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Energy and the MFF

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Energy and the MFF

DIRECTORATE GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT A: ECONOMIC AND SCIENTIFIC POLICY

Energy and the MFF

STUDY

Abstract

This study was prepared at the request of the European Parliament's Committee on Industry, Research and Energy (ITRE). It provides a summary of the EU's energy and climate targets and goals and estimates of additional investments in the energy sector required to achieve these. This is followed by a description of the current levels of energy investments and the contribution that EU programmes and financial instruments make to them. The study concludes with a review of the gaps between current funding and the levels required to meet the targets and goals as well as some recommendations on what the EU could do to maximise the value of its future contributions.

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CONTENTS

LIST OF ABBREVIATIONS

BAU	Business-as-usual
CAP	Common Agricultural Policy
CCS	Carbon Capture and Storage
CEF	Connecting Europe Facility
CF	Cohesion Fund
CHP	Combined Heat and Power
COP 21	Conference of the Parties, (meeting of the signatories to the 1992 UNFCC). The COP in Paris was the 21st such conference.
DG	Distributed Generation
DG	Directorate-General
DKB	Deutsche Kreditbank
DSO	Distribution System Operator
DTR	Dynamic Thermal Rating
EAFRD	European Agricultural Fund for Rural Development
EAGF	European Agricultural Guarantee Fund
EC	European Commission
EDF	European Development Fund
EE	Energy Efficiency
EEA	European Environment Agency
EFSI	European Fund for Strategic Investments
EGF	European Globalisation Adjustment Fund
EIB	European Investment Bank
ELENA	European Local Energy Assistance

EMFF	European Maritime and Fisheries Fund
EP	European Parliament
ERDF	European Regional Development Fund
ESF	European Social Fund
ESIF	European Structural and Investment Funds
EU-ETS	European Union Emissions Trading System
EUCO30	European Commission Policy Scenario 2030
FDP	First-of-a-kind Demonstration Project
FI	Financial Instrument
FP	Framework Programme
GDP	Gross Domestic Product
GE	General Electric
GHG	Greenhouse Gas
GNI	Gross National Income
H2020	Horizon 2020
IRENA	International Renewable Energy Agency
ITER	Fusion experiment
JRC	Joint Research Centre
LCOE	Levelized Cost Of Electricity
LIFE	EUs Environment programme
MFF	Multiannual Financial Framework
NECP	National Energy and Climate Plans
NER300	New Entrants Reserve (a fund associated with the EU-ETS)
OECD	Organisation for Economic Co-operation and Development

OJEU	Official Journal of the European Union
PCI	Project of Common Interest
R&D	Research and Development
REF2016	Reference Policy Scenario 2016
RES	Renewable Energy Sector
TOSSD	Total Official Support for Sustainable Development
TSO	Transmission System Operator
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
VCBCC	Virtual Cross-Border Control Centre

LIST OF BOXES

LIST OF FIGURES

LIST OF MAPS

LIST OF TABLES

EXECUTIVE SUMMARY

This analytical study on “Energy and MFF" has the following three main objectives:

- To provide an overview over the EU’s energy and climate targets & goals and the corresponding investment needs scenarios.
- To summarise the current energy-related expenditure and the EU’s contribution to this under the current Multiannual Financial Framework (MFF).
- To discuss how the EU could maximise its contribution to achieving future energy and climate goals.

Energy and Climate Targets and Investment Needs:

The table below provides an overview of the EU’s key short-, medium-, and long-term climate and energy targets and goals.

Table 1-1 Summary of key short, medium and long-term EU climate and energy targets (2020 / 2030) and goals (2050)

EU Level Target / Goal	2020	2030	2050	Explanation
Greenhouse gas emissions	20 %	At least 40 %	80-95 % (Indicative)	Reduction compared to 1990 levels
Renewable Energy	20 %	At least 27 % (binding on EU level; no national targets)	At least 55 % (Indicative)	% of gross final energy consumption
Energy Efficiency	20 % (Not binding)	At least 27 % (Not binding)	41 % (Indicative)	Reduction compared with BAU scenario
Electricity interconnection	At least 10 %	At least 15 % (Proposed)	No target	% of installed electricity production capacity
Smart Metering deployment	80 %	No target	No target	% of households by 2020.
Temperature rise			1.5 to 2ºC	Paris Agreement

Sources: 2020 Climate & Energy Package, Climate and Energy Framework, 2050 Low-Carbon Economy, Renewable Energy Directive, Energy Efficiency Directive, 2050 Roadmap for Energy, Third Energy Package

The following table provides the quantitative investment needs estimates corresponding to the EU’s 2030 climate and energy policy targets according to the ‘Clean Energy for all Europeans’ scenarios (REF2016 and EUCO30): between 2021 and 2030 the finance required to meet these targets is estimated to be EUR 379bn (’13 EUR) annually (excl. transport).

Table 1-2: Estimated sectoral investment needs for the EU in billion EUR (2013[1])

		Investment needs (replacement of ageing infrastructure, etc.) **under BAU conditions continued until 2030**	**Total investment needs for achieving the EU's 2030 climate and energy targets**
	Associated scenario / *Energy transition area*	**EU Reference Scenario 2016 (REF2016[2])**	**EUCO30**
Cumulative investment need, 2021-2030 (Excl. Transport)		2 330	**3 790**
(Average) annual investment needs (Excluding Transport)		230	**379**
Sectoral decomposition of (average) annual investment needs *(incl. their % share of total investment needs required to achieve the 2030 targets*)*			
Supply side	*Grid*	34	**36** *(9.5%)*
	Power generation (total)	31	**42** *(11%)*
	- RES	*25*	*34 (9%)*
	- Conventional	*6*	*8 (2%)*
	(of which CCS)	*(0.11)*	*(0.17)*
Demand side[3]	*Industry*	15	**19** *(5%)*
	Buildings - households	127	**214** *(56.5%)*
	Buildings – tertiary sector	23	**68** *(18%)*

*Source: Investment needs estimations from SWD (2016) 405, Impact Assessment on Energy Efficiency accompanying the EC Communication 'Clean Energy for All Europeans', Table 22 (p. 66), except for those indicated with *] See main report for more detail and notes.*

The largest additional investment needs compared to the REF2016 scenario are expected in the buildings sector.

[1] Estimates are quoted at EUR 2013 prices according to how they appeared in SWD (2016) 405. Later in this study, these estimates are converted into 2015 prices to allow a more contemporaneous analysis.
[2] Whereas the EUCO scenario by definition achieves the 2030 targets for RES (≥27 %), GHG (≥ 40 %) and energy efficiency ((≥30 %), the REF2016 does not.
[3] Investments on the demand side include energy equipment (covering appliances in households and tertiary sector, vehicles, industrial equipment etc.) and direct energy efficiency investments (covering renovation of buildings improving their thermal integrity).

Current Energy Expenditure

The table shows the best available data on the current level of expenditure in the energy sector, split by energy supply and demand.

Table 1-3: Energy expenditure in Europe - average annual trends and total cumulative spending (2006-2015)

		Avg. annual spending (2006-2010)	*Avg. annual spending (2011-2015)*	*Total cumulative spending (2006-2015)*
		Billion Euro (2015)		
TOTAL	**Mitigation**	**161**	**193**	**1 770**
Total	**Supply side**	**70**	**87**	**785**
Supply side	Grid	25	26	255
	Power generation - RES	34	46	400
	Power generation - Conventional	11	15	130
Total	**Demand side (excl. transport)**	**91**	**106**	**985**
Demand side	Industry	7	7	70
	Buildings – households	74	88	810
	Buildings – tertiary	10	11	105

Source: underlying data for Figure 8 in EP (2017). European Energy Industry Investments.

Of the EUR 193bn ('15 EUR) spent on mitigation between 2011-2015, roughly 65% was provided by the private sector and 35% by the public sector. Private sector investments were led by corporations, followed by private households. Public sector investments are made up of Member State contributions, stand-alone programmes (e.g. NER300 with EUR 2.1bn[4]), and the EU budget. This split should be regarded as an approximate indication.

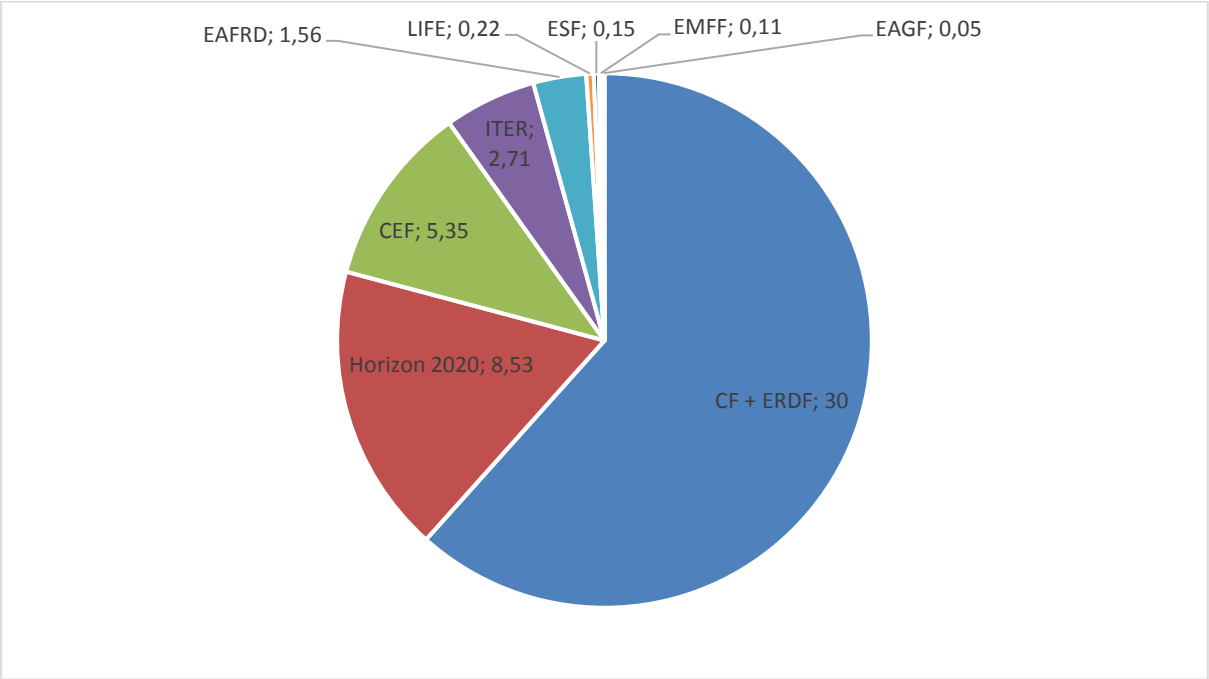
EU Expenditure on Energy

Estimating how much of each programme under MFF contribute to energy relevant projects is not straightforward, due to a lack of data and a lack of agreed definitions. Our best estimate of the total energy-relevant expenditure over the 2014-2020 period of the current MFF is estimated to be EUR 48.68bn (EUR 48.91bn in EUR '15). Compared to total EU-wide annual (public and private) mitigation spending (EUR 193bn in EP (2017)), the role of the MFF in financing the energy transition is rather small (roughly EUR 6.95bn per year/EUR 6.99bn per year in EUR '15).

The EU programmes which contribute the most are the European Structural and Investment Funds (ESIF) (particularly the European Regional Development Fund (ERDF) and the Cohesion Fund (CF), Horizon 2020, and the Connecting Europe Facility (CEF). There are also smaller contributions from ITER (Nuclear Fusion programme), the European Agricultural Fund for Rural Development (EAFRD), LIFE (Environment programme), European Social Fund (ESF), European Maritime and Fisheries Fund (EMFF) and European Agricultural Guarantee Fund (EAGF).

[4] Trinomics (2017) based on SWD (2015).

Figure 1-1: Energy-relevant spending under the 2014-2020 MFF (in 2013 EUR bn)



Source: See main report

The EU also contributes to a number of Financial Instruments (FIs) that invest in energy relevant projects. These FIs typically loan money, with some coming from the EU and some leveraged from other sources. Some of the FIs are part of the EU programmes described above, e.g. the ERDF, CEF and H2020 include FIs. Some of the energy relevant FIs (most notably the European Fund for Strategic Investments (EFSI)) are technically not part of the MFF budget, despite coming from European Funds. As with the EU programmes it is difficult to precisely measure how much each of these FIs contribute towards energy projects. The following table gives an order of magnitude figure for the EU FI contribution to the energy transition over the 2014 – 2020 period for the two main groups of EU FIs and the EFSI.

Table 1-4: Order of magnitude estimate of EU FI contribution to the energy transition

	(€bn) (2014-2020)	
	EU contribution	Total (with leverage from other sources of capital)
FIs (140.8 report)	1.26	20.64
ESIF FIs	3.22	52.8
EFSI	3.15	52.5
Total (Indicative)	7.63	125.9

Source: Own estimates (see report for more details)

The annual total from the main EU FIs that should go towards energy relevant projects over the 2014 – 2020 period (with leverage and assuming the funds are fully utilised) is in the region of EUR 18bn, based on an EU contribution of EUR 1.1bn. It is important to note that the EU contributions to the ESIF FIs and most of the 140.8 FIs are already included in the energy relevant spending under the MFF.

Combining the analysis and data leads to the following conclusions and recommendations:

There is a need to mobilise a large amount of additional investment if the EUs energy and climate targets are going to be met.

The total annual (2021-2030) mitigation financing gap is estimated to be around EUR 150bn ('15 EUR). The vast majority of this total is EUR 137bn of additional energy efficiency investment needs in buildings and industry, with a comparatively small additional finance requirement for grid infrastructure (EUR 2bn) and power generation (EUR 11bn). This figure represents roughly 1% of European Union GDP. Most of this additional financial burden will need to be met by the private sector (i.e. households and business). This is partially due to the fact that the largest finance gap exists in private household energy efficiency.

The vast majority of current energy expenditure comes from sources other than the EU and this unlikely to change into the future.

Current EU-wide annual spending on energy investments is in the order of EUR 193bn, with about 65% of this coming from the private sector. This compares to an annual EU contribution of approximately EUR 7.44bn (though it is involved in investments of up to EUR 30bn, via matching with other public and private funds). Given the pressure on EU finances and the need to increase the annual energy spend to some EUR 381bn ('15 EUR) per year in order to meet the climate and energy targets, the share of EU contribution seems unlikely to increase.

The EU's programmes and FIs are designed to intervene (directly) where the market is failing, so its contribution (in terms of direct funding) is arguably appropriate.

The EU is intervening directly in areas that are important to the transition to a low carbon economy (and meeting the energy and climate targets). Focusing on areas of market failure, such as spending on R&D, as well as deploying targeted financial instruments to lower the risk of private investments in untested but promising clean energy technologies or business models is an appropriate way to prioritise EU funding.

Beyond its direct funding, the EU's important policy influence on incentives and market design is crucial in setting the appropriate enabling framework for achieving the energy and climate targets and goals.

The EU can create an environment facilitating enhanced private investment flows through targeted signals, policies, standards and regulations. For example, the EU has a major influence on energy markets and regulations, especially EU-ETS and Renewables obligations. It also is involved in smart grid targets, energy market reforms and product and building standards. All of which are key to achieving the energy and climate targets and goals.

The design and implementation (including the monitoring and targeting of energy and climate relevant spending) of EU programmes and FIs could be improved but this should not overly interfere with the prime rationale for the programmes in question.

1. INTRODUCTION

This study on "**Energy and MFF**" was requested by The Committee on Industry, Research and Energy (ITRE).

1.1. Study Objectives

1.1.1. Main Objectives of the Study

The key questions this study seeks to address can be summarised as follows:

- What are the energy targets and goals of the European Union and what cost estimates for achieving these have been estimated?
- Have energy transition objectives been translated into EU budget estimates?
- How much of EU spending currently goes towards energy and how significant a contribution is this to overall energy funding?
- How can the EU best help to achieve its energy targets and goals?
- What recommendations could be made for improving the current and future investment framework as a major building block for effective climate mitigation?

In order to answer these questions, we have grouped the study into three stages / tasks:

- Provide an overview over the EU's energy and climate targets & goals and the corresponding investment needs scenarios (Section 2).
- Summarise the current energy-related expenditure and the EU's Contribution to this under the current MFF (Section 3).
- Discussion of how the EU can maximise its contribution to Achieving Future Energy and Climate Goals (Section 4).

1.1.2. Scope of this Study

This study addresses EU spending in the energy sector. In order to focus on the areas of key interest to the client the following decisions on scope were taken:

Transport is a major energy user and the majority of this energy use is currently fossil fuel. The total energy use in transport and the share of fossil fuels in this energy use both need to reduce in order for the transport sector to make its contribution to energy and climate targets. The scale of the transport issue is mentioned at appropriate points in this study, but it has not been covered in the same depth as the electricity and natural gas sector.

Energy vs. mitigation vs. transition spending – It is important to be clear about the differences and similarities between these terms. This varies depending on the exact context. The basic definition adopted for the purposes of this study is:

- **Total energy spending** could include fossil fuels;
- **Mitigation spending** is mainly targeted on energy efficiency and renewable energy sources, but could include fuel switching to reduce GHG emissions (e.g. from coal to gas);
- **Transition energy spending** is very similar to mitigation but refers to the transition away from a fossil fuel (and high GHG emission) energy system.

1.2. Methods

1.2.1. Summary of our Approach

Task 1: The EU's energy and climate goals and corresponding investment needs scenarios (Section 2)

This first task focuses on gathering and analysing the information and data available regarding specific energy/climate goals and corresponding investment needs scenarios, i.e. how much investment is projected to be needed in order to achieve the targets.

Task 2: Current energy related expenditure and the EU's contribution (Section 3)

This second task focuses on gathering the evidence available regarding overall investment volumes already flowing towards energy transition relevant projects, as well as the EU's contribution towards this under the current MFF. This task also provides an analysis of how efficiently the energy related EU Budget is being used towards achieving the targets.

Task 3: How can the EU maximise its contribution to achieving future energy and climate targets and goals? (Section 4)

Having carried out the review and analytical tasks 1 and 2 to gather the available knowledge on the relevant topics, this task then focuses on looking forward and developing policy options. This seeks to consider the upcoming revision of the MFF as an opportunity to respond to the budgetary difficulties currently jeopardising the credibility of the European Union with regard to its climate and energy goals and its commitments under the Paris Agreement.

1.2.2. Methods – Literature Review, Data Collection and Analysis

The majority of the study builds upon existing literature and documentation. As requested we have also developed a set of short case studies to illustrate the variety of finance methods (including those with EC involvement) used in projects relevant for the EU's energy transition (see Annex 1 and text boxes throughout the report). The main strength of the method is that it allows a wide variety of issues to be covered in reasonable depth. The main drawback of the method is the reliance on publicly available literature naturally excludes unpublished views and there is limited opportunity to test contradicting opinions against each other.

1.3. Reading Guide

Box 1-1: Reading guide

- The EU energy and climate goals and corresponding investment needs
  - An overview of the EU energy and climate targets & goals
  - An overview of corresponding investment needs scenarios
- Current energy related expenditure and the EU's contribution
  - Overview of available information on actual investment volumes in the European energy transition
  - Overview of the current EU MFF – allocation of funds dedicated to energy
  - Defining remaining gaps in finance, leverage and knowledge
- Maximising the EU's contribution to achieving future energy and climate goals – Policy recommendations
  - Policy options on how to improve the current and future investment framework in the short, medium and long-term
- Annexes:
  - Case studies
  - List of energy relevant financial instruments

2. THE EU ENERGY AND CLIMATE GOALS AND CORRESPONDING INVESTMENT NEEDS

This chapter presents the EU's energy and climate related policy targets and goals and the estimates of the investment levels needed to achieve them.

2.1. An Overview of the EU Energy and Climate Targets and Goals

In order to put the EU on the path towards a sustainable future, the European Commission (EC) has set energy and climate targets and goals in recent policies. The most relevant documents and their respective targets are briefly discussed in this section.

As a first cornerstone, the European Commission (EC) adopted the **2020 Climate and Energy Package**[5] in 2008. It sets out fundamental targets on EU-wide GHG emissions reductions, the share of renewables in the energy mix, and energy efficiency to be achieved by 2020. The objectives were later complemented with the **2050 energy roadmap** and the **2030 Climate and Energy Framework** released in 2011[6] and 2014[7] respectively. The Energy Union Governance process will streamline these targets and associated reporting requirements with regards to measuring and reporting progress towards 2030 targets across all areas under the umbrella of the so-called National Energy & Climate Plans (NECPs). Draft NECPs are due in 2018 and final plans in 2019, with subsequent progress reporting. Table 2-1 provides an overview of the EU's key short-, medium-, and long-term climate and energy targets and goals, as set out in these policies.

In November 2017, the EC updated the modelling for the 2030 targets, based (in part) on recent falls in large scale renewable energy costs that imply a 30% target for renewables may be feasible[8]. This led to a vote in January 2017 in which the MEPs agreed that they are ready to negotiate binding targets with EU ministers to boost energy efficiency by 35% and the share of renewables in the total energy mix by 35%, by 2030[9].

Table 2-1: Summary of key short, medium and long-term EU climate and energy targets (2020 / 2030) and goals (2050)

EU Level Target / Goal	2020	2030	2050	Explanation
Greenhouse gas emissions[10]	20 %	At least 40 %	80-95 % (Indicative)	Reduction compared to 1990 levels

[5] COM (2008) 30 final. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: 20 20 by 2020 - Europe's climate change opportunity. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0030:FIN:en:PDF

[6] COM (2011) 885 final. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions 'Energy Roadmap 2050'. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0885&from=EN

[7] COM (2014) 15. Communication: A policy framework for climate and energy in the period from 2020 to 2030. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0015&from=EN

[8] EURACTIV (2017). Sefcovic says 30% renewables target 'affordable' for 2030. http://www.euractiv.com/section/energy/news/eu-commission-to-push-for-30-renewables-in-updated-2030-plan/

[9] MEPs set ambitious targets for cleaner, more efficient energy use Press Releases PLENARY SESSION 17-01-2018 http://www.europarl.europa.eu/news/en/press-room/20180112IPR91629/meps-set-ambitious-targets-for-cleaner-more-efficient-energy-use

[10] The greenhouse gas emission reduction targets are based on the actual emission levels from 1990. They are split into targets for the sectors covered by the EU ETS and the non-ETS sectors (building, agriculture, waste and transport excluding aviation) for 2020 and 2030. For the non-ETS sectors, binding national targets have been set for each Member State for 2020. These national targets differ according to national wealth, which means that they range from a 20 % cut (Denmark, Ireland, Luxembourg) to a maximum 20 % increase (Bulgaria), for the different Member States.

