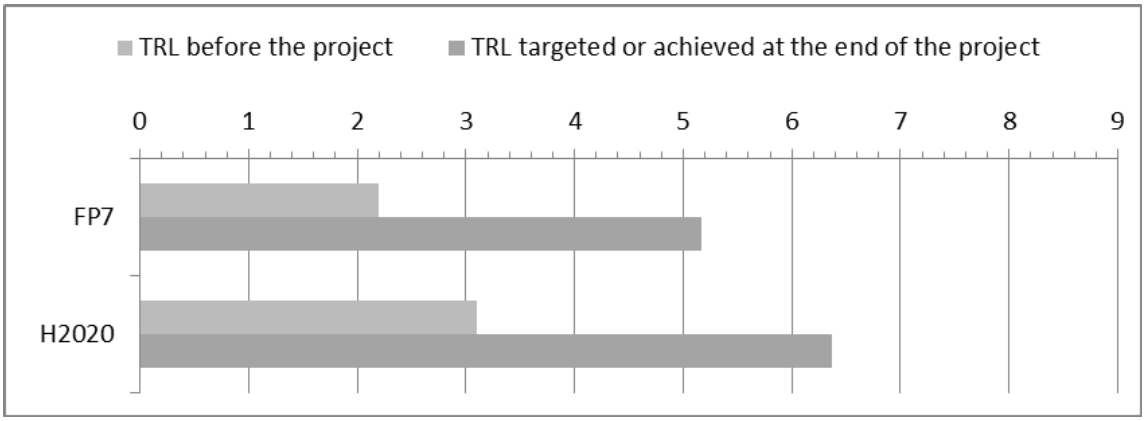
M.4.1. Short-term outputs from the programme

With just one single project finalised as of 1/01/2017 (excluding activities carried out under the SME instrument) and given the specificities of the sector, with projects yielding results only in the medium to long term, it is premature to draw conclusions on Programme outputs at this stage. Yet, many FP7 projects are now finalised and provide examples of activities delivering results in terms of addressing societal needs and generating new knowledge (see examples in section 9) and there is no evidence to date suggesting that the pattern in Horizon 2020 will be different.

Compared to its predecessor, Horizon 2020 is designed to bring research with higher **technology readiness levels** (TRL[184]) closer to market, making the transition towards deployment and/or further research more likely to happen than in FP7. The shift in focus towards closer to market activities emerges clearly from the survey carried out among project coordinators, who confirm the higher TRL level (both at the start and at the end of the respective project) of Horizon 2020 transport projects compared to FP7 ones.

[184] https://ec.europa.eu/research/participants/data/ref/Horizon 2020/wp/2014_2015/annexes/Horizon 2020-wp1415-annex-g-trl_en.pdf

Figure 238 - Technological Readiness Level (TRL) of FP7 and Horizon 2020 Transport projects



Source: Survey among project coordinators, September 2016, n=21 for FP7, n=15 for Horizon 2020. Question: If applicable, please identify the Technological Readiness Level (TRL) of the outcome / results of your project (Before the project / Already achieved / Targeted at the end of the project). Question addressed to coordinators of Horizon 2020 projects both with and without previous experience as coordinators of FP7 projects.

In terms of crowding in[185] of funding, for every EUR 1,000 of EC contribution Smart green and integrated transport projects are directly mobilising an additional EUR 156 from the private sector and EUR 220 from the public sector[186]. As a reminder, maximum rate of reimbursement of eligible costs identified in the Work Programmes 2014-17 are 100% for Research and Innovation Actions and Coordination and Support Actions, and 70% for Innovation Actions.

Innovation outputs of the transport R&I activities include developing international standards and interoperability. Interviewed stakeholders considered that, although this aspect is not always visible, it of crucial importance to the industry and for the deployment of innovative solutions in the transport sector (e.g. in rail, aviation, plugs and charging infrastructure for electro mobility).

Transport R&I in Horizon 2020 reinforces a tradition of **international cooperation** activities started in the previous Framework Programmes. The international dimension is developed in more detail in section 4.1.2 above.

Within the limits mentioned above and keeping in mind that **indicators** can only provide a very partial picture at this stage, the following can be observed:

- As part of efforts to promote Responsible Research & Innovation (RRI) across Horizon 2020, Smart, Green and Integrated Transport (including JUs and projects funded SME instrument) contributed to the co-creation of scientific agendas and scientific contents in 23 projects (3.5% of the total) where citizens, Civil Society Organisations (CSOs) and other societal actors contributed to the co-creation of scientific agendas and scientific contents.

[185] *The amount of funding contributed by the stakeholders to the Project, matching the EC contribution.*
[186] *Source: own calculations based on CORDA data, 1 October 2016, Selected Projects and Signed Grants*

- Regarding the gender dimension in research and innovation content, 70 projects (14% of the total) of projects funded in Smart, green and integrated transport have included a sex and/or gender analysis as part of their research or innovation activities[187].
- As of 1/01/2017, a total of 267 publications have been generated by projects in Smart, green and integrated transport, as reported by the respective coordinators. In detail:
    - 157 conference proceedings
    - 62 peer-reviewed articles
    - 3 monographic books
    - 2 book chapters
    - 43 other publications
- 11 patent applications were filed as of 1/01/2017, of which 4 awarded; 2 trademark applications were filed, both of which awarded.
- One in two Innovation Actions was flagged as focussing on demonstration and piloting.

Some additional insights come from the Survey among project coordinators (September 2016). The 55 project coordinators responding to the survey indicated the following expected outputs at the end of their respective projects:

- 55 training events or workshops, with a targeted audience of over 600 participants
- About 100 PhD Thesis and Master Thesis supported by the projects
- About 1000 total number of staff involved in the project implementation (70% male, 30% female).
- An increase for 80% of the projects of the mobility of own researchers
- Over 100 expected prototypes (i.e. new materials, physical parts, machinery, etc.)
- Over 150 tools, methods, databases, models, system architecture applications that are not marketed yet
- Approximately 30 new norms and standards
- Approximately 30 new products, 30 new services and 80 new technologies introduced into the market

While there is no indication that projects for which coordinators replied to the survey represent a statistically significant sample of all on-going projects, the number and especially the range of activities undertaken so far give no reason to presume that outputs in terms of Research and Innovation, of knowledge transfer and of policy might not materialise both within and – given the long-term innovation cycle in transport – beyond the lifetime of projects.

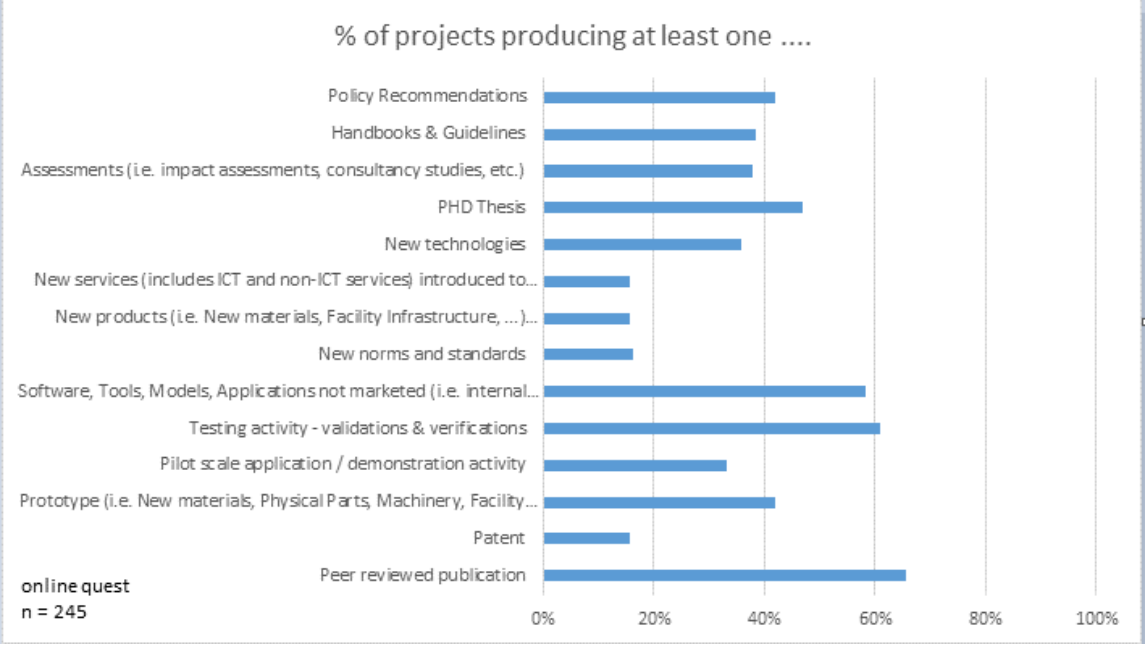
M.4.2. Expected longer-term results from the programme

As mentioned in the previous section, it is not possible at this stage to present evidence-based longer term results. However, some indications on the results to be expected can be provided on the basis of the previous Framework Programme's findings.

[187] *'Gender' has a societal connotation, while 'sex' points to biological differences between women and men. In transport research this translates in, for instance, differences in terms of modal choice between women and men (gender) and different injury patterns for women and men in the event of a crash.*

Based on the survey of project coordinators, the FP7 ex-post evaluation study of the Transport theme[188] showed that in FP7 a high share of projects (>60%) delivered **peer reviewed publications and testing activities** (validations and verifications), which may be linked with activities related to development of new products or services. Development of software, tools, models and applications (not marketed) was also very common (i.e. occurs in more than half of the projects). However, only a small proportion of projects (<20%) delivered new services, new products, new norms and standards or patents.

Figure 239 - Overview of FP7 Project Outputs



Source: TRI-VALUE, Ex post evaluation of Transport Research and Innovation in the FP7 'Cooperation' Programme – Final Report.

Such a trend may be inverted for the ongoing projects given the focus of Horizon 2020 on innovation and considering the budget allocated to Innovation Actions (over 25% of the total budget in the period 2014-2017), funding closer to market applications rather than early stage development. This expectation is supported also by the number of topics requiring the analysis and/or development of **standards[189], new services, solutions and business models.**[190]

---

[188] *Carvalho, D.; Vieira, J.; Boile, M.; Mitropoulos, L.; Mathews, B.; Pearman, A; Aparicio, A.; Ciommo, F.;.; Köhler, J. (2014) "TRI-VALUE, Ex post evaluation of Transport Research and Innovation in the FP7 'Cooperation' Programme – Final Report - Deliverable 4.2", TRI-VALUE project, funded by the European Commission under the 7th FP http://ec.europa.eu/smart-regulation/evaluation/search/download.do?documentId=16561174*

[189] *For instance:*

- *MG.3.1-2014. Technologies for low emission powertrains*
- *MG.3.2-2014. Advanced bus concepts for increased efficiency*
- *MG.3.5-2014. Cooperative ITS for safe, congestion-free and sustainable mobility*
- *MG.3.6-2015. Safe and connected automation in road transport*
- *MG.4.2-2014. Safer and more efficient waterborne operations through new technologies and smarter traffic management*
- *MG.4.4-2014. Advancing innovation in the Inland Waterways Transport (IWT) sector*
- *MG.5.1-2014. Transforming the use of conventionally fuelled vehicles in urban areas*
- *MG.7.2-2014. Towards seamless mobility addressing fragmentation in ITS deployment in Europe*
- *MG.8.3-2015. Facilitating market take up of innovative transport infrastructure solutions*

The FP7 transport theme was also successful in creating new and sustained research partnerships. More than a third of the projects have been successful in creating a formal network within their scope and an overwhelming majority (>86%) of them continued to cooperate even after completing the project for which they originally formed a consortium.[191]

The approach to **international collaboration**, introduced in FP7 by integrating the international dimension into each thematic area of the Cooperation programme, has been developed in Horizon 2020 in line with the goal of "Open to the world". Under the FP7 transport theme, globally more than 200 international participants were involved and 118 projects that included international participants were funded. Four joint calls resulted in 12 funded projects[192]. Under Horizon 2020 3 specific international cooperation calls were issued in aviation to identify topics of common interest and mutual benefit with Canada, China and Japan, and one Euro-African initiative on road safety and traffic management. Multilateral exchanges on transport R&I strategies and investment priorities with the major international partner countries are encouraged in several topics.

54% of projects developed in FP7 made a contribution to strengthening the competitiveness of the European industry and more than half of all transport research projects developed in FP7 have contributed towards the achievement of increased efficiency of the whole transport system. In general, there was good alignment between the work conducted under FP7 and the transport policy objectives. In particular, GHG reduction and safety were key focus areas for transport research, followed by reduction of pollutants and energy efficiency. Across all modes there was a large share of projects (i.e. 75%) contributing directly or indirectly to those objectives[193].

As regards Horizon 2020 projects, an analysis of the portfolio of projects selected so far and their expected results in the longer term is provided in the next section.

- *MG.9.1-2015. Transport societal drivers*
- *MG-4.2-2017: Supporting 'smart electric mobility' in cities*
- *MG-5.3-2016: Promoting the deployment of green transport, towards Eco-labels for logistics*
- *MG-6.2-2016: Large-scale demonstration(s) of cooperative ITS*

[190] *For instance:*

- *MG.2.2-2014. Smart rail services*
- *MG.4.2-2014. Safer and more efficient waterborne operations through new technologies and smarter traffic management*
- *MG.3.5-2014. Cooperative ITS for safe, congestion-free and sustainable mobility*
- *MG.3.6-2015. Safe and connected automation in road transport*
- *MG.4.2-2014. Safer and more efficient waterborne operations through new technologies and smarter traffic management*
- *MG.5.3-2014. Tackling urban road congestion*
- *MG.5.5-2015. Demonstrating and testing innovative solutions for cleaner and better urban transport and mobility*
- *MG.6.3-2015. Common communication and navigation platforms for pan-European logistics applications*
- *MG.7.2-2014. Towards seamless mobility addressing fragmentation in ITS deployment in Europe*
- *MG.8.1-2014. Smarter design, construction and maintenance*
- *MG.8.3-2015. Facilitating market take up of innovative transport infrastructure solutions*

[191] *TRI-VALUE, Ex post evaluation of Transport Research and Innovation in the FP7 'Cooperation' Programme*

[192] *Idem*

[193] *Idem*

M.4.3. Progress towards attaining the specific objectives

The Gap Analysis conducted in spring 2016 as an input to the strategic programming exercise for 2018-2020 suggests that Smart, green and integrated transport is on the right path towards attaining its specific objectives.

