European Commission

SET Plan delivering results:

The Implementation Plans

Research & Innovation enabling the EU's energy transition

SET Plan 2018 edition

Energy

Publications of the European Union
Project number 2018.5779

More information on the European Union is available on the internet (http://europa.eu).

PRINT :	ISBN 978-92-79-96478-7	DOI 10.2833/109890	MJ-03-18-372-EN-C
PDF :	ISBN 978-92-79-96479-4	DOI 10.2833/25250	MJ-03-18-372-EN-N

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Publication prepared jointly by European Commission's Directorates-General for Energy, Research & Innovation and Joint Research Centre

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SET Plan delivering on the Energy Union

The European Strategic Energy Technology Plan (SET Plan) aims at accelerating the development and deployment of low-carbon technologies, at improving new technologies and at bringing down their costs, by coordinating national research efforts and facilitating financing of projects in the energy sector. Its goal is to promote innovation partnerships across Europe by supporting the most impactful technologies that will contribute to the EU's transformation to a low-carbon energy system.

The SET Plan promotes cooperation amongst EU countries, companies, research institutions and the EU itself. It has confirmed its role as a platform for knowledge exchange and for partnership creation, evolving and adapting to address low-carbon technologies holistically. Through this process, it has put forward a specific vision for each technology area through setting ambitious targets to be reached in the next decade(s) to place Europe at the forefront of the next generation of low-carbon energy technologies and of energy efficiency. For each of these technology areas, Implementation Plans (IPs) have been developed to reach these targets.

Improving EU research and innovation performance is required to meet the new ambitious targets for 2030: a share of 32 % renewable energy consumption, as well as a 32.5 % improvement in energy efficiency and 40 % CO_2 emission reductions.

Additionally, a new long-term strategy for the reduction of EU greenhouse gas emissions, in-line with the Paris Agreement, will analyse pathways towards 2050 in the energy system and other sectors, as well as the role of innovative technologies, of sectoral integration and consumers' choice, their implications for security of supply, investments, competitiveness, growth and jobs. SET Plan has a key role to play in this respect.

The Energy Union Strategy, one of the flagship initiatives of the Juncker Commission 2014-2019, has experienced significant developments since its launch in February 2015. In all its dimensions, but particularly under the research, innovation and competitiveness one, the progress achieved so far is a telling example. SET Plan has also confirmed its key role as a vector of this progress.

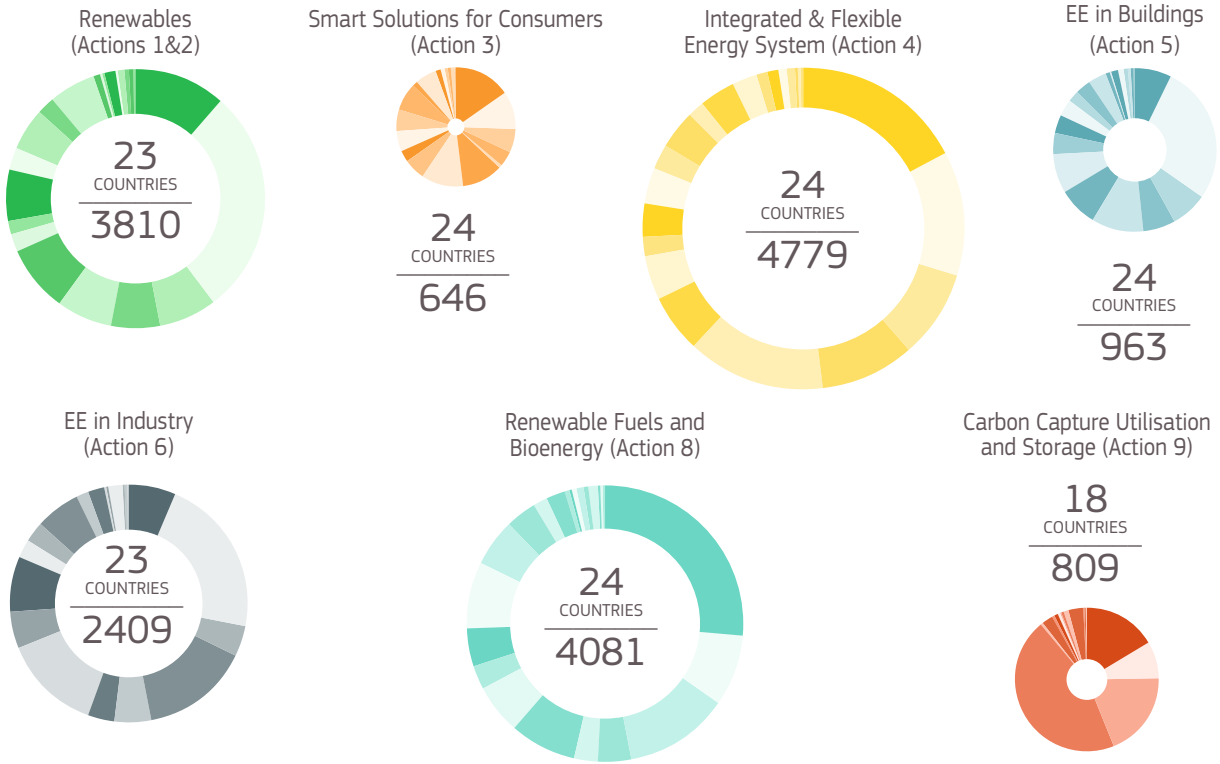
The SET Plan has been instrumental in creating a synergetic momentum among all partners in a fully transparent way. The target-setting process was concluded in 2016 through the release of Declarations of Intent[1] that cover all the Energy Union and SET Plan priority areas (its 10 Actions) and served as a basis for drafting and endorsing the corresponding Implementation Plans[2]. This was achieved by bringing together interested SET Plan countries and relevant industrial and research stakeholders to sketch out synergetic and impactful R&I activities in order to accelerate the energy transition. The participants to this process debated thoroughly the main R&I priorities for each SET Plan Action and identified the best areas for future cooperation among the SET Plan countries and relevant industrial actors. The outcome of this work is now reflected in these Implementation Plans.

This publication offers a quick overview of this remarkable achievement. Chapter 2 illustrates each Implementation Plan[3] in a concise manner and presents its specific features. Chapter 3 outlines the way forward, the expectations and the practical value of this exercise in terms of the overall EU energy transition and the optimal decarbonisation pathway to be followed.

1 https://setis.ec.europa.eu/actions-towards-implementing-integrated-set-plan
2 https://setis.ec.europa.eu/actions-towards-implementing-integrated-set-plan/implementation-plans
3 This publication includes all the non-nuclear actions of the SET Plan.

FIGURE 1

NATIONAL R&D EXPENDITURE PER SET PLAN ACTION (2012-2016) [EUR MILLION]



This graph covers all non-nuclear SET Plan actions except for batteries (Action 7).

Data source: JRC(1) based on IEA(2) and own data collection. For more information see JRC 2017 / Fiorini et al (3).

1. JRC (Joint Research Centre) (2018): Data collection and analysis on R&I investments and patenting trends in support of the State of the Energy Union Report. JRC.C7 Knowledge for Energy Union.
2. IEA (International Energy Agency). IEA RD&D Statistics, 2018 preliminary edition of the Energy technology RD&D budgets database. Available at: https://www.iea.org/statistics/rddonlinedataservice/
3. Fiorini, A., Georgakaki, A., Pasimeni, F. and Tzimas, E. (2017). Monitoring R&I in Low-Carbon Energy Technologies. EUR 28446 EN, Publications Office of the European Union, Luxembourg. ISBN 978-92-79-65591-3, doi: 10.2760/434051. Available at: https://setis.ec.europa.eu/related-jrc-activities/jrc-setis-reports/monitoring-ri-low-carbon-energy-technologies

The Implementation Plans by country

SUSTAIN TECHNOLOGICAL LEADERSHIP IN RENEWABLES (1 AND 2)

- **Solar Photovoltaics (PV) IP**
- **Concentrated Solar Power / Solar Thermal Electricity (CSP/STE) IP**
- **Offshore Wind Energy IP**
- **Deep Geothermal Energy IP**
- **Ocean Energy IP**

A SMART CONSUMER-CENTRIC ENERGY SYSTEM

- **Smart Solutions for Energy Consumers IP (3.1)**
- **Towards Positive Energy Districts for Sustainable Urbanisation IP (3.2)**
- **Energy Systems IP (4)**

DEVELOP AND STRENGTHEN ENERGY EFFICIENT SYSTEMS

- **Energy Efficiency in Buildings IP (5)**
- **Energy Efficiency in Industry IP (6)**

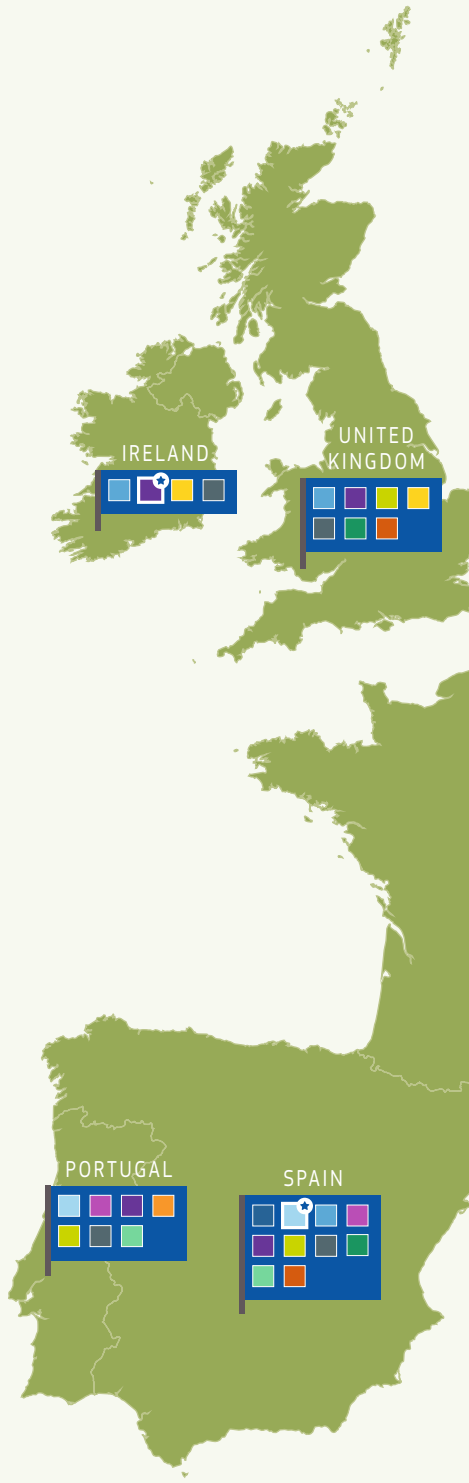
ENERGY OPTIONS FOR SUSTAINABLE TRANSPORT SYSTEMS