EU Level Target / Goal	2020	2030	2050	Explanation
Renewable Energy[11]	20 %	At least 27 % (only binding on EU level; no national targets) Under negotiation to increase to 35%[9]	At least 55 % (Indicative)	% of gross final energy consumption
Energy Efficiency	20 % (Not binding)	At least 27 % (Not binding) Under negotiation to increase to 35%[9]	41 % (Indicative)	Reduction compared with BAU scenario
Electricity interconnection[12]	At least 10 %	At least 15 % (Proposed)	No target	% of installed electricity production capacity
Smart Metering deployment[13]	80 %	No target	No target	If national Cost Benefit Analysis leads to a positive result, roll-out of smart meters is mandatory for at least 80 % of households by 2020.

Sources: 2020 Climate & Energy Package[14], Climate and Energy Framework[15], 2050 Low-Carbon Economy[16], Renewable Energy Directive[17], Energy Efficiency Directive[18], 2050 Roadmap for Energy[19], Third Energy Package[20]

The political momentum to deliver climate action has continued since the adoption of these targets and goals. A key parallel development occurred in 2015, with the global **Paris Agreement** being adopted under the UNFCCC at COP 21, which sets the target to keep global average temperature increases to well below 2°C above pre-industrial levels and to pursue

[11] National targets on Member States' level for 2020 also vary, in order to reflect countries' different starting points for renewables production and their ability to further increase it. This 2020 target also includes a 10 % share of renewables in the transport sector, which can be among other things, achieved with an increase in electrical vehicles' penetration. For 2030, no fixed targets have been set for individual Member States, rather individual contributions by Member States will need to be sufficient to add up to the overall EU target.
[12] The European Council of October 2014 called for all MSs to achieve an **interconnection level** of at least 10% of their installed electricity production capacity by 2020. Each Member State should have electricity transmission capacity that allows for at least 10 % of the electricity produced to be transported to neighbouring countries.
[13] This implementation may be subject to a long-term cost-benefit analysis (CBA). In cases where the CBA is positive, there is a roll-out target of 80 % market penetration for electricity by 2020.
[14] COM (2008) 30 final. 20 20 by 2020 Europe's climate change opportunity. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52008DC0030&from=EN
[15] COM (2014) 15 final. A policy framework for climate and energy in the period from 2020 to 2030. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0015&from=EN
[16] COM (2011) 0112 final. A Roadmap for moving to a competitive low carbon economy in 2050. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0112:FIN:en:PDF
[17] Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0028&from=DE
[18] Directive 2009/125/EC establishing a framework for the setting of ecodesign requirements for energy-related products (recast). http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0125&from=EN
[19] COM (2011) 0112 final. A Roadmap for moving to a competitive low carbon economy in 2050. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0112:FIN:en:PDF
[20] EC (2009). Third Energy Package. https://ec.europa.eu/energy/en/topics/markets-and-consumers/market-legislation

efforts to limit the temperature rise even further to 1.5ºC. This target is to be achieved on the basis of nationally determined mitigation contributions by the Parties to the Agreement. The European Commission's communication 'The Road from Paris'[21] assesses the main implications of the COP 21 Agreement for the EU and sets out how the EU will implement the Paris Agreement. Key to this is the implementation of the Energy Union transition goals, scaling up private investments, catalysing multi-stakeholder action by civil society, and boosting climate-related innovation and competitiveness.

In parallel with the Paris negotiations, the European Commission worked on a package of measures to keep the European Union competitive throughout the energy transition. This package is called '**Clean Energy for All Europeans**'[22].It is designed to demonstrate that the energy transition is a key investment and growth sector of the future. The 'Clean Energy for All Europeans' legislative proposals cover energy efficiency[23], renewable energy, design of the electricity market, security of electricity supply and governance rules for the Energy Union. In addition, the Commission proposed complementary actions including:

- a new way forward for ecodesign;
- a strategy for connected and automated mobility;
- actions to accelerate clean energy innovation;
- actions to renovate Europe's buildings; as well as
- measures to encourage public and private investment, promote EU industrial competitiveness and mitigate the societal impact of the clean energy transition.

These measures update, enhance or support previously set energy and climate related policy targets and goals for 2030 and beyond.

[21] COM (2016) 110 final. 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. https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/1-2016-110-EN-F1-1.PDF
[22] COM(2016) 860 final. Clean Energy For All Europeans. http://eur-lex.europa.eu/resource.html?uri=cellar:fa6ea15b-b7b0-11e6-9e3c-01aa75ed71a1.0001.02/DOC_1&format=PDF
[23] In particular the introduction of a binding target of 30 % energy efficiency by 2030.

2.2. An Overview of Corresponding Investment Needs Scenarios

Meeting the climate and energy targets set out in the previous section will require public sector investments as well as the mobilisation of significant private sector investments. This section provides a synthesis of relevant studies on the necessary investment needs (see Box 2-1 for an overview of the key investment needs reports).

Box 2-1: Overview of key studies estimating investment needs for Europe

- **SWD (2016) 405. Impact Assessment accompanying the 'Clean Energy for All Europeans' policy package;**
- EIB (2016). Restoring EU competitiveness;
- OECD/IEA (2014). World Energy Investment Outlook;
- SWD (2014) 16. Impact Assessment of the 2030 climate and energy framework;
- EC (2011). Energy Roadmap 2050;
- OECD/IEA and IRENA (2017). Perspectives for the energy transition – investment needs for a low-carbon energy system[24];
- OECD/IEA (2016). World Energy Outlook 2016[25];
- OECD/IEA (2016). World Energy Investment Outlook[26];
- CE Delft (2016). Investment challenges of a transition to a low-carbon economy in Europe[27];
- OECD/IEA (2015). WEO Special Report Energy and Climate Change[28];
- Barclays (2011). Financing the low carbon economy[29]; and
- Ecofys et al (2010). Financing Renewable energy in the European Energy market[30].

Sources: Own development.

It is important to understand that the estimates below are based on different underlying datasets and modelling approaches. Some of these also have a focus on specific sectors. This means that it is not feasible to directly compare the different sources of information on future investment needs. This section therefore provides the best possible presentation of investment needs for the purpose of this study.

We first present the multi-sector investment needs assessment that best matches the EU level climate and energy targets: the **SWD (2016) 405, Impact Assessment accompanying the 'Clean Energy for All Europeans' policy package**.
The investment needs estimates presented in this document are directly linked to

a) a projection of the current business-as-usual (no policy change) scenario, the so-called EU Reference Scenario 2016 (REF2016) as an investment baseline; and
b) a projection of what is needed in order to implement the EU 2030 climate and energy targets, the so-called EUCO30 scenario.

The Impact Assessment presents additional scenarios but the two listed above are most relevant for this report. Focussing on these also maximises consistency and allows for maximum comparability of investment needs.

[24] Does not disaggregate the worldwide investment figures to regional sub-divisions.
[25] Does not include figures on investment needs for a low-carbon economy (the 450 scenario); only includes figures on the EU level for the new policies scenario, which is a reference scenario.
[26] Only includes figures on the EU level of current (2015) investments.
[27] Analysis of the SWD (2014) impact assessment, no additional estimation of investment needs.
[28] Includes only an INDC and a Bridge scenario on the EU level. The most relevant scenario to reach a low-carbon economy is (the 450 scenario) is more thoroughly discussed in OECD/IEA 2014.
[29] Only includes power supply figures between 2011-2020.
[30] Only includes renewable energy between 2011-2020.

The remainder of section 2.2 presents total investment needs figures, first as an overview, and then discusses each sub-topic (electricity generation and transmission; energy efficiency in industry and buildings sectors) in more detail.

2.2.1. Multi-sector Investment Needs Overview

The following table provides the quantitative investment needs estimates corresponding to the EU's 2030 climate and energy policy targets according to the 'Clean Energy for all Europeans' scenarios (REF2016 and EUCO30): between 2021 and 2030 the finance required to meet these targets is estimated to be 379 billion Euro (2013) annually (excl. transport).

Table 2-2: Estimated sectoral investment needs[31] for the EU in billion EUR (2013[32])

		Investment needs (replacement of ageing infrastructure, etc.) **under BAU conditions continued until 2030**	**Total investment needs for achieving the EU's 2030 climate and energy targets**
	Associated scenario / *Energy transition area*	**EU Reference Scenario 2016 (REF2016[33])**	**EUCO30**
Cumulative investment need, 2021-2030. (Excluding Transport)		2 330	**3 790**
(Average) annual investment needs (Excluding Transport)		230	**379**
***Sectoral decomposition of (average) annual investment needs** (incl. their % share of total investment needs required to achieve the 2030 targets*)*			
Supply side	*Grid*	34	**36** *(9.5%)*
	*Power generation (total)***	31	**42** *(11%)*
	- RES	*25*	*34 (9%)*
	- Conventional	*6*	*8 (2%)*
	*(of which CCS)****	*(0.11)*	*(0.17)*
Demand side[34]	*Industry*	15	**19** *(5%)*
	Buildings - households	127	**214** *(56.5%)*
	Buildings – tertiary sector	23	**68** *(18%)*

[**Source:** Investment needs estimations from SWD (2016) 405, Impact Assessment on Energy Efficiency accompanying the EC Communication 'Clean Energy for All Europeans', Table 22 (p. 66), except for those indicated with *]

[31] Estimated sectoral investment needs include investment in infrastructure, energy generation, energy efficiency measures, other GHG reduction measures, as well as R&D.
[32] Estimates are quoted at EUR 2013 prices according to how they appeared in SWD (2016) 405. Later in this study, these estimates are converted into 2015 prices to allow a more contemporaneous analysis.
[33] Whereas the EUCO scenario by definition achieves the 2030 targets for RES (≥27 %), GHG (≥ 40 %) and energy efficiency ((≥30 %), the REF2016 does not.
[34] Investments on the demand side include energy equipment (covering appliances in households and tertiary sector, vehicles, industrial equipment etc.) and direct energy efficiency investments (covering renovation of buildings improving their thermal integrity).

[**Notes:** * Percentage share of total investment needs required to achieve the 2030 targets based on EUCO30 figures, but excluding other transport investments (only the EUR31Bn additional investment in energy efficiency of the transport sector have been included, i.e. a total annual investment needs figure of EUR 410bn).
** The power generation percentage split between renewable and conventional sources was calculated based on the IEA World Energy Outlook 2014: 75% renewable sources in their reference scenario (called NPS); 80% renewable sources in their decarbonisation scenario (called 450 scenario). Similar shares have also been reported in EC (2014) Impact Assessment scenarios.
*** CCS investment needs estimations are based on own estimations, see Box 2-2 below.]

The largest additional investment needs compared to the REF2016 scenario are expected in the buildings sector, followed by the transport sector. The remainder of this section explores the different energy transition sub-sector estimates in more detail.

2.2.2. Grid and Transmission Investment Needs

Annual grid investment needs increase from EUR 34bn to EUR 36bn (see Table 2-2 above), an additional financing need of EUR 2bn if the EU's 2030 climate and energy targets are to be achieved. Grid and transmission investment needs under the EUCO30 scenario represent about 9.5% of the total annual energy transition-relevant investment needs.

The investment needs for distribution are generally much higher than for transmission.[35] The largest share of the costs is related to the upgrade and extension of the distribution networks and the development of smart grids. Investment needs in interconnectors are expected to rise steeply given the high renewables share under the EUCO30 scenario.

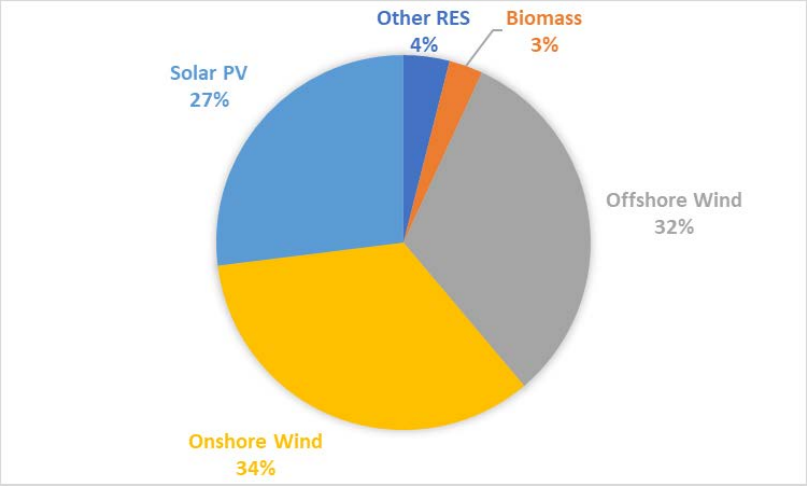
2.2.3. Renewables Investment Needs

Renewables investment needs increase from EUR 25bn to EUR34bn annually (see Table 2-2 above), an additional financing need of EUR 9bn every year, if the EU's 2030 climate and energy targets are to be met. In total, renewables investment needs under the EUCO30 scenario represent just 9% of the total annual energy transition-relevant investment needs. Despite this relatively small share they are probably the best covered sub-sector in terms of information availability regarding investment needs (as well as current expenditure levels – see Chapter 3).

Estimated investment needs vary across the renewable technologies: wind onshore (34%) (wind offshore (32%) exhibit the highest projected investments followed by solar PV (27%), biomass-waste (3%) and other renewables (incl. tidal, wave, etc.) (4%) (see Figure 2-3).[36]

[35] EP (2017). European Energy Industry Investments. Pages 31ff.
http://www.europarl.europa.eu/RegData/etudes/STUD/2017/595356/IPOL_STU(2017)595356_EN.pdf.
[36] SWD 418 (2016). Pages 275ff.
https://ec.europa.eu/energy/sites/ener/files/documents/1_en_impact_assessment_part3_v4_418.pdf

Figure 2-1: Share of required annual investments across different RES sectors, 2020-2030



[Source: Own development with data from SWD 418 (2016)]

2.2.4. (Conventional) Electricity Generation Investment Needs

Conventional electricity generation investment needs increase from EUR 5.64bn to EUR 7.46bn annually (see Table 2-2 above), an additional financing need of just under EUR 2bn every year, if the EU's 2030 climate and energy targets are to be met. The additional investment need is mainly related to an increase in energy efficiency requirements of conventional electricity generation plants. In total, conventional electricity generation investments needs under the EUCO30 scenario represent just under 2% of the total annual energy transition-relevant investment needs.

CCS Investment Needs

CCS appears in the energy mix of the EUCO30 scenario, with the inclusion of the installation of 1500MW of CCS capacity in Europe between 2020-2030. In order to arrive at the annual investment needs estimate for these plans as indicated in Table 2-2 above, a simple calculation exercise was conducted (see Box 2-2).[37] As a point of reference, investment needs calculations according to the global 2ºC Scenario are also provided for Europe. The significant difference in investment needs is based on the different relative importance of CCS in the scenarios. As will be evident from the calculations, the EUCO30 scenario sees CCS as a much less crucial instrument to fight climate change than the 2ºC Scenario.

[37] It must be noted here, however, that estimating the general cost of CCS in Europe faces many uncertainties. For one, a drop in the carbon price can jeopardise investments at any point. Second, heterogeneous geographical circumstances across potential projects imply an uneven distribution of costs in CCS. In addition, different applications of CCS in different target industries (i.e. power generation and heavy industry) have exhibited varying costs in non-EU projects.

Box 2-2: Calculation of EUCO30 investment needs for CCS

EUCO30 Scenario: The EUCO30 scenario includes 1500MW of CCS capacity by 2030[38] located in Europe. Using the global CCS cost indication from the Global CCS Institute (2017 update)[39] we calculate the annual cost for CCS in Europe to be approximately **EUR 0.17bn** (in 2013 EUR)[40] between 2020 and 2030. The calculation approach is as follows: *Average levelised cost (LCOE) of CCS plants for different power generation techniques were taken from two European countries (Germany and Poland) and set to USD 160 per MW/h (2017 prices).*

This was then converted to its EUR value at the current USD/EUR conversion rate (0.833)[41] = EUR 133 per MW/h.

The EU-wide cumulative inflation rate between 2013 and 2017 (2.7%) was applied to convert the number to 2013 values = EUR 128.2 per MW/h.

As a simplification it was assumed that all power plants run year-round (8760h). This was multiplied with the foreseen capacity of CCS in Europe under EUCO30 between 2021-2030 (1500MW) to provide an indication of MW/h = 13.14M MW/h

This was then multiplied with the cost per MW/h in Europe at 2013 prices = ***EUR 1.69bn****.*

The same is done for REF2016, which foresees 1000MW of CCS capacity by 2030 = ***EUR 1.12bn.***

Annual investment needs under EUCO30: ***EUR 0.17bn***

Annual investment needs under REF2016: ***EUR 0.11bn***

This calculation has a few inaccuracies, as costs might differ greatly between countries due to differing economic and geographic circumstances. However, the amount provides an indication of CCS investment needs under EUCO30 and is therefore used in Table 2-2.

2°C Scenario: One source of CCS investment needs on a global scale is the IEA roadmap[42]. The time horizon of the study is 2050, but indications for the 2030 landmark are made. Since the scenario employed is the globally-scaled 2°C scenario, it is hard to relate these estimates to the EU-specific targets. In order to fulfil the 2°C goals through to 2030, **EUR 3.2bn** (in 2013 EUR) will need to be invested into CCS capacities in Europe annually[43].

Calculation: 120GtCO2 of CCS capacity by 2050 costing EUR 3.2 trillion. Europe 'needs' to provide 1.8 GtCO2 by 2030. This means EUR 48bn by 2030 or EUR 3.2bn per year between 2015 and 2030.

[38] E3MELab & IIASA (2016). Technical report on Member State results of the EUCO policy scenarios. https://ec.europa.eu/energy/sites/ener/files/documents/20170125_-_technical_report_on_euco_scenarios_primes_corrected.pdf

[39] Global CCS Institute (2017). Global costs of carbon capture and storage. http://hub.globalccsinstitute.com/sites/default/files/publications/201688/global-ccs-cost-updatev4.pdf

[40] Own calculation based on data provided by the Global CCS Institute and EUCO30 scenario.

[41] Available at: http://xe.com/currencyconverter/convert/?Amount=1&From=USD&To=EUR, Accessed on 7 January, 2018.

[42] IEA (2013). Technology Roadmap Carbon Capture and Storage. http://www.iea.org/publications/freepublications/publication/TechnologyRoadmapCarbonCaptureandStorage.pdf

[43] Own calculation based on data provided in the 2013 IEA Roadmap on CCS.

2.2.5. Energy Efficiency Investment Needs

Energy efficiency investment needs largely relate to the industry, buildings and transport sectors: the vast majority of non-electricity mitigation efforts in these sectors are related to energy efficiency improvement measures.

Total energy transition investment needs in the **industrial sector** are projected to increase from EUR 15bn annually under a business-as-usual investment pathway to EUR 19bn annually (see Table 2-2 above), thus an additional financing need of EUR 4bn every year, if the EU's 2030 climate and energy targets are to be achieved. These investment needs are just under 5% of the total annual energy transition-relevant investment needs.

Annual energy transition investment needs in the **buildings sector** (both housing and tertiary sector) are projected to increase from EUR 150bn under a business-as-usual investment pathway to EUR 282bn (see Table 2-2 above), an additional financing need of EUR 132bn every year, if the EU's 2030 climate and energy targets are to be achieved. Taken together these investment requirements represent just under 75% of the total annual energy transition-relevant investment needs. When splitting these investment needs into sub-sectors, just over 56% needs to be channelled toward private housing and the remaining 18% toward energy efficiency improvements in tertiary sector buildings.

Another sector that is of interest when looking at energy efficiency improvement ambitions and corresponding investment needs is the transport sector (see Box 2-3) although this is outside the scope of this study.

Box 2-3: Investment Needs in the Transport Sector

Energy transition-related investment needs in the **transport sector** amount to EUR 31bn[44] every year, i.e. the additional efforts as compared to the business-as-usual pathway. The Impact Assessment exploring the EUCO30 scenarios highlights that the EUR 31bn is primarily related to energy efficiency type improvements in the transport sector. Whereas the very large figures in the total investment need is due to the fact that it includes investment in transport equipment for mobility purposes (e.g. rolling stock but not infrastructure) and energy efficiency. In total, the energy-transition related investment needs of the transport sector (i.e. the EUR 31bn) represent just over 7% of the total annual energy transition-relevant investment needs. It should be noted here that there are no separately specified investment needs for R&D in the transport sector.

2.2.6. Conclusions on EU Climate and Energy Targets and Corresponding Investment Needs

This chapter presented the key climate and energy relevant EU policy targets and goals and their corresponding investment needs. It demonstrated that the climate and energy targets set for 2030 and beyond require significant financing volumes in order to be achieved. However, the corresponding investment needs need to be compared with current (baseline) expenditure volumes (see next chapter) in order to establish whether the EU faces a financing challenge. At the same time, it needs to be kept in mind that additional investments are also needed in the business as usual scenario and the effort required lies in the difference between the business as usual and the more stringent EUCO30 scenario.

[44] In 2013 Euros.

3. CURRENT ENERGY RELATED EXPENDITURE AND THE EU'S CONTRIBUTION

This section provides a picture of current spending on the energy transition in the EU with a focus on the contribution of the EC via the current Multiannual Financial Framework (MFF). Apart from mapping broad public and private investments in mitigation, the major contributing funds under the MFF and corresponding financial instruments are discussed in more detail with regard to how much of their budget is spent on energy-relevant projects. Where applicable, boxes containing short case studies provide examples of fund contributions and showcase their respective impact (with full versions in Annex 1). Furthermore, full case studies are added to illustrate EU-funded solutions to e.g. adverse employment effects induced by the energy transition.

This chapter ends with a discussion of three different gaps (finance, efficiency, and knowledge) that need to be bridged in order to guarantee the successful implementation of the European energy transition and the meeting of the EU's climate targets.

3.1. Overview of Available Information on Actual Investment Volumes in the European Energy Transition

3.1.1. Total Spending on Mitigation

Actual EU-wide expenditure on the energy transition is based on historical and current spending. Important and recent sources of data are discussed to present the most up-to-date information. The latest European Parliament (2017) report on 'European Energy Industry Investments'[45] first presents the total (public and private) average annual spending on climate change mitigation in Europe over 2006-2015[46]. Table 3-1 provides an overview of the energy expenditures presented in this report.