Indeed, the analysis[194] of the first two Work Programmes, covering the period 2014-2017, shows that all 4 main activity areas and the 12 sub-areas identified in the Specific Programme have been addressed, with only 3 topics of the Work Programme 2014-2015 having remained uncovered[195], one of which was however published in the 2016-2017 Work Programme and resulted in a selected project. It should be noted that 17 of these topics addressed more than one of the 12 sub-areas.[196]

Table 181 - Matching Specific Programme activity areas and topics/other actions of the work programmes 2014-15 and 2016-17 and respective allocation of funds (in % of the total)

Specific Programme Activity Areas/sub-areas	Number of topics/other actions	Percentage of total funds
1. Resource efficient transport that respects the environment	**55**	**55.9%**
1.1. Cleaner and quieter aircraft, vehicles and vessels	29	34.0%
1.2. Smart equipment, infrastructures and services	14	11.6%
1.3. Improving transport and mobility in urban areas	12	10.2%
2. Better mobility, less congestion, more safety and security	**26**	**18.2%**
2.1. Reduction of traffic congestion	3	0.4%
2.2. Mobility of people and freight	4	2.0%
2.3. New concepts of freight transport and logistics	6	4.8%
2.4. Reducing accident rates and fatal casualties and improving security	13	11.0%
3. Global leadership for the European transport industry	**20**	**21.0%**
3.1. Next generation of transport means	5	6.9%
3.2. Smart control systems	6	4.8%
3.3. Advanced production processes	4	3.6%
3.4. Exploring entirely new transport concepts	5	5.7%
4. Socio-economic research and forward looking activities for policy making	**29**	**4.9%**

[194] The gap analysis included only the so-called 'programmable actions' of the work programme (i.e. the topics included in the various calls, for which there is a description of the specific challenge to be addressed, of the scope to be covered and of the expected impact of the projects to be funded). It does not therefore include bottom-up actions of the work programme (in particular the SME instrument and the Fast Track to Innovation) for which an ex-ante definition of the expected research areas was not possible. Similarly, this gap analysis does not include research areas covered by the Joint Undertakings which are part of Societal Challenge 4, as these activities fall outside the scope of the work programmes. Nevertheless, it must be noted that these activities also contribute to the content coverage of the Specific Programme.

[195] Three topics of the Work Programme 2014-2015 remained uncovered (meaning that either no proposal was submitted or that those submitted were not of a sufficiently good quality in order to be approved for funding). These are the topics:

- *MG.3.3-2014 - Global competitiveness of automotive supply chain management*
- *MG-8.3-2015 - Facilitating market take up of innovative transport infrastructure solutions*
- *MG-9.4-2014 - Research, technology development and market prospects for the European transport industries*

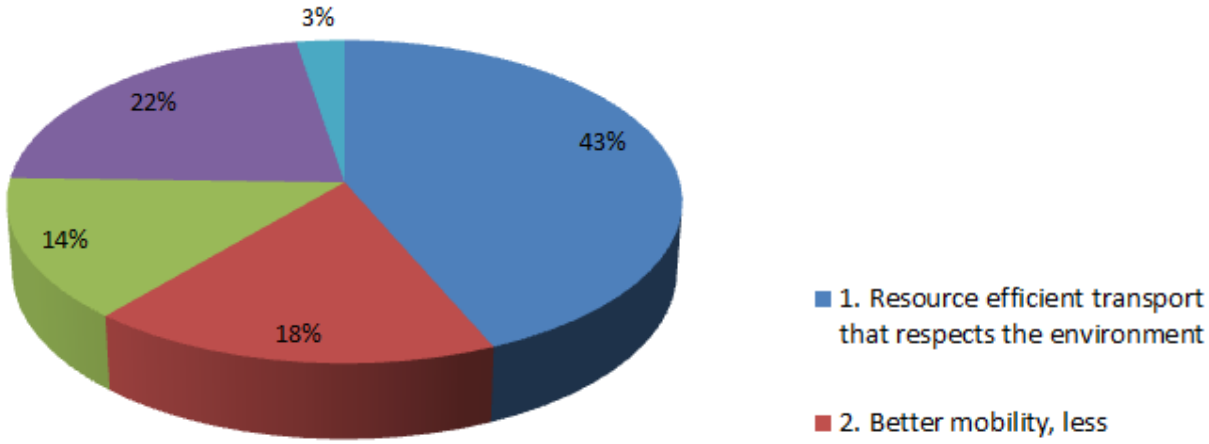
[196] The 17 topics in question are attributed to both areas concerned, hence the discrepancy between the number of topics indicated in the table (133) and the actual number of topics (116).

5. Non – covered topics	**2**	**0%**
Total	**133**	**100%**

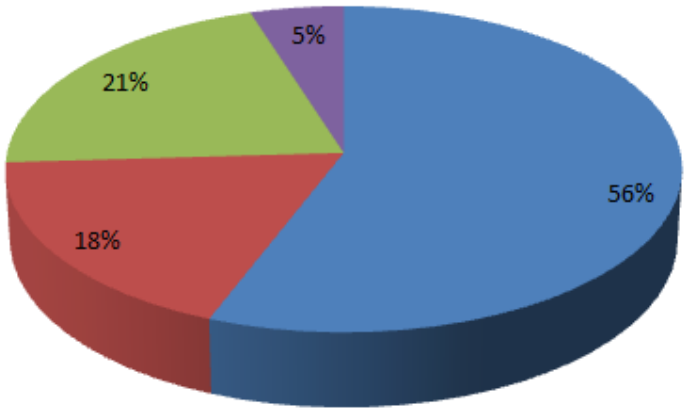
Source: European Commission, analysis carried out internally ("gap analysis").

Table 182- Topic coverage and allocation of funds of the 4 activity areas of the Specific Programme in the Work Programmes 2014-15 and 2016-17

Topic coverage



Allocation of funds



Source: European Commission, analysis carried out internally ("gap analysis").

The analysis of the funded project portfolio shows that the funded R&I activities are progressing towards providing the required impacts.

The activity area 1 "Resource efficient transport that respects the environment" is the one that appears to have been more extensively covered so far, gathering 43% of the total number of topics and approximately 56% of the available funds of the first two work programmes. This is in line with the specific objective of a sustainable transport system, in response to the grand challenge for Transport to make growth and sustainability compatible, by decoupling environmental impacts from economic growth, while assuring the competitiveness and

innovative character of the European transport industry. It is also consistent with the horizontal objectives of Horizon 2020 which foresee that climate-related expenditure should exceed 35% of the overall budget, including measures improving resource efficiency.

Embedding socio-economic and behavioural research is another SC4 target, which seems to have been adequately addressed so far. The respective activity area has attracted a significant number of topics (22% of the total, even though some of them address partially and not exclusively socio-economic issues) and a considerable part of the available funds.

At the level of sub-areas most of them have been adequately covered and only few appear to have been covered in a rather limited way. This is the case in particular of sub-areas 2.1 "Reduction of traffic congestion" (0.4% of funds and 2% of the number of topics), 2.2 "Mobility of people and freight" (2% of funds and 3% of topics) and 3.3 "Advanced production processes" (3.5% of funds and 3% of topics).

Significant parts of the Specific Programme content are addressed also through other implementation instruments beyond the work programme calls, notably the Joint Undertakings (JUs). Therefore, some topics, which appear to be covered in a rather limited way in the work programmes, are addressed in a significant way through these instruments. An illustrative example is that of sub-areas 2.1 "Reduction of traffic congestion" and 2.2 "Mobility of people and freight" which – in addition to the respective topics of the work programmes - are addressed practically by the entire SESAR JU programme, to which Societal Challenge 4 contributes with almost EUR 600 million.

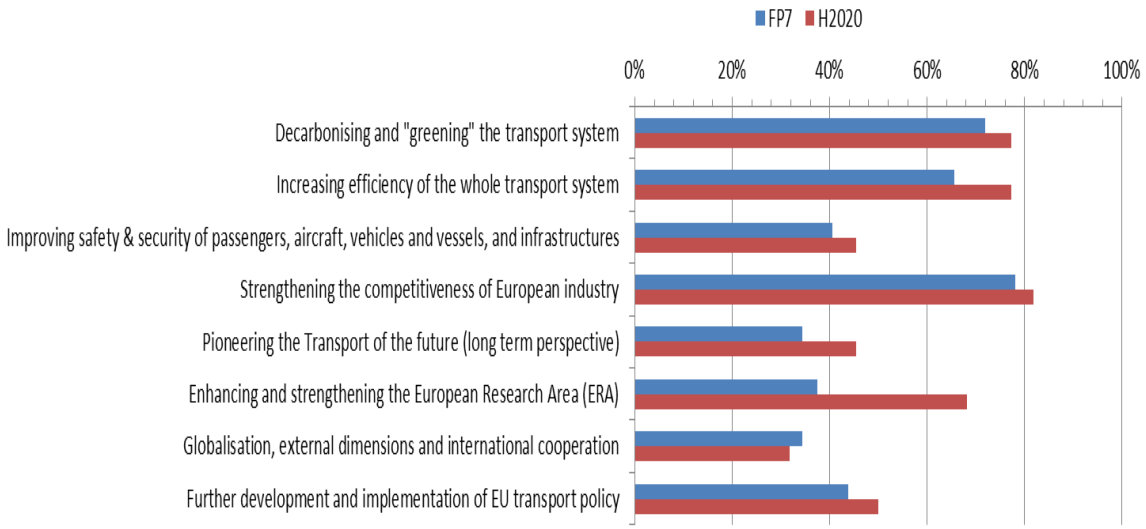
Similarly, the Clean Sky 2 JU (with a contribution of over EUR 1,700 million from SC4) covers to a significant extent both areas 1 "Resource efficient transport that respects the environment" and 3 "Global leadership for the European transport industry". Finally, the Shift2Rail JU (EUR 450 million of contribution) is also expected to contribute considerably to the coverage of areas 2 "Better mobility, less congestion, more safety and security" and 3 "Global leadership for the European transport industry" of the Specific Programme and have an indirect but significant positive impact on area 1 "Resource efficient transport that respects the environment".

The sub-area 2.4 "Reducing accident rates and fatal casualties and improving security" is the only one which can be singled out where results do not seem to improve despite the funded R&I activities.[197]

An interesting pattern emerges also from the survey carried out among project coordinators. Compared to FP7, coordinators of Horizon 2020 projects have higher expectations regarding the ability of their project to address long-term goals in transport[198], as illustrated in the chart below. Over 80% of the surveyed Horizon 2020 coordinators estimate that their projects' results, if implemented, will contribute to the European transport industry competitiveness (activity area 3), while just below 80% expect to contribute to decarbonising and increasing the efficiency of the transport system (activity area 1).

[197] *Statistics on road accidents at http://ec.europa.eu/transport/road_safety/specialist/statistics_en*
[198] *For comparability purposes, goals are formulated as combination of FP7 and Horizon 2020 goals in Transport Research and Innovation*

Figure 240 - Percentage of FP7 and Horizon 2020 transport projects that expect to contribute to one of the long term goals



Source: Survey among project coordinators, September 2016, n=32 for FP7, n=22 for Horizon 2020. Question: Assuming that the project research outputs are implemented, do you expect your research outputs to contribute to: [choice of options as presented in the above chart]. Question addressed to coordinators of Horizon 2020 projects both with and without previous experience as coordinators of FP7 projects.

M.4.4. Progress towards the overall Horizon 2020 objectives

M.4.4.1. Fostering excellent science in scientific and technological research

Excellence of the funded projects is ensured through a strict evaluation of all proposals by at least three independent and qualified external experts. Only if all evaluation criteria are considered to be at least 'good' (i.e. 3 points) and the overall score is at least 10 points (which requires that at least one criterion is even 'very good'), proposals can get funded. In practice, given the fierce competition witnessed for EU-funding in Smart, green and integrated transport, only the very best proposals are retained for funding, which translates in an expected high quality of scientific and technological research under this Societal Challenge.

Scientific excellence can be measured through the number of publications or patents (see section M.4.1 above). The excellence of technological research will be assessed on the market in terms of profits and prices. However, at this stage of the programme implementation, it is too early to assess credibly to what extent the funded projects could actually deliver the excellent scientific and technological results which were outlined in the proposals.

Looking at the broader picture, however, Smart, green and integrated transport supports building skills in the long term, focusing on the next generation of science, technology, researchers and innovations. R&I funding contributes to developing and maintaining R&I capacities, intended as training of staff, attracting researchers, career development of researchers, etc., which would be reduced without the Horizon 2020 intervention (see following section 8.2).[199]

[199] *Source: PPMI, Survey of project coordinators performed within the study 'Assessment of the Union Added Value and the Economic Impact of the EU Framework Programmes (FP7, Horizon 2020) (2012/S 144-240132)*

A strong added value of Smart, green and integrated transport is its contribution to the creation and development of networks. While intra-sectoral networks (e.g. among vehicles manufacturers) are already active outside the Programme, Smart, green and integrated transport acts as an enabler for the creation of links across countries and sectors that might not have materialised in the absence of the programme. Indeed, interviews carried out to support this evaluation showed to what extent access to complementary expertise and network effect among project partners are regarded by beneficiaries as one of the most intangible assets of the Programme. Evidence from FP7[200] shows that in a large number of cases, cooperation among partners continued even after the end of the project.

Networks are also created around specific targets, such as in the case of the Programme CIVITAS, that brings together cities committed to introducing ambitious, clean urban transport strategies, allowing them to learn from each other and facilitate exchange of ideas.

Box 20 - Contribution to the achievement and functioning of the ERA

- *More effective national research systems*

The Smart, green and integrated transport actions focus on three R&I areas identified as providing a clear added value[201], namely on transport means, infrastructure and smart systems, and services and operations. The Smart Specialisation Platform on Intelligent Transport Systems (ITS)[202] addresses the strong interrelation between smart, sustainable and safe transportation by using ICT and regional development. With the support of the Cohesion Fund and the Structural and Investment Funds, implementing intelligent transport solution projects can contribute to achieving smart growth in all regions.