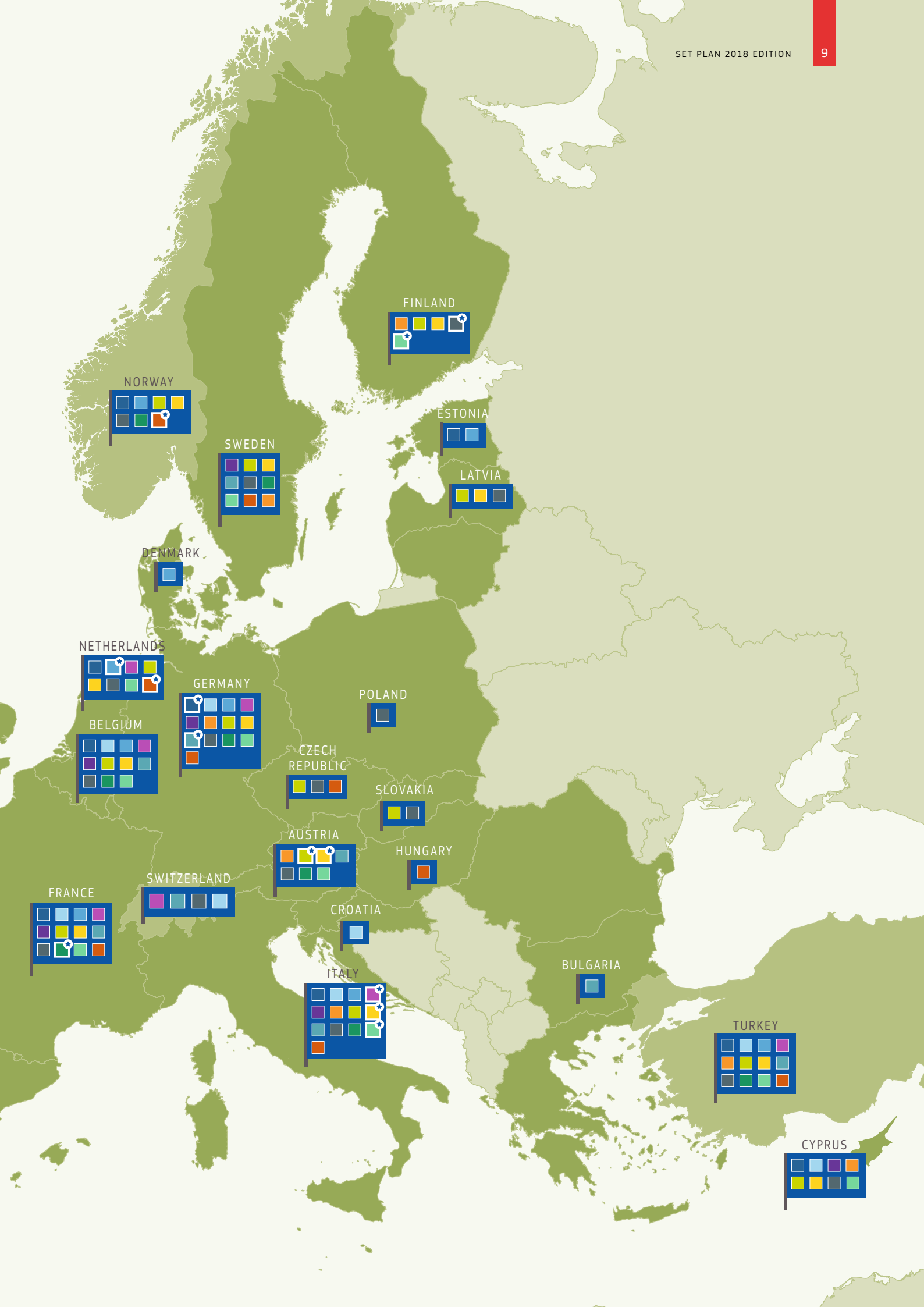
- **Batteries for E-Mobility and Stationary Storage IP (7)**
- **Renewable Fuels and Bioenergy IP (8)**

CCUS

- **Carbon Capture Utilisation and Storage IP (9)**

★ Chair




FINLAND
NORWAY
ESTONIA
SWEDEN
LATVIA
DENMARK
NETHERLANDS
GERMANY
POLAND
BELGIUM
CZECH REPUBLIC
SLOVAKIA
AUSTRIA
HUNGARY
SWITZERLAND
FRANCE
CROATIA
BULGARIA
ITALY
TURKEY
CYPRUS

2

The Implementation Plans

2.1

Sustain Technological Leadership in **Renewables**

Solar Photovoltaics (PV) IP

The Photovoltaics (PV) Implementation Plan is contributing to the development of higher performance, lower cost PV technologies. It addresses the Research and Innovation 'R&I' activities required to deliver the strategic targets identified under the SET Plan Declaration of Intent[1] (DoI) in the context of an Initiative for Global Leadership in Photovoltaics. This was agreed in December 2015 by the European Commission, SET Plan countries, and representatives of the SET Plan stakeholders most directly involved in the PV sector.

The 6 technology-related **priority activities** proposed in this IP cover: BIPV and similar applications, technologies for silicon solar cells and modules with higher quality, new technologies and materials, development of PV power plants and diagnostics, manufacturing technologies (for cSi and thin films), and cross-sectoral research at lower TRL. For each activity, **ongoing R&I actions** already in support of the DoI targets have been mapped; additional **actions and flagship activities** have also been identified. These are to be mainly supported nationally (through both public and private funding), and where an EU added value is justified, complementary funding at EU level is also identified.

TARGETS:

EFFICIENCY, COST REDUCTION, LIFETIME, MANUFACTURING

The targets we have set till 2030 regard the efficiency of crystalline silicon and thin films technologies and of new concepts; the reduction of their cost; enhancing the lifetime, quality and sustainability of PV modules, hence improving their performance; enabling more '(near) Zero Energy Buildings' through the use of Building-Integrated PV (BIPV); advancing manufacturing, installation and maintenance methods of PV modules.

[1] Available on the Strategic Energy Technologies Information System (SETIS), https://setis.ec.europa.eu

EXAMPLES OF R&I ACTIVITIES:

INNOVATIVE TECHNOLOGIES FOR MODERN UTILITY-SCALE PV

The Italian Flagship Programme '**Innovative Technologies for Modern Utility-Scale PV**' seeks to provide existing PV utilities with advanced O&M solutions including storage, power control and ICT as well as to develop a new generation of PV cells and modules where the crystalline silicon technology is combined with emerging thin film technologies (tandem and bifacial devices for very low LCOE targets). The programme envisages collaboration between PV manufacturers and a wide network of R&D institutions and labs already active in several European projects.

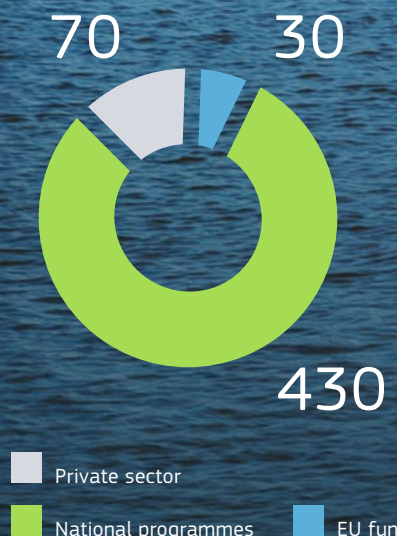
EUR 100 million
2018-2023

ACTIVITY NO. 5

In proposed Activity no. 5, the goal is the reduction of the module manufacturing cost of ownership by 25 % in 5 years and 40 % in 10 years. Accordingly, expected deliverables target a reduction of CAPEX and BOM costs by 40 % in 6 years. A number of projects are already running in Germany and Italy, while Turkey envisages an ad hoc national support programme. Several flagship projects have also been proposed under this Activity.

> EUR 25 million
2018-2023

THE OVERALL INVESTMENT TO BE MOBILISED BY THE IP ON PHOTOVOLTAICS IS EUR 530 MILLLION SPLITED AS FOLLOWS (M EUR).



The activities proposed have reached different levels of maturity in terms of concreteness, partnership and financing. There is therefore a significant need for further development of the actions. Especially in connection to demonstration and deployment of technologies, further investments, funding sources and financial instruments will be needed to fully achieve the DoI targets. At EU level, instruments such as InnovFin Energy Demo Projects and the future Innovation Fund are obvious potential sources of finance. Also, an ERA-NET Cofund project dedicated to PV has recently been granted.

10
COUNTRIES

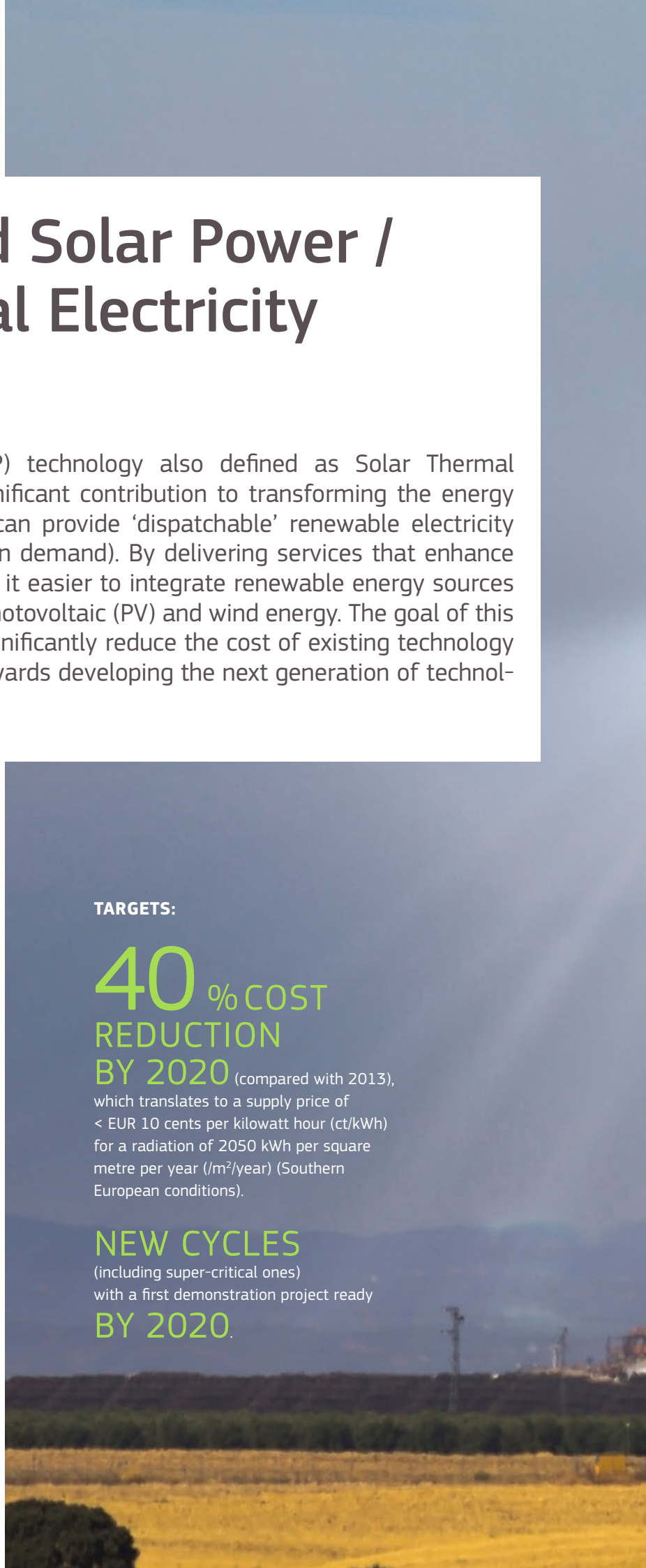
STAKEHOLDERS

15 representatives from the ETIP PV, industry and research institutions: EUREC / ETIP PV Secretariat, Enel Green Power, Manz AG, DSM, SETA Network, Becquerel Institute, SolarWorld AG, Consultores de Energía Fotovoltaica SL, Fraunhofer ISE, IMEC, ECN, University of Ljubljana, First Solar, Singulus, 3E.

Concentrated Solar Power / Solar Thermal Electricity (CSP/STE) IP

Concentrated Solar Power (CSP) technology also defined as Solar Thermal Electricity (STE) can make a significant contribution to transforming the energy system, particularly because it can provide 'dispatchable' renewable electricity (i.e. electricity that is available on demand). By delivering services that enhance grid flexibility, CSP/STE can make it easier to integrate renewable energy sources with a variable output, such as photovoltaic (PV) and wind energy. The goal of this Implementation Plan (IP) is to significantly reduce the cost of existing technology in the short term and to work towards developing the next generation of technology in the longer term.

The CSP IP identifies five strands of action: 12 **Research and Innovation (R&I) Activities**, **First-Of-A-Kind (FOAK)** demonstration projects on a commercial scale, **financing aspects**, **regulatory framework** and support towards **internationalisation**. The IP identifies the parties interested in carrying out the R&I Activities and all potential sources of finance. In this way, it aims to exploit the most effective way and synergies among research performers, industrial players, national funding agencies and the European Commission.



TARGETS:

40 % COST REDUCTION BY 2020 (compared with 2013), which translates to a supply price of < EUR 10 cents per kilowatt hour (ct/kWh) for a radiation of 2050 kWh per square metre per year (/m²/year) (Southern European conditions).

NEW CYCLES (including super-critical ones) with a first demonstration project ready **BY 2020**.