[45] EP (2017). European Energy Industry Investments. http://www.europarl.europa.eu/RegData/etudes/STUD/2017/595356/IPOL_STU(2017)595356_EN.pdf

[46] Apart from grants, these figures also include various kinds of financial instruments (FIs) such as loans, guarantees or equity.

Table 3-1: Mitigation expenditures in Europe - average annual trends and total cumulative spending (2006-2015)

		Avg. annual spending (2006-2010)	*Avg. annual spending (2011-2015)*	*Total cumulative spending (2006-2015)*
		Billion Euro (2015)		
TOTAL	**Mitigation**	**161**	**193**	**1 770**
Total	**Supply side**	**70**	**87**	**785**
Supply side	Grid	25	26	255
	Power generation - RES	34	46	400
	Power generation - Conventional	11	15	130
Total	**Demand side (excl. transport)**	**91**	**106**	**985**
Demand side	Industry	7	7	70
	Buildings – households	74	88	810
	Buildings – tertiary sector	10	11	105

Source: underlying data for Figure 8 in EP (2017). European Energy Industry Investments.

This table represents the most comprehensive order-of-magnitude figure for investments in energy efficiency to date. The data also shows that energy efficiency makes up over 50% of total mitigation expenditure[47]. Renewables and grid investments represent the largest share of energy expenditure on the supply side.

Research and development offers the possibility of reaching, or even possibly exceeding, these targets at a lower cost. Given the nature of research it is not possible to provide a figure for the 'correct' amount that should be spent on it. The following box discusses research expenditure in some key areas.

Box 3-1: Focus on energy technologies – European spending on CCS and transport R&D

CCS Expenditure

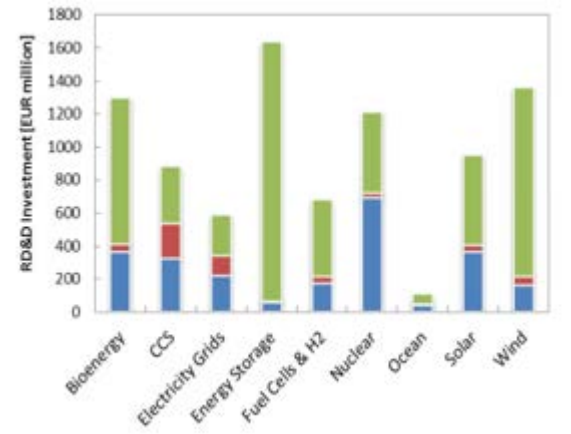
In the early 2000s, CCS enjoyed a period of momentum with numerous initiatives starting in Europe that secured commitments of financial backing. The 2009 financial crisis saw interest in CCS decrease, as the low carbon price (partly resulting from the recession) reduced the attractiveness of these investments. As of 2017, no large-scale CCS projects are operating inside the EU. According to a communication by the European Commission (2017)[48], 29 technical and economic feasibility assessments of potential CCS projects were carried out across MS in 2013-2016. None of these resulted in a positive assessment outcome. Despite three applications for storage currently being evaluated by the EC, it is

[47] In reality, this share is even lower due to the fact that the 'demand side' figures are only an approximation for energy efficiency spending.
[48] COM (2017) 37 final. Report from the Commission to the European Parliament and the Council on Implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide. https://ec.europa.eu/commission/sites/beta-political/files/report-carbon-capture-storage_en.pdf

expected that none of the planned projects will become viable until the carbon price rises to an appropriate level. For the EUCO30 scenario, this will not be the case until the year 2020[49].

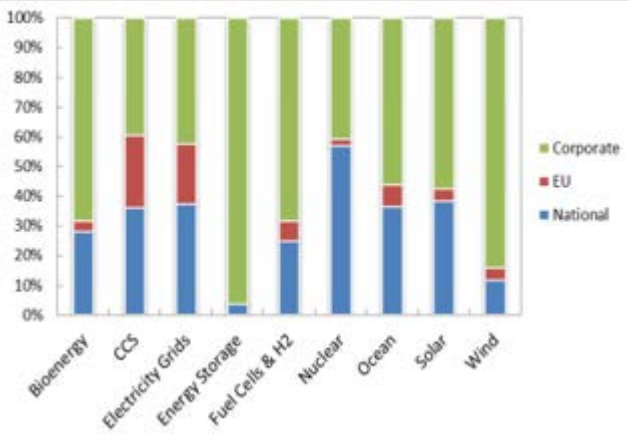
Data from the JRC indicates that a significant amount of finance is going to CCS-related R&D. Although a snapshot of the year 2011, the mapping exercise provides an indication of the current annual expenditure levels on CCS.

Figure 3-1: Absolute figures of EU, national and corporate funding to R&D for the nine SET-Plan technologies in 2011



Source: JRC Capacities Map[50]

Figure 3-2: Relative contribution of EU, national and corporate funding to R&D for the nine SET-Plan technologies in 2011



Source: JRC Capacities Map[51]

Based on the finding that construction of CCS facilities remains unfeasible with the current carbon price[52], it is reasonable to assume that the R&D expenditures on CCS represent

[49] E3MELab & IIASA (2016). Technical report on Member State results of the EUCO policy scenarios. https://ec.europa.eu/energy/sites/ener/files/documents/20170125_-_technical_report_on_euco_scenarios_primes_corrected.pdf

[50] Corsatea, T.D., A.Fiorini, A. Georgakaki, B.N. Lepsa (2015). Capacity Mapping: R&D investment in SET-Plan technologies. Reference Year 2011. JRC Science and Policy Report. https://setis.ec.europa.eu/system/files/Capacities-map-2015.pdf. Figure for 2011 (latest data available).

[51] Corsatea, T.D., A.Fiorini, A. Georgakaki, B.N. Lepsa (2015). Capacity Mapping: R&D investment in SET-Plan technologies. Reference Year 2011. JRC Science and Policy Report. https://setis.ec.europa.eu/system/files/Capacities-map-2015.pdf. Figure for 2011 (latest data available).

[52] COM (2017) 37 final. Report from the Commission to the European Parliament and the Council on Implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide. https://ec.europa.eu/commission/sites/beta-political/files/report-carbon-capture-storage_en.pdf

close to the total EU-wide spending level on the technology (i.e. currently no investment in actual CCS infrastructure). The figure of EUR 900 million CCS R&D spending per year (Figure 3-1 and **Error! Reference source not found.**Figure 3-2**Error! Reference source not found.Error! Reference source not found.**) is split rather evenly across different sources. The public sector represented by the EU and Member States (25 and 35% respectively) just about outperforms the private sector (40%). However, differences in methodology render this figure incomparable to the actual spending estimations postulated above. It hence only serves as a further point of reference and a rough indication of what CCS expenditures currently amount to.

A number of potential investment flows to CCS from different financial programmes were disregarded in this report due to a lack of relevance or non-disbursement. One example is the only CCS proposal accepted under the NER300 program[53] (White Rose CCS project in the UK). The total amount of EUR 300M was never disbursed from the NER300 since the UK government cut its financial support. The programme's future currently remains unclear[54]. Another example is CCS funding under the European Energy Program for Recovery, set up in 2009 in response to the global financial crisis. It identified 6 CCS projects in 2010, committing 1bn EUR to their development and construction. As of today,[55], only one of the six identified projects have been finished (although operation pending) with 432M EUR of the total committed amount having been disbursed. Since these numbers present historical data[56], however, they are not considered in our calculations of actual expenditures.

R&D Expenditure in the Transport Sector

While there is no doubt that R&D and other investment expenditures in the transport sector play a key role in achieving the energy transition, there are currently no reliable and sufficiently detailed estimates available on the 'energy transition relevant' parts of transport spending (i.e. how much of currently achieved R&D spending in the transport sector can be deemed energy transition relevant). As such it is not possible to determine the amount of energy transition relevant expenditure levels already achieved in the transport sector.

As demonstrated in this section, an estimate of total current EU-wide spending in sectors (and also in certain technologies) can be provided. However, there are challenges in comparing and aggregating these estimates due to differences in their scope and methodologies.

3.1.2. Private-public Finance Split for European Mitigation Investments

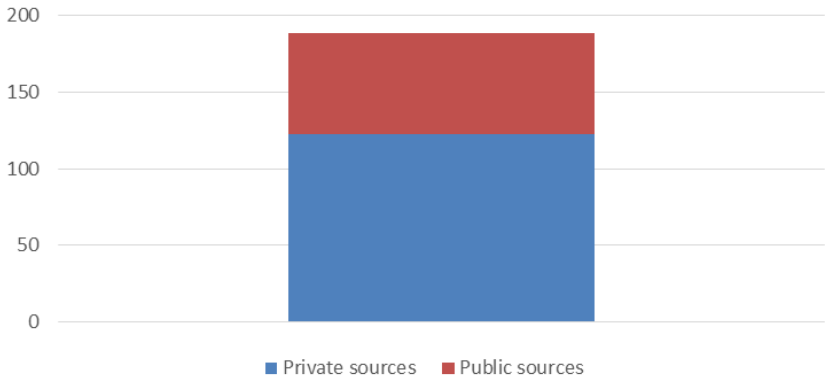
Private sector involvement is crucial for major investment challenges such as the energy transition, since the public budget (both EU and individual MS) cannot meet all the costs by itself. A good business case around most energy efficiency and RES technologies has

[53] Fund stemming from the sale of 300 million new ETS allowances.
[54] Information available at https://www.globalccsinstitute.com/projects/white-rose-ccs-project
[55] COM (2016) 743 final. Report from the Commission to the European Parliament and the Council on the implementation of the European Energy Programme for Recovery and the European Energy Efficiency Fund. https://ec.europa.eu/energy/sites/ener/files/documents/com2016743.pdf
[56] They fall under an earlier MFF.

developed in recent years. This has encouraged extensive private investment (at household and industry-level).

There is no comprehensive data source that allows a concise split of actual EU expenditures on energy between the public and private sectors. At a lower level of aggregation, three MSs (Germany[57], Belgium[58], and France[59]) extensively mapped out their climate finance landscape. In these cases, a split between public and private mitigation investment is presented. These three mapping exercises were used to produce an estimate of the EU-wide public-private split[60]. While this approach has its limitations, for example these three Member States may not be representative of the EU as a whole, it provides a credible figure that is likely to be the correct order of magnitude.

Figure 3-3: Estimated split of average annual (2011-2015) European mitigation spending across public versus private sources, in EUR bn



Source: own development based on EP (2017) and three MS climate finance landscapes.

Of the EUR 193bn mitigation spending between 2011-2015, roughly 65% was provided by the private sector and 35% by the public sector. Private sector investments were led by corporations, followed by private households. Public sector investments are made up of Member State contributions, stand-alone programmes (e.g. NER300 with EUR 2.1bn[61]), and the EU budget. This split should be regarded as an approximate indication.

As with the estimates of EU-wide energy investment volumes in the previous section, there are a few caveats regarding the estimate of the private-public funding split. These are discussed in more detail in the following section, together with a general analysis of the EU contributions under the current MFF.

3.2. Overview of the Current EU MFF – Allocation of Funds Dedicated to Energy

The EU's Multiannual Financial Framework (MFF) lays down the maximum annual amounts ('ceilings') which the EU may spend in different political fields ('headings') over a period of at least 5 years. It provides a framework for financial programming and budgetary discipline

[57] CPI (2012). The Landscape of Climate Finance in Germany. https://climatepolicyinitiative.org/wp-content/uploads/2012/11/Landscape-of-Climate-Finance-in-Germany-Full-Report.pdf
[58] Trinomics (2016). Landscape of climate finance in Belgium. http://www.klimaat.be/files/4914/6901/4152/Landscape_of_climate_finance_in_Belgium.pdf
[59] I4CE (2017). Landscape of Climate Finance in France. https://www.i4ce.org/download/landscape-of-climate-finance-in-france-2015-edition-full-report/?wpdmdl=13071. The latest 2017 edition of the report is available at https://www.i4ce.org/wp-core/wp-content/uploads/2017/12/1212-I4CE2772-Decideurs-VA-web.pdf
[60] By simply taking the average of public-private splits of all three mapping exercises.
[61] Trinomics (2017) based on SWD (2015).

by ensuring that EU spending is predictable and stays within the agreed limits. As such, the MFF is an expression of political priorities as well as a budgetary planning tool.[62]

The 2014-2020 MFF comprises 45 funds and programmes (budget lines) which are categorised according to six distinct headings. The headings which are most relevant for the energy transition are

- Heading 1 – 'Smart and Inclusive Growth',
- Heading 2 – 'Sustainable Growth: Natural Resources'.

At the time of its adoption, the Commission committed to appropriate a total of EUR 455bn under Heading 1 and EUR 373bn under Heading 2. This accounts for 86 % of the total committed appropriations (Regulation 1311/2013)[63].

A major group of EU funds[64] under Heading 1 and 2 which contribute to the energy transition are the European Structural and Investment Funds (ESIF). The ESIF is made up of five different funds: the European Regional Development Fund (**ERDF**), the Cohesion Fund (**CF**), the European Social Fund (**ESF**), the European Maritime and Fisheries Fund (**EMFF**), and the European Agricultural Fund for Rural Development (**EAFRD**). The purpose of putting these five funds within a framework is to improve coordination and harmonisation between them. The ESIF establishes a common framework with 11 thematic objectives[65] which determine the use of all five funds. The objectives of most importance for fostering the energy transition are:

- Supporting the shift towards a low-carbon economy in all sectors;
- Preserving and protecting the environment and promoting resource efficiency;
- Strengthening research, technological development and innovation.

Investment into the energy transition is also channelled via other MFF funds and programs under Headings 1 and 2. These include:

- The EUs research program **Horizon2020** includes budget lines that are energy relevant;
- The Connecting Europe Facility (**CEF**) has an energy branch that provides grants for transnational energy infrastructure projects;
- The **ITER** contributions support the design and construction of a large-scale nuclear fusion reactor;
- A clear indication of climate change mitigation expenditures can be found in the budget of the **LIFE** program;
- As one of the pillars of the Common Agricultural Policy (CAP), the European Agricultural Guarantee Fund (**EAGF**) contributes (minimally) to efforts in improving energy efficiency in agriculture.

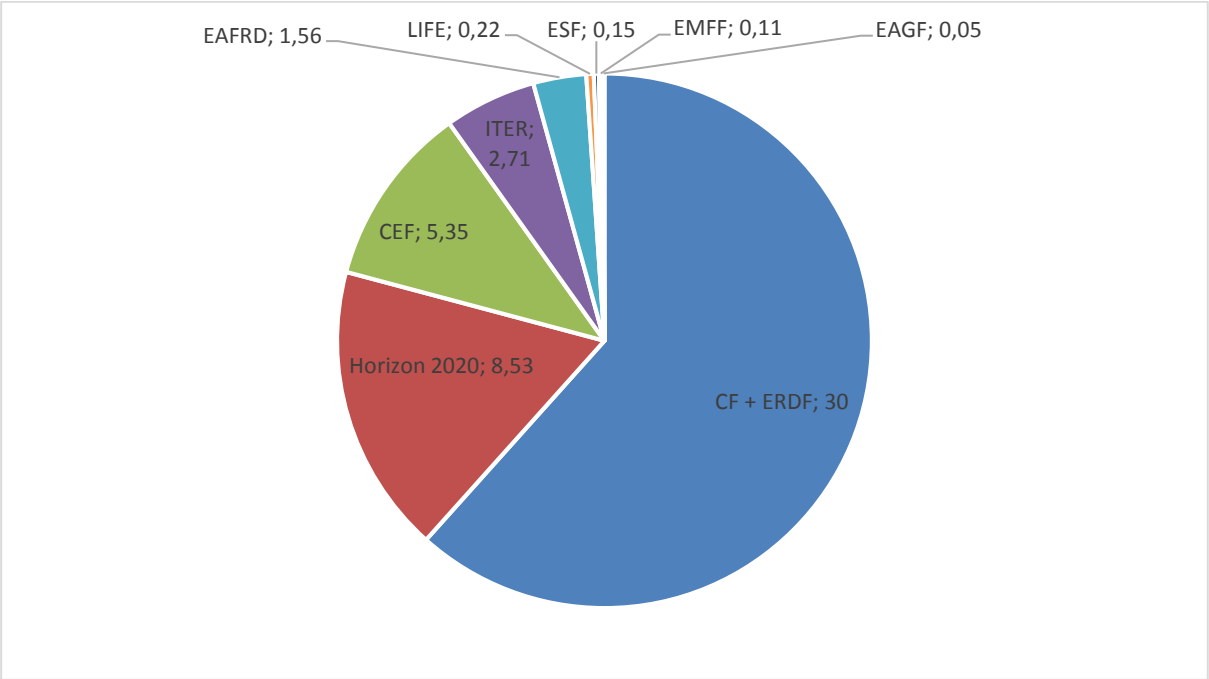
[62] Information available at http://ec.europa.eu/budget/mff/introduction/index_en.cfm
[63] Regulation (EU, EURATOM) No 1311/2013 laying down the multiannual financial framework for the years 2014-2020. Official Journal L347/884.
[64] EU funds are managed according to three different models (referred to as management modes), including: Direct management (the European Commission or the European executive agency is the contracting authority); Indirect management (management is entrusted to Member States or other third country authorities, or other international organisations); and Shared management (the European Commission delegates responsibility to Member State authorities).
[65] Regulation (EU) No 1303/2013 laying down common provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund and laying down general provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund and the European Maritime and Fisheries Fund and repealing Council Regulation (EC) No 1083/2006. Title II, Chapter 1, Article 9. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R1303&from=EN

All of these specific funds, and their respective contributions to energy projects are displayed and discussed in more detail in the following section. The role of financial instruments in these programmes is also discussed.

3.2.1. Principal EU Funds

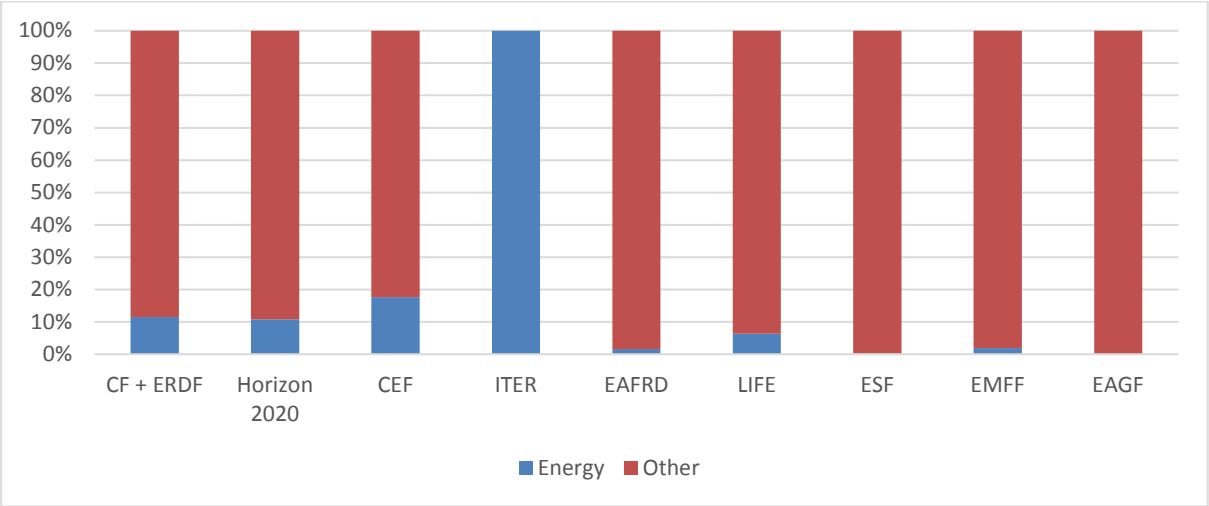
The following two summary charts provide an overview of energy-relevant MFF expenditures. Figure 3-4 depicts the total amounts of energy-relevant spending by MFF programme. Figure 3-5 shows energy's share of expenditures in each programme.

Figure 3-4: Energy-relevant spending under the 2014-2020 MFF (in 2013 EUR bn)



Source: based on calculations presented in the following sections on different MFF funds.

Figure 3-5: Energy-relevant expenditure by MFF programmes



Source: based on calculations presented in the following sections on different MFF funds.

The total energy-relevant expenditure over the 2014-2020 period of the current MFF is estimated to be EUR 48.68bn (EUR 48.91bn in EUR '15). Compared to total EU-wide annual

(public and private) mitigation spending (EUR 193bn in EP (2017))- The role of the MFF in financing the energy transition is hence rather small (roughly EUR 6.95bn per year, EUR 6.99bn in EUR '15). Section 3.3.2 investigates this low amount of EU-funding and discusses if it poses an issue for future mitigation efforts. Inside the respective programmes, energy also does not claim a large share of the budget. Amongst programmes with mixed objectives the CEF has the largest share of energy spending, with 17.6% of its total being assigned to energy.

This section continues with a discussion of each programme in more detail, including the derivations of the amounts presented in Figure 3-5. The programmes are presented in descending order of absolute contribution to the energy sector.

a. Cohesion Fund and European Regional Development Fund (Heading 1b)

The Cohesion Fund (CF) was established in 1994 to provide finance for EU-wide environmental and network projects. In order to be eligible for access as a Member State (MS), the GNI per capita of the country must be lower than 90% of the EU average. Its central goal is to close economic and social gaps between MS and to foster sustainable development.

The main CF funding of relevance to the energy transition is its second area of funding, which champions positive environmental impact. Energy efficiency and renewable energy projects can be named as examples of actions supported in this area. The CF also finances transport infrastructure projects, which manifests itself in the support of the Connecting Europe Facility (CEF) transport division with EUR 11.3bn of its budget[66].

As laid out in the Common Provisions Regulation (1303/2013)[67], the fund uses the same management architecture as the European Regional Development Fund (ERDF). The ERDF is a cohesion program that seeks to minimise regional disparities inside the EU, although more developed regions are not excluded from receiving support. It is further committed to the Europe 2020 Strategy for smart, sustainable, and inclusive growth, which outlines specific priority areas for investments. The objective 'promotion of a low-carbon energy' is the one most likely to foster the energy transition. Developed-, transition-, and less developed regions are able to spend at least 20%, 15% or 12% respectively of their ERDF resources on this priority.

The following table includes all energy- and climate-relevant spending provided by the CF and ERDF. It is based on an EC document that indicates all ESIF funding going to the thematic Commission priority of "Energy Union and Climate Change" under the current MFF[68]. Transport and adaptation figures are listed but not included in the estimation of totals due to the scope of the study (cf. Section 1.1.2).