- *Optimal transnational co-operation and competition*

Transnational cooperation is supported through the "Electric Mobility Europe"[203], which funds innovation projects focussing on the application and implementation of e-mobility to advance the electrification of mobility in Europe. Building on the results of the concluded ERA-NET Plus Electromobility+, it is designed to take transnational e-mobility research and policy exchange to the next level.

- *An open labour market for researchers*

In Aviation Safety, the project FutureSkySafety does not only coordinate 33 key stakeholders from all over Europe, but it also coordinates research from the national aeronautics establishments, leveraging national resources and boosting transnational co-operation.

- *Gender equality and gender mainstreaming in research*

Since the goals and measures to achieve more sustainable transport are not gender-neutral, fostering gender equality and gender mainstreaming in research are taken into account in the

[200] *TRI-VALUE, Ex post evaluation of Transport Research and Innovation in the FP7 'Cooperation' Programme*
[201] *Commission Staff Working Document 'Preliminary descriptions of research and innovation areas and fields – accompanying the Communication Research and Innovation for Europe's Future Mobility', SWD(2012) 260, 13.9.2012*
[202] *http://s3platform.jrc.ec.europa.eu/intelligent-transport-systems*
[203] *http://electromobility-plus.eu/?page_id=1088*

definition of the transport R&I topics[204], for instance by collecting disaggregated data[205]. The key issues at stake have been identified as mobility, safety and security, employment and sustainability[206].

- *Optimal circulation and transfer of scientific knowledge*

Circulation and transfer of scientific knowledge is clearly supported by the Smart Cities Light House projects[207]. Sustainable development of urban areas requires new, efficient, and user-friendly technologies and services, in particular in the areas of energy, transport and ICT. However, these solutions need integrated approaches, both in terms of research and development of advanced technological solutions, as well as deployment. Lighthouse cities develop and test integrated commercial-scale solutions at district scale, then should act as exemplars for their region helping to plan the replication of these solutions, adapted to different local conditions.

Dissemination and outreach activities, such as the Transport Research Arena conference[208], Aerodays 2015, national and regional seminars, Transport calls info days, as well as the Transport Research and Innovation Portal[209], foster the overall transfer of knowledge on the funding and cooperation opportunities and the R&I results[210].

M.4.4.2. Boosting innovation, industrial leadership, growth, competitiveness and job creation

Through actions funded across the different activity areas in the Work Programmes, Smart, green and integrated transport aims at supporting the competitiveness of European companies and academia, and at having a positive impact on growth and jobs.

Actions aiming at retaining leading edge European product and process capabilities, notably in the automotive and aviation sectors, were included in both the 2014-2015 and 2016-2017 Work Programmes. For instance, topics in the "Automated Road Transport" call aim at fostering the competiveness and leadership of the European transport industry while at the same time representing a contribution to the Digital Agenda.Such actions were complemented by actions looking at the socio-economic side, notably in terms of future requirements for skills and jobs across transport modes and systems.[211]

---

[204] *'She moves - Women's Issues in Transportation', European Union 2014 http://bookshop.europa.eu/en/she-moves-pbMI0414300/*

[205] *Transport Work Programme 2016-2017, (1) topic 'MG-8-4-2017: Improving accessibility, inclusive mobility and equity: new tools and business models for public transport in prioritised areas' includes the action "Addressing mobility needs of vulnerable to exclusion population groups such as: elderly, children, youth, disabled, people in poverty, migrants etc., as well as possible limitations to the use of new transport business models (e.g. IT illiteracy of elderly or low educated persons, pricing, different educational and cultural backgrounds, etc.). Identification of gender-related specificities in each group is strongly recommended." and (2) topic 'MG-8-5-2017: Shifting paradigms: Exploring the dynamics of individual preferences, behaviours and lifestyles influencing travel and mobility choices' requires that "In all aspects, issues of age and gender should be taken into consideration."*

[206] *'She moves - Women's Issues in Transportation', European Union 2014 http://bookshop.europa.eu/en/she-moves-pbMI0414300/*

[207] *Horizon 2020 Work Programme 2016 – 2017, Cross-cutting activities (Focus Areas), SCC-1-2016-2017: Smart Cities and Communities lighthouse projects - https://ec.europa.eu/inea/en/horizon-2020/smart-cities-communities*

[208] *www.traconference.eu*

[209] *http://www.transport-research.info/web/*

[210] *See page 32 for a more detailed overview of dissemination and outreach activities*

[211] *Smart, green and integrated transport Work Programme 2016 – 2017, topic MG-8.3-2016*

The survey run among project coordinators found strong evidence (85% agreement overall) of projects giving rise to new competitive businesses and industries[212] while simultaneously tackling several challenges (e.g. contribution to decreased CO_2 emissions, improved marine environment, while creating increased competitiveness of European paint industry).

The SME instrument also contributed to fostering competitiveness. Examples of disruptive proposals funded through the SME instrument include:

- In road transport: 'Invisible Helmet', the world's first airbag for cyclists. Through advanced sensors, it can sense the cyclist's movement patterns. In case of an accident, this airbag will inflate

- In maritime transport: the 'RotorDEMO' solution, offering auxiliary wind propulsion for freight vessels

- In rail transport: the Greenrail™ sleepers, obtained from recycled materials, cater for decreased vibrations, rail lateral displacement, noise and maintenance costs.

- In freight transport: '4FOLD', a container that can be folded to one quarter of its height, ensuring transport, handling and storing four bundled containers for the same price as one standard container

Based on the programme focus, the early outputs and expected results from projects selected so far, the programme appears to be on track to contribute addressing this Horizon 2020 specific objective.

M.4.4.3. Addressing the major societal challenges

As detailed in the section 4 above, addressing major social challenges such as reducing CO_2 emissions, extensive import and use of crude oil, external costs of transport like those from congestion, noise and accidents, while boosting the competiveness and industrial leadership of the transport industries, are inherent to Smart, green and integrated transport.

As mobility is a catalyst for development, the EU is highly dependent on a robust and efficient transport system to realise its potential for growth. Transport R&I aims to develop a transport system that underpins economic progress, enhances competitiveness and offers high quality mobility services while using resources more efficiently (notably by minimising transport systems' impact on climate and the environment[213]), when answering the growing and evolving demand for its activities on the European and the global markets.

Links between Smart, green and integrated transport and other research areas are visible also in the cross-sectorial impact of projects. A survey[214] conducted among project coordinators asked respondents to assess whether their projects were expected to have impact on different societal challenges over the next 10 years. Respondents for Smart, green and integrated

[212] *N=54, survey of Horizon 2020 Transport Project Coordinators carried out over September 2016, question "Is the project going to simultaneously tackle societal challenges (i.e. supporting mobility of the elderly while, at the same times, creating new business opportunities)?"*
[213] *According to own assessment, EUR 710,2 Mio – or 58,3% of the whole budget for Smart, green and integrated transport (including Joint Undertakings) are allocated to projects that contribute to fighting climate change).*
[214] *Source: PPMI, Survey of project coordinators performed within the study 'Assessment of the Union Added Value and the Economic Impact of the EU Framework Programmes (FP7, Horizon 2020) (2012/S 144-240132)*

transport indicated that transport projects will have the largest impact on thematic areas dealt with, besides within the challenge itself, in the following Societal Challenges: SC5 "Climate Action, Environment, Resource Efficiency and Raw Materials" (62.0%) and SC3 "Secure, clean and efficient energy" (36.5%). Around one fourth of project coordinators indicated that their project will also deliver results relevant to SC1 "Health", SC6 "Inclusive Societies" and SC7 "Secure Societies". Only 9.3% of Transport projects, according to this survey, would have results relevant to SC2 "Food".

M.4.4.4. Spreading excellence and widening participation

Many innovative solutions for sustainable urban mobility are developed locally or as self-standing projects in a variety of social, economic and geographical contexts. The specific challenge is to increase the take up of innovative solutions by transferring them to new contexts and studying and comparing the impacts. To maximise investment in R&I, Smart, green and integrated transport will fund actions able to successfully transfer a single solution/approach or limited package of mutually reinforcing solutions/approaches from a small number of locations in Europe (approximately five) to at least ten new locations in Europe.[215]

A coordination effort has been undertaken also in the field of road automation. Many developments and testing of automated vehicle solutions are already on-going in different European Member States and worldwide with varying framework conditions. The topic 'ART-06-2016: Coordination of activities in support of road automation'[216] will support activities to achieve a better visibility, comparability and transferability of available results and data of Field Operational Tests of vehicle automation at national and European level. They will also lead to a stronger cooperation between research centres and other stakeholders in Europe and worldwide on common challenges in the areas of vehicle automation.

As concerns the widening of participation in the Programme, it can be observed that:

- At the cut-off date of 1st January 2017, there are proportionally more participating organisations funded under Smart, green and integrated transport than there were over an equivalent duration (2007 – late 2009) under the FP7 Transport Theme. In addition, about one in three beneficiaries in Smart, green and integrated transport is a newcomer (i.e. did not participate in FP7).
- Looking at the geographical outreach, mobilisation of stakeholders from EU-13 countries has remained substantially stable (i.e. around 5% of total funding absorbed) as compared to FP7. Reflections are currently ongoing in the Commission on how to stimulate the participation by such Countries, particularly in light of their regional strengths and specialisation patterns within the European research arena.

M.4.4.5. Science with and for society

The specific objective of Smart, green and integrated transport is to *achieve a European transport system that is resilient, resource-efficient, climate- and environmentally-friendly, safe and seamless for the benefit of all citizens, the economy and society*. Against this background, the societal dimension is a very prominent one across the whole range of activities funded under this

[215] *Smart, green and integrated transport Work Programme 2016 – 2017, topic MG-4.1-2017*
[216] *Smart, green and integrated transport Work Programme 2016 – 2017*

Societal Challenge. Indeed, a chapter dedicated to the societal dimension is included in the Work Programme for Smart, green and integrated transport since the start of Horizon 2020.

Social sciences and humanities are integrated in the Transport work programme at several layers. The social sciences and humanities dimension is embedded both as a component of several topics and research questions, as well as in distinct topics of socio-economic relevance which are intended to complement and underpin the activities covered in the other sections of the Work Programme. Projects funded under the social sciences and humanities section of the Work Programme are usually retained for management directly by DG RTD.

The first two Work Programmes also included activities specifically looking at the societal dimension in transport. Amongst these, the project MOBILITY4EU[217], bringing together the civil society and the transport stakeholders to co-design transport solutions embedding societal needs.

M.4.4.6. Science for policy

Support to policymaking is ensured mainly through those Coordination and Support Actions (CSAs) that are designed to coordinating or supporting policies (networking, exchanges, research infrastructures, studies). Coordination actions promote and support the ad hoc networking and co-ordination of research and innovation activities at national, regional and European level for a specific purpose, while Support Actions underpin the implementation of the programme by e.g. complementing the other funding schemes; help in preparations for future Community research and technological development policy activities; stimulate, encourage and facilitate the participation of SMEs, civil society organisations, small research teams, newly developed and remote research centres, as well as setting up research clusters across Europe; cover one off events or single purpose activities.

Coordination and Support Actions have so far been launched (or planned) in support to policymaking in nearly all domains of the Mobility for Growth Call (Aviation, Road transport, Urban mobility, Intelligent Transport Systems, Infrastructure, Socio-economic Research, Safety, Logistics), as well as in the "Automated Road Transport" and "Green Vehicles" call.

Technology projects can also have a direct impact on policy making. The project LOWBRASYS[218], for instance, is tackling for the first time the issue of particles emissions from brake pads and discs, starting from the understanding of their generation and effects to methods for their measurement and reduction, thus supporting the work of the Commission DGs involved in road emissions regulation, namely DG GROW and DG ENV, and providing input to the United Nations Particle Measurement Programme (PMP) Working Group in assessing the situation and developing legislation.

M.4.5. Early success stories

Project LEARN[219] (Coordination and Support Action, 10/2016 – 3/2019, EUR 2.0 million EC contribution)

[217] *http://www.mobility4eu.eu/*
[218] *http://www.lowbrasys.eu/*
[219] *http://cordis.europa.eu/project/rcn/205950_en.html*

The LEARN - Logistics Emission Accounting and Reduction Network coordination and support action aims to improve carbon measurement and reporting along the logistics transport supply chain, as well as support companies involved in all aspects of transport logistics to improve their efficiency and reduce emissions, thereby contributing to the 'Resource efficient transport that respects the environment' area of activity in the Work Programme.

The lack of a coordinated and industry wide approach regarding this issue is a major market barrier. The ongoing isolated activities in this field create problems – for example, confusion over the role of different programs, disagreement over the most effective mechanisms which can be used to calculate and report emissions, where support is most needed to encourage certain behaviours, or ignorance of practical measures under development. The already undergoing activities take place in isolation. The EU funded consortium, by gathering the most representative companies and associations in the logistics sector, is in the position to create wide consensus around one shared solution. The EU contributes for almost EUR 2 million with a very high multiplying effect on the market.

Project PROSPECT[220] (Research and Innovation Action, 5/2015 – 10/2018, EUR 6.9 million EC contribution)

Even though road safety has improved in recent years, accidents remain a serious problem on European roads, where, on average, 75 people lose their lives every day and 750 are seriously injured. Vulnerable road users (VRUs) such as pedestrians, cyclists, motorbike and moped riders represent a particularly serious safety concern, since they account for a disproportionately high percentage of the total number of road fatalities and serious injuries.

By seeking to reduce cyclist and pedestrian casualties, who represent the largest shares of road fatalities, PROSPECT aims at significantly improving the effectiveness of active safety systems on vehicles – and thereby contribute to the 'Better mobility, less congestion, more safety and security' area of activity in the Work Programme.

Project EBSF 2[221] (Innovation Action, 5/2015 – 4/2018, EUR 10.0 million EC contribution)

EBSF_2 is an EU-funded project testing intelligent, energy-efficient and passenger-friendly bus service innovations, designed to bring benefits to both commuters and public authorities across 12 cities in Europe. The most effective solutions are expected to create new market opportunities for cutting-edge technology in public transport.

By encouraging the prioritisation of energy-efficient solutions in bus renewal programmes and new tenders, the EBSF_2 project aims to lower operating costs, and to cut down on carbon emissions over time. Smart IT solutions should also enable public transport authorities to offer more integrated transport solutions across urban areas.