EXAMPLES OF R&I ACTIVITIES:

FOAK PROJECTS

At present, new CSP/STE technologies face a serious market failure in Europe. As a result, these are being deployed in other continents that offer better finance and conditions. It is crucial to reverse this trend and demonstrate CSP/STE innovations in Europe so that it can maintain its position as the industrial leader in the sector. The IP intends to demonstrate one to three FOAK projects to break the current deadlock and sets out the main requirements. The projects will be implemented primarily by industry, but public support will also be sought (e.g. via the InnovFin Energy Demonstration Projects facility).

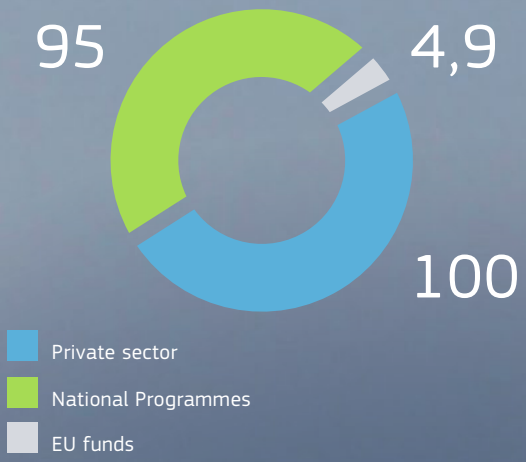
Up to EUR 1 billion
2017-2020/2022

R&I ACTIVITY NO.9

R&I Activity No.9 (thermal energy storage) aims to develop innovative thermal storage either at an affordable cost or by using outstanding volumetric energy density or higher working temperatures. Special attention will be paid to the reliability of the systems, the associated subsystems and the materials available. The aim is to achieve technology readiness level 6-7 in seven years.

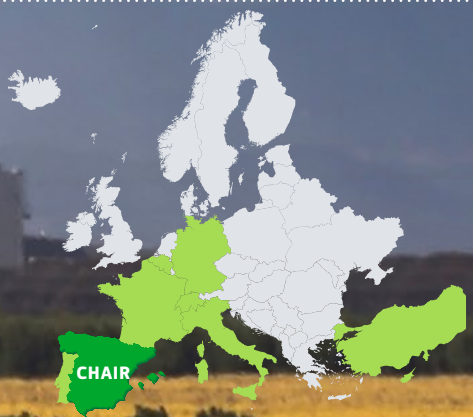
EUR 10 million
2017-2023

THE OVERALL INVESTMENT TO BE MOBILISED BY THE IP ON CONCENTRATED SOLAR POWER/ SOLAR THERMAL IS EUR 955 MILLLION SPLITED AS FOLLOWS (M EUR).



Investments under the 12 R&I activities set out in the IP amount to EUR 200 million. The FOAKs require up to EUR 1 billion in addition. Funding should originate mainly from private and public sources at national level, with EU funding made available where there is a clear added value at EU level. For example, an ERA-NET Cofund proposal dedicated to CSP has recently been submitted and one Horizon 2020 project, which is in line with R&I Activity No. 7 of the IP (pressurised air cycles for high-efficiency solar thermal power plants), has recently kicked off (total budget: EUR 4.9 million).

10
COUNTRIES



STAKEHOLDERS

The European Solar Thermal Electricity Association (ESTELA) and The European Association of Gas and Steam Turbine Manufacturers (EUTurbines).

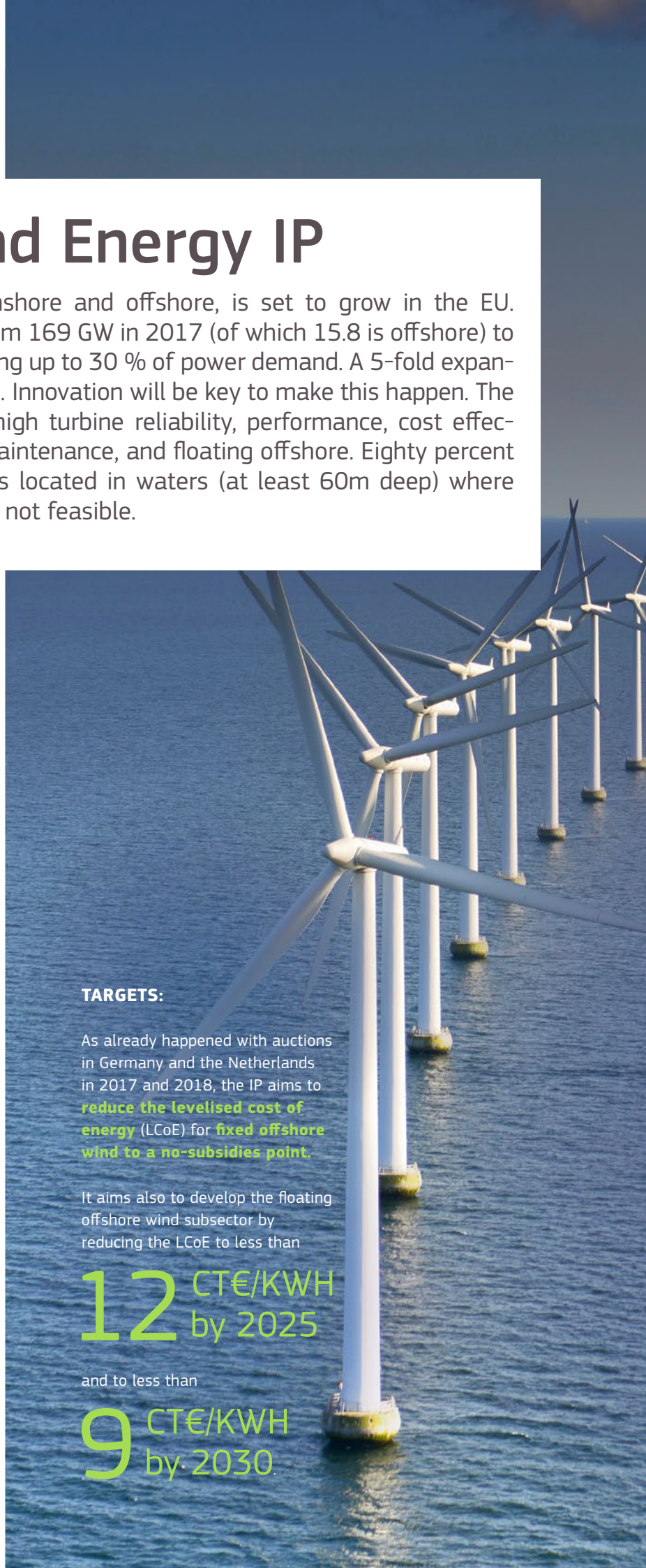
Offshore Wind Energy IP

Wind power generation, both onshore and offshore, is set to grow in the EU. Forecasts suggest an increase from 169 GW in 2017 (of which 15.8 is offshore) to 240-445 GW by 2030, representing up to 30 % of power demand. A 5-fold expansion is expected for offshore wind. Innovation will be key to make this happen. The IP focuses on R&I activities on high turbine reliability, performance, cost effective installation, operation and maintenance, and floating offshore. Eighty percent of European resource potential is located in waters (at least 60m deep) where bottom mounted foundations are not feasible.

Increasing deployment of variable renewables such as wind energy requires better **integration in the overall energy system**. The IP will focus on the design of cost-effective grids and interconnections and on solutions and business models to make wind power a more flexible energy source.

It also addresses **offshore balance of plant** (all the supporting components and auxiliary systems of the windfarm) and **operation & maintenance**, since in both cases costs are higher on offshore compared to onshore and represent a significant part of the levelised energy cost.

Finally, it attempts to further develop **floating offshore wind** given its potential to harvest the wind resource in vast currently unexploited areas. Larger turbines are a good fit for floating offshore as they can withstand high wind-speeds and are much easier to install thanks to cranes available in many shipyards and ports. Reliable platforms need to be designed, tested and validated.



TARGETS:

As already happened with auctions in Germany and the Netherlands in 2017 and 2018, the IP aims to **reduce the levelised cost of energy** (LCoE) for **fixed offshore wind to a no-subsidies point.**

It aims also to develop the floating offshore wind subsector by reducing the LCoE to less than

12 CT€/KWH by 2025

and to less than

9 CT€/KWH by 2030.

EXAMPLES OF R&I ACTIVITIES:

DIGITAL TRANSFORMATION IN WIND ENERGY SYSTEM O&M

By processing large quantities of data from sensors, big data analytics may revolutionise predictive maintenance and promises to increase energy yield, efficiency of operation and maintenance and decrease cost.

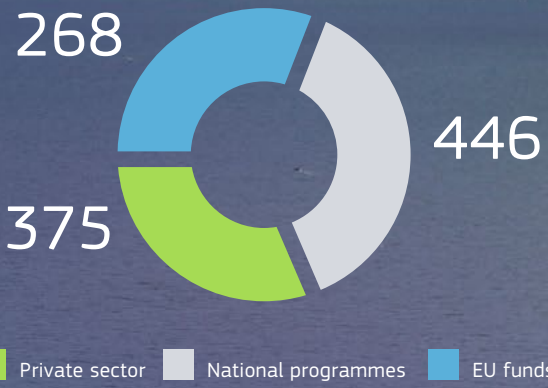
EUR 10 million
2018-2022

DEVELOPMENT & DEMONSTRATION OF LARGE TURBINES

Large turbines produce more energy and may harvest wind and lower speeds. However, their development is increasingly costly. The IP focuses on demonstrating the viability of both >10 MW turbines (2018-2022) and >15 MW (2021-2025). The largest turbines require innovations in design, and component and full-scale testing.

EUR 350 million
2018-2025

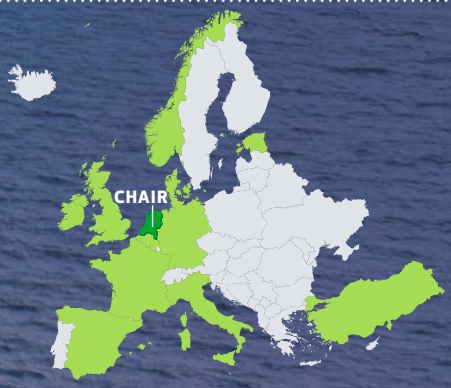
THE OVERALL INVESTMENT TO BE MOBILISED BY THE IP ON OFFSHORE WIND ENERGY IS EUR 1 090 MILLLION SPLITED AS FOLLOWS (M EUR).



To ensure the proper implementation of the actions crucial to meet the targets set in the relevant Declaration of Intent[1], a first estimation of the overall investment needs amounts to EUR 1 090 million by 2025.

1 https://setis.ec.europa.eu/system/files/setplan_wind_implementationplan_0.pdf

12
COUNTRIES



STAKEHOLDERS

3 (representing together 88 organisations): European Technology and Innovation Platform on Wind (Co-Chair, representing 26 organisations), European Energy Research Alliance – Joint Programme on Wind Energy (representing 52 organisations), and European Energy Research Alliance – Joint Programme on Ocean Energy (representing 10 organisations)

Deep Geothermal Energy IP

District heating systems can easily be adapted to make use of local geothermal resources instead of relying on imported fossil fuels. This can increase energy security and price stability as well as independence from fossil fuel sources.
The importance of geothermal energy is recognised at a political level with the launch of the Geothermal Global Alliance at COP21. This is a coalition of 42 countries and over 29 development and industry partners joining political forces to increase the share of geothermal global energy.

The research and innovation (R&I) Actions envisaged in the Deep Geothermal Implementation Plan address relevant issues crucial for the development of the use of geothermal energy resources, both as heat and electricity. The Implementation Plan (IP) pays due attention to **low enthalpy** resources, which are widely present in Europe where development, together with that of urban district heating networks fed by geothermal, represents a key opportunity to increase renewable heat supply. **Geothermal electricity** can represent a major contributor to balancing local effects resulting from the dependence on non-dispatchable renewables, such as wind and PV and solar thermal. Relevant attention is paid to developing this capability, with a specific key action in the IP.

TARGETS:

→ Reduce the exploration costs by **25 %** in **2025**, and by **50 %** in **2050** compared to 2015;

→ Reduce the unit cost of drilling (€/MWh) by **15 %** in **2020**, **30 %** in **2030** and by **50 %** in **2050** compared to 2015;

→ Demonstrate the technical and economic feasibility of responding to commands from a grid operator, at any time, to increase or decrease output ramp up and down from **60 %** - **110 %** of nominal power.

Costs must be confirmed, establishing at least 5 plants in different geological situations, of which at least one with large capacity (20 MWel or, if for direct use only, 40 MWth).

