

Scoping Paper for
Horizon 2020 work programme 2018-2020
Societal Challenge 3: Secure, clean and efficient energy

Important Notice: Working Document

This scoping paper will guide the preparation of the work programme itself. It is a working document not formally endorsed by the Commission, and its content does not in any way prejudge the final decision of the Commission on the work programme.

The adoption and the publication of the work programme by the Commission are expected in October 2017. Only the adopted work programme will have legal value.

Scoping paper for the Horizon 2020 work programme 2018-2020
Societal Challenge 3: Secure, clean and efficient energy

1. Context

The EU's commitment to a clean energy transition is irreversible and non-negotiable¹ and the establishment of a 'resilient Energy Union with a forward-looking climate change policy' is one of the 10 top priorities of the current Commission. At the global level, COP21 and the Paris Agreement have recently set ambitious targets which will stimulate huge investments in low-carbon energy solutions in the next decades and, at the same time, demand a fundamental shift in technology, energy, economics, finance and ultimately society as a whole. The EU underlined its commitment to the Paris Agreement by joining forces with other major economic blocks in 'Mission Innovation'².

The Energy Union – the key reference framework for the EU's energy policy – calls for the EU to become the world leader in renewable energy, boost energy efficiency and to have strong, innovative and competitive companies that develop energy-efficient and low-carbon solutions. To support this vision, increase the coherence of R&I efforts across different areas (e.g. energy, transport, industrial technologies, bio-economy) and to contribute to the Paris Agreement, the Commission will present a dedicated strategy on 'Accelerating Clean Energy Innovation', to be adopted by the end of this year. While this strategy goes well beyond the energy area and Horizon 2020, it will integrate the outcome of the work carried out in the context of the Strategic Energy Technology Plan (SET-Plan), where technology-specific targets are set within each of its ten key actions in consultation with stakeholders as well as the SET Plan countries³. These targets are focused on reducing the cost of energy and improving the performance of a new generation of low-carbon technologies, in particular renewables. In a next step, a number of actions addressing these targets will be selected of which the majority will be implemented through private efforts and national programmes, while the Energy work programme 2018-2020 will focus on the actions with strong EU added value.

In devising the strategic priorities of the next work programme, various inputs have been considered: the consultation on the SET-Plan Integrated Roadmap and the 10 key actions, the public online consultation for the forthcoming Communication 'Accelerating Clean Energy Innovation', a targeted consultation on priorities as regards policy supporting actions and market uptake, the Strategic Research Agendas of the Technology and Innovation Platforms, the work on relevant legislative proposals to be adopted by the Commission this year⁴, discussions in international fora (e.g. the EU-US Energy Council) as well as the Horizon 2020 Advisory Group on Energy (for an overview see Annex). Delegations of the Energy configuration of the Horizon 2020 Programme Committee were invited to submit their national priorities. Through these consultations, all stakeholders could bring forward their views. This allowed the Commission to identify the most relevant priorities to be targeted in the next years.

¹ See COM(2016) 110

² <http://mission-innovation.net/>

³ More information is available on the SETIS website: <https://setis.ec.europa.eu/towards-an-integrated-SET-Plan>

⁴ E.g. reviews of the Directives on Energy Efficiency, Renewable Energy and the Energy Performance of Buildings.

The activities supported under the 2014-2017 calls have addressed all activity lines of the Energy Challenge as specified in the legal base (although the final outcomes of the 2016 and 2017 calls are not yet known). The final work programme of Horizon 2020 will contribute fully to meeting the programme's overall spending targets on climate actions and sustainable development⁵, and ensure that the energy-specific spending targets⁶ will be honoured.

Strategic orientations for 2018-2020 and translation into calls

In addition to the initiatives outlined above, the forthcoming Communication 'Accelerating Clean Energy Innovation' will set out a number of priority actions integrating research, innovation, competitiveness and regulatory aspects. The work programme 2018-2020 will support these priority areas with targeted actions across relevant work programme parts, including energy, in particular as regards their research, innovation and competitiveness dimension.

The Energy Challenge in 2018-2020 will strike a balance between activities focussing on R&I breakthroughs (e.g. emerging technologies with a medium/long-term prospect until deployment), integration (e.g. systems integration, interoperability and flexibility) and facilitating exploitation (taking into account the regional differences in the EU).