The project will enable suppliers to add to their product portfolios, which will strengthen their competitiveness as leading suppliers of cutting-edge products for buses (contribution to the 'Global leadership for the European transport industry' area of activity in the Work Programme).

[220] *http://cordis.europa.eu/project/rcn/193275_en.html*
[221] *http://cordis.europa.eu/project/rcn/193395_en.html*

M.4.6. Lessons learnt/Areas for improvement

As detailed in the preceding sub-sections, a full and objective assessment of Smart, green and integrated transport would be premature at this stage. Yet, the following trends emerge:

- The focus on innovation in Horizon 2020 translates in projects with higher expected technology readiness levels (TRL[222]) under Smart, green and integrated transport than in the Transport Theme in FP7
- Key Performance Indicators give no reason so far to doubt that outputs in terms of Research and Innovation, of knowledge transfer and of policy will materialise in the longer term
- All four main activity areas and the 12 sub-areas identified in the Specific Programme have been addressed so far

In addition, many FP7 projects are now finalised and provide examples of activities delivering results in terms of addressing societal needs and generating new knowledge (see examples in section M.9)

As regards the final (2018-2020) Work Programme of Smart, green and integrated transport, with the exception of two topics remained uncovered in the previous two Work Programmes (see section M.4.3 above), all specific activities mentioned in the Specific Programme have been covered so far. Therefore, there appear to be no particular limitations linked to uncovered areas that might have an impact on the final Work Programme.

M.5. EFFICIENCY

M.5.1. Budgetary resources

The EC contribution allocated to SC4 as of 1/01/2017 has been EUR 1,485 billion, about 24.1% of the total expected budget allocated to Smart, Green and Integrated Transport in Horizon 2020, which is EUR 6,151 billion for the period 2014-2020 and which represents a considerable (almost 50%) increase compared to the budget allocated to the FP7 Transport theme. Despite this, the value of eligible proposals so far is over three times that of available budget, meaning that less than one third of all proposals having made it to the second stage were financed until now.

As regards the budget allocated to the different funding instruments, the programme has so far been implemented mainly through Innovation Actions (IA) and Research & Innovation Actions (RIA) accounting together for over 93% of the total EU contribution for grants.

In terms of focus on the different parts of the innovation chain, the budget share for innovation-related activities (implemented through IAs and ERA-NETs) is about 27%. This implies that – whereas some of the stakeholders interviewed expressed a fear that Smart, green and integrated transport would largely focus on innovation and market-oriented issues to the detriment of research-oriented activities – basic research is still allocated a considerable share of the budget.

[222] https://ec.europa.eu/research/participants/data/ref/Horizon 2020/wp/2014_2015/annexes/Horizon 2020-wp1415-annex-g-trl_en.pdf

Looking at the funding allocated by type of participant, while in absolute terms this has risen following the overall rise in budget for Smart, Green and Integrated Transport in Horizon 2020 compared to the Transport theme in FP7, shares have remained substantially constant. Indeed, similarly to FP7, industrial participants (including SMEs) account for over half (53%) of the total grant-based EU contribution, whereas Research Centres received 20%, Universities 16%, Public Bodies 7% and beneficiaries in the category 'other' the remaining 4% of the total EU contribution.

The budget allocation among thematic areas is illustrated in section M.4.3 above.

M.5.2. Programme's attractiveness

M.5.2.1. Mobilisation of stakeholders

As presented above, so far, in Smart, green and integrated transport over half of the financing for activities in the Work Programmes was absorbed by Private Companies, reflecting, as in FP7, the industry-oriented nature of the Programme. This category of beneficiaries is the one having the highest share of newcomers: about 42% of all Private Companies participating in Smart, green and integrated transport have not participated in projects under the Transport theme in FP7. Among public bodies and beneficiaries in the 'Other' categories the share of newcomers is comparable (39% and 38%, respectively), while it is considerably lower for Research Centres (12%) and Universities (4%).

Despite the generally high level of satisfaction among beneficiaries, mainly in terms of the added value of activities funded under Smart, green and integrated transport and of the networking possibilities the Programme offers, areas for which disappointment was expressed by those interviewed or surveyed remain, amongst which the oversubscription in some topics.

Indeed, overall success rates for proposals in the Work Programme part of Smart, green and integrated transport are 24.4% in terms of proposals and 29.6% in funding, with differences depending on the type of instrument, as detailed in table below.[223]

[223] *From the moment a proposal is retained for funding several weeks pass before the corresponding Grant Agreement is signed between the Commission and the consortium. This explains why the number of retained proposals (198) does not correspond to that of projects analysed in this evaluation (154)*

Table 183 - Success rates (as % of proposals submitted, and as % of budget available) for Smart, Green and Integrated Transport

Type Of Action	Nr of Eligible Proposals	Nr of Retained Proposals (mainlist)	EC Contribution requested by Eligible Proposals (EUR million)	EC Contribution to Retained Proposals (EUR million)	Success Rate Proposals	Success Rate Funding
CSA	162	37	241.8	65.8	22.8%	27.2%
ERA-NET-Cofund	1	1	10.0	10.0	100.0%	100.0%
IA	499	161	1 165.5	559.2	32.3%	48.0%
RIA	1 038	283	3 420.4	1 157.2	27.3%	33.8%
SME-1	1 935	253	96.8	12.7	13.1%	13.1%
SME-2	872	78	1 346.2	119.8	8.9%	8.9%
Total:	**4 507**	**813**	**6 280.7**	**1 924.7**	**18.0%**	**30.6%**

Source: CORDA data, 1 January 2017, Selected Projects and Signed Grants by Type of Action, for Smart, green and integrated transport as a whole (including JUs and projects funded SME instrument)

It should be noted, however, that for 2-stage topics figures above are calculated including only those proposals having made it through stage 1. When looking at the picture in terms of proposals selected over the total number of proposals submitted, success rates drop to about 10% in terms of both funding and proposals. Further elements related to this aspect are provided in section M.5.3 below.

It should be noted that the 2-stage approach for the evaluation of proposals does not in itself generate unanimous consensus among applicants, although it is not entirely clear whether the dissatisfaction expressed by some of the stakeholders interviewed actually relates to the selection process as such or to the low success rate that originates as a consequence of the high volumes of proposals submitted. It should also be noted that a comparable process is in use in several Member States.

This approach will continue to be used for the evaluation of proposals submitted under the calls of the last Work Programme of Smart, green and integrated transport.

Regarding Time to Grant, the Horizon 2020 objective to reduce the period between submission of a proposal and signature of the grant agreement to a general maximum of 8 months was met in 98.6% of the grants signed for actions included in the Work Programmes.

As concerns management, following the handover to the Innovation and Network Executive Agency (INEA) in December 2014, this Programme Part is being implemented primarily by INEA. Certain projects with particularly relevant policy content were retained and are being managed in-house by DG RTD, DG MOVE and DG CONNECT. The latter, in particular, is responsible for some topics and projects for which the centre of gravity of the activities is ICT.[224]

[224] *Involvement through sub-delegation*

The participation of Small and Medium-sized Enterprises (SMEs) in Horizon 2020 is closely monitored by the Commission. Overall, it is expected that 20% of the total combined budget for all Societal Challenges and the specific objective Leadership in Enabling and Industrial Technologies (LEITs) will go to SMEs. At the time this report is drafted, 20.4% of the Smart, green and integrated transport budget (including activities carried out in Joint Undertakings) has been allocated to SMEs.

SMEs can participate as beneficiaries in collaborative research projects or be granted funding under the dedicated SME instrument. The latter is meant to help high-potential SMEs to develop ground-breaking innovative ideas for products, services or processes that are ready to face global market competition

In Smart, green and integrated transport, so far 196 projects were funded under Phase I and 65 projects under Phase II of the SME Instrument, with a total contribution of EUR 105.4 Mio (9.8 Mio in Phase I and 95.6 Mio in phase II). In the domain of transport, the average project funded under the SME instrument phase II lasts just under 2 years and receives an EC contribution in the order of EUR 1.5 Mio, about 70% of the project total cost.

To date, several promotional activities and awareness campaigns have been undertaken, notably:

- Yearly central Information Days held in Brussels targeting potential applicants to the Smart, green and integrated transport calls, with the aim to provide detailed information on the calls for proposals, covering the various topics open for submission, and the application procedure. In order to capture the largest possible audience among interested applicants, Information Days are given broad visibility and take place in the Commission's largest available premises, with the audience in the room always nearing or matching the capacity of the meeting rooms (around 800 seats) and many more potentially interested applicants following the event remotely via the web streaming facility provided.
- TRA (Transport Research Arena), the major conference on transport in Europe, which took place in 2014 and 2016 with the support of the European Commission. TRA offers researchers, industry representatives and policy-makers the opportunity to meet, discuss and identify innovative solutions that can drive a better future transport system. In addition, TRA showcased some of the most successful EU-funded projects which have contributed so far to a cleaner, safer and smarter pan-European transport system
- Within the framework of the Information Days and of TRA, networking and brokerage events were organised. Such events gave potential applicants looking for partners the opportunity to present their organizations and ideas for project proposals
- National information events, that took place on a number of occasions with support by Commission staff
- Transport SME Innovation Day, open to SMEs active in the Transport sector and interested in receiving first-hand information on the opportunities for SMEs in Horizon 2020 and other EU financial instruments in support of innovation
- The ETNA 2020 project, targeting transnational cooperation by organising specific initiatives to raise awareness on the EU transport R&I landscape and by improving the level of expertise on EU funding tools at NCP and researcher level. ETNA aims at raising awareness and give support to national/regional research stakeholders to

identify funding sources and suitable partners in Framework Programmes and complementary funds.

- Aerodays is the European flagship event in aviation R&I which takes place once during each EU Research Framework Programme. Aerodays2015 acted as an enabler for industry, governments, the European Commission, research institutions and academia to come together to present strategic perspectives and achievements in aviation R&I. The event goal was to share achievements of collaborative R&I in aeronautics and air transport within Europe and world-wide. Reflecting this, the programme included multiple plenary and parallel technical sessions together with technical site visits and networking opportunities
- The clustering of funded projects, by means of workshops and exchange of information, that has been undertaken to identify and better exploit synergies among funded activities, bringing together players from the same or from complementary sectors to start closer cooperation. Such overview of the expected results across an area of activity provides input to the policy making and helps identify gaps for future R&I actions. A successful example is the cluster trans-topic[225] in the infrastructure sector, which in addition created a new multimodal community of infrastructure stakeholders, facilitating also the vertical integration of constructors, owners and operators.
- Information on all transport R&I conducted at European and national levels was ensured through the Transport Research and Innovation Portal (TRIP - http://www.transport-research.info) and its regular updates.

M.5.2.2. Geographical dimension

In terms of budget breakdown by the beneficiary's country of origin, activities funded in the 2014-2015 and 2016-2017 Work Programmes of Smart Green and Integrated Transport sees a concentration in funding absorbed by beneficiaries established in large industrialised Countries, in line with the industrial nature of the programme, with EU-13 Countries accounting for a small share of both funding received and participations, as well as in terms of successfulness in applications (see section M.3 above).

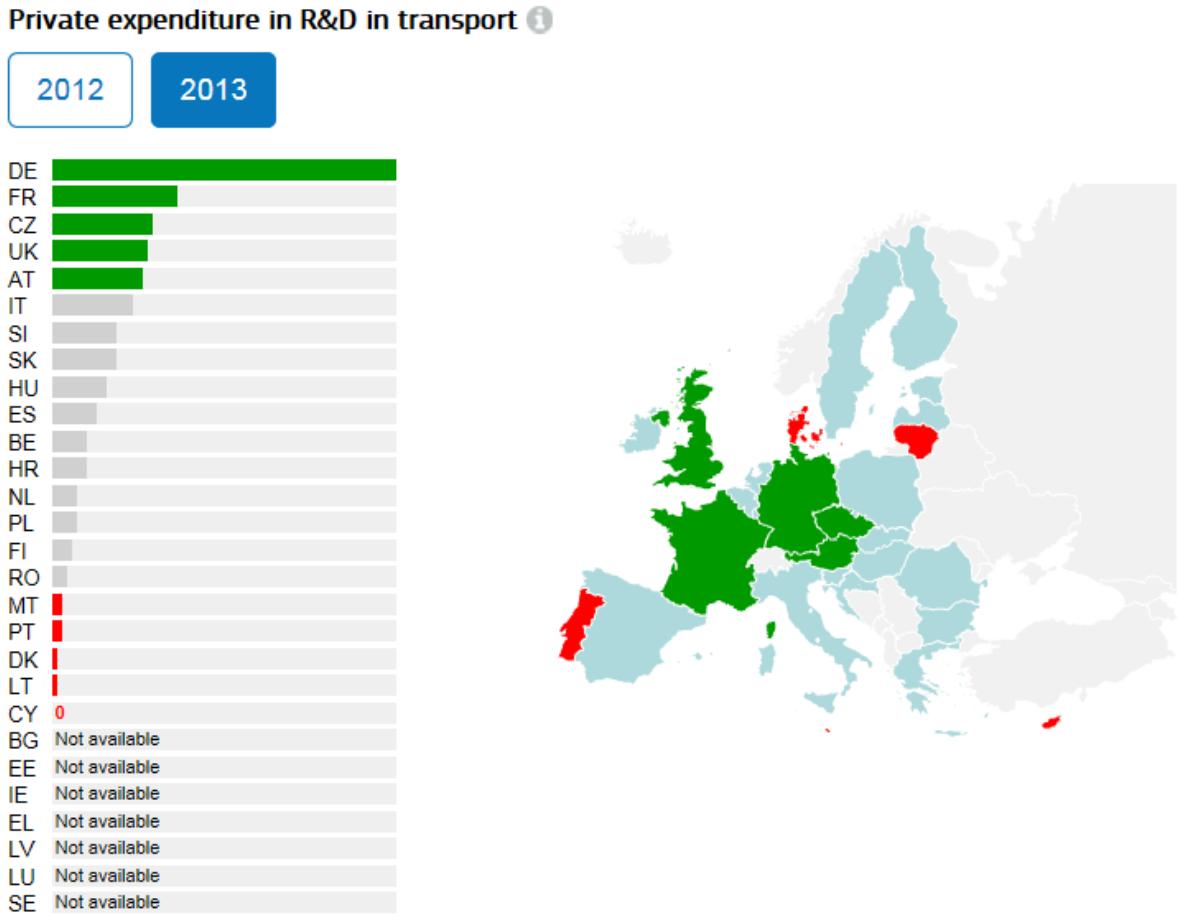
In terms of budget breakdown by the beneficiary's country of origin, activities funded in the 2014-2015 and 2016-2017 Work Programmes of Smart Green and Integrated Transport sees a concentration in funding absorbed by beneficiaries established in large industrialised Countries, in line with the industrial nature of the programme, with EU-13 Countries accounting for a small share of both funding received and participations, as well as in terms of successfulness in applications (see section M.2 above).