EXAMPLES OF R&I ACTIVITIES:

REDUCTION IN DRILLING/WELL COMPLETION COSTS

Demonstrate concepts that can significantly reduce drilling/well completion costs (reduce drilling time and non-productive time, reduce costs, mitigate risks) or enhance reservoir performance (including directional and horizontal multilateral drilling).

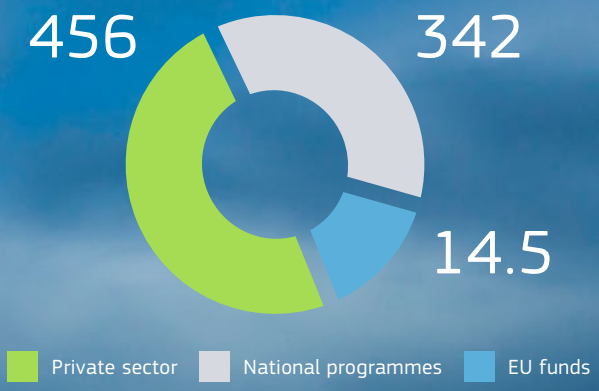
EUR 52 million
2018-2022

PERFORMANCE IMPROVEMENT OF SYSTEMS

General performance improvement of systems that enable the generation of electricity from geothermal energy resources with medium and low enthalpy, including double flash and complex/hybrid cycle systems, organic Rankine Cycles (ORC), Kalina and supercritical CO_2 cycles.

EUR 22 million
2018-2022

THE OVERALL INVESTMENT TO BE MOBILISED BY THE IP ON DEEP GEOTHERMAL ENERGY IS EUR 936.5 MILLLION SPLITED AS FOLLOWS (M EUR).



To ensure the proper implementation of the actions crucial to meet the targets set in the Deep Geothermal Declaration of Intent, a first estimation of the overall investment needs amounts to EUR 937 million by 2030.

10
COUNTRIES

STAKEHOLDERS

In total, over 110 organisations from industry, research and science represented by ETIP Deep Geothermal, European Geothermal Energy Council and EERA JP Geothermal.

Ocean Energy IP

Ocean Energy provides a unique chance in Europe to generate jobs in different regions throughout the local supply chain. Europe, as a world leader in ocean energy and home to the most advanced technology in the world, needs continued investment and support. With a technological advantage, and staying close to the resource to reduce costs, ensures that manufacturing remains European. However, to create this new industrial sector major investments in research, demonstration and innovation are still needed.

Several high-level activities for **tidal and wave energy** are proposed in the implementation Plan. Collaboration in the areas of **installation**, **logistics and infrastructure** is needed to create a supply chain. For the whole sector, knowledge building will be important. Other actions are: (i) co-ordination and development of **standards/guidelines** for wave/tidal technology evaluation and LCoE analysis, (ii) collaboration on the development of **certification** and safety standards for the development, testing, deployment of ocean energy devices and, (iii) **de-risking** of environmental consenting through an integrated programme of measures and in particular through promoting open data sharing.
To make the technical development possible, financial support is needed. For example; the potential for creation of an Investment Support Fund for ocean energy farms will be investigated and the creation of an **EU Insurance** and **Guarantee Fund** to underwrite various project risks.

TARGETS

For the levelised cost of energy (LCoE) of tidal stream and wave energy, quantitative targets were set:

→ The LCoE for tidal stream energy should be reduced to at least

15 CT€/KWH IN **2025** and
10 CT€/KWH IN **2030**

→ Wave energy technology should follow the same pathway through convergence in technology development and reach at least the same cost targets maximum 5 years later than tidal energy:

20 CT€/KWH IN **2025**
15 CT€/KWH IN **2030** and
10 CT€/KWH IN **2035**

A combination of both step changes in technology performance combined with mass production will deliver the required cost reduction and performance improvements of both wave and tidal technology.

[1] The costs for delivering the electricity to onshore substations are taken into account within the LCoE.

EXAMPLES OF R&I ACTIVITIES:

DEVELOPMENT OF TIDAL ENERGY

Development of tidal energy will be done by assisting technology development up to TRL 6 and supporting system demonstration in operational environment in the TRL 7-9 categories.

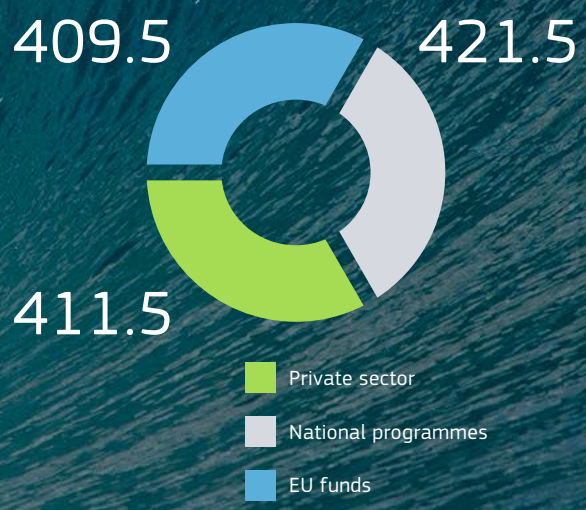
EUR 540 million
2018-2025

WAVE ENERGY TECHNOLOGY

For wave energy technology development support is needed for assisting technology development up to TRL 6, and support device and system demonstration in operational environment in the TRL 7-9 categories is encouraged.

EUR 558 million
2018-2030

THE OVERALL INVESTMENT TO BE MOBILISED BY THE IP ON OCEAN ENERGY IS EUR 1.2 BILLION SPLITED AS FOLLOWS (M EUR).



To ensure the proper implementation of the actions crucial to meet the targets set in the ocean energy Declaration of Intent, a first estimation of the overall investment needs amounts to EUR 1240 million by 2030.

10
COUNTRIES

STAKEHOLDERS

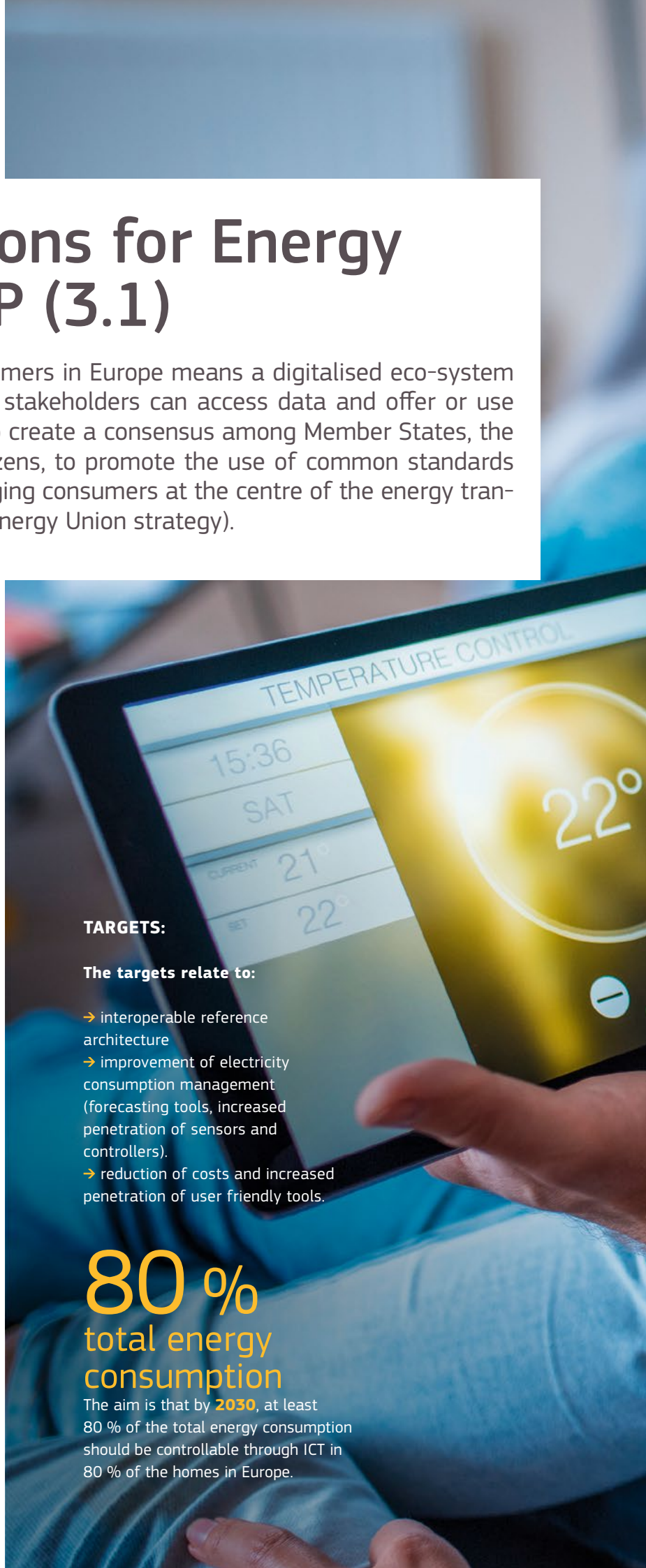
In total, over 120 organisations from industry, research and science represented by ETIP Ocean, Ocean Energy Europe and EERA JP Ocean.

2.2 A Smart Consumer-centric Energy System

Smart Solutions for Energy Consumers IP (3.1)

Smart energy solutions for consumers in Europe means a digitalised eco-system where consumers, companies or stakeholders can access data and offer or use energy services. The IP intends to create a consensus among Member States, the EC, private stakeholders and citizens, to promote the use of common standards when financing projects and bringing consumers at the centre of the energy transition efforts (highlighted in the Energy Union strategy).

Such R&I activities/projects are aimed at developing **energy services and applications** for houses and commercial buildings in cities. This will be done through different sources of data (energy, weather, traffic, etc.) offering real-time monitoring and control. The IP also includes activities that will contribute to setting up a quantitative and qualitative framework to measure **consumers' benefits and engagement** via indicators, commonly used throughout Europe to ensure comparability. Finally, it proposes setting up a **Societal Readiness Level Framework**, to help generate a positive and constructive engagement 'for all citizens' in the energy transition, that will ultimately lead to a 'people-centred' energy system in Europe, a system that people trust, like and are engaged in.



TARGETS:

The targets relate to:

→ interoperable reference architecture
→ improvement of electricity consumption management (forecasting tools, increased penetration of sensors and controllers).
→ reduction of costs and increased penetration of user friendly tools.

80 %
total energy consumption
The aim is that by **2030**, at least 80 % of the total energy consumption should be controllable through ICT in 80 % of the homes in Europe.

EXAMPLES OF R&I ACTIVITIES: [1]

SIT4ENERGY

Germany and Greece collaborate in a project called SIT4Energy that demonstrates how integrated energy management for prosumer scenarios can be realised through a smart IT solution considering both efficiency potentials in the local energy production and consumption.

EUR 0.5 million
2018-2021

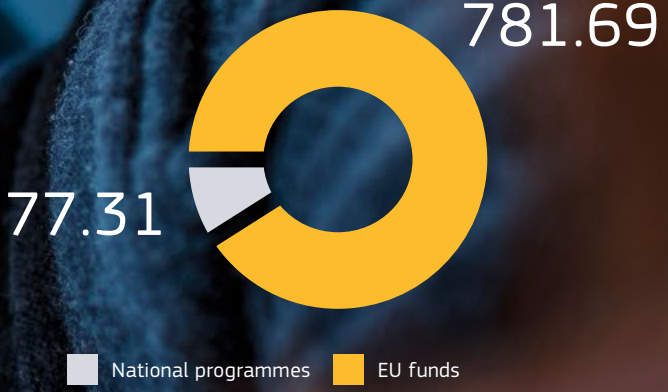
ENERGIEWENDEBAUEN

In Germany, the program 'Energiewendebauen' focuses on the digitalisation of the energy system and integrated concepts for smart buildings, smart districts and smart city considering the coupling of the sectors of electricity, heat and electromobility. This considers consumer needs and engagement within energy management research. Ongoing projects consider aspects of interoperability and standards, digital service platforms, tools for energy services and efficient energy management and KPIs to evaluate energy consumption.