The activities supported under the Energy Challenge in 2018-2020 will be structured according to the Energy Union priorities and the SET-Plan key actions⁷. In particular they will help to further reduce the carbon footprint of energy, enhance the security of energy supply, keep energy affordable in the long run, and increase the global competitiveness of European industry in the field of innovative low-carbon energy technologies. In addition, important cross-cutting issues will be covered wherever relevant, such as:

- *Open innovation and smart financing*: Translating research outcomes into disruptive, market-creating innovations and their diffusion across society will be crucial for transforming the energy system and boosting the competitiveness of EU companies. A special focus will therefore be on creating more favourable market conditions, supporting innovative business models and increasing citizen involvement. For leveraging the necessary investment particularly in highly innovative sustainable energy solutions, the Energy Challenge will support targeted financial instruments, e.g. by expanding the InnovFin Energy Demo Projects (EDP) loan facility.
- *Open to the world*: Cooperation with international partners will focus on delivering on the Paris Agreement which promotes technology development and transfer, collaborative approaches to research and access to technology. These objectives are in line with 'Mission Innovation' (initiative of 20 leading economies of the world to double public expenditure on R&I in clean energy in 5 years) which the Commission joined recently on

⁵ Recital 10 of the Horizon 2020 Regulation states that it is expected that at least 60 % of the overall Horizon 2020 budget should be related to sustainable development and that climate-related expenditure should exceed 35 % of the overall Horizon 2020 budget.

⁶ The Declaration of the Commission annexed to the Horizon 2020 legal base states that at least 85% of the energy challenge budget of Horizon 2020 is spent in non-fossil fuels areas, within which at least 15 % of the overall energy challenge budget is spent on market up-take activities.

⁷ The final structure of the calls will have to take into account the possible establishment of overarching 'focus areas' and the Delegation Acts to the Executive Agencies.

behalf of the EU, and the 'Sustainable Energy for All' initiative. Specific attention will be devoted to large and rapidly emerging economies, notably in Africa and Latin America, supporting European industry to benefit from the opportunities in these (future) growth markets. Cooperation with industrialised economies should also be reinforced, notably, but not exclusively, in the framework of Mission Innovation.

- *Digitisation*: Based on the integration of ICTs, the energy sector will transition from an asset-centric sector to a consumer-centric one, by enabling new business models, services and processes, appropriate and secure data management and also new actors in a newly designed energy market. Big Data, Artificial Intelligence and the Internet of Things will be key drivers for this transformation, which will help save energy and money, and to generate new profit streams and jobs. Furthermore, digitisation will enhance the active participation of consumers/prosumers along the energy value chain. To pro-actively embrace these opportunities and significantly improve the performance of the energy sector, the Energy Challenge will develop synergies with the ICT part of Horizon 2020.
- *Social Sciences and Humanities (SSH)*: A better understanding of the 'energy behaviour' of different actors, the effects of policy/economic interventions and a deeper involvement of citizens are crucial for changing the energy system. Therefore, SSH considerations, including the age and gender dimensions, will inform social innovation and guide technology-oriented activities. In addition, modelling and energy-related SSH research will be supported in their own right taking into account the recommendations of the SSH-platform to be launched this year.
- *Education, Training and Skills*: The transformation of the energy system requires a fundamental change in how society relates to the production, distribution and use of energy. In addition, there is a need for a highly skilled and well trained work force. The Energy Challenge will therefore address the improvement of education and training for people in different age groups and professions.
- *Joint actions with Member States/Associated Countries*: In line with the spirit of the Energy Union and the essence of the SET-Plan, the Energy Challenge will continue its efforts to improve the coordination of energy R&I programmes at different levels thus increasing impact.

All activities supported by the Energy Challenge will also have an impact on the implementation of the United Nations (UN) Sustainable Development Goals (SDGs), particularly SDG 7 'Ensure access to affordable, reliable, sustainable and modern energy for all' and SDG 13 'Take urgent action to combat climate change and its impacts'.

1. Global leadership in renewables

The EU's ambition is to be the global leader in renewable energy technologies. While the EU has a technological and economic lead in some renewable technologies, a strong and concerted effort is needed to sustain this position and to catch up in areas where the EU is lagging behind. The challenge is to create an EU-integrated industrial renewable energy sector which is economically sustainable and competitive in European and global markets in the long-term, despite strong international competition, with significant volumes of related manufacturing located in the EU. Given various climatic and geographical conditions in the EU and different national energy mixes, the Energy Challenge will continue in 2018-2020 supporting a portfolio of renewable

energy technologies with tailored approaches, taking into account technology-specific challenges, potential, cultural aspects, level of maturity, risk, and competitive situation. The main focus will be on decreasing capital and operational costs of renewable energy technologies.