[66] Regulation (EU) No 1316/2013 establishing the Connecting Europe Facility, amending Regulation (EU) No 913/2010 and repealing Regulations (EC) No 680/2007 and (EC) No 67/2010. Article 5(1a).
http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R1316&from=EN

[67] Regulation (EU) No 1303/2013 laying down common provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund and laying down general provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund and the European Maritime and Fisheries Fund and repealing Council Regulation (EC) No 1083/2006.
http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R1303&from=EN

[68] EC (2015). Contribution of the European Structural and Investment Funds to the 10 Commission Priorities – Energy Union and Climate.
https://ec.europa.eu/commission/sites/beta-political/files/key-energy-union-climate_en.pdf

Table 3-2: Summary of 2014-2020 ERDF and CF spending on energy and climate change related projects

Thematic area	Fund	Amount
Energy efficiency (buildings)	ERDF and CF	EUR 13.3bn
Energy efficiency (industry)	ERDF and CF	EUR 3.4bn
Energy efficiency (cogeneration)	ERDF and CF	EUR 1.7m
Transport*	ERDF and CF	EUR 39.7bn*
Power generation (RES)	ERDF, CF and EAFRD	EUR 5.8bn
Smart grids	ERDF and CF	EUR 1.1bn
Storage and transmission	ERDF and CF	EUR 2.3bn
R&D	ERDF	EUR 2.6bn
Adaptation (CC risks and disaster resilience)*	ERDF and CF	EUR 7.5bn*
Total (mitigation)	**ERDF and CF**	**Roughly EUR 30bn****

Sources: Own development based on EC (2015)[69] and EC (2014)[70] documents / *the figure has not been included in the total estimate of mitigation spending and only serves an illustrative purpose / **a rough indication since it cannot be ascertained how much of the EUR 5.8bn spent on RES was provided by the EAFRD (although its contribution is assumed to be low).

Of all the MFF schemes and funds, the CF and ERDF combined provide the largest amount of energy-relevant investments at roughly EUR 30bn.

A report from the European Court of Auditors[71] also presents climate relevant spending of the ESI funds. The final estimate of EUR 29.7bn (excluding transport and adaptation spending) in this document is close to the one presented in Table 3-2.

The split between mitigation and adaptation spending in the CF and ERDF is the most comprehensive to be found of any of the MFF's funds. This allows a straightforward estimate of energy-relevant expenditures under these funds. Unfortunately, the division is less straightforward for other funds, which can be seen in the following sections[72].

[69] EC (2015). Contribution of the European Structural and Investment Funds to the 10 Commission Priorities – Energy Union and Climate.
https://ec.europa.eu/commission/sites/beta-political/files/key-energy-union-climate_en.pdf
[70] EC (2014). How EU Cohesion Policy is helping to tackle the challenges of Climate Change and Energy Security.
http://ec.europa.eu/regional_policy/sources/docgener/informat/2014/cp_investments_energy2014_2020.pdf
[71] European Court of Auditors (2016). Spending at least one euro in every five from the EU budget on climate action: ambitious work underway, but at serious risk of falling short.
https://www.eca.europa.eu/Lists/ECADocuments/SR16_31/SR_CLIMATE_EN.pdf
[72] Especially if funds have a dedicated budget line on climate action as opposed to energy only.

Box 3-2: Case Study – Buildings at state-run art schools across Poland made more energy efficient[73]

The EU's Cohesion Fund contributes EUR 94M through its "Infrastructure and Environment" Operational Programme covering around 82 % of the total expected investment costs for making state-run art school buildings across Poland more energy efficient. In total, 187 buildings are to be made more energy efficient, covering 139 art schools in all 16 regions of Poland.

CF contribution: **EUR 93.9M**

Other public/private finance: **EUR 21.2M**

Box 3-3: Case Study – ARBED Programme[74]

The ARBED programme was initiated by the Welsh government in 2009 with the overarching goal to put energy efficiency of Welsh homes on the agenda. It has led to improvement of energy efficiency in 4800 homes and a reduction of GHG by 2.54 KTC (Kilo tons of carbon) in all of Wales.

ERDF contribution: **EUR 37M**

Other public finance: **EUR 55M** (Government of Wales) / **EUR 22M** (Local governments)

Private finance: **EUR 12M** (Energy companies)

b. Horizon 2020 (Heading 1a)

Horizon 2020 is the EU's main programme for supporting pure and applied research and development. It builds on a long history of previous EU Framework Programmes (FPs). With a budget of EUR 79.4bn during the 2014-2020 MFF funding period[75], Horizon 2020 seeks to deepen Europe's role as a leader in R&D of cross-cutting technology in, among others, biology, security, space, transport, health, climate change and energy. The programme is divided into different sections, of which two in particular contribute to the energy transition: **Excellent Science** and **Societal Challenges**.

Under 'Excellent Science', the 'Future Emerging Technologies' sub-section (budget: EUR 2.7bn) funds a number of energy-related projects in, for example, Exascale supercomputers or energy storage technology. A review of the Commission's R&I project portal[76], enabled an approximate identification of how much of the allocated funding for 'Future Emerging Technologies' can be deemed energy-relevant. Roughly 7.5% of current commitments appear to be directed towards energy-relevant technologies[77]. If this percentage stays constant up to 2020, some EUR 202M of the 'Future Emerging Technologies' 2014-2020 budget could be deemed energy-relevant.

[73] Full case study can be found in the annex.
[74] Full case study can be found in the annex.
[75] EC (2013). Factsheet: Horizon 2020 budget.
http://ec.europa.eu/research/horizon2020/pdf/press/fact_sheet_on_horizon2020_budget.pdf
[76] Research and Innovation Participant Portal of the EC.
http://ec.europa.eu/research/participants/portal/desktop/en/projectresults/index.html
[77] The list of projects was skimmed for energy-relevant projects and their rough combined value related back to the overall amount of 'Future Emerging Technologies' commitments up until today. This percentage (7.5%) was then used to stipulate the EUR amount of 'Future Emerging Technologies' funding that has and will go into energy-relevant projects between 2014-2020.

The 'Societal Challenges' section is also divided into specific sub-sections. It includes a dedicated sub-section supporting the energy transition (SC3 - 'Secure, clean, and efficient energy'). The funding of this specific budget line is EUR 5.93bn for the 2014-2020 period[78].

H2020 also supports R+D in transport technologies designed to reduce CO_2 emissions. Although transport is outside the scope of our study the following box provides a short summary of this investment and some examples.

Box 3-4: Special focus on R&D of transport technologies (Horizon 2020)

Under the section 'Societal Challenges', the Horizon 2020 budget also channels funds towards the R&D of transport technologies. Qualified projects are listed under SC4 ('Smart, green, and integrated transport') and financed with EUR 6.34bn between 2014-2020.

Examples of funded projects (so far) are:

- Hydrogen Mobility Europe (H2ME 1&2) – EUR 67M
- Piloted Automated Driving on European Roads (L3Pilot) – EUR 36M
- Innovative Intelligent Rail (IN2RAIL) – EUR 18M[79]

Ascertaining the relevance of transport projects for energy is a complex task, which is beyond the scope of our work and is omitted from our estimates[80].

The H2020 budget also contributes EUR 2.4bn to Euratom[81] for a designated research program[82]. This can be counted towards energy-relevant spending as it mainly covers projects concerning nuclear power generation (fission and fusion).

Considering the three different sources ('Future Emerging Technologies', SC3, and Euratom) an approximate indication of total H2020 energy transition relevant expenditures between 2014-2020 can be given at EUR 8.53bn.

Box 3-5: Case Study – RUGGEDISED[83]

The RUGGEDISED project will create urban spaces powered by secure, affordable and clean energy, smart electro-mobility, smart tools and services. This means improving the quality of life of citizens, reducing the environmental impact of activities, and creating a stimulating environment for sustainable economic development. Its three lighthouse cities are Rotterdam, Glasgow, and Umeå.

Horizon 2020 contribution: **EUR 17.7M**

Other public finance & private finance: **EUR 1.9M** (municipalities, energy providers, and tech-companies)

[78] Secure, Clean and Efficient Energy (Horizon 2020). https://ec.europa.eu/programmes/horizon2020/en/h2020-section/secure-clean-and-efficient-energy
[79] Research and Innovation Participant Portal of the EC. http://ec.europa.eu/research/participants/portal/desktop/en/projectresults/index.html
[80] As done so for transport figures in preceding chapters.
[81] EC (2013). Factsheet: Horizon 2020 budget. http://ec.europa.eu/research/horizon2020/pdf/press/fact_sheet_on_horizon2020_budget.pdf
[82] Regulation (EURATOM) No 1314/2013 on the Research and Training Programme of the European Atomic Energy Community (2014-2018) complementing the Horizon 2020 Framework Programme for Research and Innovation. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R1314&from=EN
[83] Full case study can be found in the annex.

c. Connecting Europe Facility (Heading 1a)

The Connecting Europe Facility (CEF) is a funding instrument that aims to establish and improve inter-European networks in transport, energy, and telecommunications. The broad goal of the CEF is to make connectivity in these sectors more efficient and sustainable across Europe. Further focus of the CEF lies on leveraging infrastructure projects that the market would not pick up due to unfavourable cost and financial risk estimations.

The CEF has a total budget of EUR 30.4bn over the period 2014-2020. Funding of the CEF is divided into three priority sectors: transport (EUR 24.05bn)[84], energy (EUR 5.35bn)[85], and telecommunications (EUR 1.04bn)[86].

The Cohesion Fund has transferred EUR 11.3bn of its budget to the CEF[87]. This amount is to be used exclusively on transport infrastructure projects and only in countries eligible for Cohesion Fund investments[88]. This clean division of funds avoids the hazard of double-counting when drafting estimates of energy-relevant budget allocations of the two funding instruments (CF & CEF) since none of the CF funds go towards CEF energy projects.

Due to the clear CEF budget division of priority sectors and the exclusion of transport expenditures, the total energy-relevant spending of the CEF is EUR 5.35bn.

Box 3-6: Case Study – SINCRO.GRID PCI (Phase 1)[89]

CEF Action is contributing to the PCI 10.3 SINCRO.GRID (Slovenia/Croatia) project, which aims to solve network voltage, frequency control and congestion issues as well as enabling further deployment of renewables. The project will enable electricity network operators to deliver an acceptable level of security of operation for at least the next ten years, with no need for repeated investments to maintain this security level, while hosting levels of RES in line with the trends foreseen to reach the 2030 targets safely.

CEF Energy contribution: **EUR 40.49M**

Private finance: **EUR 38.9M** (Slovenian and Croatian TSOs and DSOs as a joint initiative)

d. ITER (Heading 1a)

ITER is a Big Science project seeking to make nuclear fusion a commercially feasible source of energy in the future. Its appeal lies in the fact that, unlike nuclear fission power generation, it exhibits much less environmental and health hazards. This makes it a potentially important contributor to the future energy mix (albeit only post-2050).

Euratom is represented by the Commission in the Joint Undertaking for ITER. This means that there is a direct budget line under the current MFF for ITER. The EU budget contribution towards the ITER project over the period 2014-2020 is EUR 2.71bn[90].

[84] Includes already the 11.3bn transferred to the CEF by the CF for the exclusive use in transport infrastructure projects. https://ec.europa.eu/inea/en/connecting-europe-facility/cef-transport
[85] EC (2017). Connecting Europe Facility Energy – Key figures. https://ec.europa.eu/inea/sites/inea/files/cef_energy_keyfigures_2017_leaflet_final_0.pdf
[86] Available at https://ec.europa.eu/inea/en/connecting-europe-facility/cef-telecom
[87] Some online sources misquote Regulation 1300/2013 on this, stating that no funds are transferred from the CF and that the 11.3bn are simply reserved in the CEF budget for MSs "meeting the CF eligibility requirements".
[88] Regulation (EU) No 1300/2013 on the Cohesion Fund and repealing Council Regulation (EC) No 1084/2006. Article 3. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R1300&from=NL
[89] Full case study can be found in the annex.
[90] Council Decision (2013/791/Euratom) amending Decision (2007/198/Euratom) establishing the European Joint Undertaking for ITER and the Development of Fusion Energy and conferring advantage upon it.

e. European Agricultural Fund for Rural Development (Heading 2)

The European Agricultural Fund for Rural Development (EAFRD) is one of the pillars of the EU's Common Agricultural Policy (CAP). As is evident from its name, the EAFRD seeks to support and finance programs for the development of rural areas in the EU. Financial allocation to the EAFRD in the period 2014-2020 is EUR 100bn[91].

The EAFRD is involved in two energy-related Focus Areas under the Union Priorities[92]. These are:

- 5B – Increasing efficiency in energy use in agriculture and food processing
- 5C – Facilitating the supply and use of renewable sources of energy, of by-products, wastes and residues and of other non-food raw material, for the purposes of the bio-economy

A calculation based on a COWI report[93] puts amounts allocated to EAFRD Focus Areas 5B and 5C at EUR 783M and EUR 791M respectively.

According to an EC document[94], EUR 870M has been allocated for energy efficiency in rural development. Furthermore, a share of the innovation (EUR 438M) and knowledge transfer (EUR 810M) budgets are targeted on energy efficiency and renewable energy investments. The EAFRD also has a stake in the EUR 5.8bn invested in EU renewable energy capacity supported by ESI funds[95].

It is difficult to provide a clear split between adaptation and mitigation spending in both of these sources. Therefore, only an approximate indication of energy-relevant expenditures in the EAFRD can be given and this estimate is EUR 1.56bn[96].

Box 3-7: Case Study – Producing and packaging biofuel (PELLET) from olives harvesting residues in Greece[97]

A Greek biofuel production unit that processes olive residues was established. LEADER support helped with the purchase of the necessary machinery and equipment. The company set up a complete line for producing and packaging biofuel (PELLET) where the raw material is cut, crushed, dried, pressed, weighed and packaged. Approximately 5 400 tonnes of raw material will produce around 4 000 tonnes of product. The company's future plans are to place its product on internal and external markets alike.

http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013D0791&rid=1

[91] Available at https://ec.europa.eu/agriculture/rural-development-2014-2020_en

[92] Regulation (EU) No 215/2014 laying down rules for implementing Regulation (EU) No 1303/2013 of the European Parliament and of the Council laying down common provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund and laying down general provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund and the European Maritime and Fisheries Fund with regard to methodologies for climate change support, the determination of milestones and targets in the performance framework and the nomenclature of categories of intervention for the European Structural and Investment Funds. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0215&from=EN

[93] COWI (2016). Mainstreaming of Climate Action into ESI Funds. https://ec.europa.eu/clima/sites/clima/files/budget/docs/report_mainstreaming_of_climate_action_en.pdf

[94] EC (2015). Contribution of the European Structural and Investment Funds to the 10 Commission Priorities – Energy Union and Climate. https://ec.europa.eu/commission/sites/beta-political/files/key-energy-union-climate_en.pdf

[95] Together with the CF and ERDF (see section a. above).

[96] Calculations:
EC Report = (870M + 0.5*438M + 0.5*810M + 0.01*5800M). Weight of 0.5 given to amounts for innovation and knowledge transfer as a rule-of-thumb for energy-relevance. Share of EAFRD investment into infrastructure of renewables deemed to be low (hence weighting of 0.01).
COWI Report = (783M + 791M).

[97] Full case study can be found in the annex.

EAFRD contribution: **EUR 211.5k**

Public finance: **6.3k**

Private finance: **84.6k** (National/Regional government)

f. Programme for the Environment and Climate Action (LIFE) (Heading 2)

The Programme for the Environment and Climate Action (LIFE) is a funding program that aims to facilitate the implementation of EU policies on climate and the environment. Under the current MFF, EUR 3.46bn is allocated to LIFE.

LIFE consists of two strands: the environment and climate action. Unlike other EU funds, LIFE makes a clear distinction between mitigation, adaptation and climate governance. This makes identification of energy-relevant expenditures easier. Roughly EUR 864M is earmarked for the climate action strand under the current 2014-2020 LIFE regulation (25% of the total budget)[98].

Since its inception in 1992, about 50% of LIFE mitigation actions have benefitted the energy sector[99]. Assuming that this share will continue, and that half of the climate action strand funding contributes to mitigation, 2014-2020 energy-relevant spending of the LIFE program will be approximately EUR 216M.

g. European Social Fund (Heading 1b)

The ESF is a fund targeted at fostering job creation for EU-citizens and thus enabling a heightened quality of life inside the Union. This goal is pursued by helping workers to adapt to an ever-changing job environment, improving access to employment, and by offering vocational training to enhance and diversify the general skill level of the population[100].

According to the ESF regulation, ESF can contribute to thematic objective 4[101] via a 'secondary theme' (code 01) on "supporting the shift towards a low-carbon, climate-resilient, resource-efficient and environmentally sustainable economy, through the improvement of education and training systems necessary for the adaptation of skills and qualifications, the up-skilling of the labour force, and the creation of new jobs in sectors related to the environment and energy"[102].

According to a COWI (2016)[103] evaluation, which is based on the analysis of the 185 ESF Operational Programmes, 1.4% of ESF funds (EUR 1.15bn) are estimated to support climate change actions (of which mitigation spending is a part). It is complicated to estimate how much of the climate-related ESF investments are spent on mitigation. Some of its resources

[98] Available at http://climate-adapt.eea.europa.eu/eu-adaptation-policy/funding/life
[99] EC (2015). LIFE and Climate Change Mitigation. http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/climate_change_mitigation.pdf
[100] Available at http://ec.europa.eu/esf/main.jsp?catId=35&langId=en
[101] Supporting the shift towards a low-carbon economy in all sectors.
[102] Regulation (EU) No 1304/2013 on the European Social Fund and repealing Council Regulation (EC) No 1081/2006. Article 3 (2a). http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R1304&from=en
[103] COWI (2016). Mainstreaming of climate action into ESI Funds. https://ec.europa.eu/clima/sites/clima/files/budget/docs/report_mainstreaming_of_climate_action_en.pdf

could be classified as supporting the energy transition but, in comparison, the ESF's contribution is close to negligible.

h. European Maritime and Fisheries Fund (Heading 2)

The European Maritime and Fisheries Fund (EMFF) has a MFF allocation of EUR 5.75bn. It seeks to support EU fishermen by making their practices more sustainable, improve the livelihood of coastal communities, and facilitate access to finance for the fishing sector.

The only energy-relevant theme under the EMFF is that of the 'Low-Carbon Economy'. Some EUR 113M is budgeted under this topic between 2014-2020[104]. Examples of measures financed under this subheading are 'Energy efficiency and mitigation of climate change' or 'Fishing ports, landing sites, auction halls, and shelters'[105]. However, the contribution of the EMFF towards the energy transition can be regarded as minimal.

i. European Agricultural Guarantee Fund (Heading 2)

The European Agricultural Guarantee Fund (EAGF) is the 'first pillar' of the CAP and is responsible for direct payments to farmers and measures regulating or supporting agricultural markets.

In the 2016 EAGF Financial Report[106] there is mention of a 'payment for agricultural practices beneficial for the climate and the environment'. However, these payments seem to largely target crop diversification and permanent grassland maintenance. In general, energy-relevant spending does not necessarily fall into the scope of the EAGF and its contributions towards the energy transition are hence assumed to be negligible.

3.2.2. Financial Instruments

In general terms a Financial Instrument (FI) is considered to be a structure which offers repayable loans (from a central fund) as opposed to non-repayable grants, which most of the programme expenditure discussed in the section so far is, although this definition is not universal. This section covers FIs with contributions from the European Commission and also discusses the role of the European Investment Bank (EIB). Financial instruments are seen as having an increasingly important role in EC funding. They are seen as a way of increasing EC influenced / controlled funding (by leveraging in private and/or Member State funds), making up for possible reductions in Member State contributions to the EC in the future and a reflection of the large scale of many of the issues to be addressed (such as the energy transition). The current MFF includes a greater use of the FIs than the previous MFF did and this trend appears likely to continue into the future according the recent EU reflection paper[107] on the future of EU finances.

[104] EC (2015). Contribution of the European Structural and Investment Funds to the 10 Commission Priorities – Energy Union and Climate.
https://ec.europa.eu/commission/sites/beta-political/files/key-energy-union-climate_en.pdf
[105] Regulation (EU) No 508/2014 on the European Maritime and Fisheries Fund and repealing Council Regulations (EC) No 2328/2003, (EC) No 861/2006, (EC) No 1198/2006 and (EC) No 791/2007 and Regulation (EU) No 1255/2011 of the European Parliament and of the Council. Article 41ff.
http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0508&from=EN
[106] COM (2017) 456 final. 10th Financial Report on the European Agricultural Guarantee Fund – 2016 Financial Year. http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52017DC0456&from=EN
[107] EC (2017). Reflection Paper on the Future of the EU Finances.
https://ec.europa.eu/commission/sites/beta-political/files/reflection-paper-eu-finances_en.pdf

a. Definitions – EU Financial Instrument

The first step in considering the contribution to energy funding from EU financial instruments is to provide a definition of an *EU financial instrument*. There are several examples of interventions described as financial instruments where the EU contribution takes the form of a grant to enable a project to become ready to apply for other forms of finance. There are also interventions where EU funds are combined with private funds and the EU contribution is a grant but this is packaged alongside a repayable loan, or the EU contribution is a concessional loan (i.e. lower interest rate and/or longer term) or the 'first loss' part of a loan (i.e. if there is any defaulting on the loan the EU contribution is written off first).

The second definition issue to consider is whether a financial instrument can be considered to have EU funds in it. There is currently no agreed definition or list of all EU financial instruments (FIs). The two EU reports which collate information on large groupings of EU FIs are the annual '140.8' report[108] on centrally managed financial instruments and the annual report on financial instruments under the European Structural and Investment funds (ESIF)[109].

The most recent report on centrally managed instruments quotes a 2014-20 budget envelope for financial instruments of EUR 8.4 billion which is targeted to support the financing of EUR 87.8 billion, implying an average leverage of 10.5 (Box 3-8 below explains and discusses leverage), and an investment amount of EUR 137.6 billion. This budget excludes appropriations for successor instruments to certain instruments established for Enlargement and Neighbourhood or Development Cooperation countries.

Box 3-8 Measurement of leverage

The EU financial regulations have a simple definition of leverage which includes all non-EU contributions (e.g. private finance, public Member State finance, other international sources of finance) as additional. They also require the target and achieved leverage to be reported. This approach is followed for the centrally managed FIs which are reported in the Art 140.8 report and the ESIF FIs in the ESIF situation report. It is not guaranteed that this approach is also followed by the FIs which are not covered by these reporting obligations (e.g. the EFSI uses a more nuanced (transaction level) approach. While the actual multiplier can only be measured at portfolio-level and at the end of the investment period, the EIB Group is required to estimate total investment mobilised as a Key Performance Indicator to monitor progress toward achieving the EUR 315 bn target.