EUR 20 million
2017-2022

[1] The presented projects should be considered as examples for the set-up of similar cooperation activities between Member States, stakeholders and private sector. The release of the reference architecture for consumers at smart home and city level, the commitment of Member States to use it for projects, the set-up of the joint framework for consumer engagement and the societal readiness level framework will enable to progress in developing projects delivering smart energy services for consumers.

THE OVERALL INVESTMENT TO BE MOBILISED BY THE IP ON SMART SOLUTIONS FOR ENERGY CONSUMERS IS EUR 859 MILLLION SPLITED AS FOLLOWS (M EUR).



8
COUNTRIES

STAKEHOLDERS

EERA e3s Joint Programme on economical, environmental and social impacts, KIC Innoenergy, European association of Smart Energy solutions providers, BAUM (Energy management services), FIWARE foundation and E.ON Energy Research Center, BEUC (The European Consumers Organisation).

Towards Positive Energy Districts for Sustainable Urbanisation IP (3.2)

Positive Energy Districts (PED) are energy efficient districts that have net zero carbon dioxide (CO_2) emissions and work towards an annual local surplus production of renewable energy (RES). Such districts help raise the quality of life in European cities, while reaching the COP21 targets and making Europe a global role model. An open innovation framework with cities, industry, investors, research institutes and citizens' organisations all working together will help develop PEDs and the necessary R&I Activities. The approach integrates the technological, spatial, regulatory, financial, legal, environmental, social and economic perspectives.

In this Implementation Plan (IP), the pathway towards PEDs includes **Labs** to develop new ideas, solutions and services. **Guides and Tools** supporting replication and mainstreaming *(e.g. definition and certification to business models and capacity building)* are also included. **Replication and Mainstreamin**g can further help other cities to develop strategies that include PEDs using the necessary pre-conditions for their deployment and maintenance. The goal of positioning European industry as a global leader in PED solutions is addressed via **Pilots** for international collaboration. Finally, PED **Monitoring and Evaluation** along the way will help ensure constant improvement and adaptation.

TARGETS:

This Implementation Plan on Action 3.2 'Smart Cities and Communities' aims to support the planning, deployment and replication of

100

'Positive Energy Districts' for sustainable urbanisation by **2025**

EXAMPLES OF R&I ACTIVITIES:

PED LABS

Funded by transnational R&I funding such as JPI Urban Europe (and the European Commission) and by aligning national R&I funding.

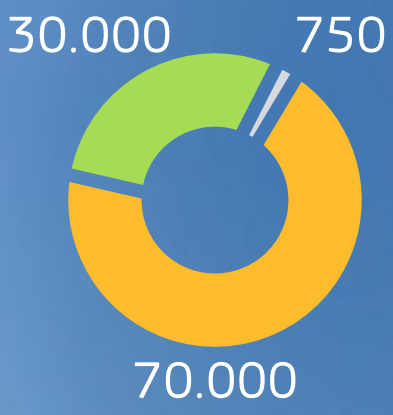
EUR 150 million
2018-2025

INNOVATION ACTIONS

Transnational R&I funding topped up by a six-fold alignment of national R&I funding will finance these innovation actions.

EUR 485 million
2018-2025

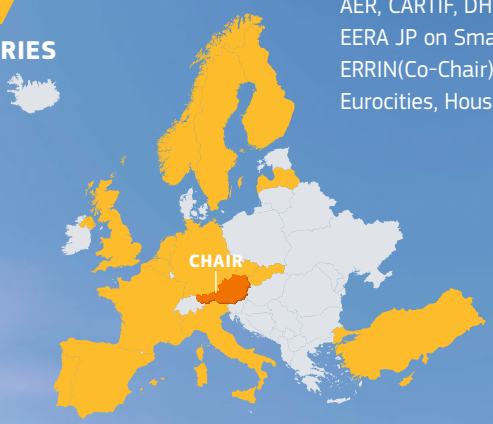
IP PLEDGES AND LEVERAGED INVESTMENT IN EUR MILLION:



- Public infrastructure investments in PED districts
- Initial IP investment from public, private and EU funds
- Private construction investments in PED districts

In the majority of participating countries national public research funding, especially innovation funds, needs to be matched by contributions from beneficiaries. On average, at least 30% (EUR 225 million out of EUR 750 million) of public funding will be contributed by beneficiaries (depending on national funding rules). Public R&I funding is also expected to have a leverage effect, leading to investments for the deployment and operation of PEDs, infrastructure, construction and refurbishment by cities, public housing organisations and real estate developers. Investments on the ground can be estimated at a minimum of EUR 100 billion.

17
COUNTRIES



STAKEHOLDERS

AER, CARTIF, DHC+TP, ECTP(Co-Chair), EERA JP on Smart Cities, EIP SCC, EPRA, ERRIN(Co-Chair), EUA-EPUE, EUREC, Eurocities, Housing Europe, IE.

Energy Systems IP (4)

Endorsement of the EU's 2030 global renewable energy (RES) target by co-legislators (32 %) will have considerable impact on the share of renewable electricity in the grid. It will reach over 50 % of electricity consumption by 2030 (the majority –over 30 %– from wind and solar combined). Expansion of these variable energy sources will increase the need for flexibility. This Implementation Plan (IP) identifies research and innovation (R&I activities) including storage, flexible power generation, demand response and sector coupling (such as power to electric vehicles).

R&I activities (total 21) were clustered under **two** complementary Flagship Initiatives: **'Develop an Optimised European Power Grid'** and **'Develop Integrated Local and Regional Energy Systems'**. In addition, five cross-cutting R&I activities aimed at promoting innovative services, digitalisation and cybersecurity were endorsed. This built on the well-functioning structures:

ETIP SNET → The European Technology and Innovation Platform on Smart Networks for Energy Transition (**ETIP SNET**). The R&I activities developed within ETIP SNET served as a basis for the majority of those included within the Implementation Plan. They were complemented by the local energy system dimension.

bridge HORIZON 2020 → The **BRIDGE** knowledge sharing community gathers together Horizon 2020 demonstration projects.

Smart Energy Systems ERA-Net → Joint actions developed using the **Smart Energy System Platform**, are driven by Member States and mainly funded from national and private resources. They are also supported by the European Union, which provides top up funding through the **ERA-NET** instrument available under Horizon 2020.

INDICATIVE TARGETS

To achieve quality of supply in a system with many uncertainties, maximum RES integration, optimised use of the grid and deferred grid investments, these are some of the targets addressed (expressed in simplified terms):

80 % observability of networks at high and medium voltage level

25 % peak load reduction

10 % improved accuracy of forecasting for aggregated RES plant power production

50 %–70 % reduction of specific storage costs

BEYOND 100 % RES use in the local or regional supply, by linking different energy domains (electricity, heat/cold, gas, mobility).

EXAMPLES OF R&I ACTIVITIES:

Two of the Important projects currently under way – both are double winners of the European Sustainable Energy Awards. They provide a clear contribution towards reaching targets specified in the IP of Action 4:

TILOS PROJECT

A European research project engaging 13 participating enterprises and institutes from seven European countries (France, Germany, Greece, Italy, Spain, Sweden, UK). The aim is to achieve large-scale RES penetration at affordable cost.
This can be reached by combining hybrid renewables energy plants (e.g. wind and photovoltaic) together with an advanced central battery storage system. Demonstration takes place on the island of Tilos.

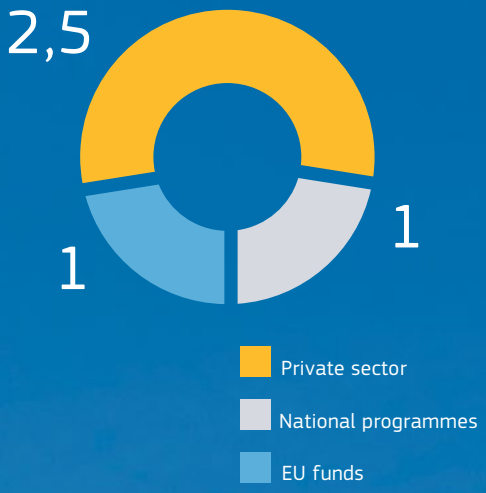
EUR 13.7 million
A 4-year project ending in 2019

WISEGRID PROJECT

This project develops advanced information technology (ICT) services for smart grids and empowers energy consumers.
Nine EU countries participated (Belgium, France, Germany, Greece, Italy, Romania, Spain, UK). Four large-scale demonstration projects are under way in Belgium, Greece, Italy and Spain.
More than 1700 users, 60 batteries, 50 heat pumps, 180 electric vehicles, 40 charging stations and 70 MWh of RES capacity (PV, wind turbines and hydro).

EUR 17.6 million
The project will run until mid-2020

THE OVERALL INVESTMENT TO BE MOBILISED BY THE IP ON ENERGY SYSTEMS IS EUR 4.5 BILLION SPLITED AS FOLLOWS (BILLION EUR).



This approximate allocation constitutes only a preliminary estimate for the funding needs under this IP (using to the extent possible estimates of ETIP SNET for actions where such estimate is available). Some of the activities of this IP are already underway.

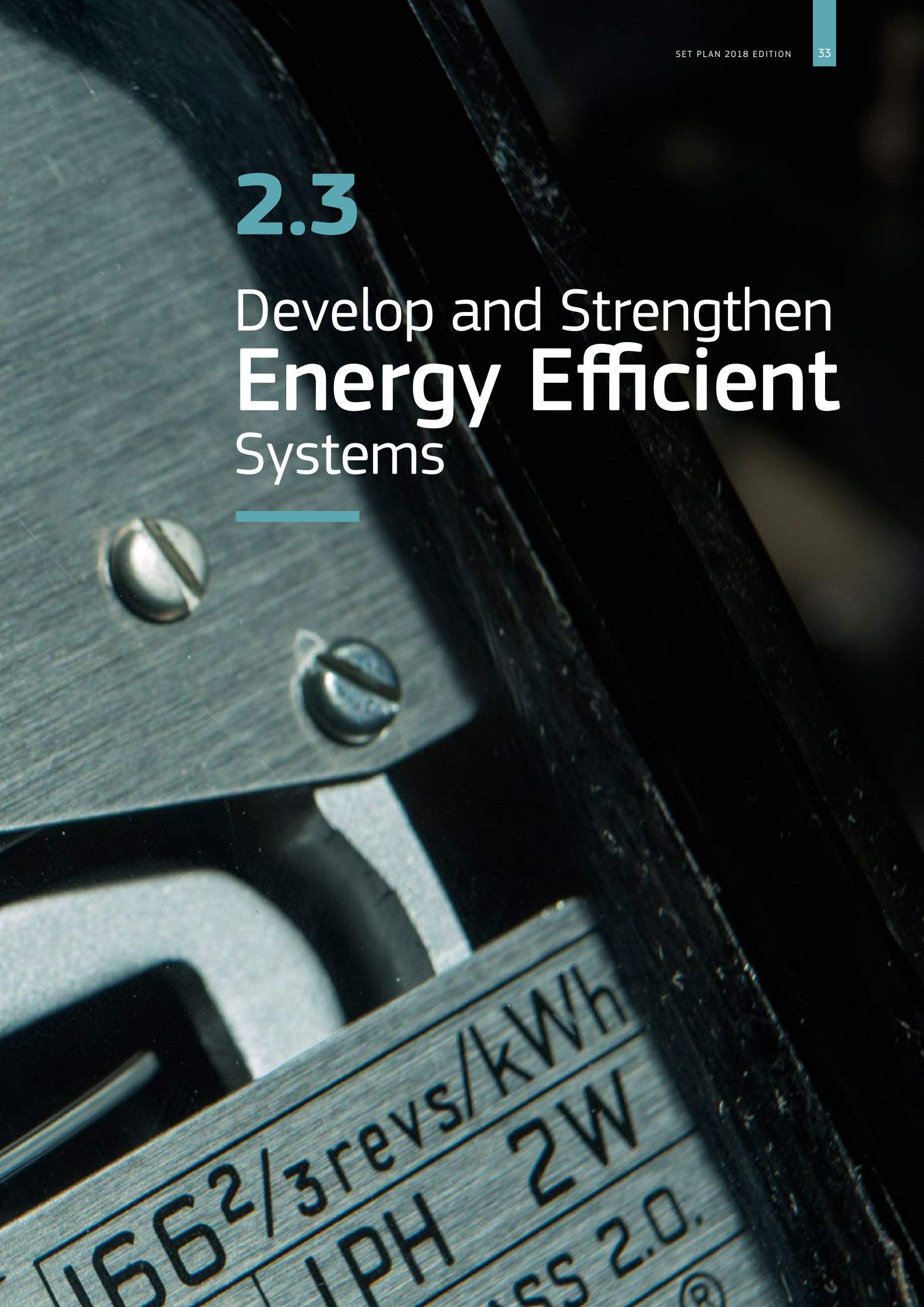
STAKEHOLDERS

The ETIP SNET, participating in all activities related to the Flagship Initiative 1 'Develop an Optimised European Power Grid', plus the cross-cutting activities on ICT and cybersecurity; ETIP PV, participating in the cross-cutting activity on socio-economic impact and the living labs concepts; ETIP DHC, showing high interest in all activities related to the Flagship Initiative 2 'Develop Integrated Local and Regional Energy Systems'.


kWh

2.3

Develop and Strengthen **Energy Efficient** Systems



Energy Efficiency in Buildings IP (5)

Buildings account for a substantial share of the EU's total energy consumption. This Implementation Plan (IP) addresses how energy demand could be reduced and security of supply improved. As European citizens we spend more than 90 % of our time indoors, which means citizens are at the centre of energy efficiency actions implemented in buildings. The potential to reduce high carbon dioxide (CO_2) emissions is also significant given that heating and cooling in buildings comes mainly from natural gas, fuel oil and coal, and very little is from renewable energy (RES).