The support will cover the full innovation cycle:

- Sustained support for low-TRL research activities aiming at breakthroughs is needed to feed the innovation cycle and ensure that the EU is competitive also in the next technology generation. This will be done through a bottom-up approach to long-term research and technology development, targeting a specific technological challenge for particular renewable energy sources.
- The main objectives of the mid-TRL development phase will be to mature and demonstrate the technology, reduce its costs, improve its performance, prove its reliability and improve its operation and handling.
- In addition to technology-specific demonstration activities, support mechanisms for first-of-a-kind plants with a higher leverage than 'standard grants' will be explored (e.g. through an enlarged InnovFin EDP facility) in order to bridge the gap between technological demonstration and commercial deployment.

An increased focus will be put on measures intended to stimulate and encourage the creation of an industrial sector for renewables in the EU and to ease the market uptake, e.g. tools for plant operation and maintenance, database access on in-situ measurements, earth observation data, global monitoring tools, forecasting, public acceptance, development of skills and standards. In addition, a smart integration of renewables into the energy system and further reduction of costs will be key priorities (see also section 2.2. below)

2. A smart citizen-centred energy system

The integration of an increasing share of renewable energies, a more active role for consumers ('prosumers') and the completion of the EU internal energy market require appropriate integration of existing technologies and – on a case by case basis – new technologies, infrastructure (including communications infrastructure), management approaches as well as market and business models. EU support for R&I is crucial for ensuring system reliability, providing more flexibility and resilience and for allowing a larger penetration of variable renewables by balancing over larger areas (and also between Member States).

2.1. Smart distribution and end use

The Energy Challenge will focus on smart and integrated energy solutions for all energy vectors. Smart energy grids, energy storage, more efficient buildings (with higher integration of renewables on-site), etc. shall ensure a local contribution to decarbonisation at controlled costs and higher benefit for all the involved parties, while minimizing any negative impacts on the whole energy system's reliability, security and resilience. An efficient share of self-consumption of local renewable energy sources (electricity, gas, heat and cold, etc.) will be targeted. Electric vehicles are relevant in this context as a demand-response instrument and potential provider of ancillary services for the grid and buildings. Smart systems will obviously rely to a large extent on digitisation. Given the crucial role of citizen's engagement, social sciences and humanities and gender issues will be key research aspects.

2.2. Smart interfaces between generation and transmission

The main focus will be on enabling energy systems to integrate (very) high shares of renewable generation with conventional generation, by smartening transmission and distribution grids as well as storage systems. This includes also power-to-X, enabler technologies (power electronics), batteries and other storage systems in order to increase the efficiency of power generation with higher flexibility and resilience.

An additional priority will be on smart digital management of energy systems to enable efficient exploitation of the combined capacities and flexibilities of the electricity, gas, heating and cooling, water and transport sectors. Cross-border and cross-sectorial energy systems will have to be enabled from a technical, economic, regulatory and legal point of view.

2.3. Smart Cities and Communities

The lighthouse city approach from previous calls will continue to increase the number and diversity of the Lighthouse cities involved and will put stronger focus on Positive Energy Blocks (PEB)⁸ as integral part of smart city districts. The goal is to have by 2020, an EU-wide network of lighthouse cities that foster creation, deployment and replication of smart city solutions, which will help to strengthen the EU's role in this important, fast growing global market.

The demonstration activities will be supported by citizen-centred urban mapping and planning actions which should:

- Explore the energy consumption and all climate and air quality relevant emissions systems of cities and their interactions.
- Model investments with attractive returns.
- Analyse and implement actions looking at a better understanding of the driving forces behind behaviour change contributing to a sustainable energy transition.
- Explore and employ inclusive planning and decision processes for a sustainable energy transition at local and regional level.

3. Efficient Energy Use

Energy efficiency is at the heart of the Energy Union strategy which considers it as an energy source in its own right, representing the value of energy saved. The biggest contribution for reducing greenhouse gas emissions is expected to come from energy efficiency, requiring many individual actions and projects implemented nationally, regionally or locally. This requires vertical and horizontal coordination of efforts between different levels and exchange of good practices, to strengthen the EU added value of energy efficiency policies.

