Trends on renewable heating and cooling in research and development

Support to Research and Innovation in Renewable Heating and Cooling in the Horizon 2020 Work Programme "Secure, Clean and Efficient Energy"

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Renewable Energy Sources

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European Commission

Outline

- EU Energy Research Policy Framework
- Renewable Heating and Cooling in Horizon 2020
- Outlook on Horizon Europe

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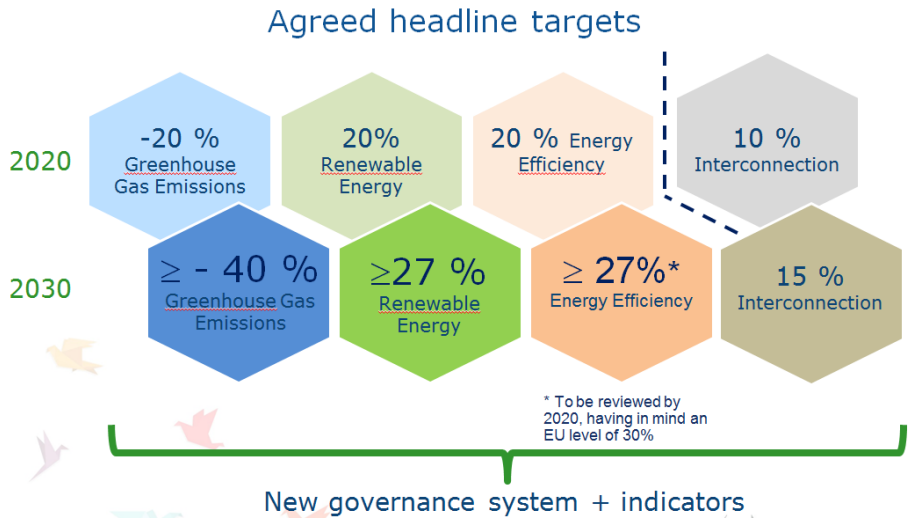
Policy Framework

"Clean Energy for all Europeans"

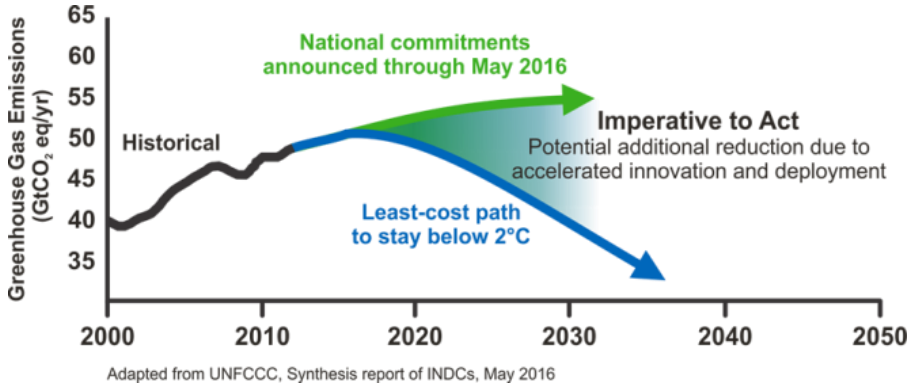
- *Putting energy efficiency first*
- *Demonstrating global leadership in renewables*
- *Delivering a fair deal for consumers*



Paris Agreement

*Holding the increase in the global average temperature to **well below 2°C** above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels*

*Accelerating, encouraging and enabling **innovation** is crucial...*



Other EU policy priorities

- Digital Single Market
- Jobs, Growth and Investments
- EU as a strong global actor
- …