The Implementation Plan is instrumental to the accomplishment of the targets prioritised for energy efficiency in buildings.

TARGETS FOR HEATING & COOLING by 2025:

→ **50 %** reduction of cost of heat pumps compared with 2015 market price; develop prefabricated, fully integrated 'plug-and-play' hybrid/multi-source heat pump systems and integrated compact heating/cooling plants.
→ Increasing renewable heat in DHC by **25 %** while ensuring quality and cost-effectiveness; **20 %** decrease in costs of DHC substations for residential buildings (compared with 2015 prices).
→ **50 %** cost reduction for equipment and installation of micro-combined heat and power (CHP) and combined cooling, heat and power (CCHP); **20 %** increase in the energy efficiency of micro-CHP/CCHP (compared with 2015 levels).
→ **25 %** improvement of energy storage performance compared with 2015 levels; 200 % increase of storage density at the system level (including pumps, valves, pipes, short-term buffer) from the current state-of-the art 60 kilowatt hour per cubic metre (kWh/m³).

TARGETS FOR MATERIALS by 2025:

→ **60 %** reduction on average primary energy demand in buildings and limiting the payback time to 10 years;
→ at least **10 %** reduction of Nearly Zero Energy Buildings (NZEB) or positive energy buildings costs compared with 2015 levels (with a view to a 15 % reduction);
→ at least **20 %** reduction of the average duration of energy-related construction for renovation and for new buildings compared with current national standard practice; and
→ reducing the difference between the predicted and measured energy performance to at least **15 %** (with the aim of 10 %) after the commissioning period.

EXAMPLES OF R&I ACTIVITIES:

DIGITAL PLANNING AND OPERATIONAL OPTIMISATION

Today's modern functions and management systems in buildings, used correctly, have the potential to reduce energy consumption and maintenance costs to eventually achieve Nearly Zero Energy Buildings (NZEB) status, as well as reduce the difference between predicted and measured energy performance.

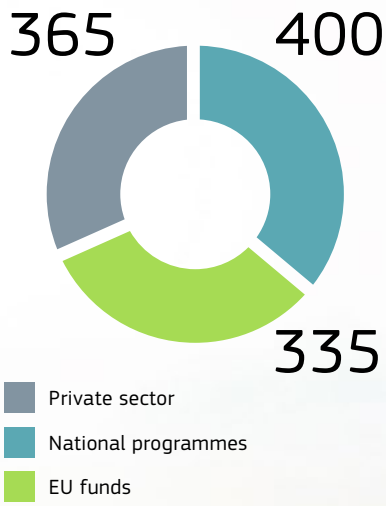
EUR 250 million
The project will run 2019-2023

DEVELOPMENT OF COMPACT THERMAL ENERGY STORAGE MATERIALS, COMPONENTS AND SYSTEMS

Compact thermal energy storage systems can store renewable electricity for short or intermediate periods in power to heat configurations. Electricity can be taken from the grid at peak times, stored, and used for heating and cooling later. These systems can also store solar thermal energy.

EUR 240 million
The project will run 2019-2025

THE OVERALL INVESTMENT TO BE MOBILISED BY THE IP ON ENERGY EFFICIENCY IN BUILDINGS IS EUR 1100 MILLLION SPLITED AS FOLLOWS (M EUR).



Source: TWG elaboration from data and figures from different sources

To ensure proper implementation of the actions that are vital to meeting the targets set out in the relevant Declaration of Intent, a first estimate puts overall investment needed at EUR 1.100 million.

7
COUNTRIES

STAKEHOLDERS

There are ten industry/stakeholders including Euroheat & Power, the European Construction Technology Platform (ECTP), the European Heat Pump Association (EHPA), the European Association for the Promotion of Cogeneration (COGEN Europe), European Turbine Networks (ETN), European Geothermal Energy Council (EGEC), European Platform of Universities in Energy Research and Education (EUA-EPUE), European Technology and Innovation Platform on Renewable Heating & Cooling (RHC), SINTEF Energy Research Steering Committee of the Biomass panel, and the European Solar Thermal Industry Federation (ESTIF).

Energy Efficiency in Industry IP (6)

Research and innovation (R&I) in industrial energy and resources efficiency is crucial to ensure that the European industry contributes to climate change targets and increases its export competitiveness. This is especially important in a situation where manufacturing companies from across the globe have access to lower cost energy and to energy-saving technologies. R&I investment especially in technology sectors such as iron/steel, chemicals or pharma, where the energy efficiency potential remains significant for European companies, are instrumental in boosting the EU's technological leadership and innovation know-how.

The Implementation Plan (IP) foresees actions to enhance cooperation between national programmes and to develop activities into actual projects. Activities are well underway already; a cooperation workshop was also organised in June 2018. In the **steel sector**, 7 projects have already started to address the first feasibility or pilot phase(s). Next phases – of pilot/industrial scale demonstrations – are yet to be financed and launched. In the other sectors, in the **chemical**, **heat and cold**, systems 'project ideas' were presented with the aim to potentially become collaborative projects.

The participating countries have expressed their readiness to open bi/multi-lateral cooperation using instruments such as the Berlin model or EUREKA. Next steps include a **survey** to identify if a critical mass of interested beneficiaries exists in the specific areas of the Implementation Plan in the participating countries.

TARGETS:

1/3 of the technical potential energy savings

In the iron/steel and chemical /pharma sectors, the aim **by 2030** is to improve the payback time (up to 3 years) of 1/3 of the technical potential energy savings and to boost market uptake of emerging technologies.

20 % reduce energy consumption

For the cross-cutting priorities, the aim **by 2025** is to: (a) demonstrate cost effective heat and cold recovery solutions and: (b) reduce energy consumption by 20 % through system integration, optimal design and intelligent operation, including industrial symbiosis and digitisation.

EXAMPLES OF R&I ACTIVITIES:

HYBRIT PROJECT

The HYBRIT breakthrough technology will use hydrogen, produced by electrolysis fuelled by renewable electricity, as the reductant to produce iron without CO_2 emissions. Following a successful feasibility study, the construction of the pilot plant started in June 2018. HYBRIT has the ambition to reduce emissions in Sweden by 6 million tons of CO_2 by 2040. HYBRIT is a joint venture by the SSAB (steel producer), LKAB (iron ore mining) and Vattenfall (energy producer).

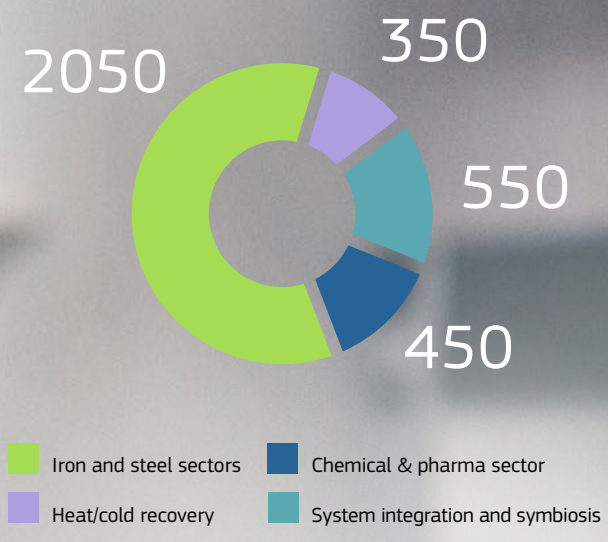
EUR 140 million
mid 2018 – mid 2024

EPOS PROJECT

The innovative approach of the industrial symbiosis developed by the EPOS project is based on 'blue prints': more than 30 technologies in key sectors (steel, cement, chemicals, minerals and engineering) have modelled, making it possible to identify potential energy and resources flows that could be exchanged without disclosing proprietary data on internal processes. The platform supporting the data exchange has been developed and is being validated in 5 use cases for implementing industrial symbiosis in real industrial clusters.

EUR 5.2 million
2015-2019

THE OVERALL INVESTMENT TO BE MOBILISED BY THE IP ON ENERGY EFFICIENCY IN INDUSTRY IS EUR 3.4 BILLION SPLITED AS FOLLOWS (M EUR).



Some 14 R&I activities have been identified, representing an estimated investment of EUR 3-4 billion. All activities are new projects, and their duration ranges from 3-5 years to 17 years. The funding sources and instruments will be a mix of public (national) and private funding, plus EU funding where the activity has demonstrable European added value.

20
COUNTRIES

STAKEHOLDERS

Association — Sustainable Process Industry through Resource and Energy Efficiency (A.SPIRE, Co-Chair), European Energy Research Alliance (EERA), Euroheat & Power, the European Association for the Promotion of Cogeneration (COGEN Europe), the European Chemical Industry Council (CEFIC), the European Confederation of Iron and Steel Industries (EUROFER), the European Geothermal Energy Council (EGEC), the European Turbine Network (ETN), EUTurbines, the European University Association (EUA) and, the Fuel Cells and Hydrogen Joint Undertaking (FCH JU).


FM 104.5 MHz
Radio Presets Info FM1

2.4

Energy Options for Sustainable Transport Systems

Batteries for e-Mobility and Stationary Storage IP (7)

Europe produces less than 1% of global Li-ion battery cells. Absence of domestic Li-ion batteries cell manufacturing in the EU affects competitiveness of European electric vehicle producers and energy storage service providers. Competing with foreign global economies in the batteries sector on a cost-only basis is not enough. Instead, Europe needs to differentiate itself on battery aspects other than cost including environmental and performance. Within the 'European Battery Alliance'[1], Europe supports the development of a domestic green battery value chain consisting of high performant, safe and sustainable battery cells with the lowest environmental footprint possible.

The Implementation Plan is proposed as an input to the R&I dimension of the European Battery Alliance. It identifies battery R&I activities and defines objectives covering the period 2018 to 2030 for e-mobility and stationary energy storage applications. The R&I activities are structured along **five flagship initiatives** that illustrate how coordinated R&I actions, at private, national and EU level, can contribute to the achievement of the agreed targets[2] and entail activities of interest to the European citizens.

The Implementation Plan also identifies a number of issues related to **market/market access and education/training/knowledge,** which cannot be addressed by R&I alone, but which nevertheless need to be addressed in a European initiative on batteries. Besides the R&I activities under the Flagship initiatives mentioned above, additional R&I activities for instance focused on domestic recovery of lithium for the anticipated high volumes of traction batteries are also mentioned.

TARGETS:

The targets are differentiated into performance, cost and manufacturing targets for lithium-ion batteries and future technologies for use in automotive and stationary storage applications.