Technology development for energy efficiency in buildings and industry is specifically addressed in the Energy Challenge and the LEIT-NMBP in particular through the contractual PPPs on Energy-efficient Buildings and SPIRE⁹.

⁸ Positive Energy Blocks (PEB) consist of several interconnected buildings (including new, retro-fitted and historic) that actively manage the energy flow between them and the larger energy system. Their concept is intrinsically up-scalable with a positive impact on the cities ecosystem. They shall serve as seeding point for the surrounding area to scale up eventually to a net-zero-energy/emission districts (ZED).

⁹ The Energy Challenge focusses on technologies that are closer to market deployment; their integration in real operation conditions and the preparation of their massive uptake:

3.1. Buildings & consumers

Buildings offer the largest potential for energy savings in the EU. This large energy saving reserve is also an opportunity for the EU to support job creation and retention, health and comfort improvements, better energy security, competitiveness and energy poverty alleviation.

The main focus will be on:

- *Buildings digitisation*: Integration of ICT will be promoted for buildings as well as in their design, construction, operation and commissioning processes. This would facilitate more accurate energy monitoring and control, including fault detection, better user information and a more empowered and active demand side management, as well as realizing the multiple benefits to building occupants that can be provided by smart home technologies.
- *Building renovation*: Emphasis will be put on technologies facilitating faster, cheaper and more environmental friendly renovation including user and installer-friendly solutions both for envelope and systems, with low-carbon and efficient energy sources and heating and cooling solutions.
- *Innovative demand-side energy services*: The Energy Challenge intends to support the demonstration of technologies empowering energy end-users to actively participate in the energy system as prosumers. This implies the integration of residential and commercial buildings in multiple energy grids, including city-wide grids and micro networks.

3.2. Industry & services

Increasing industrial energy efficiency is crucial for achieving the EU's climate targets and improving competitiveness. Energy in industry is mostly used for process heating and cooling. The priority of the Energy Challenge will therefore be to address technological and non-technological challenges regarding heat and cold recovery and reuse technologies, renewable production of heat and cold, efficient system design and industrial symbiosis based on optimised energy flows. In addition, the energy efficiency of data centres will be addressed.

3.3. Market uptake measures

The creation of favourable market conditions for energy efficiency is an important stimulus for innovation. The Energy Challenge will put a particular emphasis on the following areas:

- *Buildings & consumers* with a special focus on nearly zero-energy buildings and construction skills; behavioural change, including the user - investor dilemma (split incentives) and energy poverty; energy consumption data; and the participation of consumers in the energy market.
- *Energy efficiency market uptake in industry & services (including SMEs)*, in particular energy efficiency awareness of enterprises and their supply-chain.
- *Policies enabling actions for better policy design, implementation and enforcement*, including social sciences, environmental and economic modelling, life cycle perspective and long term impact assessment. Also, capacity building of public authorities including public procurers.
- *Mobilising investments in energy efficiency*.

4. Decarbonising the use of fossil fuels (CCS/CCUS)

Given that fossil fuels will remain part of the global and the EU's energy mix during the next decades and that greenhouse gas emissions will have to be drastically cut, especially in the power sector and carbon-intensive industries, CCS will need to be deployed as soon as possible. In addition, the industrial utilisation of captured CO₂ has both the potential to replace fossil fuels as raw material and to provide a moderate revenue stream for CCS project development. In particular, the conversion of CO₂ into fuels could provide opportunities for energy storage and for higher security of fuel supply.

Therefore, in 2018-2020 the Energy Challenge intends to support the most promising capture technologies and support the large-scale demonstration of the full CCS chain in the power sector, to reinforce the application of CCUS in carbon-intensive industry (including bio-CCS) and to strengthen the technology base and public awareness of CCUS through pilots in capture, transport, storage and utilisation.

Contribution to overarching 'Focus Areas'¹⁰

The activities supported by the Energy Challenge target the decarbonisation of the energy sector (one of the most significant emitters of greenhouse gases) and will thus contribute to mitigating climate change. The Energy Challenge intends to contribute to the focus area **Building a low-carbon, climate resilient future**, by supporting the development of renewable energies and their integration into the energy system; Smart Cities and Communities; energy efficiency; as well as the decarbonisation of the use of fossil fuels.

Activities supporting the re-use of CO₂ in other industry sectors have the objective to accelerate the uptake of CCS technologies and to improve resource efficiency in industry. The Energy Challenge therefore intends to contribute such activities to the focus area **Connecting economic and environmental gains – the Circular Economy**.