The treatment of MS public funds is an area where the Court of Auditors have stated that the Commission should clarify its approach[110]. In terms of additionality to European funds the logic of including Member State public funds is understandable. However, it does imply a risk of double counting (if a calculation is done on the basis of public plus private and the assumption is made that all the non-EC money mobilised by an FI is private) which would make the total mobilised appear larger than reality.

[108] COM(2017) 535 final. Report on financial instruments supported by the general budget according to Art.140.8 of the Financial Regulation as at 31 December 2016.
https://ec.europa.eu/transparency/regdoc/rep/1/2017/EN/COM-2017-535-F1-EN-MAIN-PART-1.PDF
[109] EC (2015). Summaries of the data on the progress made in financing and implementing the financial instruments for the programming period 2014-2020 in accordance with Article 46 of Regulation (EU) No 1303/2013 of the European Parliament and of the Council.
http://ec.europa.eu/regional_policy/sources/thefunds/fin_inst/pdf/summary_data_fi_1420_2015.pdf
[110] European Court of Auditors (2016). Spending at least one euro in every five from the EU budget on climate action: ambitious work underway, but at serious risk of falling short.
https://www.eca.europa.eu/Lists/ECADocuments/SR16_31/SR_CLIMATE_EN.pdf

Another difficult area for leverage calculations is on assigning a value to 'soft' (or concessional) loans (i.e. with interest rates or other terms that are better than those available on the open market). In international climate lending, there is an agreed method for assessing the value of these. Currently, concessional loans are valued against face value (for TOSSD[111] and UNFCCC reporting) and grant equivalence (for Overseas Development Aid reporting under OECD DAC), depending on the reporting purpose.

The most recent (November 2016) ESIF report covers the situation as of 31 December 2015. Given the early stage of the MFF, relatively little of the planned FI allocation has yet been committed, but the allocations to the funds that support the FIs are clear:

- ERDF and CF EUR 20 billion,
- ESF EUR 949 million,
- EAFRD EUR 455million and
- EMFF EUR 80 million.

The ESIF report does not include information on the intended leverage of the FIs it covers. This appears to be because Member States are not required to submit this data and because the instruments are very diverse with a variety of expected leverage rates.

There are a number of FIs which are not included in either of these reports. These exclusions include the European Fund for Strategic Investments (EFSI[112], also known by some as the 'Juncker fund') the European Development Fund (EDF) and the Guarantee Fund for external actions. The Commission's explanations for excluding these funds from the Art 140.8 report are as follows:

- EFSI was designed with its own reporting requirements as a stand-alone instrument and does not fall under the scope of Chapter VIII on financial instruments of the current Financial Regulation. As a result, EFSI may not need to fully comply with provisions on financial instruments under Art. 139 and Art. 140 which also include requirements for reporting, state aid or exclusion of contingent liabilities.
- The 'Guarantee Fund for external actions' has a contingent liability implied and thus the instrument is not a financial instrument in the sense of the Financial Regulation. It also predates the Financial Regulation.
- The EDF (oversea aid focussed) is excluded because it is not part of the MFF.

Assigning a total budget and total EU contribution to these FIs is not straightforward for a number of reasons. The main reasons are:

- *The lifespan of the FIs*: There are FIs still operational that were set up with EU contributions from the previous MFF and some of them have had extra EU contributions, so the figures on the original fund sizes are out of date. The Art 140.8 report includes the FIs from the previous MFF, with a distinction made on the date of the contribution;
- *The nature of the FI*: In some of the instruments (e.g. ELENA, the Neighbourhood Investment Facility (and its successors), which are known as FIs, some or all of the EU contribution is actually used as a grant, not a loan. In these cases, the grant is being used to help gain access to private finance, hence its association with FIs.

[111] TOSSD = total official support for sustainable development. See http://www.oecd.org/dac/financing-sustainable-development/tossd.htm

[112] https://ec.europa.eu/commission/priorities/jobs-growth-and-investment/investment-plan-europe-juncker-plan/european-fund-strategic-investments-efsi_en

There are a number of other variations regarding the nature and management of the FIs, for example some of the instruments, e.g. the EFSI, are stand alone and are not covered by the FI requirements of the EU Financial Regulations. Some are wholly under the control of specific programmes and some are funded from more than one source.

There are other energy relevant financial and funding mechanisms which the EC is involved in. A key example here is the EU Emissions Trading System (EU-ETS) and its associated NER 300 fund. NER 300 is so called because it is funded from the sale of 300 million emission allowances from the New Entrants' Reserve (NER) set up for the third phase of the EU emissions trading system (EU ETS). The funds from the sales are to be distributed to projects selected through two rounds of calls for proposals. Under the first and second calls the EU distributed €2.2 billion of funds to support 38 renewable energy projects, with this expenditure leverage additional private funding of over €2.8 billion[113]. The NER 300 has been excluded because it is funded by EU-ETS income (mainly from electricity generators, and ultimately their customers) and not by the EU budget.

b. European Investment Bank

The European Investment Bank (EIB) describes itself as the European Union's bank. It lends money to finance projects that support the implementation of EU policy. Most of the money which it lends is raised on international markets, but some comes from the EU Member States via the EU. The vast majority of its financing is through loans, but it also offers guarantees, microfinance, equity investment, etc. The EIB also blends its funds with those from other sources, particularly from the EU budget. The EIB also helps with administrative and project management capacity to facilitate investment. The bank is active worldwide but over 90% of its activity is in Europe.

The EIB helps to finance a diverse portfolio of projects, but a significant fraction of these are classified as being in the energy sector. The latest figures on the EIB website[114] show a total energy sector investment of €56.1 billion between 2012 and 2017. This is about 13.8% of its total finance provision. The energy investments concern a variety of sub sectors, varying from individual loans for large renewables, fossil fuel and electricity infrastructure projects to framework loans (often lent via national intermediary banks) that are available to (relatively) small energy projects in buildings. There are also thematic loans (e.g. for R+D), that are likely to include energy relevant investments. Some recent examples of specific projects that have received loans from the EIB include:

North Pole Onshore Wind Farm[115]. (Sweden) Loan: EUR 179million. Construction of an 650MW onshore wind farm in northern Sweden Promoter / financial Intermediary: GE Financial Services / Macquarie Capital (Europe) Limited. January 2017.

TRANSGAZ BRUA GAS Interconnection Project[116]. (Romania) Loan of EUR 50million to Transgaz, Backed by the European Fund for Strategic Investments (EFSI). New Romanian section of the gas pipeline from Bulgaria to Austria via Romania and Hungary (BRUA).

Credit facility to finance energy modernisation in housing portfolio[117]. (Germany) Loan agreement for EUR 100 million. EFSI), for the pro rata financing of energy-efficient

[113] NER300 programme description https://ec.europa.eu/clima/policies/lowcarbon/ner300_en
[114] Projects available at http://www.eib.org/projects/loan/sectors/index.htm (accessed on 27/11/2017)
[115] North Pole Onshore Wind Farm Factsheet: http://www.eib.org/projects/pipelines/pipeline/20160729
[116] EIB (2017). EIB supports gas supply improvements and diversification in Europe with the EFSI guarantee. http://www.eib.org/infocentre/press/releases/all/2017/2017-290-eib-supports-gas-supply-improvements-and-diversification-in-europe-with-the-efsi-guarantee
[117] EIB (2016). EIB and LEG sign credit facility to finance energy modernization in housing portfolio. http://www.eib.org/infocentre/press/releases/all/2016/2016-346-investeu-eib-and-leg-sign-credit-facility-to-finance-energy-modernisation-in-housing-portfolio

modernisation measures in the property company's housing portfolio. The credit facility can be drawn down in several tranches and has a term of up to 13 years.

The annexes to this report include a more detailed case study on an EIB supported investment, this is summarised in the box below.

Box 3-9: Case Study – InnovFin FDP Instrument (Example WaveRoller)[118]

The EIB InnovFin First-of-a-kind Demonstration Projects (FDP) is a thematic pilot product under InnovFin (EU Horizon 2020 resources) for the financing of demonstration projects in the pre-commercial stage of development. The EIB and the EU hereby share the risk associated with a selected and funded project.

The WaveRoller is the first and so far only (2016) project supported by the InnovFin FDP. It is a submerged wave energy converter that generates electricity from the movement of the waves (surge phenomenon) and connects to the electric grid onshore. AW-Energy currently runs three of such 100kW demonstration units off the Portuguese coast. The EUR 10 million quasi-equity loan provided to the company by the EIB is supposed to boost the commercial roll-out of the technology.

EIB (InnovFin FDP) contribution: **EUR 10M**

c. European Fund for Strategic Investments

The European Fund for Strategic Investments (EFSI) is a EUR 16 billion guarantee from the EU budget, complemented by a EUR 5 billion allocation of the EIB's own capital. The total amount of EUR 21 billion aims to unlock additional investment of at least EUR 315bn by 2018. EFSI is implemented by the EIB Group and projects supported by it are subject to usual EIB procedures. EFSI is demand-driven and provides support for projects everywhere in the EU, including cross-border projects. There are no geographic or sector quotas. As of November 2017[119], EFSI has committed some €251.6 billion of finance (of which 21% is classified as energy relevant). In the past articles by BankWatch[120] raised concerns about EFSI-related investments in energy. Although energy efficiency projects and renewables were clearly encouraged in the EFSI portfolio, investments in fossil fuel projects were still supported. According to the authors, 'during its first year, the fund leveraged €1.5 billion for fossil fuel infrastructure, and 68% of transport investment is destined for carbon-intensive projects'. They recommend that fossil fuel projects should be taken off the EFSI agenda altogether. The proposal for an EFSI 2[121], appear to be addressing this, by adding an objective and proposing guidance – "The EIB shall target that at least 40 % of EFSI financing under the infrastructure and innovation window supports projects with components that contribute to climate action, in line with the COP21 commitments. The Steering Board shall provide detailed guidance to that end".

[118] Full case study can be found in the annex.
[119] Provisional and unaudited figures available at http://www.eib.org/efsi/index.htm
[120] CEE Bankwatch Network (2016). The best laid plans - Why the Investment Plan for Europe does not drive the sustainable energy transition. http://bankwatch.org/sites/default/files/best-laid-plans.pdf
[121] COM (2016) 597 final. Proposal for a regulation amending Regulations (EU) No 1316/2013 and (EU) 2015/1017 as regards the extension of the duration of the European Fund for Strategic Investments as well as the introduction of technical enhancements for that Fund and the European Investment Advisory Hub. http://eur-lex.europa.eu/resource.html?uri=cellar:08ec00f9-7a52-11e6-b076-01aa75ed71a1.0001.02/DOC_1&format=PDF

Box 3-10: Case Study – K.I.E.L. Coastal Power Plant[122]

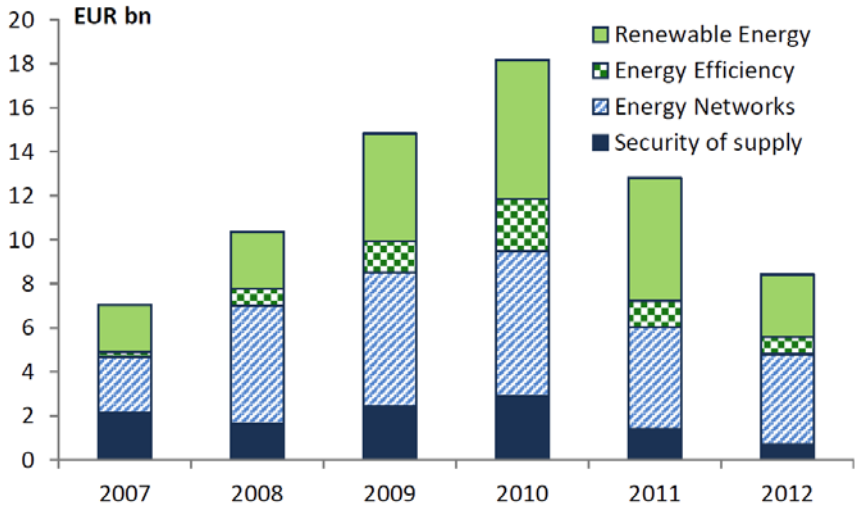
The K.I.E.L. (Kiel's intelligent energy solution) in the North German city of Kiel is a state-of-the-art, gas-powered CHP plant that will start operation in the second half of 2018. Energy conversion efficiency will come close to 90%, stemming from 45% thermal and 45% electric generating efficiency. This high performance of the plant will hence allow the city of Kiel to cut CO2-emissions from its primary source of energy by 70% relative to its retired predecessor.

EIB (EFSI) contribution: **EUR 105 million**

Other public finance & private finance: **EUR 185 million** (utility companies, banks, regional government)

The EIB applies energy lending criteria to assess projects that approach it requesting financial support. These criteria were adjusted on the basis of a 2013 review[123] to ensure that the banks' lending in the energy sector reflects EU energy and climate policy, as well as current investment trends. Their energy lending focuses on energy efficiency, renewable energy, energy networks, as well as related research and innovation. The EIB has also introduced an Emissions Performance Standard which it applies to all fossil fuel generation projects to screen out investments whose carbon emissions exceed a threshold level which reflects existing EU and national commitments to limit carbon emissions. The 2013 review provided the following sectoral split of energy funding by the EIB:

Figure 3-6: EIB Lending to the Energy Sector 2007 - 2012



***Source**: EIB (2013): EIB Energy Lending Criteria*

This sub sectoral split does not appear to have been updated since. The EIB website provides a list of all the projects it finances[124] (above a certain threshold) but only filters them by high level sector (so energy, rather than sub sector).

[122] Full case study can be found in the annex.
[123] EIB (2013). European Investment Bank Energy Lending Criteria. http://www.eib.org/attachments/strategies/eib_energy_lending_criteria_en.pdf
[124] Project list available at http://www.eib.org/projects/loan/list/index.htm http://www.eib.org/projects/loan/list/index.htm

d. Overview of main Climate Change relevant EU Financial Instruments

We have presented a table in Annex 2 that lists the main European FIs that support energy focussed projects. We have not attempted to quantify how much of each FI goes to energy projects. The second part of the table lists a number of other funds that are energy relevant but are arguably not financial instruments or are not part of the current MFF (although some are still active).

It is difficult to assess how much each of these FIs contributes towards energy projects. As discussed earlier in this report the Commission does have a system for capturing *climate relevant* expenditure, but this includes climate adaptation (e.g. flood resilience, adapting agriculture to altered weather patterns, urban drainage etc.) and climate mitigation (which is mainly energy related expenditure). Even when FIs quantify the amount or percentage of climate relevant finance they plan to provide there are also variations in what each FI defines as climate relevant. The Rio markers are the most commonly used approach, but their use is not universal.

In order to produce an order of magnitude figure for the EU FI contribution to the energy transition, we have taken the EU contribution and the predicted total fund value (so including leverage) over the 2014 – 2020, period for the two main groups of EU FIs and the EFSI and applied a simple 15% cut to this. The 15% is based on the 20% of EU investments being climate related and the assumption that ¾ of this is energy (climate mitigation as opposed to adaptation – which appears to be in line with reality). This gives the following indicative figures:

Table 3-3: Order of magnitude estimation of EU FI contribution to the energy transition

	(EUR bn) (2014-2020)			
	EU contribution	Total budget	Energy (15% – EU contribution)	Energy Total (15%)
FIs reported in the 140.8 report	8.4	137.6	1.26	20.64
ESIF FIs	21.5	352*	3.22	52.8
EFSI	21	350	3.15	52.5
Total (Indicative)			7.63	125.9

Source: Own estimates *The ESIF report does not estimate total predicted leverage, and there is likely to be a wide range between the many individual instruments and types[125]. We have used the leverage rate from the 140.8 report FIs to enable an estimate – though this may be somewhat optimistic.

The annual total from the main EU FIs that should go towards energy relevant projects over the 2014 – 2020 period (7 years, with leverage and assuming the funds are fully utilised) is in the region of EUR 18bn (125.9 / 7), based on an EU contribution of EUR 1.1bn (7.63 / 7). This figure is the value for 7 years and assumes that all of the FIs will utilise their entire fund value within this period. If the experience of the last MFF is repeated it is likely that the FIs will continue beyond 2020 in order to fully utilise their value. It is also interesting to calculate

[125] This was certainly the case in the previous MFF – see https://publications.europa.eu/en/publication-detail/-/publication/0084cc81-db02-11e7-a506-01aa75ed71a1/language-en/format-PDF/source-search

the leverage (the amount of money provided to match the EU contribution to the loans) this equates to a figure of approximately EUR 16.9bn per year ((125.9 – 7.63)/7).

3.2.3. Illustrative Case Studies – Employment Effects of the Energy Transition

Apart from its crucial positive impact on climate change mitigation efforts, as well as the creation of new job opportunities, the energy transition has, and is likely to continue to, lead to some adverse employment effects in fossil industries. For example, as power generation shifts from fossil fuels towards renewable energy sources (which creates some new job opportunities), some workers in the conventional energy sectors may face the threat of job loss. However, at the same time, the expansion of 'green' economic sectors are expected to have positive employment effects (e.g. OECD 2017). These job losses and job gains are likely to be in different locations and from different skill sets.

In order to help address any negative consequences of unemployment resulting from the energy transition, EU funds and programs target the people that potentially loose out via training and other support. This should help their switch to another sector. However, it is hard to ascertain exactly how much specific EU programmes seek to balance out negative impacts of the energy transition. For this reason these labour market support actions are not included in our calculations of EU-wide energy expenditures.

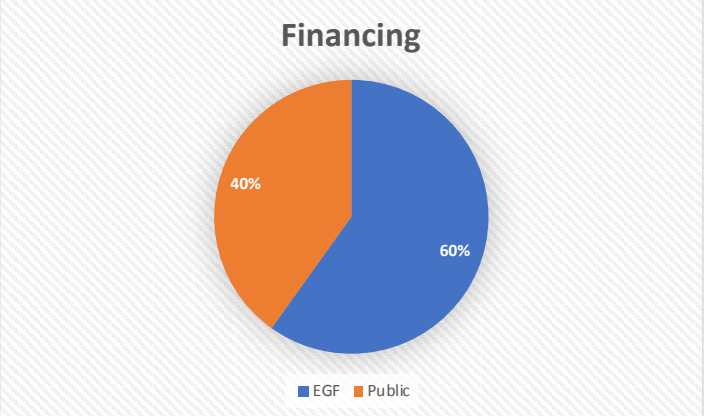
However, in order to illustrate the existence and relevance of EU activity, we have prepared the following two case studies of how the energy transition has affected sector-specific employment and what has been done to address these developments.

a. European Globalisation Adjustment Fund (Example: Coal & Lignite Mining in Spain)

European Globalisation Adjustment Fund (EGF)

Spain: Castilla y León Mining (Coal and Lignite)

(Sub)-Sector	Fossil Fuels
Technology	NA
Lead organisation	Government of Spain (ES)
Total capital costs	**EUR 1.67M**
EU finance:	**EUR 1M** • EGF



Leverage factor (EU / other combined): 1.5

Other public finance:	**EUR 0.67M** National/Regional Government
Private finance:	**NA**
Discussion	The European Globalisation Adjustment Fund (EGF) provides support to projects to help people who lost their employment due to structural changes in world trade patterns as a result of globalisation. The pressure to make the energy transition can be classified as such a change in global economic patterns. For the period 2014-2020, the EGF has an annual budget of maximum EUR 150 million to fund up to 60 % of the costs of projects which target unemployed workers and supports them in finding other employment or starting their own businesses. In general, the EGF can be used in cases in which more than 500 employees in a single company plus its supply chain are made redundant. The EGF can also be utilised if a large number of employees are **laid off in a particular sector** in one or more neighbouring regions. The EGF provides co-finance to projects which include the following measures: • Support for finding new employment opportunities, • career advice, • education, training and re-training, • mentoring and coaching, • entrepreneurship and business creation. --- Europe is a net importer of coal. Production of coal and lignite in the EU is relatively costly and production outside the EU has a competitive advantage. In addition to this, as a result of the energy transition coal and lignite will become less and less relevant as an energy source in Europe. While this example of support to 'losers' from the energy transition is mainly related to globalisation trends, it shows how such groups may be supported by the EU. In this particular example 339 employees in the coal and lignite sector in the Castilla y León region were made redundant, with 125 of these being classified as young individuals not in employment, education or training. Spain applied for support from the EGF in order to provide these workers with welcome and information sessions, occupational guidance and counselling, general training, re-training and vocational training, intensive job-search assistance, promotion of entrepreneurship and support for business start-up and various types of incentives, contributions and allowances. In case of the business start-up support, for example, the program would provide individuals with EUR 15 000 to cover set-up costs, investment in assets and current expenditure. This example may prove useful in the context of the energy transition as the territory affected in this case includes 81 towns which are economically dependent on coal mining and located in a rural area.
Sources	▪ COM (2017) 266 final. Proposal for a Decision of the European Parliament and of the Council on the mobilization of the EGF following and application from Spain. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52017PC0266&qid=1499441884661&from=EN ▪ EC (2017). European Globalisation Adjustment Fund. http://ec.europa.eu/social/main.jsp?catId=326&langId=en ▪ Regulation (EU) No. 1309/2013 on the European Globalisation Adjustment Fund (2014-2020) and repealing Regulation (EC) No 1927/2006. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R1309&from=EN

b. Indirect Effects of 'Green Expenditure'

Employment growth induced by investment in renewable energy in Germany	
(Sub)-Sector	Renewable Energy
Discussion	While the transition towards renewable energy may have negative employment effects for those employed in the coal industry, investments in renewable energy lead to the creation of new jobs in a growing sector worldwide. Renewable energy employment worldwide has continued to grow over the last years. Although the rate of growth has been moderate for the last two years, the trend remains positive in contrast to traditional energy industries where employment has decreased in several markets. This decrease has been due to rising automation in extraction, overcapacity, industry consolidation, regional shifts and the substitution of coal by natural gas in the power sector. Climate policies put additional pressure on the sector. Additionally, according to IRENA (2017), on average, renewable energy technologies create more jobs per unit of output than fossil-fuel technologies. Germany provides an interesting case study for these dynamics with a rather high share of renewable energy and a strong dependency on coal at the same time. In 2016, 31.7% of gross electricity consumption was supplied by renewable energy, while lignite and hard coal accounted for 40.3% of gross electricity production. In Germany, 333,700 people were employed in the renewable energy industry in 2015, making up about 1% of the total workforce. By contrast, direct employment in the lignite and hard coal industry only amounted to about 30,000 jobs in 2016. Two thirds of the employees in this industry will be older than 60 in 2030. The relatively small size of the industry, and its ageing workforce suggest that a coal phase-out over the next 20 years would not threaten a large amount of jobs. About EUR 15 billion were invested in Germany in 2015 in renewable energy plants; about 2/3 of these investments went to wind power plants. According to a recent study commissioned by the Ministry for Economy and Energy, the expansion of renewable energy production plants has the largest influence on employment in the renewable energy sector. A total investment volume of EUR 1,900 million by producers of means of production for the renewable energy industry has created 10,100 jobs in that sector in Germany in 2013. The federal state of Saxony-Anhalt is one of the main geographic areas in Germany where coal plays a very important role for the economy. About 8,300 jobs (out of 1.044 million employees in that state, or 0.8%) were directly linked to the lignite industry in that state in 2016. However, at the same time, Saxony-Anhalt is the state with the highest relative employment (direct and indirect) in the renewable energy industry (2.5% in 2015; roughly 24,000 employees in total in 2013). 57% of those employees are working in the wind power sector, but through the expansion of solar energy, a high number of jobs is available in this branch as well. This includes jobs related to the construction of new power plants, running and maintaining these plants and generating biomass and other renewable fuels. In Saxony-Anhalt comparatively, few different industry branches are settled, and its economy is comparatively weak. For its future economic development, renewable energy as well as urban energy transition were identified as potential new and promising fields of engagement. However, in terms of expenditure on research and development for renewable energy, Saxony-Anhalt only ranked 7th out of 16 German federal states for 2014-2015, spending about EUR 23 per million EUR GDP of the state on renewable energy. For research and development spending for the system integration of renewable energy, the state ranked 5th with EUR 21 per million EUR GDP of the state for 2014-2015. In 2017, the EIB and the German credit bank DKB agreed on a framework loan of EUR 250M, enabling DKB to invest EUR 500M. 50% of this money will go into projects on renewable energy.