2030

Performance:
Energy density at cell level:
>350Wh/Kg and **> 750 Wh/L**

Cost:
Automotive battery pack: **75€/kWh**
Stationary energy storage: **0.05€/kWh per cycle**

Manufacturing:
Automotive: **50 GWh/year**
Stationary: **10 GWh/year**

[1] https://ec.europa.eu/growth/industry/policy/european-battery-alliance_en
[2] https://setis.ec.europa.eu/system/files/integrated_set-plan/action7_declaration_of_intent_0.pdf

EXAMPLES OF R&I ACTIVITIES:

eCAIMAN

The overall objective of eCAIMAN is to bring European expertise together to develop a battery cell that can be produced in Europe and meet the energy density of Lithium-ion batteries (LIB) of ~270 Wh/kg and cost of 200 €/kWh. The project also investigates the integration in light, passenger and heavy-duty vehicles validating safety and reliability of the cells leaders. It finally aims to help with international standardisation and raise market share of (PH)EVs while addressing a broad scope of real end-user demands. The eCAIMAN scale-up is designed with existing European production technologies and inexpensive materials mined in Europe.

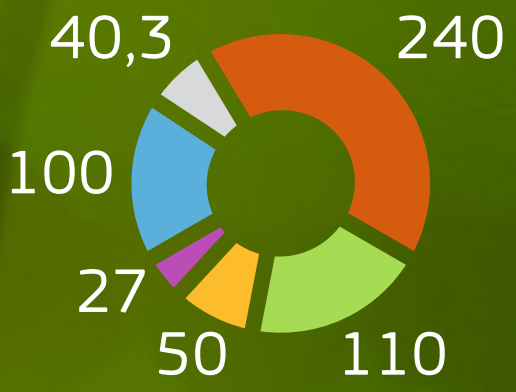
EUR 6 million
2015-2018

BATCircle

As a leader of the Action 7 work-stream on Battery Recycling, Finland has identified deficits in support for battery recycling R&I in Europe. Acknowledging the massive anticipated growth of battery use and recycling, Finland has launched the ambitious nationally funded BATCircle project. While many technical and logistical challenges need to be addressed for battery recycling, the BATCircle project focuses on upscaling of metallurgical or chemical processes and improvement of current commercial processes recovering Cu, Ni, Co, Li and other metals in order to increase the process efficiency and lower the environmental footprint. The sub-group on recycling, led by Outotec and Aalto University, currently gathers experts from 7 Member States (FI, FR, IT, DE, AU, NO, BE) and is dedicated to advance lithium-ion battery recycling R&I priorities, identified in the Action 7 Implementation Plan. By building on existing research, knowledge and competences, the sub-group aims to enlarge BATCircle at European level.

EUR 20 million
2018

THE OVERALL INVESTMENT[3] TO BE MOBILISED BY THE IP ON BATTTERIES FOR E-MOBILITY AND STATIONARY STORAGE IS EUR 568 MILLION SPLITED BY FLAGSHIP AS FOLLOWS (M EUR).



To ensure the proper execution of the Implementation Plan on globally competitive batteries, a first estimation of the minimum overall investment needs amounts to EUR 568 million by 2030.

[3] Investments indicated are the absolute minimum needed. More may be potentially required.

10
COUNTRIES

STAKEHOLDERS

AVL/AT, BMW, BLUE SOLUTIONS, BOSCH, BOUYGUES, Electricité de France (EDF), European Energy Research Alliance (EERA), European Platform of universities in energy Research and Education (EUA-EPUE), Association of European Manufacturers of automotive, industrial and energy storage batteries (EUROBAT), Kompetenznetzwerk Lithium-Ionen Batterien (KLiB), Lechanché, Lithops, Northvolt, Renault-Nissan, French research network on electrochemical energy storage (RS2E), Saft, Solvey, Umicore, Valdi, and Volkswagen group.

Renewable Fuels and Bioenergy IP (8)

Bioenergy is essential for reaching EU's renewable energy targets and the Paris Climate Agreement. Development of low-carbon renewable fuels decreases greenhouse gas emission (GHG); furthermore, advanced biofuels and other renewable fuels play an important role in decarbonising transport, as well as integrating electricity, heating, transport and industrial sectors. These bioenergy advantages trigger three needs addressed by this IP: enhances economies of scale, reduces the production costs and optimises the greenhouse-gas performance of all bioenergy-products. The targets set address: (1) bioenergy; (2) renewable fuels; (3) intermediate bioenergy carriers, and (4) biomass Combined Heat and Power (CHP). This IP identifies 61 actions under 13 Research and Innovation (R&I) activities.

This IP addresses the following technologies: advanced biofuels for transport, other renewable fuels of non-biological origin, intermediate bioenergy carriers, renewable hydrogen and large-scale biomass Combined Heat and Power (CHP). Activities to reach the targets are structured along the technical maturity of different technologies. Activities at the **development level** include improving existing biofuels technologies through reliable tools and ensuring technology diversity for security of energy supply and cost competitiveness. For the more mature work at the **demonstration stage**, the focus is on converting sustainable biomass into biofuels, improving the performance of large-scale biomass generation of modern heat and power technologies and contributing towards renewable energy storage as renewable solid, liquid and gaseous fuel.

TARGETS:

The Implementation Plan has three common goals for the field of Bioenergy and Renewable Fuels at large: improve performance (yield and efficiency) of production, reduce GHG emissions along the value chain and reduce cost.

Targets:	2030	2050
Reduce GHG emissions	80 %	80 %
Improve performance (yield and efficiency) of production	↗ 30 %	
Reduce conversion system costs	↘ 20-30 %	↗ 50 %

EXAMPLES OF R&I ACTIVITIES:

BioTfuel

The project is focused on developing an innovative conversion of combined thermal and chemical treatment of biomass and fossil feedstocks into biodiesel and bio jet-fuel. It took five years of R&D for the project to initiate the construction of a demonstrator platform. The validation of the set of four process steps – pre-treatment of biomass by torrefaction, gasification, purification and catalytic synthesis of liquid fuels – is completed. 2020 is the target date for application at an industrial scale and for commercial deployment.

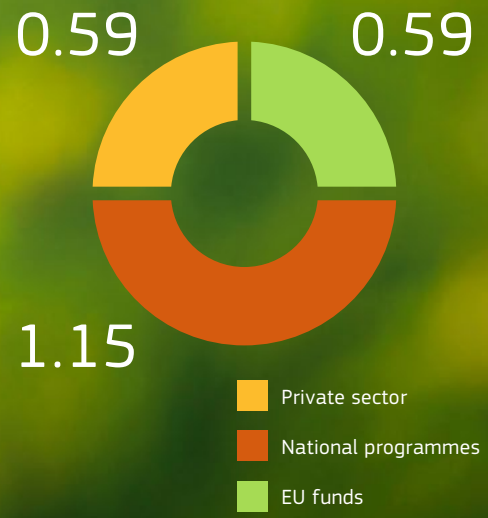
EUR 180 million
From 2019 onwards, for commercial deployment

4REFINERY

4refinery will develop and demonstrate the production of next generation biofuels from more efficient primary liquefaction routes integrated with upgraded downstream (hydro)refining processes to achieve overall carbon yields of >45 %. The consortium will aim for successful deployment into existing refineries, including delivering a comprehensive toolbox for interfacing with existing refinery models. The main objectives of 4REFINERY are: (1) to develop new biofuels production technology; (2) to scale up testing procedures; (3) to develop solutions to answer key societal & environmental challenges.

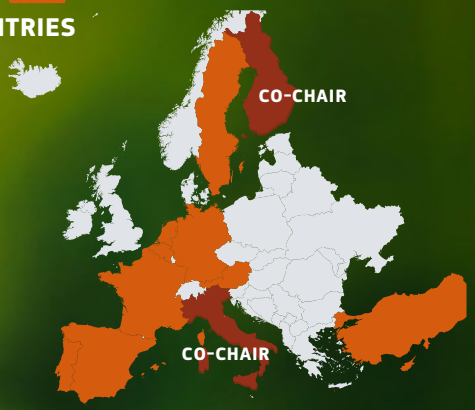
EUR 6 million
2017-2021

THE OVERALL INVESTMENT TO BE MOBILISED BY THE IP ON RENEWBLE FUELS AND BIOENERGY IS EUR 106.65 BILLION. THE ESTIMATED VOLUME OF INVESTMENT FOR R&I ACTIVITIES IS EUR 2.33 BILLION SPLITED AS FOLLOWS (BILLION EUR).



The estimated volume of investment for demonstration and scale-up activities is EUR 104.32 billion

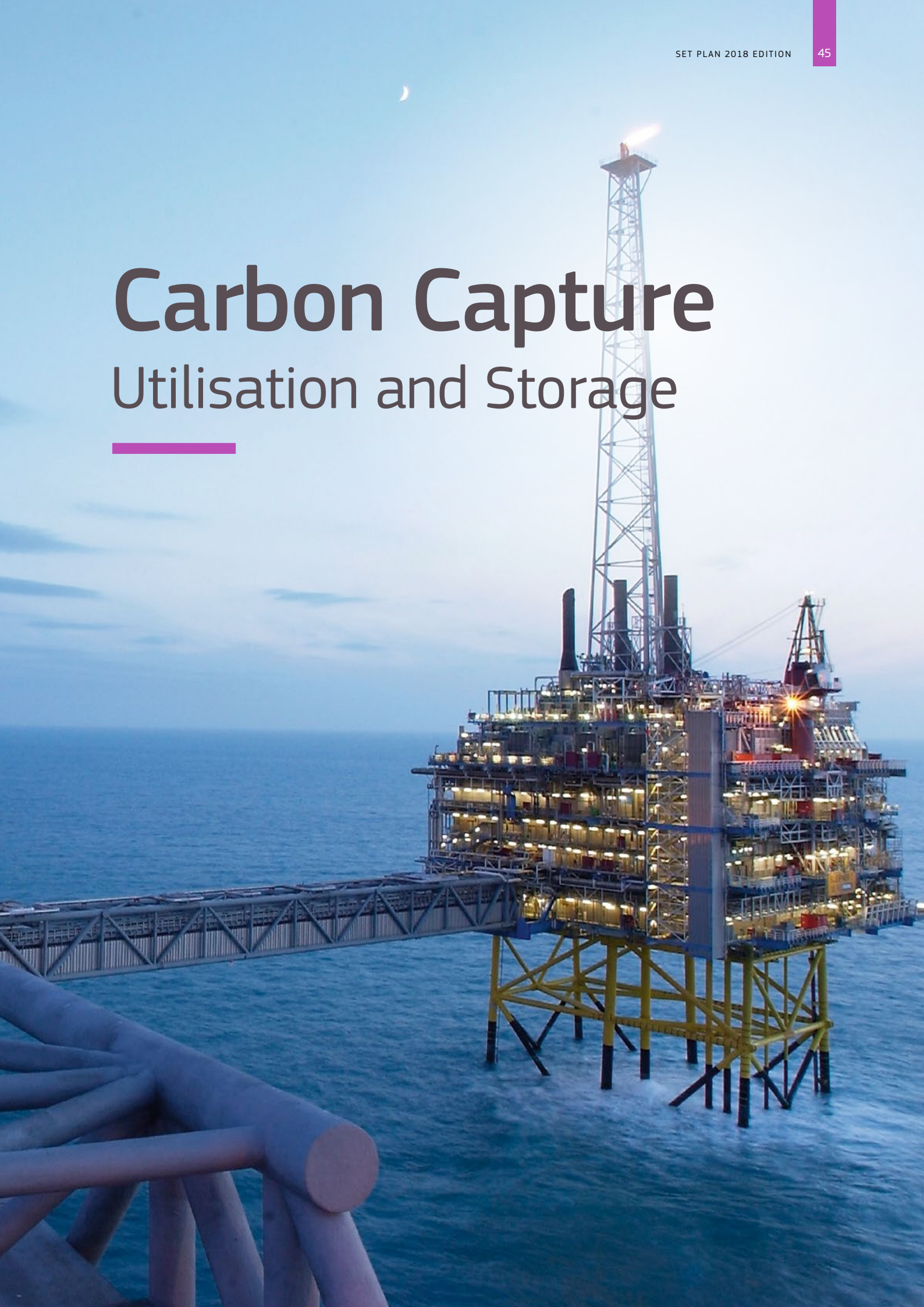
12
COUNTRIES



STAKEHOLDERS

European Technology and Innovation Platform (ETIP) Bioenergy; EERA on Bioenergy; ETIP Renewable Heating and Cooling (RHC); European Automobile Manufacturers' Association (ACEA); European Biogas Association (EBA); European Biomass Industry Association (EUBIA); European Energy Research Alliance (EERA) on Hydrogen; European Power Plant Suppliers Association (EPPSA); FlightPath; Fraunhofer Institute for Environmental, Safety, and Energy Technology (UMISICHT) ;European University Association; Fuel Cells and Hydrogen Joint Undertaking (FCH JU); Italian National Hydrocarbon Agency (Ente Nazionale Idrocarburi S.P.A.-ENI); Leaders of Sustainable Biofuels (LSB); Neste; previously Danish energy powerhouse Dong Energy-now Orsted; previously Fiat-Iveco, now CNH Industrial; previously Institut Français du Pétrole-now IFP Energies Nouvelles (IFPEN); Technical Research Centre of Finland Ltd (VTT)

Carbon Capture
Utilisation and Storage



Carbon Capture Utilisation and Storage IP (9)

Carbon capture, utilisation and storage (CCUS) represents an important set of technologies for the decarbonisation of power generation and energy-intensive industries. Pilot projects and other R&I activities are under way in the sector aiming to make CCUS cost-effective measure against climate change. The CCUS implementation plan identifies eight R&I priorities. Where ongoing projects are seen to be insufficient to achieve the SET Plan targets by 2020 and 2030, the plan proposes new actions to address such gaps. It also addresses the problem of insufficient finance to put ongoing and new projects into operation.