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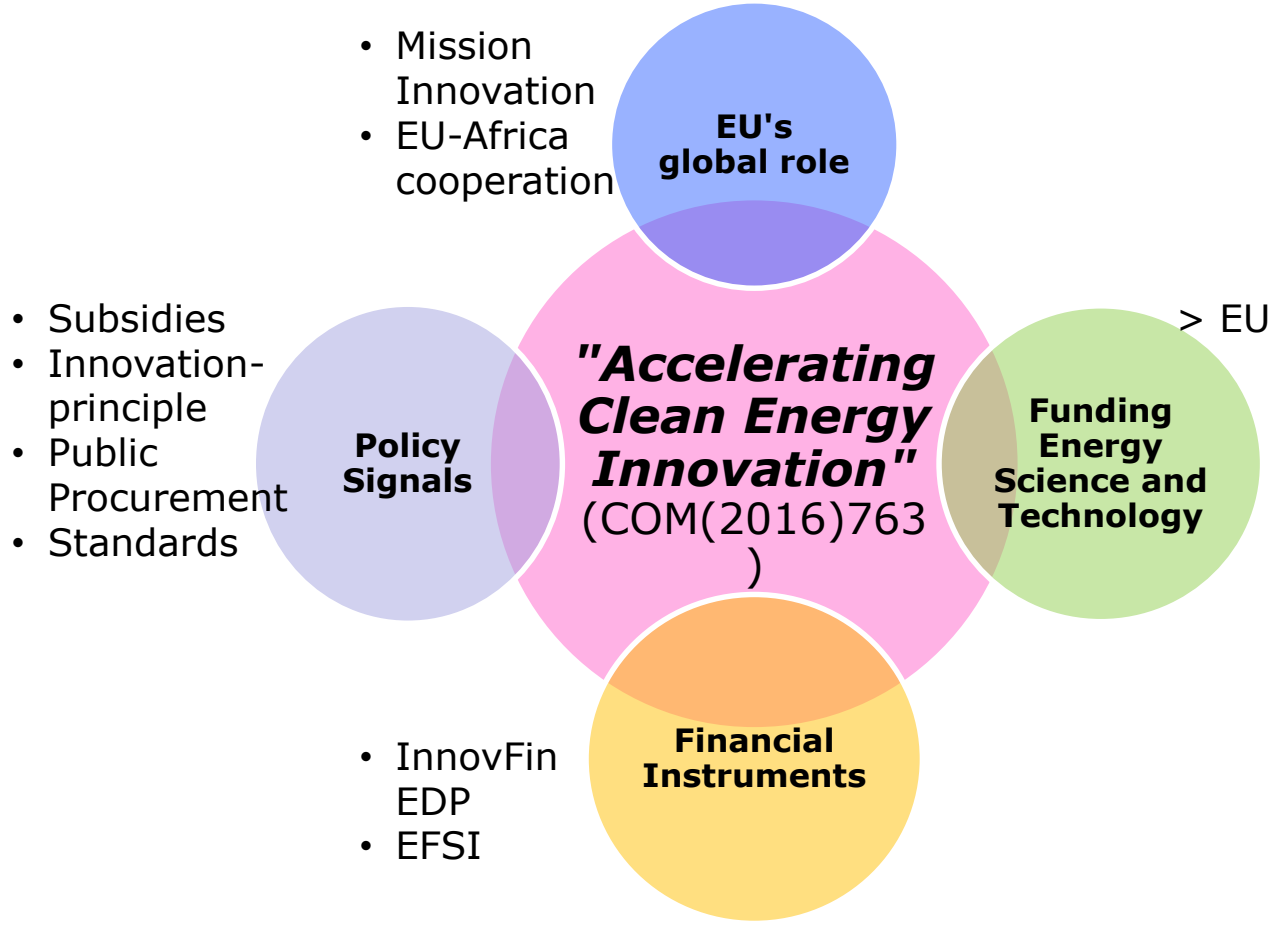
Accelerating Clean Energy Innovation

- ✓ R&I 5th pillar of the Energy Union
- ✓ New EU R&I strategy for the coming years
- ✓ Energy Union Winter Package/Clean Energy for all European *30.11.2016*