It is interesting to compare (at least for EU Countries) the above pattern to that of national private expenditures in transport Research and Innovation. It emerges from that comparison that most of the Countries which are particularly active in Smart, green and integrated transport also show a high share of expenditure in transport Research and Innovation, expressed as a permillage of GDP. This suggests that, similarly to FP7, Smart, green and integrated transport is reinforcing existing networks more than it is fostering research in new Countries.

[225] *Transport Work Programme 2014-2015, topics 'MG.8.1-2014. Smarter design, construction and maintenance' and 'MG.8.2-2014. Next generation transport infrastructure: resource efficient, smarter and safer'*

According to Eurostat data (see below), German transport companies are those investing the most (6.8‰ of GDP) in Research and Development, followed by France (2.5‰), Czech Republic (2.0‰), the United Kingdom (1.9‰) and Austria (1.8‰).

Figure 241 - Private expenditure in R&D in transport



Source: Eurostat (2013 data) - Investment by transport companies in research and development, as permillage of GDP. Transport companies include manufacturers of motor vehicles and of other transport equipment (NACE C29 and C30) and transportation and storage companies (NACE H). The EU value is calculated selecting only the countries whose R&D data was available.

M.5.2.3. Cross-cutting issues

The systematic monitoring of cross-cutting issues, as defined in Annex 3 of the Horizon 2020 Decision, has started in Horizon 2020. It is therefore not possible, due to a lack of data, to quantify the difference in performance between the Horizon 2020 Smart, green and integrated transport Challenge and the FP7 Transport Theme.

However, based on a qualitative assessment of transport-related topics supported under both programmes an increase appears as regards the Transport Challenge's contribution to climate actions and sustainable development. Also, a strong industry involvement was already the case in the FP7 Transport Theme.

M.5.3. Cost-benefit analysis

As mentioned in previous sections, it is too early to assess whether the resources are reasonable in light of the results that are likely to be generated. However, in terms of value for money some interesting discussions came up around the interpretation of value among stakeholders.

Cost benefit looks at the ratio of cost to benefit in purely financial terms, yet many of the participants and stakeholders clearly stated that from their perspective the main value of taking part in European Research projects is to be found in the collaborative exchanges, the learning and the opportunity to work on major challenges from a multicultural and multidisciplinary perspective, a value that can hardly be formally recognised and monetised.

In terms of the process for the selection of proposals, the high oversubscription rate for stage 1 proposals in two-stage topics has an impact on administrative costs, both on the Commission and on the applicants' side. In this regards, concerns commonly expressed by interviewed project coordinators about the evaluation procedure in Horizon 2020 touch upon the following aspects:

- The wide expertise needed by experts evaluators to properly evaluate proposals in topics that are wide in scope. A proposal may require an evaluator to have scientific knowledge, practitioner experience and/or state-of-the-art business or industry understanding;
- Broad topics included in the call also make it difficult to evaluate and compare proposals that may be very different between one another;
- Different experts evaluate proposals in stage 1 and stage 2, sometimes with different opinions that can lead to a lack of coherence in the evaluation.

The two-stage proposals as such give raise to dissatisfaction to a larger proportion (45%) of project coordinators compared to those (35%) who praise this approach.[226] Reasons for expressing dissatisfaction include the following:

- In order to be successful in stage 1, it is necessary to invest already a lot of money and effort in creating a good proposal and a solid consortium. This turns stage 1 de facto into a full proposal with a high investment and an extremely low success rate;
- Conversely, a 2-stage approach can induce a 'give it a try' behaviour, where applicants submit low quality proposals in the first stage in the hope to make it to the second stage and, only in that case, fully develop a high quality proposal;
- More precise and better defined scope of the topics would allow for less oversubscription and no need to have a two-stage process;
- A 2-stage approach is perceived as lengthening the time from call to grant. In this respect, however, it should be recalled that time to grant was usually longer in FP7 than under the two-stage procedure of Horizon 2020.

While unsuccessful proposals are given the possibility to ask for a redress, statistics developed by INEA show that of the 416 received proposals, only four requests for a redress were received, of which two were not upheld and two were upheld but did not lead to re-

[226] *Assessment of the two-stage evaluation on the effectiveness of Horizon 2020 compared to FP7 from 33 coordinators that participated both in FP7 and Horizon 2020. Source: Survey among project coordinators, September 2016.*

evaluation. This shows that participants either acknowledge the result of the evaluation, or that they do not believe that the effort of going into a redress procedure is cost effective. It is not clear to the Expert Group supporting the Commission for this evaluation exercise whether one or the other is predominant. On the other hand, the Expert Group considers that biennial Work Programmes are beneficial to applicants as they give sufficient time to prepare and allow applicants to be aware of what is upcoming.

M.5.4. Lessons learnt/Areas for improvement

Despite a considerable increase compared to the budget allocated to the FP7 Transport theme, available funding allowed for less than one third of all proposals having made it to the second stage to be financed until now.

Although the share of participants by type shows a certain degree of continuity with that of FP7 (with Private Companies accounting for about one half of the funding absorbed), there is a substantial share of newcomers, i.e. beneficiaries not having participated to FP7.

Oversubscription might represent a hurdle discouraging applicants from submitting proposals. In addition, the 2-stage approach for the evaluation of proposals does not generate unanimous consensus.

Concerning the mobilisation of stakeholders from EU-13 countries, reflections are currently ongoing in the Commission on how to stimulate the participation by such Countries, particularly in light of their regional strengths and specialisation patterns within the European research arena.

M.6. COHERENCE

M.6.1. Internal coherence

M.6.1.1. Internal coherence of the actions implemented

Smart, green and integrated transport utilises a wide variety of actions and instruments to address the full cycle of research (e.g. RIAs), innovation (e.g. IAs, inducement prizes) and deployment (JUs) in an integrated manner, depending on the nature and the needs of the sectors and technologies involved.

The predominant budgets dedicated to Research and Innovation Actions and Innovation Actions correspond to the need of further developing technological solutions in sectors such as aviation, waterborne, logistics, etc. with a view to deploy them through prototyping, testing and demonstrations up to large-scale product validation and market replication activities. Excluding the JUs and cPPP budgets, RIAs and IAs account for around 75% of the budget available for open calls (including topics under the European Green Vehicles Initiative). More specifically, IAs represent 25.9% and RIAs amount to 50% of the total work programme budget (and additional 0.2% is allocated to topics proposed for both IA and RIA).

Table 184 - Actions funded in Smart, Green and Integrated transport

Action / Instrument	Number of actions funded	EC contribution to funded actions	Objectives
Research and Innovation Actions (RIAs)	104	€ 593.8 Mio	Actions including basic and applied research, technology development and integration, testing and validation on a small-scale prototype in a laboratory or simulated environment
Innovation Actions (IAs)	18	€ 231.0 Mio	Actions including prototyping, testing, demonstrating, piloting, large-scale product validation and market replication
Coordination and Support Actions (CSAs)	32	€ 50.4 Mio	Actions consisting primarily of accompanying measures
SME Instrument	253 (phase 1) 78 (phase 2)	€ 96.8 Mio €1 346.2 Mio	Support to high-potential SMEs to develop groundbreaking innovative ideas for products, services or processes that are ready to face global market competition
ERA-NET (Cofunded)	1	€ 9.5 Mio	Actions designed to be suited for the involvement of small actors and national, regional or local public administrations, helping to facilitate the adaptation and deployment of innovations
Public Procurement of Innovative Solutions (PPI) actions [227]	0	-	Actions aimed to enable groups of procurers to share the risks of acting as early adopters of innovative solutions, whilst opening market opportunities for industry
Inducement prizes	1	€ 1.5 Mio (2017)	Financial contributions given as rewards following the publication of a contest. Inducement prizes are used to spur investment in a given direction, by specifying a target prior to the performance of the work
Joint Undertakings (JUs)	4	€ 4,205 Mio	Legal entities established under the TFEU, encompassing collaborative structures proposed for the "efficient execution of Union research, technological development and demonstration programmes". In Smart, green and integrated transport, Clean Sky 2, SESAR, Shift2Rail, Fuel Cells and Hydrogen 2
Contractual Public-Private Partnerships (cPPP)[228]	1	€ 750 Mio	Cooperative arrangements between one or more public and private sector actors in the case of research and innovation activities of strategic importance to the Union's competitiveness and industrial leadership, or to address specific societal challenges. In Smart, green and integrated transport, European Green Vehicles Initiative (EGVI)
Other actions	Several individual contracts /	€ 26.6 Mio	External expertise for evaluation and monitoring, studies, provision of technical/scientific services, modelling, service contracts, public procurement,

[227] http://ec.europa.eu/research/participants/data/ref/Horizon 2020/wp/2014_2015/annexes/Horizon 2020-wp1415-annex-e-inproc_en.pdf

[228] *https://ec.europa.eu/research/industrial_technologies/pdf/contractual-ppps-in-horizon2020_en.pdf*

	actions		, etc.

Sources: CORDA data, 1 January 2017; 2014-2015 and 2016-2017 Work Programmes, for Smart, green and integrated transport as a whole (including JUs and projects funded SME instrument).

Under FP7, large scale research programmes under PPPs and JUs have successfully been conducted and have demonstrated their value to maximise public and private commitment, enabling joint definition of topics for long-term research and speeding up technological developments[229]. Hence the Clean Sky 2[230], Single European Sky ATM Research (SESAR) 2020[231], Shift2Rail (S2R)[232] and Fuel Cells and Hydrogen 2 (FCH2)[233] Joint Undertakings have been continued under Horizon 2020. Focusing mainly on high TRL[234] research and innovation, not covered by other instruments such as RIAs and IAs, the JUs fit coherently in the range of the Smart, green and integrated transport actions.

The table in section M.2.1 shows the current Joint Undertakings and contractual Public-Private Partnership supported by the Horizon 2020 Transport budget and their leverage effect on private funding.[235]

According to the Expert Group supporting this evaluation, the number of PPP/JUs initiatives is already very large and caution should be taken when considering new ones. This should only be done after a clear gap analysis of needs. A small number of stakeholders (mainly from outside the PPPs) suggested the need for greater coordination across the various transport initiatives (i.e. how each PPP relates specifically to the other and to the regular Horizon 2020 programme): stronger links between air and surface PPPs, for example, and opportunities for best-practices exchange.

ERA-NETs cover an important link between European Commission actions and national or regional levels. ERA-NET actions are designed to be particularly suited for the involvement of small actors and national, regional or local public administrations, helping to facilitate the adaptation and deployment of innovations. One such action, "Electric Mobility Europe", is currently being funded under Smart, green and integrated transport, with European countries and regions further promoting electric mobility in Europe. The initiative will bring together about EUR 30 million for supporting applied innovation projects, including up to EUR 10 million of co-funding provided by Smart, green and integrated transport.

---

[229] *See Panel Report of Clean Sky 1st Interim Evaluation, 15.12.2010 https://ec.europa.eu/research/jti/pdf/clean_sky_interim_evaluation_15-12-2010.pdf; CLEAN SKY 2 Impact Assessment - Final Report of the Expert Group, 29.9.2012 http://www.cleansky.eu/sites/default/files/documents/admin/20120929-panel-report-impact.pdf; Second mid-term evaluation of the SESAR Joint Undertaking, DG MOVE, June 2014 http://ec.europa.eu/transport/sites/transport/files/facts-fundings/evaluations/doc/2014-06-sju-2nd-midterm-evaluation-report.pdf; Commission Staff Working Document 'Executive Summary of the Thematic Assessment accompanying the document Proposal for a Council Regulation establishing the Shift2Rail Joint Undertaking', SWD(2013) 534 final, 16.12.2013; Impacts and success stories from the European Green Cars Initiative http://egvi.eu/calendar/94/20/Impacts-and-success-stories-from-the-European-Green-Cars-Initiative*

[230] *Clean Sky aims to develop innovative, cutting-edge technology aimed at reducing CO2, gas emissions and noise levels produced by aircraft, http://www.cleansky.eu/*

[231] *The objective of SESAR is to modernise European Air traffic Management (ATM) by defining, developing and delivering new or improved technologies and procedures, http://www.sesarju.eu/*

[232] *Shift2Rail seeks focused R&I and market-driven solutions by accelerating the integration of new and advanced technologies into innovative rail product solutions, http://shift2rail.org/*

[233] *The FCH JU aims to develop by 2020 to the point of market readiness a portfolio of clean, efficient and affordable solutions that fully demonstrate the potential of H2 as an energy carrier and fuel cell as energy convertor, http://www.fch.europa.eu/*

[234] *Technology Readiness Level*

[235] *http://ec.europa.eu/programmes/horizon2020/en/area/partnerships-industry-and-member-states*

In the opinion of the Expert Group, a gap between the objectives and ambition of ERA-NET and the implementation becomes apparent when comparing budgets: the EUR 30 million pooled together in the project "Electric Mobility Europe" are comparable to the EU contribution to two large Innovation Actions.

It was mentioned on several occasions by stakeholders that the SME instruments including the *Small business innovation research for Transport* call[236] are seen as being successful. Respondents refer to the SME instrument as complementary to the SME participation target in conventional Horizon 2020 calls: SMEs in the SME instrument playing the central role and considering closer to market activities while participation in a consortium provides more opportunities for networking and becoming part of larger value chains, for example.

M.6.1.2. Internal coherence with other Horizon 2020 intervention areas

Transport systems can use novel technologies and concepts developed in other sectors, e.g. security technologies, new materials, while at the same time transport R&I results have an impact on other sectors – for instance in terms of energy efficiency, reduction of environmental impact, etc. This cross-cutting nature of transport is reflected by the numerous cross-references to transport R&I in other Horizon 2020 intervention areas, as well as in the references of the Transport Work Programmes to other relevant calls for proposals and initiatives[237]. This is intended to create synergies with other parts of Horizon 2020.