Sources	
	▪ BMWi (2017). Erneuerbare Energien. ▪ https://www.bmwi.de/Redaktion/DE/Dossier/erneuerbare-energien.html ▪ BMWi (2015). Erneuerbare Energien in Zahlen. https://www.bmwi.de/Redaktion/DE/Publikationen/Energie/erneuerbare-energien-in-zahlen-2015-09.pdf?__blob=publicationFile&v=14 ▪ BMWi (2015). Beschaeftigung durch erneuerbare Energien in Deutschland: Ausbau und Betrieb, heute und morgen. https://www.bmwi.de/Redaktion/DE/Publikationen/Studien/beschaeftigung-durch-erneuerbare-energien-in-deutschland.pdf?__blob=publicationFile&v=6 ▪ DIW Berlin (2017). Vergleich der Bundeslaender: Analyse der Erfolgsfaktoren fuer den Ausbau der Erneuerbaren Energien 2017. ▪ EIB (2017). EUR 250M loan for investment in renewable energy. http://www.eib.org/infocentre/press/releases/all/2017/2017-016-250-millionen-euro-fur-investitionen-in-erneuerbare-energien.htm ▪ IRENA (2017). Renewable Energy and Jobs Annual Review 2017. http://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/May/IRENA_RE_Jobs_Annual_Review_2017.pdf ▪ SRU (2017). Kohleausstieg jetzt einleiten.

3.3. Defining Remaining Gaps in Finance, Leverage, and Knowledge

This section seeks to highlight the gaps that appear to exist between the current situation and what is needed in order to achieve the EU energy transition.

First, the overall financing challenge is presented by comparing the projected business-as-usual (BAU) level of EU-wide investments with the required future expenditures to meet the energy and climate targets. In a second comparison, the relative contribution of EU finance (funds and FIs under the MFF) is assessed and how it needs to progress to support the energy transition effectively. Lastly, knowledge gaps relating to investment needs and expenditure levels are discussed that currently constrain proper analysis of energy spending in the EU.

3.3.1. Comparison 1: Overall Energy/Climate Objectives versus current total actual Investment Volumes

The EUCO30 scenario is the most recent scenario drafted by the European Commission based on achieving the EU's 2030 climate and energy goals. The REF2016 scenario is the business-as-usual scenario, based on the current policy environment not changing until the year 2030, yet still requiring a certain level of investment. Therefore, *the difference between the two scenarios illustrates the magnitude of the additional finance (on top of projected spending) that needs to be mobilised up to 2030 in order to meet the targets.*

The following table gives a quantitative overview of the annual finance gap for achieving the 2030 climate and energy goals in the EU.

Table 3-4: Overview of the remaining annual mitigation finance gap in Europe to achieve the EU's 2030 climate and energy targets, in Billion 2015 EUR

Scope: EU-28, excl. transport **Unit**: all figures presented in Billion 2015 EUR [126]	***Forward-looking projected mitigation spending baseline*** *(based on latest EC business-as-usual scenario[127])*	**Estimated total annual mitigation investment needs** *(based on latest EC scenario achieving 2030 targets[128])*	**Remaining annual mitigation financing gap**[129]
	Annual average spending projection, *2021-2030*	*Annual average estimated total investment needs,* *2021-2030*	*Annual average additional investment volumes required in addition to projected spending volumes,* *2021-2030*
Total – Mitigation (excl. Transport)	**231**	**381**	**150**
Total – Supply side[130]	**65**	**78**	**13**
Grid infrastructure[131]	34	36	2
Power generation (total)[132]	31	42	11
- RES[133]	*25*	*34*	*9*
- Conventional *(of which CCS)*	*6* *(0.11)*	*8* *(0.17)*	*2* *(0.06)*
Total – Demand side[134]	**166**	**303**	**137**
EE- Industry	15	19	4
EE – Buildings (households)	128	216	88
EE - Buildings (tertiary sector)	23	68	45

Source: Trinomics (2017) own development based on EP (2017) and EC (2016)

[126] All figures from different sources have been converted into EUR'15 constant figures to enable a direct comparison. The inflation rates used to carry out this conversion are based on https://www.statbureau.org/en/eurozone/inflation-calculators. All figures have been rounded to full billions. This explains why some figures do not add up exactly to the totals presented in the table.
[127] EC (2016) Impact Assessment. The so-called 'REF2016' represents the latest business-as-usual scenario assuming all current (2016) existing and already planned policies will continue to be implemented in the future, but no additional efforts will be made. Figures converted from EUR'13 bn to EUR'15 bn.
[128] EC (2016) Impact Assessment. The so-called 'EUCO30' is the scenario that best represents achieving the latest set climate and energy goals of the EU, namely 40 % GHG reduction, 27 % RES share, 30 % energy savings. Figures converted from EUR'13bn to EUR'15bn.
[129] The remaining financing gap can be defined as an order of magnitude indication of the additional investments that will need to be mobilised every year from public and/or private sources in order to achieve the European climate and energy targets by 2030; these financing gap volumes need to be realised in addition to what is already projected to be financed under a business-as-usual pathway (i.e. projecting current financing volumes and existing policy measures into the future).
[130] Supply side: Investments on the supply side (power generation) include grids as well as power generation (power generation plants and industrial boilers).
[131] For both EP (2017) and EC (2016) 'grid infrastructure' includes distribution and transmission infrastructure.
[132] For both EP (2017) and EC (2016) 'power generation' includes power plants and steam boilers.
[133] Breakdown RES/conventional from IEA WEO (2014): 75 % RES for baseline; 80 % RES for needs.
[134] Demand side: Investments on the demand side include energy equipment (covering appliances in households and tertiary sector, industrial equipment etc.) and direct energy efficiency investments (covering renovation of buildings improving their thermal integrity). Although not entirely accurate, it is the best order of magnitude figure currently available for representing the investments in energy efficiency. Excludes transport figures.

Table 3-4 above shows that the total annual (2021-2030) mitigation financing gap is EUR 150bn. The vast majority of this total is EUR 137bn of additional energy efficiency investment needs in buildings and industry, with a comparatively small additional finance requirement for grid infrastructure (EUR 2bn) and power generation (EUR 11bn). This shows that most of the additional investment required is in energy efficiency.

This financing gap for the energy transition represents roughly 1% of European Union GDP[135]. Most of this additional financial burden will need to be met by the private sector (i.e. households and business). This is partially due to the fact that the largest finance gap exists in private household energy efficiency[136].

The implications of this gap for policies and how they could stimulate the appropriate financial actors to invest in the energy transition is discussed in Chapter 4 of this report.

3.3.2. Comparison 2: The Role of the EU Budget in the overall Financing Challenge

The figures below summarise our estimates of the total current and projected energy spending needs along with our estimates of current EU energy relevant spending.

Total finance (all public and private sources – EUR '15	**EUR bn / year**
Total current annual energy investment volumes	193
Predicted baseline annual energy investment by 2030	231
Predicted total annual energy investment needed by 2030 to reach targets	381
Remaining financing gap (predicted baseline investment vs. needed investment level)	150 (381 – 231)
EU-level finance	
Current EU MFF energy relevant expenditure[137]	6.99 (48.91 / 7)
Non MFF EU contribution to FI expenditure with energy relevance (the EFSI)	0.45 (3.15 /7)
Leverage from the FIs to expenditure with energy relevance	16.9
Role of EU Budget in overall financing challenge	
Total current EU contribution to energy relevant expenditure (without leverage from the FIs)	7.44 (6.99 + 0.45)
Total current EU contribution to energy relevant expenditure (with leverage from the FIs)	24.34 (16.9 + 7.44)

In comparison to current EU-wide annual energy investments (EUR 193bn), the predicted spending baseline up to 2030 (EUR 231bn) and the extra finance required to meet the EUs

[135] Eurostat (2016). Available at http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nama_10_gdp&lang=en
[136] EC (2016) Institutional Paper 041. Investment Challenges in Energy, Transport & Digital Markets – A Forward Looking Perspective. https://ec.europa.eu/info/sites/info/files/file_import/ip041_en_2.pdf
[137] Converted to EUR '15.

targets and goals (EUR 381bn – EUR 231bn = EUR 150bn), the contribution of the EU budget appears to be rather small. Adding together our estimates of energy relevant contributions from MFF funds and FIs that EU funds contribute to, the annual EU financial contribution to the energy transition is approximately EUR 7.44bn (3.8% of current annual EU-wide investments). If the leverage associated with the FIs that the EU contributes to is included, the total energy investments that EU funds are associated with increases to EUR 24.34bn per year. This is 12.6% of current energy investments. It is important to remember that this figure includes numerous assumptions and it should only be treated as an approximate estimate.

If the current EU spending (including the leverage) is compared to the total projected energy investment required to meet the targets by 2030 (EUR 381bn) it is 6.9% of the total. It is not credible to compare current EU spending to the finance gap because this would assume that the EU expenditure could be removed from the baseline energy expenditure and applied solely to the gap.

This relatively low percentage contribution leads to the conclusion that rather than being a very large-scale investor, the EU's programmes and FIs are designed to intervene (directly) where the market is failing. This role at the margins of economically feasible investment has led to important progress in the transition to a low-carbon economy[138].

It is also important to recognise that the EU has a major influence on spending in the energy sector via its policies and regulations (e.g. renewables obligations and smart grid targets). The EU's management of the EU-ETS and energy market reforms are also key to influencing energy investments.

3.3.3. Comparison 3: Remaining Knowledge and Data Gaps

It is apparent from our work, and the work we have referenced, that the EC has recognised the role its direct expenditure can play in helping to achieve its energy and climate targets and goals, as reflected by the commitment that 20% of its budget should be spent on climate-relevant investments (of which mitigation is a part)[139]. A recent study from DG CLIMA which the consulting team was involved in found that progress on this mainstreaming effort has been made but it will require continued determination by policy makers to sustain momentum and there are numerous improvements that could be made to the monitoring and reporting of the target[140].

Our work has confirmed that several knowledge and data gaps exist that restrict the proper assessment of energy transition expenditures in Europe under the current MFF. These gaps stem from either methodological problems or a lack of available data.

As can be seen in the discussion of MFF funds in section 3.2.1., the split between climate change adaptation and mitigation spending is currently not defined. This makes it difficult to filter out the exact amount of energy transition-relevant expenditures per programme and

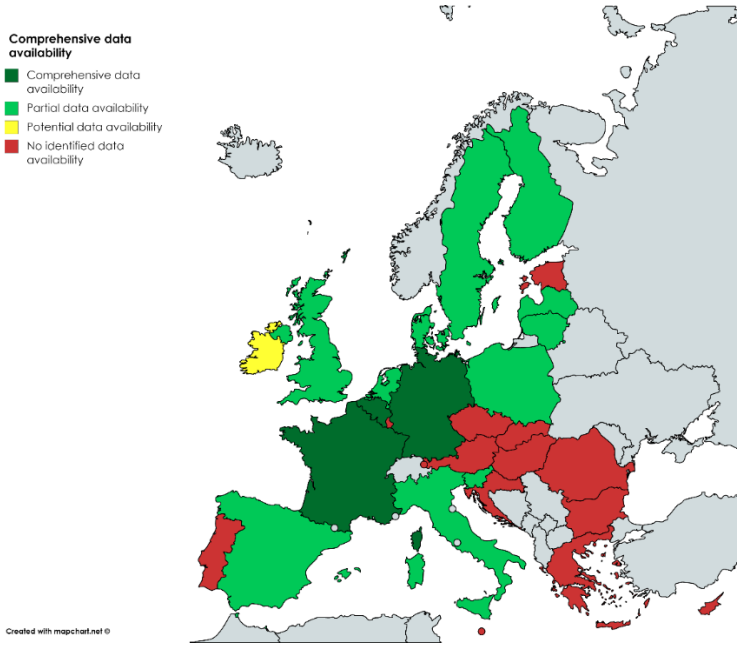
[138] See case studies in Annex 1 for examples of this.
[139] COM (2011) 500 final. A Budget for Europe 2020 – Part II: Policy fiches. http://ec.europa.eu/budget/library/biblio/documents/fin_fwk1420/MFF_COM-2011-500_Part_II_en.pdf
[140] EC (2017). Climate mainstreaming in the EU Budget: preparing for the next MFF. https://publications.europa.eu/en/publication-detail/-/publication/1df19257-aef9-11e7-837e-01aa75ed71a1/language-en

FI. In some instances, the budgeting methodology also fails to allow thorough tracking of energy-relevant spending as investments can be spread across numerous sub-sections of the budget (e.g. Horizon 2020).

At EU level, data is lacking to split energy investments by different sources of finance. A detailed analysis of mitigation expenditures from the public and private sector is currently only available from three Member States (Germany, France, Belgium)[141]. For some technologies (e.g. RES) EU-wide data development is more advanced and detailed splits are possible. However, this also only provides a fraction of the necessary information to accurately assess EU energy investments according to their source of finance.

In order to visualise the data availability on mitigation expenditures, Map 3-1 provides an overview for all EU member states. As can be seen, only three countries have conducted domestic climate finance landscape exercises that provide sufficiently comprehensive data. Partial information is available for most of the 'old' Member States, but the new Member States lag behind in providing detailed information on current mitigation expenditures.

Map 3-1: Availability of actual mitigation spending data across EU Member States



Source: Adapted from Trinomics (2017). Assessing the State-of-Play of climate finance tracking in Europe.]
[Note: dark green = comprehensive actual spending figures available, light green = limited/partial actual spending figures available, yellow = respondent indicated availability, but figures could not be verified (confidential), red = no figures were found.]

[141] See section 3.1.2. for more information and links to the MS climate finance mapping exercises.

4. MAXIMISING THE EU'S CONTRIBUTION TO ACHIEVING FUTURE ENERGY AND CLIMATE GOALS – POLICY RECOMMENDATIONS

4.1. Conclusions

The key findings from this analytical study reiterate what has been concluded by previous studies:

- The financing gap to achieve the targets and goals associated with the European energy transition is substantial (ca. 1% of EU-wide GDP on an annual basis between 2021-2030).
- Currently, the vast majority of energy expenditure comes from private investors, as well as (non EU) public sources in Member States.
- The volume of EU finance (i.e. from the EU Budget) is too small to close the financing gap alone; and there appears to be no prospect of an increase of the order of magnitude likely to change this.
- The EU has recognised that its direct expenditure can play a positive role in helping to achieve its climate and energy targets, with its commitment to spend 20% of its budget on climate relevant investments. However, there are a number of ways in which the targeting, measurement and reporting of this 20% commitment could be improved.
- The EU's role in encouraging additional finance is very important. EU driven market instruments are key to directing private investment (e.g. EU-ETS, renewables, energy in buildings, product policy, market mechanisms).
- Direct EU finance (programmes and FIs) has an important role to play in helping to finance the energy transition. This role should continue to prioritise supporting aspects which are not yet attractive to private finance, possibly because of their transnational nature.

4.2. Recommendations

Due to the very wide scope of the programmes, FIs and sectors covered in this study, it is beyond the scope of this report to develop detailed programme level recommendations. However, the key findings of the previous chapters lead to four main policy recommendations. The remainder of this section develops each of these main recommendations in more detail.

4.2.1. Recommendation 1: Recognising the Limits of EU Finance and emphasising the central Importance of EU Policy Influence on Incentives and Market Design

The vast majority of current energy expenditure comes from sources other than the EU and this is unlikely to change in the future. Current EU-wide annual spending on energy investments is in the order of EUR 193bn (EUR 2015), with the majority of this finance coming from private sources and non-EU public sector in Member States. This compares to an annual EU contribution of approximately EUR 7.44bn (EUR 2015) (roughly 4% of total annual EU-wide energy expenditure). Annual spending on energy would need to increase to about EUR 381 bn per year in order to reach the EU's climate and energy targets and goals. Given the pressure on EU finances, the EU contribution to total energy spending seems unlikely to increase.

Therefore, it is crucial to recognise the limits of EU finance and rely on the central importance of EU policy influence on incentives and market design to mobilise the vast majority of the

additional finance that is required in order to meet the EU's energy and climate goals. If the additional financing needs are to be achieved, significant increases in private and other public finance are urgently needed. The EU can play a vital role in shaping and enabling a policy and market environment that supports this major shift.

In particular, the transition of the electricity sector, as well as addressing energy efficiency in the building sector represent the largest remaining financing challenge if energy and climate targets and goals up to 2030 are to be met.

Filling the Financing Gap for R&D and Technological Development

Research and innovation (R&I) is one of the pillars of the EU's Energy Union. The 2016 EU Communication on 'Accelerating the Clean-Energy innovation'[142] recognises the important role that EU policy and funding can play in this field where private investors typically do not (yet) invest large enough amounts. Three key roles for the EU to play in this field have been identified[143] in the Communication and should continue to be emphasised, namely:

- Set the political ambition and create the right business environment through targeted signals, policies, standards and regulations to foster research and innovation relevant for the energy transition.
- Deploy targeted financial instruments to lower the risk of private investments in untested but promising clean energy technologies or business models.
- Focus its research and innovation funding, in particular through Horizon 2020, to push the frontiers of science and knowledge.

Furthermore, it is important to continue supporting R&I actions in the four focal areas, selected in the Communication for their potential to accelerate the development and market introduction of breakthrough technologies: (a) decarbonising Europe's building stock, (b) strengthening the EU's leadership in renewable energy technology (RES), (c) energy storage solutions, and (d) e-mobility. More than EUR 2 billion are earmarked in support of these priorities for the last three years of the Horizon 2020 programme (2017-2020). Additional financing is already available through the European Innovation Council and by deepening synergies with and therefore increasing applicability of the European Structural and Investment Funds. The Commission also works with the European Investment Bank (EIB) to boost private investment in innovative technologies, for example, by at least doubling the budget of the InnoFin Energy Technology Innovation Scheme to more than EUR 300 million. Additionally, the Commission actively supports developing a project pipeline of innovative clean energy projects and brings them to the attention of investors. It is crucial that these activities are continued and even strengthened in order to reach 2030 and 2050 EU policy ambitions.

Shaping an enabling Policy Environment and optimising Market Design

Various specific policy options exist when looking into how to best shape an enabling policy environment and the right market design for maximising investments in the energy transition. Among others, the following options have been suggested by experts:

[142] COM(2016) 763 final. Accelerating Clean Energy Innovation. Available at https://ec.europa.eu/energy/sites/ener/files/documents/1_en_act_part1_v6_0.pdf
[143] COM(2016) 763 final. Accelerating Clean Energy Innovation. Available at https://ec.europa.eu/energy/sites/ener/files/documents/1_en_act_part1_v6_0.pdf

- The High-Level Group on Sustainable Finance suggested exploring the introduction of political risk guarantees for sustainable (climate-resilient) infrastructure investments.[144] In order to better promote the development of sustainable financial products as well as new energy investments, political risk guarantees could be introduced to limit investor uncertainties regarding future policy changes.
- The Mid-term Review of the Capital Markets Union proposed pursuing the 2016 proposal to amend the capital requirements legislation thereby creating a more risk-sensitive regulatory framework which then would better incorporate climate risks into investment decisions.[145]

Mobilising additional Investments in the Electricity Sector

A recent study[146] on European Energy Industry Investments for the ITRE committee identified a number of policy options on this. The first group of policy options concerns methods of incentivising investments in the liberalised subsectors via properly functioning electricity and carbon markets. Examples of these policy options include:

- Liquid and EU wide integrated electricity wholesale and ancillary services markets.
- Market-based, predictable and harmonised national policies and support schemes.
- Internalisation of GHG emission cost via stronger carbon price signals.
- Abolishing price regulation in electricity retail and wholesale markets.
- EU wide capacity market with suppliers' obligation to ensure RES development and security of supply.

The report states that if the carbon and electricity price signals generated by properly functioning markets are not sufficient to trigger the required investments, the following policy options can be considered to incentivise low carbon investments:

- An EU wide legal initiative to phase out outdated conventional power plants.
- Abolishing ETS and replacing it with an EU wide carbon tax.
- Tendering at (supra)national level for conventional and/or RES generation capacity (technology specific or technology neutral tendering).

The regulatory framework is very important to facilitate investments, both in the regulated (grids) and non-regulated subsectors; to this end two specific policy options were suggested:

- Determining clear EU wide rules to encourage investments in flexibility (storage and demand response).
- Enabling a more rapid permitting procedure for investments in grids and power generation units.

Two policy options identified to improve the financial framework for electricity investments in the regulated and not regulated sub-sectors were:

- Facilitating availability of, and access to, appropriate public and private financing instruments and partners for electricity investments.