- Mission Innovation
- EU-Africa cooperation

- Subsidies
- Innovation-principle
- Public Procurement
- Standards

> EUR **2.2 billion** in H2020 2018-2020

- Decarbonising EU building
- EU leadership in renewables
- Energy storage
- E-mobility
- European Innovation Council

- InnovFin EDP
- EFSI

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Mission Innovation

<u>Overall objective</u>:
To reinvigorate global efforts in clean energy innovation, Mission Innovation members share a common goal to **develop and scale** breakthrough technologies and substantial **cost reductions**. MI members aim to seek to **double public clean energy research & development investment** over 5 yrs

EC is proactively engaged :

- 150 Million € on MI-relevant calls by 2020 in Horizon 2020
- Engaged in all the 8 Innovation Challenge (IC)
  - ✓ smart grids, off-grid access to electricity, CCS, biofuels, solar fuels, clean energy materials, **H&C buildings**, hydrogen
- Co-leading IC5, IC7 and IC8

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The Strategic Energy Technology Plan

Overall objective: Accelerating the development and deployment of low-carbon technologies through cooperation among EU countries, companies, research institutions, and the EU itself, based on common priorities, targets and actions.

Defining priorities
- SET-Plan Communication 2015

Setting targets
- Declaration of Intents

Implementation Plans (IP)
- Temporary Working Groups

Execution of IPs

Priority Actions:

1+2. Improving performance and reducing cost of renewable energy
3. Smart solutions for consumers
4. Smart Resilience and Secure Energy System
5. Energy Efficiency in Buildings
6. Energy Efficiency in Industry
7. Batteries and e-Mobility
8. Renewable Fuels and Bioenergy
9. Carbon Capture Utilisation and Storage
10. Nuclear Safety

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Bottom-up activities

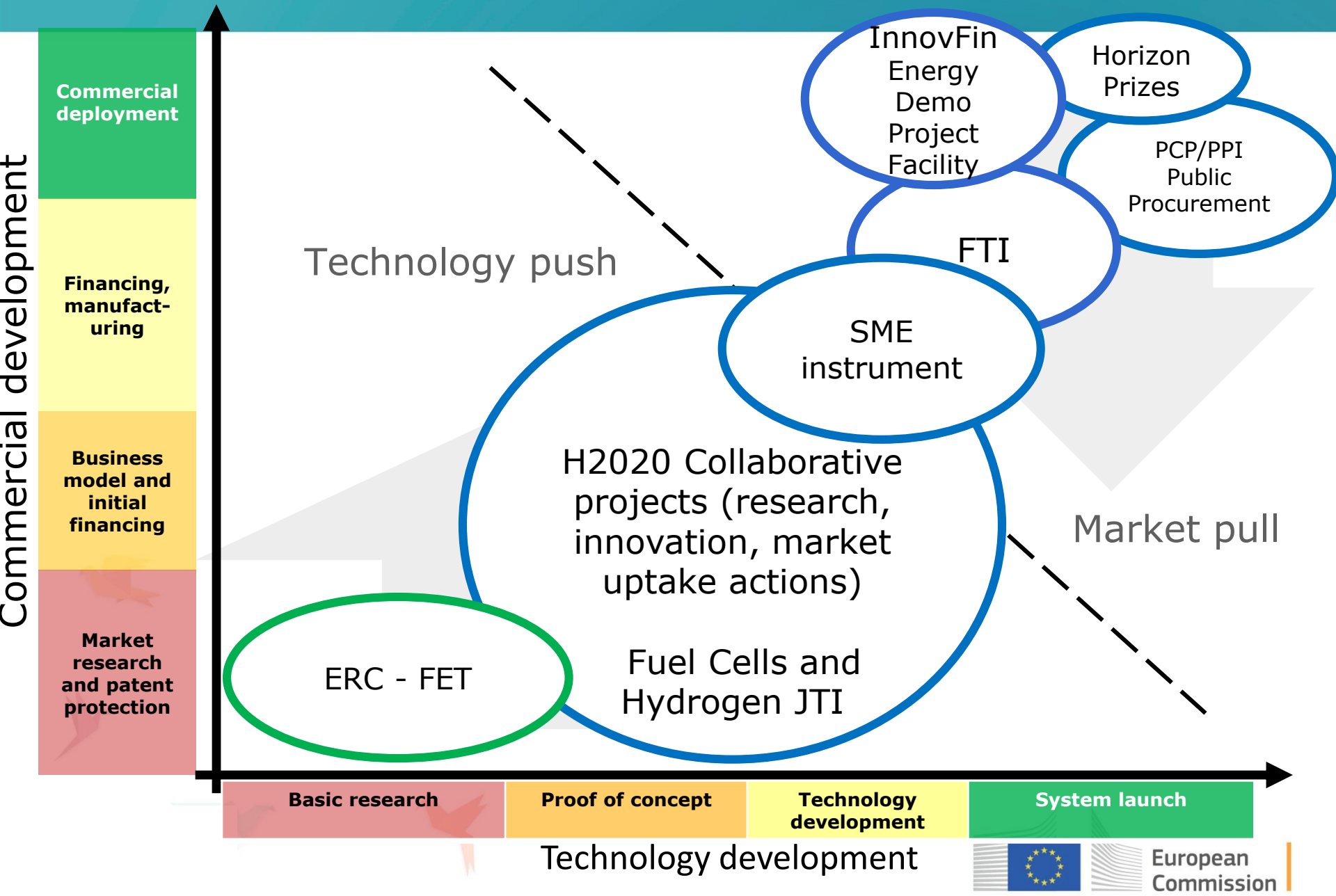
- European Research Council (ERC)
- European Innovation Council (SME instrument, FTI pilot, FET)
- Marie-Sklodowska Curie Actions