Table 185 presents examples of transport related or relevant topics funded under other Horizon 2020's areas of intervention.

Table 185 - Examples of transport related topics in Horizon 2020

<table>
<tr><th colspan="2">Transport related topics in Horizon 2020</th></tr>
<tr><th>Societal challenges</th><th>Other parts of Horizon 2020</th></tr>
<tr><td>Secure, clean and efficient energy
• Biofuels and alternative fuels
• Bioenergy engine
• Energy storage
• 'Smart Cities'</td><td rowspan="3">Leadership in enabling and industrial technologies (LEIT)
• ICT for Transport applications
− Post-lithium ion batteries
− Advanced functional materials
− Fibre-based materials
Other areas
• Future and Emerging Technologies
• European Research Council
• Marie Sklodowska Curie actions
• Access to risk finance</td></tr>
<tr><td>Climate action, environment
• Urban air quality</td></tr>
<tr><td>Secure societies
• Crisis and disaster resilience
• Critical infrastructure protection
• Freight inspection technologies</td></tr>
</table>

Source: Horizon 2020 specific work programmes.

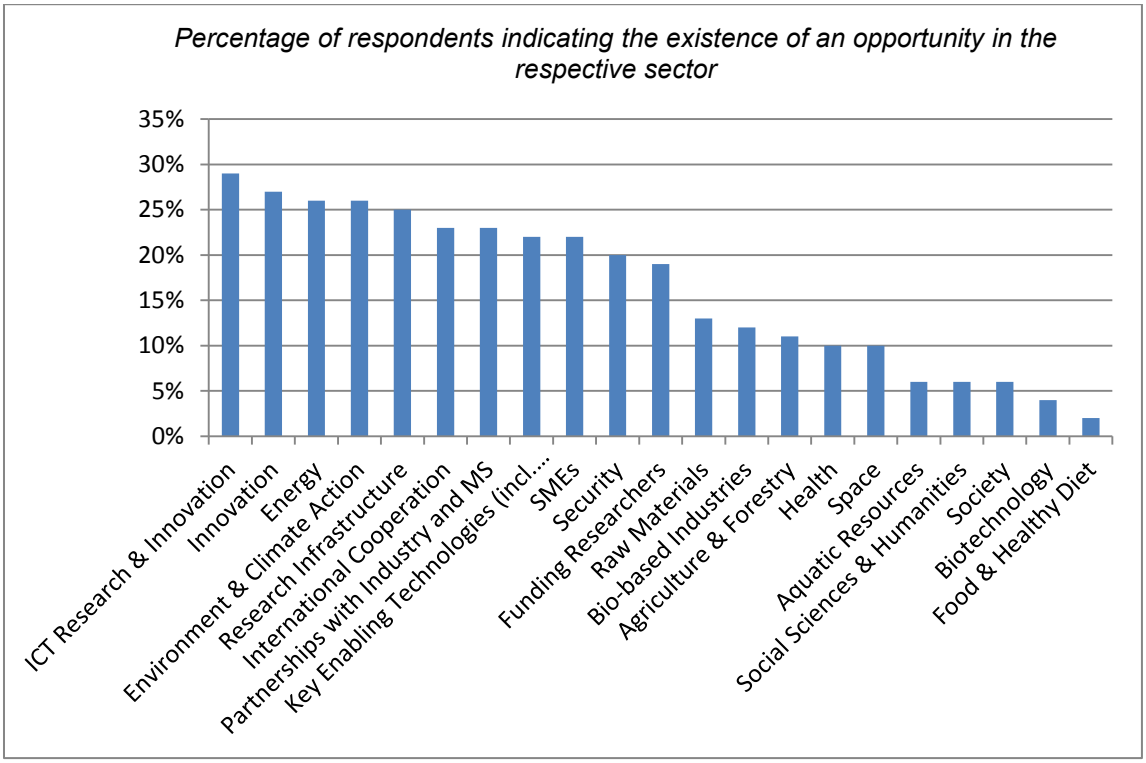
[236] *SME instrument phase 1, topic SMEInst-10-2016-2017*

[237] *2014-2015 Transport Work Programme: "In addition to the topics of this call, a topic on post lithium ion batteries for electric automotive applications (NMP 17 – 2014) is included in 'Nanotechnologies, Advanced Materials and Advanced Manufacturing and Processing (NMP)' under "'Leadership in Enabling and Industrial Technologies' (LEIT)".*
2016-2017 Work Programme: "transport-related actions are also included in other parts of Horizon 2020 Work Programme 2016-2017, particularly in the LEIT/NMBP call 'Nanotechnologies, Advanced Materials, Biotechnology and Production'; LEIT/Space call 'Applications in Satellite Navigation – Galileo'; and SC/Energy calls 'Competitive Low-Carbon Energy' and 'Smart Cities and Communities'".

The development of batteries is a good example of collaboration among different Societal Challenges of Horizon 2020: NMP[238], Energy and Transport. Such collaboration is performed via the consultation of the Transport Challenge Group. Another concrete example of opportunity for transport R&I is found in the EE-22-2016-2017 call: Project Development Assistance of the Energy programme.[239]

Project coordinators surveyed in the frame of this interim evaluation confirmed that several areas and programmes of Horizon 2020 represent also a good opportunity for transport related R&I, as showed in Table 186 below. This complementarity is supported by information and coordination mechanisms with other areas of Horizon 2020, which are appropriate according to 73% of the respondents.[240] According to survey of project coordinators[241] 65% of the projects are expected to produce interdisciplinary solutions, which cut across multiple specific objectives of Horizon 2020 (for instance, in the domains of new batteries for electric vehicles or light-weight material applications for high-speed trains).

Table 186 - Horizon 2020 thematic areas representing an opportunity for transport research, innovation and implementation (survey of projects' coordinators)



[238] *Nanotechnologies, Advanced Materials and Advanced Manufacturing and Processing*

[239] *Horizon 2020 Work Programme 2016 – 2017 'Secure, Clean and Efficient Energy', European Commission Decision C(2016)4614, 25.7.2016. The EE-22-2016-2017 call is designed to help build the technical, economic and legal expertise needed for project development with public and private actors that will lead to concrete investments, with the text of the topic stating that "the PDA focuses on the sectors of existing public and private buildings; street lighting; retrofitting of existing district heating/ cooling; energy efficiency in urban transport (such as transport fleets, the logistics chain, e-mobility, modal change and shift) in urban/sub-urban agglomerations and other densely populated areas and energy efficiency in industry and services".*

[240] *N=54, survey of Horizon 2020 Transport Project Coordinators carried out over September 2016, question "Would you say that there are enough information and coordination mechanisms within those other areas of Horizon 2020 that are complementary or synergetic for transport?"*

[241] *N=54, survey of Horizon 2020 Transport Project Coordinators carried out over September 2016, question "Is your project going to produce interdisciplinary solutions which cut across multiple specific objectives of Horizon 2020 (for instance, new batteries for electric vehicles, or lightweight material applications for high-speed trains)?"*

Source: N=54, survey of Horizon 2020 Transport Project Coordinators carried out over September 2016, question "To your knowledge, what other Horizon 2020 areas or programmes also represent an opportunity for transport research, innovation and implementation?"

This rather positive picture obtained from the project coordinators survey does not fully coincide with the opinions of some interviewees, who indicated concerns about the amount or accessibility of information regarding other funding opportunities either within other areas of Horizon 2020 or outside Horizon 2020. As almost a quarter of the project coordinators surveyed also indicated that they either rather or fully agreed that there are not enough information and coordination mechanisms this indicates in the opinion of the Expert Group that even if project coordinators tend to have a positive opinion on this matter, opportunities for better dissemination still exist.

Smart, green and integrated transport financially contributes to the following Horizon 2020 activities:

- Energy Efficiency (through the ELENA facility[242]);
- SME instrument (as explained in the previous section);
- Fast Track to Innovation Pilot.

A marginal degree of duplication[243] was spotted by projects' coordinators between Smart, green and integrated transport and other R&I programmes such as research infrastructures, fundamental research funded by the European Research Council (ERC) projects, Knowledge and Innovation Communities launched by the European Institute for Technology EIT, etc.

M.6.1.3. Ensuring that every euro spent counts twice

The results of the analysis of the Transport Challenge budget committed per topic among the different lines of activities (Work Programmes 2014-2015 and 2016-2017 budgets) show that half of the budget is directed into topics addressing several transport challenges, mainly under global leadership and resource efficiency (see previous section 6.1 on budgetary resources). In other words, according to the Expert Group, leadership through efficiency.

Examples of expected interdisciplinary solutions cutting across multiple specific objectives of Horizon 2020

- Lighter aircraft components and repair concepts that can be transferred to other transport modes
- New antifouling coatings for marine transport, but also adoptable to static constructions (e.g. renewable marine energy)
- Expertise in propulsion and aerodynamics applicable for all other disciplines in high-speed trains, automotive, aircraft

[242] *Run by the European Investment Bank and funded by Horizon 2020, the "European Local ENergy Assistance" supports the preparation of investments in sustainable energy, http://www.eib.org/products/advising/elena/index.htm*

[243] *N=54, survey of Horizon 2020 Transport Project Coordinators carried out over September 2016, question "From a broader perspective, what is your opinion about the EC's diversification of research and innovation programmes (for example research infrastructures supported within European Strategy Forum on Research Infrastructures ESFRI, or the fundamental research supported by the European Research Council ERC projects, Knowledge and innovation Communities launched by the European Institute for Technology EIT…)?". On average, respondents attributed a score of 1,09 (on a scale from 1 to 5) to the sub-answer "duplication among actions", indicating a very low perceived degree of duplication .*

- Application of robotics platforms to waterborne sector
- Aero-servo-elastic research touching flight control, aircraft structures and aerodynamics, which could be interesting for other industries like wind energy
- Lightweight material applications due to innovative and composite processes for surface transport and aerospace which are applicable to other sectors
- High efficient combustion engines that will be applied in different truck applications, but also potential for off-road application
- New motor topology applicable to EV-s and industrial applications

One example of both competitiveness and societal objectives being coherently addressed by R&I in Smart, green and integrated transport is the Automated Road Transport call in Work Programme 2016-2017:

> *"Automated Road Transport holds the promise to help address many of the major challenges of today's transport system, such as user safety, energy efficiency, air quality and congestion, and to enhance the drivers' individual comfort and convenience. At the same time, it represents a critical testing ground for the ability of the European automotive industry to preserve and consolidate its global leadership".*

The survey run among project coordinators found strong evidence (85% agreement overall) of projects simultaneously tackling several challenges and give rise to new competitive businesses and industries[244] (e.g. contribution to decreased CO_2 emissions, improved marine environment, while creating increased competitiveness of European paint industry).

M.6.2. External coherence

M.6.2.1. Coherence with other EU funding programmes

Several funding instruments can usefully complement possibilities offered in Smart, green and integrated transport (Connecting Europe Facility, European Fund for Strategic Investment, European Structural and Investment Funds, Cohesion Fund, European Regional Development Fund). Around one third of project coordinators surveyed as part of this evaluation agreed that complementarities and synergies are necessary with other public support initiatives.[245]

For instance, the section on Infrastructure of the Transport Work Programme 2016-2017 states that projects aiming at a fast implementation of results should demonstrate their

[244] *N=54, survey of Horizon 2020 Transport Project Coordinators carried out over September 2016, question "Is the project going to simultaneously tackle societal challenges (i.e. supporting mobility of the elderly while, at the same times, creating new business opportunities)?"*

[245] *N=54, survey of Horizon 2020 Transport Project Coordinators carried out over September 2016, question "Do you think that complementarities and synergies are necessary with other public support initiatives such as the Connecting Europe Facility (CEF), European Structural and Investment Funds (ESIFs), Regional Research and Innovation Strategies for Smart Specialisation (RIS3), Smart Cities European Innovation Partnership EIP, European Investment Bank's European Fund for Strategic Investments (EFSI), LIFE programme?"*

readiness for timely deployment. They could then be considered for further support under the EU complementary schemes available at the moment of project conclusion.[246]

However, in other areas, the level of coherence is not optimal according to the Expert Group. According to the European Investment bank, the transport sector has benefited from around 7% of the European Fund for Strategic Investment funds.[247] This represents, in opinion of the Expert Group supporting this interim evaluation, a small percentage of the total, considering the large cost of some transport projects.

Although recognising the complementarity and opportunities offered by other programmes beyond Smart, green and integrated transport, at the hearing, interviews and surveys, stakeholders generally considered burdensome for applicants to find funding opportunities in Horizon 2020 outside Transport related calls. Different rules for different programmes[248], and the effort to become familiar with other sets of rules, were frequently mentioned as important deterrent factors. In other words, once the process in Smart, green and integrated transport is understood, there is a reluctance to move outside of it.

A significant proportion of the stakeholders interviewed was of the opinion that the level of information on opportunities for the continuation of projects funded in the Transport Societal Challenge with external sources of funding (either for further research or for exploitation of resources) is still insufficient. Also based on stakeholders' interviews, it is clear that while some countries or regions have put in place efficient coordination mechanisms with European level initiatives, this is not the case for all European countries. The lack of information referred to by the interviewees should be put under the light of the large amount of existing information on this issue that, for some reason, does not yet fully reach the research community.

M.6.2.2. Coherence with other public support initiatives at regional, national and international level

The coordination of national and regional strategic planning and prioritisation within the EU framework is central for an integrated approach to research, development and innovation activities, requiring a proactive attitude of national and regional authorities and main stakeholders (industry and research institutions) involved in transport research, development and innovation. Synergies are triggered by enhanced multilevel interaction, alignment and coordination of independent policies and programmes, allowing increased impact and better achievement of objectives.