The CCUS Implementation Plan identifies eight R&I activities required to deliver the following SET Plan targets:

→ reduce the cost of CO_2 capture;
→ complete a detailed appraisal of cost-effective and bankable storage capacity;
→ initiate CO_2 hubs and clusters and a cross-border CO_2 transport infrastructure
→ initiate piloting and demonstration of CO_2 re-use technologies.

The plan also includes an action with a socioeconomic focus, which relates to the role of CCUS in meeting European and national climate and energy objectives.

TARGETS

The SET Plan's key R&I objectives for carbon capture, utilisation and storage (CCUS) are:

→ to demonstrate and to deploy on a commercial scale the full CCUS value chain;

→ to reduce the costs of CO_2 capture;

→ to demonstrate safe CO_2 storage.

EXAMPLES OF R&I ACTIVITIES:

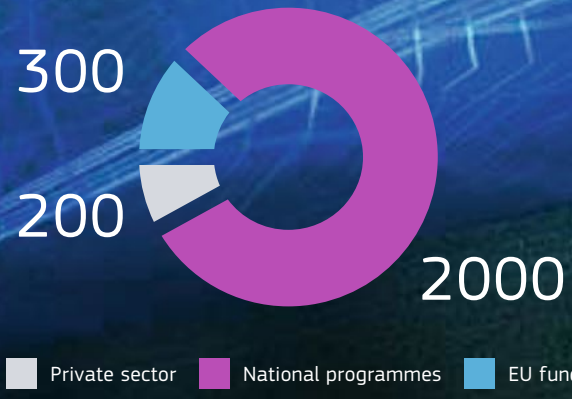
DELIVERY OF REGIONAL CCS AND CCU CLUSTERS

Delivery of 5 CCS clusters is already being progressed, with all projects at least reaching the FEED study. The construction stage will take place in the early to mid-2020. In addition, 2 to 3 CCS and CCU clusters should be initiated, preferably located in Eastern Europe.

UNLOCKING EUROPEAN STORAGE CAPACITY

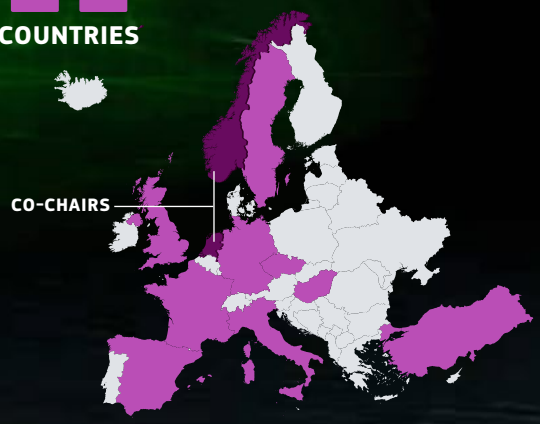
Expand European experience of CO_2 storage across a range of storage options and industrial regions and development of at least 3 storage pilots, covering a range of storage options by 2020.

THE OVERALL INVESTMENT TO BE MOBILISED BY THE IP ON CARBON CAPTURE UTILISATION AND STORAGE IS EUR 2.500 MILLLION SPLITED AS FOLLOWS (M EUR).



To ensure the proper implementation of the actions crucial to meet the targets set in the relevant Declaration of Intent, a first estimation of the overall investment needs amounts to EUR 2.5 Billion.

11
COUNTRIES



STAKEHOLDERS

The European Technology Platform for Zero Emission Fossil Fuel Power Plants (Co-Chair), Actys BEE, ArcelorMittal, Bellona, the British Geological Survey, BP, EERA, the European Chemical Industry Council (CEFIC), the European Steel Technology Platform, the European Turbine Network, the European Steel Association (Eurofer), Gassnova, the Global CCS Institute, General Electric, the German Aerospace Center, Greenwin, Heidelberg Cement, the International Energy Agency, IFP Energies Nouvelles, the International Association of Oil and Gas Producers, Mitsubishi Hitachi Power Systems, Port of Rotterdam Authority, the Research Council of Norway, Scinnov, Shell, Sintef, Sotocarbo SpA, TAQA Global and the Netherlands Organisation for Applied Scientific Research (TNO).

3

SET Plan : next steps ahead

The EU's global commitments under the Paris Agreement, the Energy Union and the legislative package 'Clean Energy for all Europeans' requires the acceleration of clean energy innovation. The European Union is a global leader in this sector with renewable energy technologies already producing 27.4 %[1] of the EU energy mix. The 'Clean Energy for all Europeans' package encourages cross-border cooperation and aims to mobilise public and private investment while generating an estimated 900 000[2] jobs and contributing to an increase of up to 1 % in GDP over the next decade.

The SET Plan is the implementing tool for the research, innovation and competitiveness dimension of the Energy Union. It aims to support and strengthen partnerships among national governments, industry and research actors to enable R&I actions that contribute to deliver on the EU energy objectives. It focuses on development of technologies that have the highest and most immediate systemic potential for GHG emission reductions, cost reductions and improvement of performance.

The SET Plan has been proved a successful platform for all-inclusive, join decision making on concrete R&I activities through the endorsement of its Implementation Plans (IPs), covering all energy R&I priorities of the Energy Union[3]. Countries aim to mobilise funding at national level but also through partnerships with other countries on R&I activities that had been previously outlined within the SET Plan Actions.

The experience gained in developing the SET Plan's IPs will be key in advancing specific technology and innovation as well as system integration in general, and will also be instrumental in further aligning energy technology and innovation policies at national and EU level.

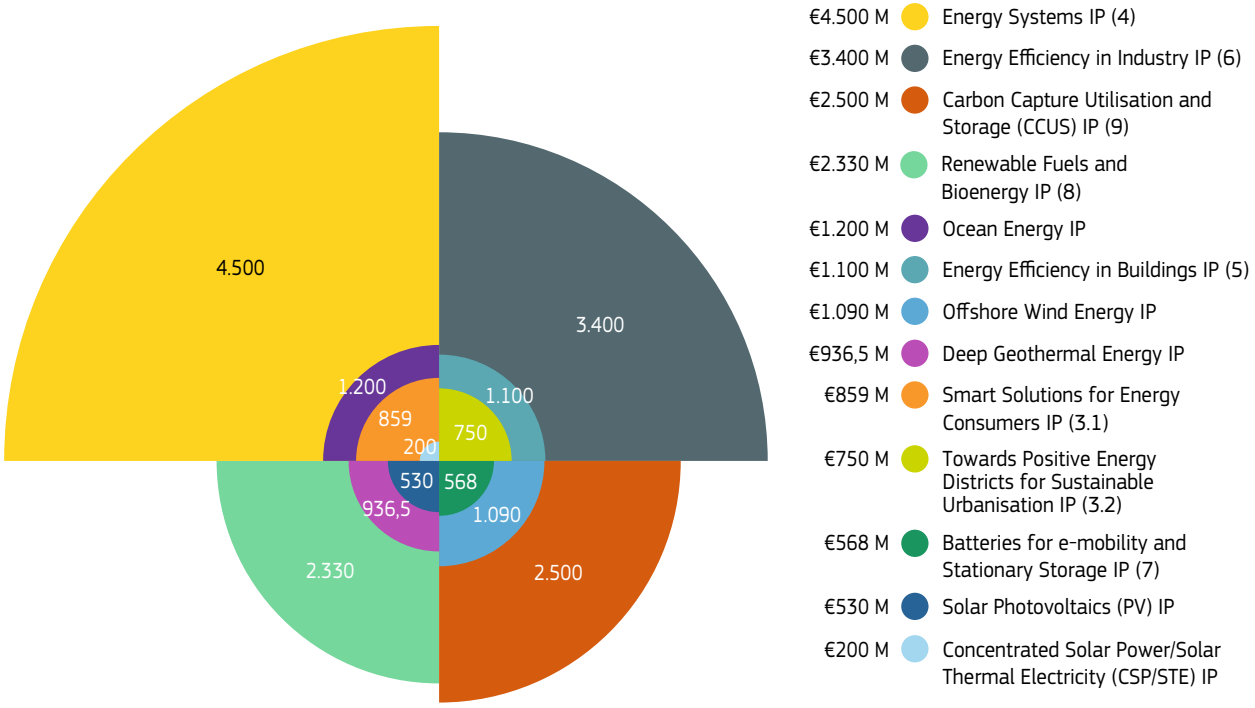
1 https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/clean-energy-all-europeans
2 EC Staff Working Document (2016) 405: Impact Assessment
3 This publication includes all non-nuclear activities of the SET Plan.

A key element of the SET Plan in the future will be to strengthen the alignment of Member State R&I actions within EU priorities and engage with less active countries. Notably, the reporting on SET Plan Actions will be an important part of Member States integrated National Energy and Climate Plans (NECPs) mandated under the Energy Union Governance Regulation[4]. The SET Plan's main objective of ensuring implementation and effective deployment of the strategic energy technologies across the EU is key to the reporting framework established for research, innovation and competitiveness as part of the NECPs. These Plans will also serve the Energy Union aims for further alignment of national R&I strategies at EU-level, for fostering transparency and for increasing R&I joint efforts and transnational funding schemes.

The SET Plan's inclusive approach ensures the involvement of key energy stakeholders (Member States, Industry and the Research community). The Commission's proposal for Horizon Europe (HE), the research and innovation framework programme for 2021-2027, builds on this approach. It is designed to promote integration by pushing systemic transformations at the intersection of disciplines, sectors and policies similarly to the next Multiannual Financial Framework proposal (EU budget 2021-2029). Based on its long-lasting experience of partnerships that brings together all relevant actors, SET Plan is centrally positioned to maximise the success of joint R&I actions between countries and the alignment of national R&I priorities with the Energy Union strategy (i.e. avoid unnecessary duplication).

4 https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/governance-energy-union

FIGURE 2
EXPECTED VOLUME OF INVESTMENTS IN R&I ACTIVITIES AS IDENTIFIED IN THE IMPLEMENTATION PLANS (EUR MILLION)



Source: https://setis.ec.europa.eu/actions-towards-implementing-integrated-set-plan/implementation-plans

Up to 2030, an estimated aggregated total of more than EUR 20 billion (see Figure 2) is expected to be invested in R&I activities that have the highest impact for the clean energy transition, as well as for the competitiveness of Europe in low carbon technologies, as proposed in the IPs illustrated in this publication. This will be part of a wider effort to decarbonise the EU energy system and further mobilise significant shares of R&I investments to meet our long-term EU strategy for the reduction of GHG emissions, in accordance with the Paris Agreement.

Europe will only be able to remain globally competitive in the energy sector if we increase our ambition towards R&I. Acting together, already at the heart of the SET Plan, will make a cost-efficient and quick transition to a decarbonised economy.

European governments, industry, research organisations and the European Commission shall continue working together for the coming years to reshape Europe's energy future and accelerate the transformation of European Energy System through innovation. The priority is now to step up public and private investments in the R&I priorities identified in these IPs under the umbrella of the SET Plan that will maximise National and EU investments.

MJ-03-18-372-EN-N

Publications Office

ISBN 978-92-79-96479-4
DOI 10.2833/25250