Main calls for proposals¹¹

Call / Proposed focus area call	Brief description of the scope of the call including information if it is CPPP. If a focus area please show how each selection criterion has been met.	Possible contribution from and to other work programme parts
Global leadership in renewable energy technologies (RES)	The expected impact of this call is to advance a broad portfolio of renewable energy technologies, notably decreasing their capital and operational costs. In addition, the call will feed the innovation pipeline with new technological approaches to be matured in the coming years. The market-uptake of renewable energy technologies will be	Synergies will be developed with other programme parts, e.g. <ul style="list-style-type: none"> – SC2 and SC4 as regards bioenergy – SC2 on marine energy – LEIT-Materials on new energy materials

¹⁰ The content of this section will have to be reviewed in the light of the on-going discussions on the design and scope of focus areas.

¹¹ The final structure of calls for proposals might be adapted once the modalities for implementing the focus areas have been clarified. The majority of activities included in these calls will contribute to the focus area dedicated to the implementation of the Paris Agreement.

	improved.	<ul style="list-style-type: none"> - LEIT-ICT and -Space on the use of ICT and space data
Smart citizen-centred energy system	The expected impact of this call is to empower consumers ('prosumers') to play a more active role, enable a higher share of renewable energy in the energy system whilst increasing its overall resilience and flexibility as well as to make the use of energy in cities smarter. The call will also result in a strengthening of Europe's position in the area of energy storage.	<p>Synergies will be developed with other programme parts, e.g.</p> <ul style="list-style-type: none"> - LEIT-NMBP and SC4 on energy storage - LEIT-ICT on the application of ICT in energy system management
Efficient energy use	The expected impact of the call is to improve energy efficiency in different key sectors by developing more efficient technological solutions. In addition market condition for energy-efficient solution will be improved by influencing the behaviour and decision-making of citizens and industry, and by supporting capacities building of public authorities.	<p>Synergies will be developed with other programme parts, e.g.</p> <ul style="list-style-type: none"> - LEIT-Advanced manufacturing on energy efficiency in buildings and industry - LEIT-ICT on using ICT for improving energy efficiency
Decarbonisation of fossil fuels	The expected impact of the call is to demonstrate and mature CCS technologies so they can soon be taken up at a large scale.	<p>Synergies will be developed with other programme parts, e.g.</p> <ul style="list-style-type: none"> - LEIT-Materials on new energy materials

Annex: Overview of consultations influencing the definition of priorities for the Energy WP 2018-2020

Initiative / Area	Time period	Stakeholders addressed	Main outcomes
Communication 'Accelerating Clean Energy Innovation'	March – May 2016	Open public online consultation	Detailed results of the consultation published on Your voice in Europe (http://ec.europa.eu/research/consultations/euric/eurics-public_consultation-analysis_complete.pdf)
SET-Plan: Integrated Roadmap	September 2013 – December 2014	> 150 key stakeholders, including Technology Platforms, European Energy Research Alliance (EERA), universities, Member States	Comprehensive overview of R&I priorities for all energy areas until 2020 ¹²
SET-Plan: Target setting for 10 Key Action	January – Summer 2016	Key stakeholders, including Technology Platforms, European Energy Research Alliance (EERA), universities, Member States	Agreed targets for most of the priority action lines ¹³ (Declarations of Intent); implementation mechanisms at national and European level still being discussed
SET-Plan: Selection of R&I activities to reach the targets within the 10 Key Actions	Summer 2016 – Spring 2017	Key stakeholders, including Technology Innovation Platforms, European Energy Research Alliance (EERA), Member States	Implementation Plans including a set of activities and the means of implementing them through national programmes, industry, or Horizon 2020
Energy efficiency: Policy supporting actions and market uptake priorities	April – May 2016	185 replies, mainly from industry, NGOs, research institutes and public authorities	
Horizon 2020 Advisory Group on Energy (AGE)	March – June 2016	30 high-level experts ¹⁴	AGE report 2016 ¹⁵

¹² https://setis.ec.europa.eu/system/files/Towards%20an%20Integrated%20Roadmap_0.pdf

¹³ <https://setis.ec.europa.eu/towards-an-integrated-SET-Plan>

¹⁴ <http://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetail&groupID=2981>

¹⁵ <http://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetailDoc&id=25609&no=1>