[144] HLEG Sustainable Finance (2017). Interim Report. Available at: https://ec.europa.eu/info/sites/info/files/170713-sustainable-finance-report_en.pdf
[145] COM(2017) 292 final. Mid-term review of the Capital Markets Union Action Plan. Available at: https://ec.europa.eu/info/sites/info/files/communication-cmu-mid-term-review-june2017_en.pdf
[146] European Energy Industry Investments. Study for the ITRE committee, February 2017, Available at http://www.europarl.europa.eu/RegData/etudes/STUD/2017/595356/IPOL_STU(2017)595356_EN.pdf

- Providing more targeted and coordinated public support at EU level for research & development (including pilot projects) in innovative and promising technologies.

Boosting Investment in Energy Efficiency Renovation of existing Buildings

A 2016 study[147] for the ITRE committee on 'Boosting Building Renovation: What potential and value for Europe; 'identified a range of policy options to achieve this. The report concluded that a full range of mandatory and voluntary policy measures are needed to boost investment in renovation of private and public buildings. A combination of tougher obligations, stronger incentives and more creative use of instruments alongside effective transposition, implementation and enforcement of existing legislation are prerequisites to boost renovation.

In addition, the report states that it is crucial to support local authorities and actors from the building sector in their investment decisions. They are essential players, but their respective needs in terms of applying for funding and implementing projects are currently not explicitly addressed. Given the lack of available, reliable data, local actors sometimes find themselves in the dark when it comes to planning investments. In this sense, establishing a strong role for the EU as a data/information aggregator/observatory could provide both the right authority for gathering data on risks, challenges and investment needs to address them and the right counselling for local and regional actors at the time of project development and implementation.[148]

4.2.2. Recommendation 2: Concentrating the limited EU Funding available on its important Role at the Margins of the Energy Transition

The limited EU funding sources – rather than being dispersed across multiple fields – could better be focused on the important role that the EU Budget is playing at the margins of the energy transition, i.e. where Member States and private investors do not spend their money. Two key roles for the EU's funding identified in this report are (a) supporting R&D and technological innovation, as well as (b) leveraging co-finance for those projects that would otherwise not receive investment.

For these roles for EU funding, it is important to retain a mix of grants and FIs to reflect how 'near to market' the activities being supported are – far from market needs grants, closer to market needs FIs. The funding mix (and involvement) needs to be able to evolve to reflect the changing energy market - as things become commercially viable EC support should stop. FI design needs to allow redirection if market needs do not materialise or if it is duplicating commercial loans. This already happens to an extent, as annual priorities change within programmes and between MFFs, but needs to be explicit in FIs as well as grant programmes. Current FI rules appear to make this difficult.

Policy options to improve current grant programmes and FIs therefore include (but are not limited to) the following:

- Retain the grant-based programmes targeted on energy transition – with adjustments on monitoring and reporting (see next groups of recommendations).

[147] Boosting Building Renovation: What potential and value for Europe? Study for the ITRE Committee. October 2016. Available at: http://www.europarl.europa.eu/RegData/etudes/STUD/2016/587326/IPOL_STU%282016%29587326_EN.pdf
[148] E3G (2017), Climate Action and the EU Budget: Priorities for the Next MFF. Available at: https://www.e3g.org/docs/2017_PDF_E3G_Key_issues_for_post_2020_MFF.pdf

- Retain FIs – with adjustments on monitoring and reporting (see next groups of recommendations).
- Increased use of FIs, with efforts to maximise the impact per EU euro spent. However, there is also a need to address the risk of duplicating private funds in areas that are already economical, and the fact that 'cutting edge' areas will not be attractive to match funders, so financing these technologies is not likely to work via FIs.
- Assess ways of making changes in FIs as they go along easier. This should include possibly stopping them and/or moving their focus elsewhere if demand shifts.

4.2.3. Recommendation 3: Improving the Mainstreaming of Climate Objectives in other EU Policies and Budget Lines

While there are multiple ways to implement this recommendation, it is beyond the scope of this report to describe approaches and strategies for each programme and FI. Generally, the mainstreaming of climate objectives in other EU policies and corresponding budget lines can help maximise funding availability and relevance for the energy transition. However, mainstreaming should be done in such a way that it does not overly distract from the primary purpose of each EU programme. Options to implement mainstreaming include, for example, the provision of guidance on how to mainstream climate objectives in the various EU programmes.

Additionally, there are further research needs to improve evidence and support decision making. All EU programmes could be further analysed to identify those which are the most capable of delivering climate objectives. This could be achieved using a traffic-light system, based on the budget, climate contributions, and potential to deliver climate outputs.

4.2.4. Recommendation 4: Further Developing the Reporting and Monitoring of Energy and Climate Expenditure across all Financing Sources.

The following specific actions (as recommended in a recent report for DG CLIMA[140]) could be taken by the European Commission in the next MFF to improve reporting and monitoring of energy and climate expenditure from European Union sources:

- ✓ **Develop further guidance** to lead climate mainstreaming activities within budget programmes and improve consistency.
  - Develop a "single rule book"/ investment guidelines for climate mainstreaming.
  - Provide guidance on what should be included in a list of FIs under the EU budget.
  - Provide guidance, in line with the Multilateral Development Bank approach, to support the reporting of leverage by climate relevant FIs.
  - A greater focus on the use of guidance in practice, and a commitment to learn from experience.

- ✓ **Develop further tools and methodologies.** To improve mainstreaming and tracking:
  - Develop harmonised methodologies for the calculation of GHG impacts.
  - For financial instruments, efforts should be made to fully utilise existing data (on the nature of the individual loans) to enable accurate climate change impacts to be estimated (and /or monitored).

- ✓ **Ensure that methodologies are applied consistently**
  - Revisit the allocation of climate markers. To ensure consistency, for example on the application of "significant" and "moderate" and excluding some expenditure.

- Ensure a consistently accurate presentation of the 20% objective e.g. expenditure which "contributes towards climate objectives"

✓ **Establish some new requirements** to support mainstreaming.
- Require climate mainstreaming to be considered for all investment areas.
- Earmark climate funding. Consider more minimum spending requirements on climate objectives in the future MFF, though primary objectives cannot be over ridden.
- Separate climate mitigation and adaptation mainstreaming targets in order to ensure that attention is paid to both objectives.
- Consideration of a mandatory climate change 'window' for all new and substantially revised FIs. As with EFSI 2.0, to an agreed definition. Not relevant for all.

✓ **Improve linkages with other requirements and activities**
- Create a link between the monitoring of climate contributions through shared management programmes, and the National Energy and Climate Plans (NECPs) under the currently negotiated Regulation on the Governance of the Energy Union.
- Establish a stronger link between allocations for mitigation actions and their contributions to the overall delivery of EU and Member State climate objectives.
- Make greater use of vulnerability and risk assessments and in particular creating a closer link between National Adaptation Strategies and EU allocations to adaptation.

Additionally, the EU could play a role in supporting better monitoring and reporting from Member State and private financing sources:

✓ **Act as a facilitator / aggregator of energy finance data from private sources.** There is a clear lack of publicly available data from all private sources of finance. As has been highlighted before, the private sector is expected to contribute the largest share of the remaining financing gap; yet at the same time it is the source of finance with the most apparent data accessibility gap for monitoring progress.

✓ **Support MS in carrying out data collection and reporting exercises to gather investment information relevant for the energy transition.** There is a clear lack of (sufficiently detailed) information regarding estimated total investment needs, as well as current and planned expenditure volumes for climate and energy purposes across almost all MS.[149] As a result, the EU estimates of total climate finance investment needs are not matched by complementary national assessments. This introduces considerable uncertainty about the magnitude and nature of the remaining financing gap Europe is facing to meet and manage the transition to a low-carbon climate-resilient economy.

4.2.5. SWOT Analysis of the Policy Recommendations

As a next step, the four recommendations elaborated above are analysed with SWOT tables.

[149] See key findings in Trinomics (2017). Assessing the state-of-play of climate finance tracking in Europe. Available at: http://trinomics.eu/climatefinancetrackingineurope/?aid=3295&sa=0

1. **Recognise the limits of EU finance**, but **emphasise the central importance of EU policy influence and direction** on incentives and market design.

Strengths	**Weaknesses**
• *Recognises the reality in the balance of who funds energy investments* • *Policy influence / setting (incentives, market design, standards etc.) can mobilise extensive private finance to help achieve energy and climate finance – without having to inject extensive EU level funds.*	• *Risks underemphasising the important role of EC direct finance in supporting investments that are not attractive to the market, either because of technological immaturity or the lack of market structures and incentives to fully reward the benefits.*
Opportunities	**Threats**
• *Helps to stress the importance of policy decisions and avoids any illusions that EU direct finance can close the finance gap alone.*	• *The opportunities available through maximising the positive climate impacts of EU direct spending might be lost, if this is seen as an admission that EU influence on achieving its energy and climate targets is limited.*

2. **Concentrate the limited EU funding available on its important role at the margins of the energy transition** – for example EU funding should continue its focus on supporting R&D and technological development not yet attractive for private investors.

Strengths	**Weaknesses**
• *Focusses intervention on where the market failures are most pronounced and important.* • *Leading by example*	• *Fast moving marketplace, in which some technologies can (relatively) quickly become commercial and no longer need public support.* • *Picking which technologies / investments are most deserving of EU support is not easy – though the existing programmes and FIs do attempt to achieve this.*
Opportunities	**Threats**
• *Opportunity to design programmes and (especially) FIs for the next MFF with the flexibility to adjust their scope / targeting to allow adjustments based on technology and market developments. (i.e. to stop support for technologies that become commercially viable, or to withdraw EU FIs when private finance becomes available, or there is no demand for loans manifests itself (because it's still too far from the market)*	• *Some energy investments are very long term and high risk / reward (e.g. ITER). Comparing these with other energy technologies/ investments may not be fair and could lead to withdrawing support for potentially very valuable technologies that will never attract private finance.*

3. **Improve mainstreaming of climate objectives in other EU policies and budget lines** to maximise funding availability and relevance for the energy transition.

Strengths	**Weaknesses**
• *Low cost, maximises existing opportunities, extracts more benefit from existing expenditure* • *Could improve links with MS activities (for programmes with decentralised management e.g. ESIF), so deepens influence / impact.* • *Leading by example (demonstrating to other public and private bodies) that these issues can and should be considered.*	• *May not result in significant additional investment, primary objectives of spending will (and arguably should) 'win' over climate.* • *Seen as additional administrative burden.*
Opportunities	**Threats**
• *Raise profile for relatively low cost* • *Opportunity to use existing system to raise profile and engage across multiple policy areas.*	• *Primary objectives of spending will (and should) 'win' over climate. Seen as additional admin burden.* • *Subsidiarity risks – seen as overly interfering in how MSs spend EU funds (on decentralised management programmes)*

4. **Further develop the reporting and monitoring of energy and climate expenditure across all sources of EU finance**.

Strengths	**Weaknesses**
• *Improves monitoring and uptake – so full use is made of the potential benefits and areas of poor practice can he highlighted and addressed.* • *Extracts more benefit from existing expenditure* • *Identifies opportunities on a consistent and comprehensive basis*	• *Seen as additional administrative burden, relating to policy objectives that may not be at the core of the programme / FI in question.* • *Optimum approach will vary across programmes and FIs, depending on sector specifics and scale, meaning that approach needs to be tailored – labour intensive and outside the expertise of sectoral experts (needs energy / climate input as well)*
Opportunities	**Threats**
• *Raise profile for relatively low cost* • *Use existing system to increase energy expenditure.* • *Opportunity to use existing system to engage across multiple policy areas*.	• *Primary objectives of spending will (and maybe should) 'win' over climate.* • *Seen as additional admin burden.*

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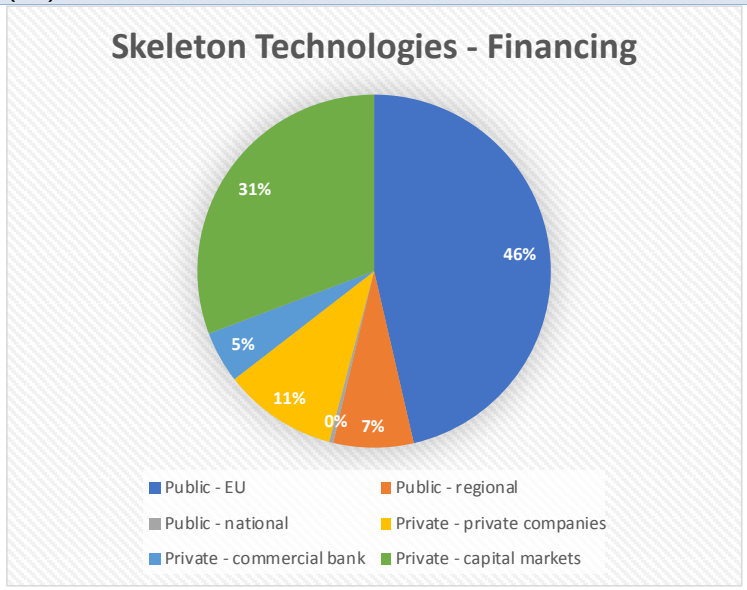
ANNEX 1. CASE STUDIES

a. Skeleton Technologies

Skeleton Technologies

(Sub)-Sector	Energy efficiency
Technology	Graphene-based ultracapacitors and energy-storage systems
Lead organisation	Private project developers (Taavi Madiberk & Oliver Ahlberg as well as two other Estonian researchers) (EE)
Total capital costs	**EUR 42.27M**
EU finance:	**EUR 19.61M** • FP7 (HESCAP) – EUR 0.28M (0.66%) • JRC (e-Gotham) – EUR 0.19M (0.44%) • JRC (I3RES) – EUR 0.13M (0.3%) • H2020 (SME Instrument) – EUR 2.49M (5.83%) • ESIF – EUR 0.96M (2.25%) • EEA – EUR 0.56M (1.31%) • EIB – EUR 15M (35.13%)
Other public finance:	**EUR 3.26M** • Sächsische AufbauBank (Public - Regional) – EUR 3.1M (7.26%) • Estonian Government (Public - National) – EUR 0.16M (0.37%)
Private finance:	**EUR 19.4M** • InnoEnergy (Private - Company) – EUR 4.4M (10.3%) • Swedbank AS (Private - Bank) – EUR 2M (4.68%) • UP Invest (Private – Capital markets) – 13M (30.44%)
Discussion	In the first years, Skeleton Technologies funded technology development with support of various research grants (JRC, FP7). The company benefited from the fact that two of its founding members are Estonian researchers with very good understanding of the opportunities for research funding. Other than that, the company's founders did not have any particular fundraising experience or skills. The "push" for cooperation with the European Space Agency came through a large space systems integrator company which aimed to integrate ultracapacitor technology into telecom satellites. A key person of this company had heard of the Estonian research team previously and proactively approached Skeleton Technologies. Further funding opportunities were then searched within Estonia, the home country of Skeleton Technology's founders, as this approach promised to prevent language barriers and create benefits through similar understandings of local business culture. In 2013, capital for production equipment was obtained with support from the Estonian government which organized a state delegation visit to Saxony, Germany.

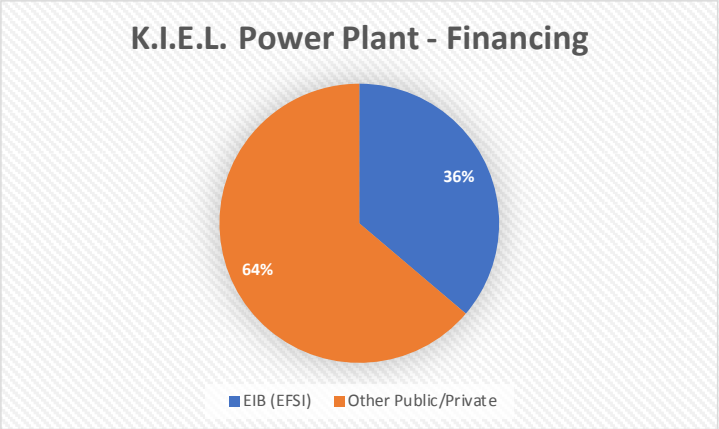


Leverage Factor (EU/Combined Other): 0.84

	The company's first financial investor (UP Invest) and its corporate investor (Harju Elekter) are also Estonian companies. Skeleton Technologies has secured funding from two EU sources - the SME Instrument and the EIB. The company identified these opportunities itself through online research. It is currently in the process of identifying further public financial instruments, particularly on the EU-level and in Germany.
Sources	▪ Trinomics (2017) – Building the investment community for innovative energy technology projects

b. K.I.E.L. Coastal Power Plant

K.I.E.L. Coastal Power Plant	
(Sub)-Sector	Power Generation
Technology	Gas Engine CHP
Lead organisation	Stadtwerke Kiel AG – Municipal Utility Kiel (DE)
Total capital costs	**EUR 290M**
EU finance:	**EUR 105M** • EIB (EFSI)
Other public finance:	**AMOUNT UNKNOWN** • Federal KWKG subsidy, Regional Government of Schleswig-Holstein, Helaba (Public bank)
Private finance:	**AMOUNT UNKNOWN** • Berliner Sparkasse (Bank), Landesbank Berlin, Commerzbank, ING Bank, ING-DiBa, SEB (Bank)
Discussion	The K.I.E.L. (Kiel's intelligent energy solution) in the North German city of Kiel is a state-of-the-art, gas-powered CHP plant that will start operation in the second half of 2018. For a while, however, it was looking as if this project was not going to receive a green light. MVV, an energy provider and majority owner of the Stadtwerke Kiel, was not willing to carry the costs of the investments. The deadlock was only broken when the EIB, together with the German government, announced their financial support for the project. This significantly lowered the risks associated with the investment and helped the planning committee to involve a wide range of private sector banks to join the endeavour. The new power plant represents a crucial puzzle piece in the city's plans to become one of Germany's *Energiewende*[150] hubs: It will replace the 47 year-old, 354MW, coal-based plant and significantly cut emissions through its flexible generation- and CHP capacities. The enabler for Germany's most modern power generator comes in the form of 20 parallel GE Jenbacher gas motors. With a total capacity of 190MW, these engines can be turned on in a matter of 5 minutes and precisely respond to daily energy demand. Cloudy skies or calm days with low wind speeds leading to minimal contributions from renewables to the grid can hence be balanced efficiently by K.I.E.L. *À propos* efficiency: energy conversion efficiency will come close to 90%, stemming from 45% thermal and 45% electric generating efficiency. This high performance of the plant will hence allow the city of Kiel to cut CO2-emissions from its primary source of energy by 70% relative to its retired predecessor.



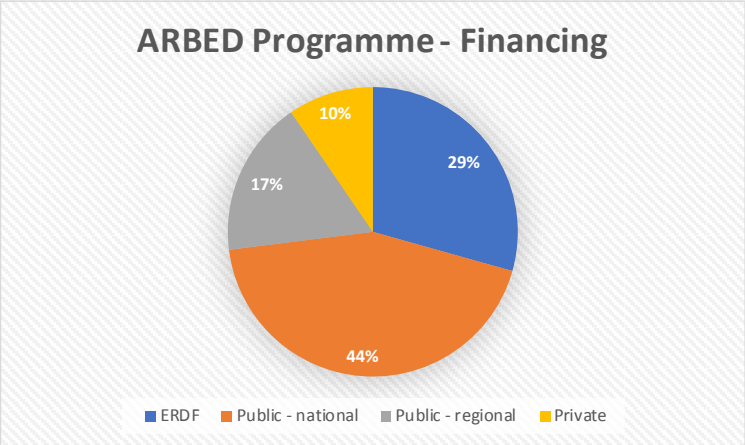
Leverage Factor (EU/Combined Other): 0.57

[150] German: energy transition

	The city of Kiel can embark on a path to sustainable energy supply come 2018. Without the necessary financial backing from an EU-instrument sparking private capital investments, however, this would have not been possible.
Sources	▪ EC (2016). Investitionsoffensive für Europa: 105 Mio. Euro EU-Unterstützung für modernes Gaskraftwerk in Kiel. https://ec.europa.eu/germany/news/investitionsoffensive-f%C3%BCr-europa-105-mio-euro-eu-unterst%C3%BCtzung-f%C3%BCr-modernes-gaskraftwerk-kiel_de ▪ EIB (2016). Innovative Power Plant: Heat and Light With Less CO2. http://www.eib.org/infocentre/blog/all/innovative-power-plant.htm ▪ InvestEU (2017). K.I.E.L Coastal Power Plant. https://europa.eu/investeu/projects/kiel-coastal-power-plant_en ▪ KWKG (2016). Kieler 'Thermoskanne' wächst. http://www.kwkg2016.de/bhkw-news.html?post=Kieler-%27Thermoskanne%27-waechst_44890 ▪ Power Technology (2017). K.I.E.L. Coastal Power Plant. http://www.power-technology.com/projects/kiel-coastal-power-plant/ ▪ Stadtwerke Kiel (2016). Küstenkraftwerk K.I.E.L. Broschüre.