Project coordinators surveyed for this evaluation were asked whether in their country, and based on their experience as researcher, Horizon 2020 and its Transport Societal Challenge

---

[246] *As an example "The EU's TEN-T Programme will co-fund with almost EUR 5 million a study and a pilot deployment of 200 charging points for electric vehicles on the main French highways. The project will contribute to the development of charging infrastructure and enable a wider use of electric transport in Europe."* https://ec.europa.eu/inea/en/news-events/newsroom/200-charging-points-electric-vehicles-open-france-eu-support

[247] *EFSI dashboard (updated 15/11/2016), http://www.eib.org/efsi/*

[248] *Differences relate to e.g. the type of actions funded, the application formal requirements and the selection criteria and procedure, the funding rates, etc. For instance, while Horizon 2020 funds at 100% research and innovation activities, the Connecting Europe Facility Transport focuses on innovation activities much closer to market deployments, which are funded at 50% and require a cost-benefit/cost-effectiveness analysis.*

was influencing the national research programmes.[249] About 60% of respondents indicated that there was a positive influence of Horizon 2020 Transport on the national research programmes.

Interviews with four delegates in the Transport configuration of the Horizon 2020 Programme Committee highlighted the following aspects:

- The positive influence of the transport components of Horizon 2020 on the national programmes of their respective Countries. The national representative of a small country indicated than even if there was not a dedicated transport research programme in that country, some of the Horizon 2020 transport priorities made their way into the general national research programme;
- Its The contribution of Smart, green and integrated transport to align and concentrate national priorities in transport research.

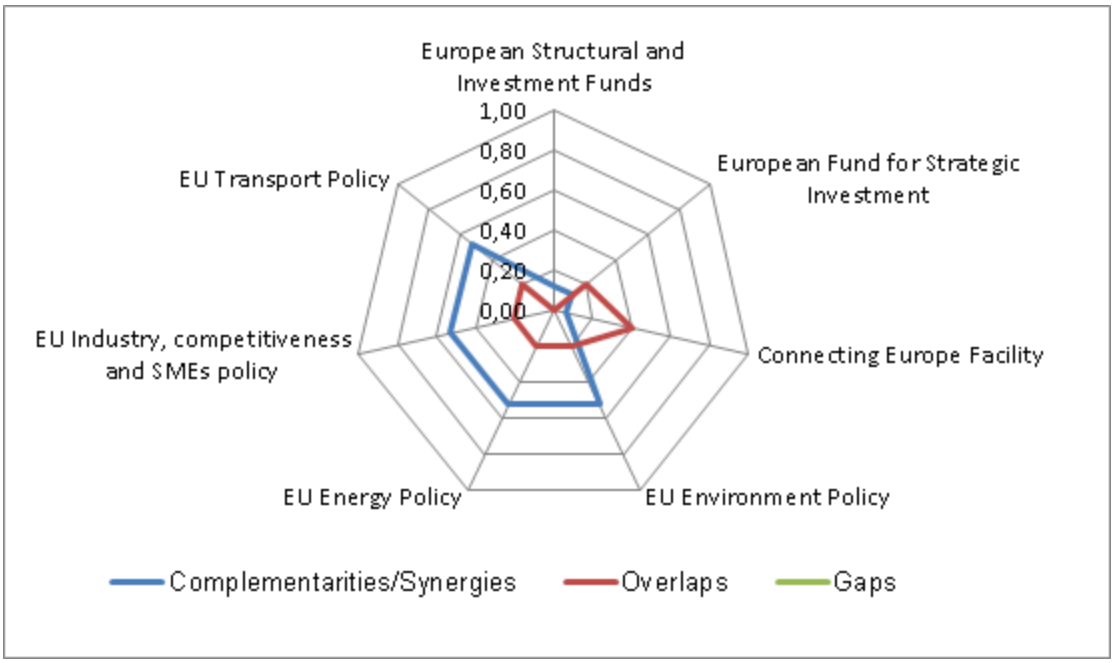
Coherence is also sought through actions involving key international partners. Under Smart, green and integrated transport, ongoing and planned international cooperation flagships include initiatives addressing, among others: road vehicle automation and safety; safer, green and faster aviation; clean urban transport in medium/mega sized cities in developing and emerging economies; cooperation on particles in relation to health and climate change. The involvement of partners at international level allows for shaping global solutions to challenges that are global in nature, ensuring that project outputs have global reach.

M.6.2.3. Results of the Likert scale

Based on an internal assessment, for Smart, green and integrated transport most complementarities and synergies with other programmes are to be found with Environment, Energy, Industry (incl. Competitiveness and SME) and Transport policies. It should be noted, however, that this analysis and its results as presented in the chart below do not include Joint Undertakings, which account for about half of the budget for this Societal Challenge. Clean Sky 2, for instance, has a high degree of complementarity with European Structural and Investment Funds.

Table 187 - External coherence of Smart, green and integrated transport with other EU policies / programmes

[249] *N=54, survey of Horizon 2020 Transport Project Coordinators carried out over September 2016, question "In your country, and based on your experience as researcher, would you say that the Horizon 2020 Transport research programme is influencing your national research programmes?"*



Source: European Commission, (own analysis).

M.6.3. Lessons learnt/Areas for improvement

Smart, green and integrated transport utilises a large range of actions to cover the full research to innovation and deployment cycle.

Overall, stakeholders agreed on the structure and goals of the instruments being coherent with the ambition of Smart, green and integrated transport and the stated objectives of the Union for transport R&I. However, in some areas the need for improvement in the implementation and how the instruments work both individually and in complement to each other was expressed. For instance, a large number of stakeholders recommended that research support instruments/programmes have the same rules so that proposals being successfully evaluated, but which could not be funded due to the call budget, could more easily apply for funding from other instruments without having to start again from scratch.

It is clear that there are opportunities for transport researchers and innovators in many other areas of Horizon 2020 beyond Smart, green and integrated transport, such as European Research Council (ERC), Future and Emerging Technologies (FET), Marie Skłodowska-Curie Actions, European Research Infrastructures (RI), Access to Risk Finance (ARF), Fast Track to Innovation (FTI), Space (Galileo applications), etc. Different rules for different programmes, however, are generally considered by stakeholders as an important factor stopping potential applicants from looking for funding opportunities beyond Smart, green and integrated transport.

International cooperation initiatives allows for outputs having global reach. Increasing impacts and ensuring the achievement is also ensured through enhanced multilevel interaction, alignment and coordination of independent policies and programmes at national and regional level. The majority of project coordinators that participated in the survey conducted for this interim evaluation indicated that generally there was a positive influence of Smart, green and integrated transport on the national research programmes. This was also corroborated by the Transport Programme Committee delegates and other stakeholders that

were interviewed for this assessment. Based on the interviews and exchanges with stakeholders, it is clear that while some countries or regions have put in place coordination mechanisms with European level initiatives, this is not the case for all of them.

M.7. EU ADDED VALUE

M.7.1. Smart, green and integrated transport projects demonstrating EU Added Value

E-ferry[250] (Innovation Action, 6/2015 – 5/2019, EUR 15.1 Mio EC contribution)

Ferries are a lifeline for many communities in Europe, moving people and goods across the continent's waterways and more than 68 000 km of coastline. As a major petroleum consumer, waterborne transport offers enormous potential for cutting emissions while saving energy and operational costs. The young technology central to electric ferries offers one way to achieve this. So a consortium of industry, transport, consumer and research stakeholders – the E-ferry project – is developing a prototype mid-range 100 % electric ferry and testing its operational viability to add knowledge to the sector. The project aims to boost environmentally-friendly transport in Europe's waterways, thereby contributing to the 'Resource efficient transport that respects the environment' area of activity in the Work Programme. Furthermore, it invests in a technology that would be quite costly for industry players to develop alone.

INFRALERT[251] (Research and Innovation Action, 5/2015 – 4/2018, EUR 3.2 Mio EC contribution)

The INFRALERT - Linear infrastructure efficiency improvement by automated learning and optimized predictive maintenance techniques project aims to develop an expert-based information system to support and automate linear asset infrastructure management from measurement to maintenance. INFRALERT will be directly applicable by Rail and Road Infrastructure Managers in the field of Intelligent Maintenance and long term strategic planning. Cooperation and exchange of knowledge between the two transport modes infrastructure managers will not be possible without a strong EU incentive to go this way. INFRALERT will develop and deploy solutions that enhance the infrastructure performance and adapt its capacity to growing needs by: (i) ensuring the operability under traffic disruptions; (ii) keeping and increasing the availability by optimising operational maintenance interventions and assessing strategic long-term decisions on new construction; and (iii) ensuring service reliability and safety by minimising incidences and failures. It is important that these activities are developed at European level to ensure a proper implementation of the Internal Market also in the field of Transport Infrastructure.

SafetyCube[252] (Research and Innovation Action, 5/2015 – 4/2018, EUR 5.8 Mio EC contribution)

[250] *http://cordis.europa.eu/project/rcn/193367_en.html*
[251] *http://cordis.europa.eu/project/rcn/193404_en.html*

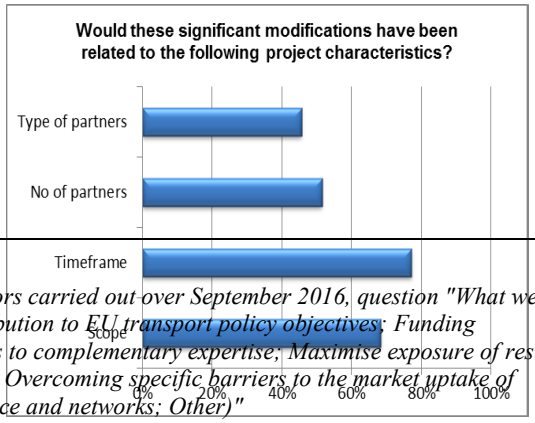
The objective of SafetyCube - CaUsation, Benefits and Efficiency is to develop an innovative road safety Decision Support System (DSS) that will enable policy-makers and stakeholders to select and implement the most appropriate strategies, measures and cost-effective approaches to reduce casualties of all road user types and all severities. The close involvement of road safety stakeholders of all types at national and EU levels and wider will enable the DSS to be focussed on the most appropriate policy-making procedures and ensure the project outputs have global reach. One of the main objectives of the project is to enhance the European Road Safety Observatory and work with road safety stakeholders to ensure the results of the project can be implemented as widely as possible.

M.7.2. Other issues related to EU Added Value

The added value of EU-funded transport R&I in terms of knowledge gained from the programmes and projects combined with the coordination and interactions between SMEs, research organisations, industries and universities from different Member States working together, is considered very important or extremely important by nearly 80% of the survey respondents for this interim evaluation[253]. This is consistent with the research performed within FP7 where the ex-ante evaluation also reveals strong added value described in similar terminology (TRIVALUE, 2013[254]).

In particular this value is associated with the R&I that could, or would, not have been funded at national level. The PPMI survey[255] for Smart, green and integrated transport shows that about half of the respondents (49%) indicated that the project would not have gone ahead at all without it, while 44% indicate that the project would have gone ahead but with significant modifications. For the projects that would have gone ahead within Smart, green and integrated transport, the data shows that the scope would have been narrower (68%), 77% state that the timeframe would have been longer and with fewer partners (51%), underpinning a clear added value of the Smart, green and integrated transport Programme. Without Horizon 2020, 73% of PPMI responders in transport indicated that their international relationships and networks would also have been affected.

Table 188 - Impacts on projects in Smart, green and integrated transport had they not been funded in Horizon 2020

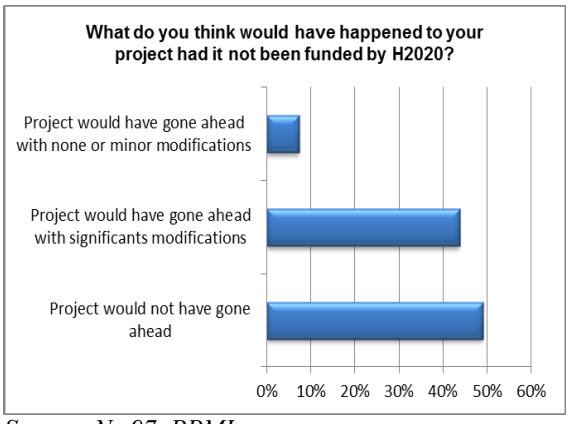


[252] *http://cordis.europa.eu/project/rcn/193237_en.html*

[253] *N=54, survey of Horizon 2020 Transport Project Coordinators carried out over September 2016, question "What were the main reasons to apply for EC funding for your project? (Contribution to EU transport policy objectives; Funding opportunity; Cooperation with other countries/institutes; Access to complementary expertise; Maximise exposure of results; Understanding the needs and characteristics of a wider market; Overcoming specific barriers to the market uptake of research results; Capitalising on previous EU projects experience and networks; Other)"*

[254] *TRIVALUE Ex-post Evaluation of Transport Research and Innovation in the FP7 Cooperation Programme, http://ec.europa.eu/smart-regulation/evaluation/search/download.do;jsessionid=KV5TiKJehiUP--AmvJc5fkCCKSKFimo7-4HunC2ytYgmFhvJ-jYp!-1309476061?documentId=16561174*

[255] *Source: PPMI, Survey of project coordinators performed within the study 'Assessment of the Union Added Value and the Economic Impact of the EU Framework Programmes (FP7, Horizon 2020) (2012/S 144-240132). For Smart, green and integrated transport: 237 projects sampled out of 355 in Cordis, 97 respondents = 41%*



Source: N=97, PPMI survey.

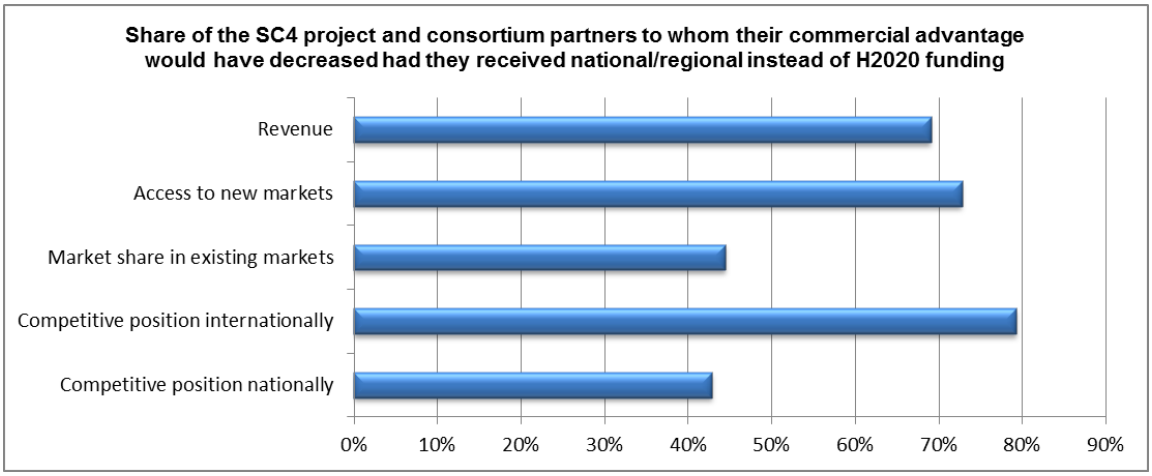
Among the most relevant reasons for not going ahead with the project[256], respondents mentioned the lack of alternative sources of funding (48.5%), the lack of access to necessary knowledge, expertise and skills (43.4%), as well as the lack of access to necessary research infrastructure, databases and other tools (48.9%) in other countries without Horizon 2020.