c. ARBED Programme

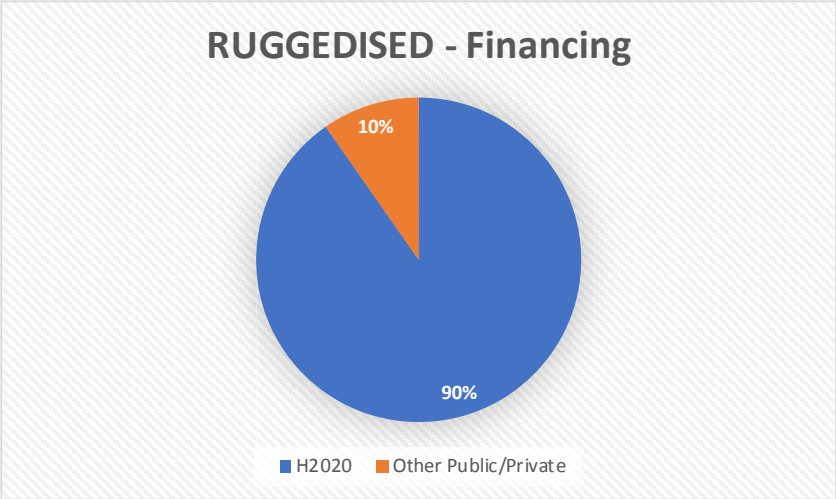
ARBED Programme	
(Sub)-Sector	Energy Efficiency
Technology	Various
Lead organisation	Government of Wales (UK)
Total capital costs	**EUR 126M**
EU finance:	**EUR 37M** • ERDF Grant
Other public finance:	**EUR 77M** • Government of Wales – EUR 55M • Local Governments – EUR 22M
Private finance:	**EUR 12M** • Energy companies
Discussion	The ARBED programme was initiated by the Welsh government in 2009 with the overarching goal to put energy efficiency of Welsh homes on the agenda. Over the years, it has helped to decrease the incidence of energy poverty in Welsh households and driven sustainable private sector investments into energy savings and emissions reduction. In the case of the ARBED programme, EU finance played much more of a supporting role than that of an initiator. Funding from the ERDF was only granted in Phase 2 of the project, when national public and private finance had already been heavily involved. The EU contribution allowed a massive scaling-up of ARBED activities, including the improvement of energy efficiency in 4800 homes and a reduction of GHG by 2.54 KTC (Kilo tons of carbon) in all of Wales. The programme's schemes are further supported by 2 OJEU (Official Journal of the European Union) scheme managers. This guarantees the sound delivery of contributions into particular investments on the ground. With the financial future of the programme secured, the Welsh government further seeks to foster sustainable local economic development. This is done by contracting exclusively local businesses to deliver and execute the programme's installations. Paired with efforts to provide training and employment opportunities to Welsh workers, ARBED leads the way in creating both an environmentally and economically sustainable future for Wales.
Sources	▪ Housing Europe (2010). A Mid-Term Review of the Use of Structural Funds. http://www.buildup.eu/sites/default/files/content/housing_structural_funds_web.pdf ▪ Warm Wales (2017). Arbed. https://www.warmwales.org.uk/past-work/arbed/ ▪ Welsh Government (2013). Arbed: Strategic energy performance investment programme. http://gov.wales/topics/environmentcountryside/energy/efficiency/arbed/?lang=en ▪ Welsh Government (2017). Warm Homes Programme. http://gov.wales/topics/environmentcountryside/energy/efficiency/warm-homes/?lang=en



Leverage Factor (EU/Combined Other): 0.42

d. RUGGEDISED

RUGGEDISED	
(Sub)-Sector	Energy Efficiency
Technology	Various (Thermal, Grids, ICT-Solutions)
Lead organisation	Municipalities of Rotterdam (NL), Glasgow (UK), and Umeå (SE)
Total capital costs	**EUR 19.6M**
EU finance:	**EUR 17.7M** • Horizon 2020 Grant
Other public finance:	**AMOUNT UNKNOWN** • Municipalities of member cities (small contributions)
Private finance:	**AMOUNT UNKNOWN** • Local energy providers and tech-companies (small contributions)
Discussion	The RUGGEDISED project is a collaborative smart cities initiative, operationalized in 6 locations across Europe. Three lighthouse cities (Rotterdam, Glasgow, and Umeå) will pave the way by testing and implementing innovative smart city solutions. Three follower cities (Brno, Gdansk, Parma) will learn from their experience and henceforth accelerate proliferation of successful technologies. The program aims to support urban development towards a smarter, more resilient future. Special focus hereby lies on improving the quality of life of citizens, reducing the environmental impact of activities, and creating a stimulating environment for sustainable development. To achieve the aims, a key innovation challenge in all three lighthouse cities of RUGGEDISED is to arrange successful combinations of integrated smart solutions for energy and e-mobility (enabled by ICT platforms and open data protocols), and business models with the right incentives for stakeholders to invest and participate in a smart society. The execution of RUGGEDISED is hoped to deliver a broad range of innovative, efficient, replicable, scalable, and integrated solutions that can guide the way towards a more prosperous, inclusive, and environmentally-friendly urban society. The project is almost exclusively funded by Horizon 2020 but has seen increased (financial) involvement of third parties from the public and private sector.
Sources	▪ INEA (2016). Ruggedised. ▪ https://ec.europa.eu/inea/en/horizon-2020/projects/h2020-energy/smart-cities-and-communities/ruggedised ▪ Pictec (2016). Ruggedised: sustainable energy deployment. http://pictec.eu/portfolio/ruggedised/ ▪ More information available on the RUGGEDISED Website. http://www.ruggedised.eu/



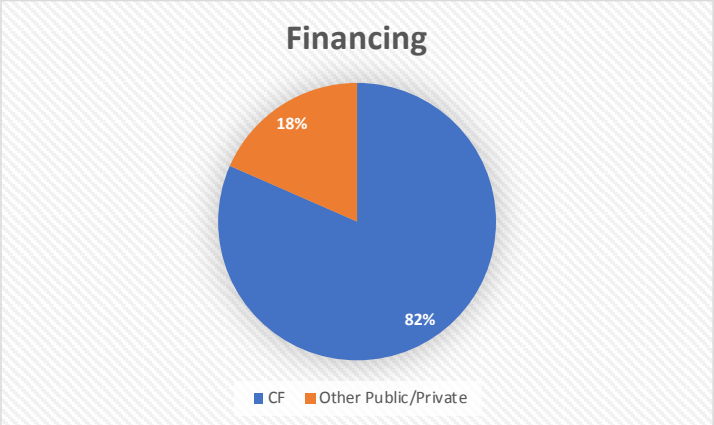
Leverage Factor (EU/Combined Other): 9.32

e. Buildings at state-run art schools across Poland made more energy efficient

MINISTERSTWO ROZWOJU

Buildings at state-run art schools across Poland made more energy efficient

(Sub)-Sector	Energy Efficiency
Technology	Various
Lead organisation	Ministry of Development (PL) / Ministry of Culture and National Heritage (PL)
Total capital costs	**EUR 115.1M**
EU finance:	**EUR 93.9M** • Cohesion Fund
Other public finance:	**AMOUNT UNKNOWN**
Private finance:	**AMOUNT UNKNOWN**
Discussion	The EU's Cohesion Fund contributes EUR 94M through its "Infrastructure and Environment" Operational Programme covering around 82 % of the total expected investment costs for making state-run art school buildings across Poland more energy efficient. In total, 187 buildings are to be made more energy efficient, covering 139 art schools in all 16 regions of Poland. By focussing on state-run art schools, the investments made in the course of this project therefore not only relate to the energy union objectives (in particular secure, affordable and climate friendly energy supply), but also provide the co-benefit of preserving Poland's cultural heritage. It is expected that after completion, energy consumption could be reduced by 60 %, ranging between 12 % and 90 % across the individual buildings. This would translate to a reduction of annual CO_2-emissions by 73 %. Upgrading these buildings will thus contribute to the EU target of reducing GHG emissions by 20% from 1990 levels in 2020 and energy consumption by 20 % compared to 2005. In the process of upgrading, focus will lie on insulation, ventilation, air conditioning and lighting. Heating sources will be upgraded to be sourced from renewable energies, coupled with building management systems to monitor energy consumption. To date, no further information is available on how the remaining 18 % are precisely financed.
Sources	▪ EC (2017). Buildings at state-run arts schools across Poland made more energy efficient. http://ec.europa.eu/regional_policy/en/projects/poland/buildings-at-state-run-arts-schools-across-poland-made-more-energy-efficient



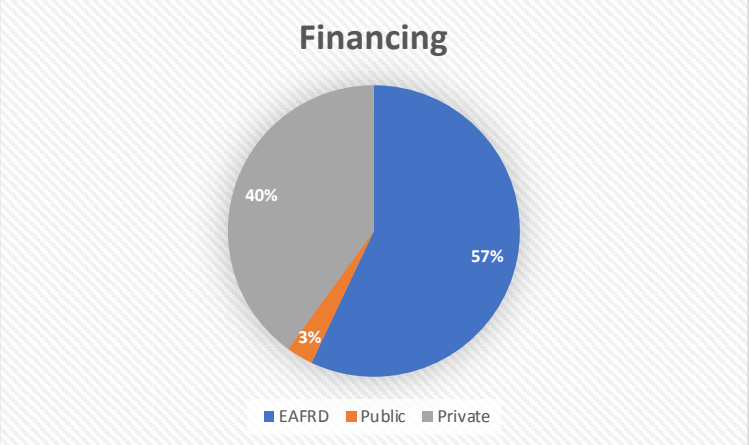
Leverage factor (EU/Combined Other): 4.43

f. Producing and packaging biofuel (PELLET) from olives harvesting residues in Greece

Common Agricultural Policy (CAP)

Producing and packaging biofuel (PELLET) from olives harvesting residues in Greece

(Sub)-Sector	Biofuels
Technology	Processing olive residues into biofuel (PELLET)
Lead organisation	DELI AEBE
Total capital costs	**EUR 211.5k**
EU finance:	**EUR 120.6k (LEADER approach)** • EAFRD
Other public finance:	**EUR 6.3k** National/Regional Government
Private finance:	**EUR 84.6k**
Discussion	A biofuel production unit that processes olive residues was established. LEADER support (approach to support rural development; implemented under national and regional Rural Development Programmes of Member States, co-financed from the EAFRD under pillar 2) helped with the purchase of the necessary machinery and equipment. The company set up a complete line for producing and packaging biofuel (PELLET) where the raw material is cut, crushed, dried, pressed, weighed and packaged. The biofuel pellets are packed in bags but are also available in bulk. The capacity of the production plants amounts to 700kg per hour. Approximately 5 400 tonnes of raw material will produce around 4 000 tonnes of product. The company's future plans are to place its product on internal and external markets alike. As a result of the project, the produced biofuel can be used as an environmentally friendly alternative to fossil fuels and it is making good use of an otherwise unused material. The pellet production unit is generating significant economic benefits for olive farmers who are paid for collecting and delivering their raw material. Six jobs were created at the production unit. This project is an example of successful support to rural areas that creates economic benefits while enhancing the use of energy from renewable sources.
Sources	▪ EC (2013). Overview of CAP Reform 2014-2020. https://ec.europa.eu/agriculture/sites/agriculture/files/policy-perspectives/policy-briefs/05_en.pdf ▪ EP (2017). The European Union and the World Trade Organisation. http://www.europarl.europa.eu/atyourservice/en/displayFtu.html?ftuId=FTU_5.2.2.html ▪ EC (2017). Rural Development 2014-2020. https://ec.europa.eu/agriculture/rural-development-2014-2020_en ▪ ENRD (2013). LEADER/CLLD. https://enrd.ec.europa.eu/leader-clld_en ▪ ENRD (2015). Producing and packaging biofuel (PELLET) from olives harvesting residue. https://enrd.ec.europa.eu/projects-practice/producing-and-packaging-biofuel-pellet-olives-harvesting-residues_de

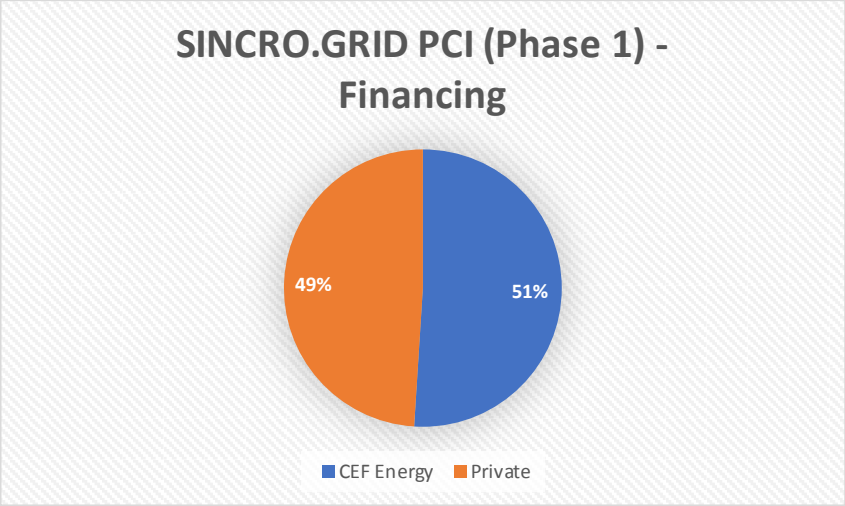


Leverage Factor (EU/Combined Other): 1.33

	▪ Regulation (EU) No. 1305/2013 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD)and repealing Council Regulation (EC) No. 1698/2005. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0487:0548:en:PDF

g. Implementation of the SINCRO.GRID PCI – Phase 1

SINCRO.GRID	**Implementation of the SINCRO.GRID PCI – Phase 1**
(Sub)-Sector	Smart Grids
Technology	Various
Lead organisation	Joint cross-border project run by the TSOs and DSOs of Slovenia and Croatia: • ELES, Ltd., Electricity Transmission System Operator (ELES) • Croatian Transmission System Operator Ltd. (HOPS) • SODO Electricity Distribution System Operator (SODO) • HEP Distribution System Operator (HEP)
Total capital costs	**EUR 79.39M**
EU finance:	**EUR 40.49M** • CEF-Energy
Other public finance:	**EUR 0M**
Private finance:	**EUR 38.9M** • Slovenian (ELES & SODO) and Croatian (HOPS & HEP ODS) TSOs and DSOs as a joint initiative
Discussion	This CEF Action contributes to, and almost completely finishes, the PCI 10.3 SINCRO.GRID which is a joint initiative of Slovenian and Croatian TSOs and DSOs. It is set to run from 2016 to 2021 and will significantly improve the link of electricity grids between the two countries. Furthermore, the Action will secure the supply of energy in the region. This is achieved by enabling smaller and local power sources to add their generated power to the grid more efficiently. New infrastructure and technology deployment will also enhance the energy storage capacity of the region. At the core of SINCRO.GRID lies the solving of cross-border issues regarding network voltage, frequency control, and congestion. This allows SINCRO.GRID to also positively contribute to the energy transition by enabling further deployment of RES and replacement of fossil fuel-based power generation. Overall, the 5 main technical activities of the Action will be: • Deployment of 5 compensation devices to address at cross-border level overvoltage and voltage instability issues within the regional transmission grid • Deployment of advanced dynamic thermal rating (DTR) systems in the Slovenian and Croatian transmission grids • Deployment of electricity storage systems • Integration of distributed renewable generation (DG)



Leverage Factor (EU/Combined Other): 1.04

	• Deployment of a virtual cross-border control centre (VCBCC) consisting of dedicated IT infrastructure and software to be used by system operators for the efficient and coordinated management of RES.
Sources	▪ Balkan Green Energy News (2017). SINCRO.GRID project to secure regional electricity supply. https://balkangreenenergynews.com/sincro-grid-project-to-secure-regional-electricity-supply/ ▪ EC (2017). Implementation of the SINCRO.GRID PCI – Phase 1. https://ec.europa.eu/inea/sites/inea/files/5-action_fiche_10.3-0022-sihr-w-m-16.pdf ▪ ELES (2017). Goals and positive effects of the project. https://www.eles.si/en/sincro-grid-project/goals-and-positive-effects-of-the-project ▪ Engerati (2017). Slovenia and Croatia get €40m to bridge the energy gap. https://www.engerati.com/article/slovenia-and-croatia-get-%E2%82%AC40m-bridge-energy-gap ▪ Government of Slovenia (2017). Support from the Slovenian Government for the SINCRO.GRID project. (Press Release) ▪ Metering (2017). Slovenian and Croatian utilities sign agreement on Sincro.Grid project. https://www.metering.com/news/slovenian-croatian-utilities-sincro-grid/ ▪ More information available on the SINCRO.GRID Website. http://www.sincrogrid.eu/

h. EIB - InnovFin FDP Instrument (Example WaveRoller)

InnovFin Energy Demo Projects	**EIB – InnovFin FDP Instrument (Example WaveRoller)**
(Sub)-Sector	RES - Ocean
Technology	Wave Energy Converter
Lead organisation	AW-ENERGY OY (FIN)
EIB finance:	**EUR 10M** • EIB (InnovFin FDP)
Public finance:	**AMOUNT UNKNOWN** Municipality of Peniche (PT), Tekes (Finnish Funding Agency for Innovation)
Private finance:	**AMOUNT UNKNOWN** Aura Capital, Fortum, John Nurminen Oy, Sitra, Bosch Rexroth AG, Estaleiros Navais de Peniche S.A., Eneolica Energia e Ambiente S.A.
Discussion	The EIB InnovFin First-of-a-kind Demonstration Projects (FDP) is a thematic pilot product under InnovFin (EU Horizon 2020 resources) for the financing of demonstration projects in the pre-commercial stage of development. The EIB and the EU hereby share the risk associated with a selected and funded project. The WaveRoller is the first and so far only (2016) project supported by the InnovFin FDP. It is a submerged wave energy converter that generates electricity from the movement of the waves (surge phenomenon) and connects to the electric grid onshore. AW-Energy currently runs three of such 100kW demonstration units off the Portuguese coast. The EUR 10 million quasi-equity loan provided to the company by the EIB is supposed to boost the commercial roll-out of the technology. Earlier EU grants under the FP7 (Total cost: EUR 5.37M, FP7 contribution: EUR 3M) already brought together private and public finance to test the feasibility and strengthen the WaveRoller's business case. Building upon completion of this first phase of demonstration, the EIB InnovFin FDP investment now seeks to upkeep financial momentum of the project by lowering its risk profile in the long-run and bringing in large-scale investors. AW-Energy is about to install a full-scale 350kW device in Peniche, Portugal. The company has further identified commercial leads in six countries and has the potential objective of selling more than 50 units until 2020. The EIB investment will add further credibility to the project and is hoped to kick-start the technology's broad proliferation. *Further background information on InnovFin Energy:* The ***InnovFin Energy Demonstration Projects*** pillar provides loans, loan guarantees or equity-type investments between EUR 7.5M and EUR 75M to innovative first-of-a-kind commercial-scale demonstration projects in the fields of renewable energy, and hydrogen / fuel cells, helping them to bridge the gap from demonstration to commercialisation.
Sources	▪ CORDIS (2013). Simple Underwater Generation of Renewable Energy. http://cordis.europa.eu/project/rcn/92897_en.html ▪ EIB (2017). InnovFin. http://www.eib.org/products/blending/innovfin/index.htm?lang=de ▪ EIB (2017). Quasi-equity: A new financial structure for a new challenge. http://www.eib.org/infocentre/blog/all/quasi-equity-a-new-financial-structure-for-a-new-challenge.htm ▪ EIB (2016). InnovFin Final Recipients 2014-2016. http://www.eib.org/attachments/documents/innovfin_final_recipients_2016_en.pdf ▪ EIB (2016). EU support for development of commercial wave energy technology in Europe. http://www.eib.org/infocentre/press/releases/all/2016/2016-165-eu-support-for-development-of-commercial-wave-energy-technology-in-europe.htm ▪ More information available on the AW-Energy Website. http://aw-energy.com/

ANNEX 2. ENERGY RELEVANT FINANCIAL INSTRUMENTS

Overview of main Energy relevant EU Financial Instruments (Excluding Overseas Aid and Neighbourhood Countries)

FIs	Programme / Budget line	EU contribution	Total (target)	Type
Research and Innovation		*m Euro*	*m Euro*	
Horizon 2020 Loans service	H2020	1060	13250	loans and hybrid or mezzanine finance to improve access to risk finance
Innovfin SME guarantee	H2020	1060	9500	
InnovFin SME venture capital	H2020	460	2700	Early stage R+I driven SMEs and small midcap access to risk finance
Infrastructure, climate, environment and energy efficiency				
Connecting Europe Facility (CEF) - Debt instrument	CEF	2400	18000 to 45000	Debt
CEF - Equity instrument	CEF	100		Equity
Private Finance for Energy Efficiency Instruments (PF4EE)	LIFE	80	540 to 1000	Risk sharing plus technical assistance
Natural capital financing facility (NCFF)	LIFE	60	100 - 125	
Financial Instruments under the European Structural and Investment Funds (ESIF) (2014- 2020)				
European Regional Development Fund (ERDF) and Cohesion fund (CF)	ESIF	20000		'off the shelf' FIs available
European Social Fund (ESF)	ESIF	949		'off the shelf' FIs available
European Agricultural Fund for Rural Development (EAFRD)	ESIF	455		
European Maritime and Fisheries Fund (EMFF)	ESIF	80		
Others (2014-20)				
European Fund for Strategic Investment (EFSI)	Own budget line	21000	350000	Loans, guarantees, equity
Competitiveness of Enterprises and Small and Medium-sized Enterprises (COSME) - The Loan Guarantee Facility (LGF)	COSME	868	21,000	Guarantee
Competitiveness of Enterprises and Small and Medium-sized Enterprises (COSME) - The Equity Facility for Growth (EFG)	COSME	432	4,000	Equity

Source: DG CLIMA – Mainstreaming CC in EC Expenditure

Relevant FIs – but not current MFF or arguably not an FI

Financial instrument	Reason for exclusion	Funding period	Progr / Budget line	Managed by	Available budget	Instrument type	Type of management	Eligible projects / Comment
Project Development Assistance (PDA)/ELENA	**Grant not loan**	Ongoing	H2020	EIB	EUR 80 million (2014-2017) [2] EUR 20 million (grants & TA)		Grants & technical assistance	TA for buildings, RES, CHP, urban transport, local energy infrastructure. Typically, EUR 6 – 50 million per project (EIB-ELENA also >50 million)
Neighbourhood Investment Facility (NIF)	**Previous MFF**	2008 2015	External blending facility	DG NEAR	€13.8bn. EU contribution €1,454m		Indirect	Energy, transport, climate change, infrastructure in neighbourhood countries
The 2020 European Fund for Energy, climate change and infrastructure (Marguerite)	**Previous MFF**				EU contribution €80m	Pan European equity fund		Supports infrastructure investments in transport (TEN-T), energy (TEN-E) and renewables
European Energy Efficiency Fund (EEEF) (co-financed by EEPR)	**Previous MFF**	2011-ongoing	Not really under a programme – has its own budget line	DG ENER, managed by: Deutsche Bank	€265 million (€125 mln EU; €75 mln EIB; €60 mln CDP; €5 mln DB)	senior and junior loans, guarantees, or equity	Indirect	Energy efficiency, renewable energy and clean urban transport (for local or regional public authorities)
Programme for employment and Social innovation (EASI)	**Not CC relevant**	2014-20			€528 m total fund, €96m EU contribution	Micro finance and Social entrepreneurship		In the Art 140.8 report
Risk sharing instrument (RSI) and Risk sharing finance facility (RSFF)	**Previous MFF**							
NER 300	**No direct EU funds contribution**							

Source: Climate mainstreaming in the EU Budget: preparing for the next MFF. DG CLIMA https://publications.europa.eu/en/publication-detail/-/publication/1df19257-aef9-11e7-837e-01aa75ed71a1/language-en

NOTES

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