These results were also confirmed by the coordinators of projects in Smart, green and integrated transport surveyed for this evaluation and the interviewed stakeholders. By involving a wide variety of players there are gains in European trans-national cooperation, knowledge sharing, and synergies and cross-fertilization of ideas brought together under the common objective. Respondents felt that the focus on commercialising outputs tends to undervalue this collaborative aspect of European R&I, which is valued very highly by the participants.

In terms of impact on competitiveness and European leadership, 80% of the respondents to the Smart, green and integrated transport survey[257] indicated medium to high added value in terms of improving market positions or competitiveness. This data was confirmed by the PPMI survey[258]: if Horizon 2020 projects had been implemented with national or regional funds, beneficiaries deem that they would be experiencing relatively large negative impacts on their commercial position (i.e. not only in terms of revenue but also their competitive position nationally/internationally, market share), as showed by Table 189 below.

[256] *Idem, question "Which of the following would have been relevant reasons for not going ahead with the project?"*
[257] *N=54, survey of Horizon 2020 Transport Project Coordinators carried out over September 2016, question "Attributable to the EC funding, what kind of additionality effects do you expect in your project, e.g.: Funding being leveraged in addition to the EC contribution(input added value); Faster progress (added value by acceleration); Work done on a larger scale (scale additionality); Risk reduction; Improved market position or competitiveness; Improving scientific quality; Other"*
[258] *PPMI survey, question "Compared to your present situation where the project is funded by Horizon 2020, would you say that the following capacities of your project and consortium partners would have increased, decreased or remained similar had your project been funded by national/regional sources?"*

Table 189 - Negative impacts on commercial position/advantage if projects in Smart, green and integrated transport had been funded at national/regional level



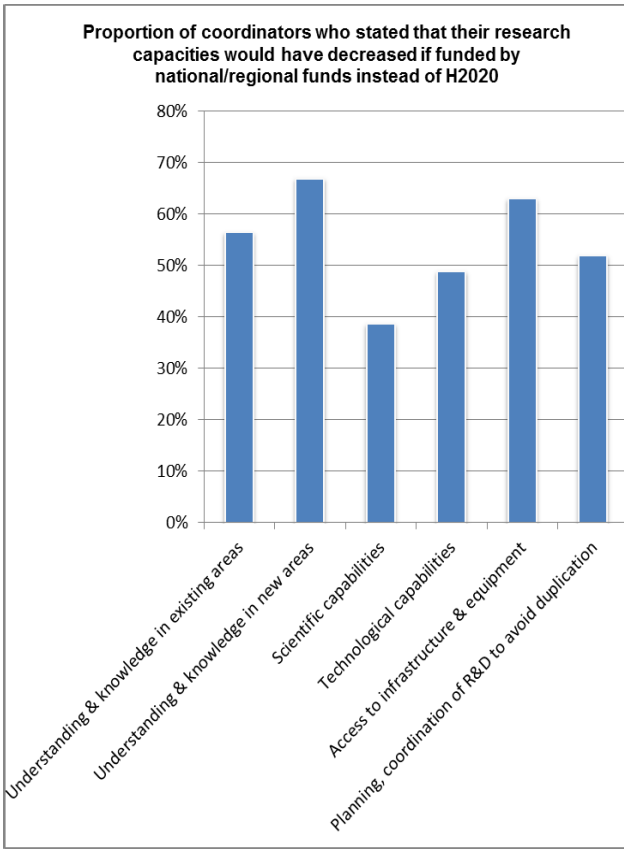
Source: PPMI survey.

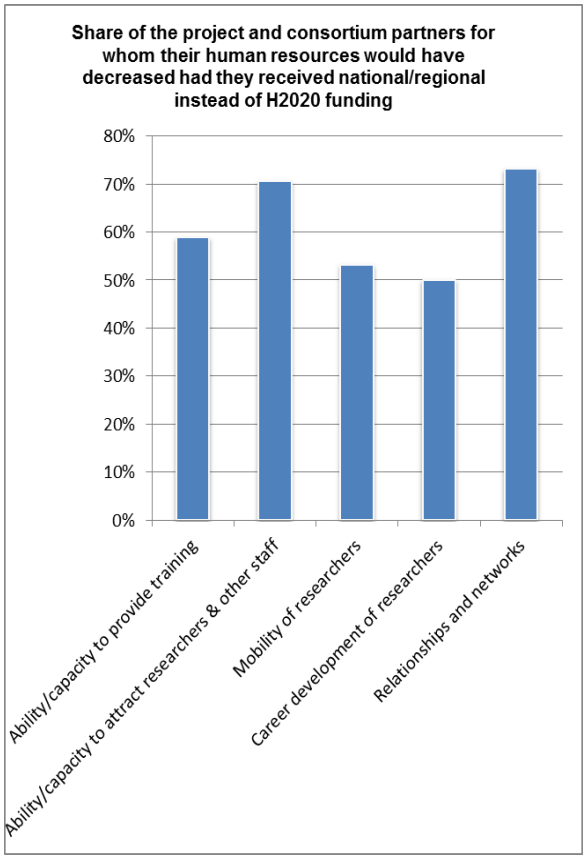
Funding from Smart, green and integrated transport also supports the development and maintenance of R&I capacities, as well as the reduction of gaps in research competences and knowledge, across Europe. Surveyed project coordinators declared that their research capacities[259] and human resources capacities[260] would have decreased with national/regional instead of Horizon 2020 funds, as showed in Table 190 below.

[259] *PPMI survey, question "Compared to your present situation where the project is funded by Horizon 2020, would you say that the following capacities of your project and consortium partners would have increased, decreased or remained similar had your project been funded by national/regional sources?"*

[260] *PPMI survey, question "Compared to your present situation where the project is funded by Horizon 2020, would you say that the following capacities of your project and consortium partners would have increased, decreased or remained similar had your project been funded by national/regional sources?"*

Table 190 - Impact on research capacities and human resources capacities





Source: PPMI survey.

M.7.3. Lessons learnt/Areas for improvement

The most relevant EU value added aspects can be summarised as:

- Without EU funding many projects would not have gone ahead. The benefits of cooperation at EU level are identified as: for many projects, wider scope and scale, making such projects more qualified to tackling the transport sector challenges and create more impact than would have otherwise occurred;
- Increased competitiveness, access to larger markets and new business opportunities;
- Contributions to excellence of science, enhancement of scientific reputation and improving scientific quality.

R&I activities funded under Smart, green and integrated transport, as well as under the rest of Horizon 2020, is seen as being highly instrumental in creating a strong and connected European research community, based on open exchange of knowledge and researchers. This is essential in view of the increasing complexity of the research landscape, new research methods and the requirement to involve interdisciplinary top-researchers to address Europe's societal challenges.

Project participants expect more support from the Commission to help take results to the market and to feed results of (small) projects and demonstrators into other sectors.

M.8. SUCCESS STORIES FROM PREVIOUS FRAMEWORK PROGRAMMES

Among the many success stories from FP7 finished projects, the following three have been selected as having been particularly successful in tackling the objectives of Smart, green and integrated transport, in inducing socio-economic impacts and in providing EU Added Value:

EUNICE[261] (Collaborative Project, 9/2012 – 8/2015, EUR 2.9 Mio EC contribution)

EUNICE (Eco-design and Validation of In-Wheel Concept for Electric Vehicles) demonstrated the viability and cost-effectiveness of a high-power, fully integrated in-wheel motor for electric and hybrid vehicles. The concept concentrates all powertrain components of an electric vehicle except the battery in a package behind the wheel, offering customers and car-makers a number of potential benefits, including more efficient use of an electric vehicle's footprint, better handling, increased passenger safety and simplified construction. At the same time it allows easily converting an existing car design into a hybrid vehicle, without extensive modifications.

The project established the basis for a world-level European industry manufacturing electric motors and components with required performances at competitive costs. The success of the project has attracted interest from both large automotive manufacturers and cutting-edge urban vehicle designers.

AsPeCSS[262] (Collaborative Project, 9/2011 – 7/2014, EUR 2.4 Mio EC contribution)

The main goal of the AsPeCSS project was to develop a series of harmonised test and assessment procedures for safety systems in cars to avoid pedestrian collisions. The AsPeCSS system looks at likely pedestrian injury and calculates how this would be reduced by Autonomous Emergency Braking, or by the design of the front of the car (known as passive safety protection).

The procedures developed by AsPeCSS, that can be used for consumer rating and regulatory purposes, are being adopted by EuroNCAP for its standards on Autonomous Emergency Braking. Both the assessment procedure and the collision avoidance system will have a significant effect on the reduction of pedestrian fatalities on the world's roads.

FLY-BAG2[263] (Collaborative Project, 8/2012 – 9/2015, EUR 4.4 Mio EC contribution)

FLY-BAG2 has developed a technology that enables airplanes to survive a Lockerbie-type explosion scenario. FLY-BAG2 is the first lightweight solution able to contain the devastation caused by bombs hidden in luggage.

The technology developed in the project is ready to be manufactured and installed in the holds and cabins of all passenger aircrafts.

[261] *http://cordis.europa.eu/project/rcn/104622_en.html*
[262] *http://cordis.europa.eu/project/rcn/99619_en.html*
[263] *http://cordis.europa.eu/project/rcn/104541_en.html*

M.9. LESSONS LEARNT/CONCLUSIONS

M.9.1. Relevance

Key findings:

- Transport R&I is highly relevant for EU environmental sustainability, society at large, competitiveness and the European economy.
- Compared to previous Framework Programmes, Smart, green and integrated transport is more focused on innovation, demonstration and new financial instruments.
- International cooperation has a key role to play in shaping global solutions to global challenges such as CO2 and polluting emissions, oil dependency, transport safety and security, and standardisation of many services, products and procedures.

The strengths are:

- Stakeholders largely support the objectives of the European transport and transport R&I policy. Newly emerging issues can be embraced by the existing goals of Smart, green and integrated transport.
- Relevance of the work programmes is assured by a wide stakeholder consultation process and by a sound preparation of the call topics.

The bottlenecks/weaknesses are:

- Bi-annual programming is too rigid to swiftly integrate new and "urgent" topics dictated by disruptive and counter-intuitive technologies and business models which cannot be anticipated over any length of time.

M.9.2. Effectiveness

Key findings:

- The successfulness of Smart, green and integrated transport in achieving its objectives will only become apparent in a longer time horizon.
- Finalised transport projects from previous Framework Programmes, however, provide examples of results in terms of addressing societal needs and generating new knowledge
- Higher expectation are expressed by Horizon 2020 project coordinators compared to their FP7 counterparts regarding the ability of their projects to address long-term goals in transport.

The strengths are:

- Work Programmes so far see a satisfactory coverage of activities, suggesting that the programme is on its way towards delivering on the expected impacts.

The bottlenecks/weaknesses are:

- No specific weaknesses have been identified so far with respect to the Effectiveness criterion.

M.9.3. Efficiency

Key findings:

- Smart, green and integrated transport is successful in attracting proposals from industrial applicants, reflecting the industry-oriented nature of the Programme.
- Participants and stakeholders interviewed stress that the main value of their participation is to be found in the collaborative exchanges, the learning and the opportunity to work on major challenges from a multicultural and multidisciplinary perspective
- There is a high share of newcomers (about one in three) among project beneficiaries
- There appears to be a clear link between funding granted under Smart, green and private investment in Transport Research at country level

The strengths are:

- Several activities and awareness campaigns are organised to reach potential applicants to the Smart, green and integrated transport calls and to disseminate results
- As concerns Time to Grant, so far the Horizon 2020 objective to reduce the period between submission of a proposal and signature of the grant agreement to 8 months was met for a very large majority of proposals.

The bottlenecks/weaknesses are:

- A high oversubscription rate for stage 1 proposals in two-stage topics, resulting in low success rates and impact on administrative costs both on the Commission and on the applicants' side
- The broadness of topics is questioned by some stakeholders
- A low share of participations by beneficiaries in EU-13 Countries

M.9.4. Coherence

Key findings:

- Smart, green and integrated transport utilises a wide variety of actions and instruments to address the full cycle of research, innovation and deployment in an integrated manner, depending on the nature and the needs of the sectors and technologies involved.

- The cross-cutting nature of transport is reflected by the numerous cross-references to transport R&I in other Horizon 2020 intervention areas, as well as in the references of the Transport Work Programmes to other relevant calls for proposals and initiatives.

The strengths are

- Several areas and programmes of Horizon 2020 represent a good opportunity for transport related R&I.
- Several funding instruments can usefully complement possibilities offered in Smart, green and integrated transport (Connecting Europe Facility, European Fund for Strategic Investment, European Structural and Investment Funds, Cohesion Fund, European Regional Development Fund).
- Positive influence of Horizon 2020 Transport in the national research programmes.

The bottlenecks/weaknesses are

- Due to the complexity of the programmes and rules, it is difficult for applicants to find funding opportunities under other Horizon 2020 themes or other EU programmes.

M.9.5. EU Added Value

Key findings:

- The added value of EU-funded transport R&I in terms of knowledge gained from the programmes and projects combined with the coordination and interactions between various players from different Member States working together, is considered extremely important by the stakeholders.
- This value is associated with the R&I that could, or would, not have been funded at national level.

The strengths are

- Transport R&I funding supported impact on competitiveness, European leadership and improving market positions of the beneficiaries.
- Smart, green and integrated transport funding also supports the development and maintain of R&I capacities, as well as the reduction of gaps in research competences and knowledge, across Europe.