Industrial Leadership

- Materials
- PPPs on Energy-efficient Buildings and SPIRE

Societal Challenges (SC)

- SC2: Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy
- SC3: Secure, clean and efficient energy
- SC4: Electric vehicles, Batteries, Energy-efficient transport
- SC5: Climate action, environment, resource efficiency and raw materials
- SC7: Secure societies (*cybersecurity*, *critical energy infrastructure*)


Commercial development
Commercial deployment
Financing, manufact-uring
Business model and initial financing
Market research and patent protection
InnovFin Energy Demo Project Facility
Horizon Prizes
PCP/PPI Public Procurement
FTI
Technology push
SME instrument
H2020 Collaborative projects (research, innovation, market uptake actions)
Market pull
ERC - FET
Fuel Cells and Hydrogen JTI
Basic research
Proof of concept
Technology development
System launch
Technology development
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Projects funded include:

- RIA: BECOOL, Bio-HyPP, FlexiFuel-SOFC, Residue2Heat, Biofficiency, HiEff-BioPower, FLEXCHX, ARABAHEAT, FlexiFuel-CHX, CHPM2030, DESCRAMPLE, Geo-COND, GeoFit, POLYPHEM…
- IA: CHeapGSHPs, DEEPEGS, DESTRESS, GeoTECH, HyCool…
- CSA: Bin2Grid, AgroBioHeat, BioVill, BiomasudPlus, BioRES, Bioenergy4Business, Biosurf, GreenGain, SECUREChain, BiogasAction, ISAAC, ISABEL, uP-running, FORBIO, SEEMLA, CoolHeating, progRESsHEAT, SDHp2m…
- …

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	2018	2019	2020
Next renewable energy solutions	RES-2	RES-1	RES-3
Renewable energy solutions at consumer scale	***Energy generation at building scale*** RES-4, RES-5, RES-6	***Renewable energy solutions at distrcit level and for industrial processes*** RES-7, RES-8	RES-9, RES-10
Renewable energy solutions for energy system implementation	***Reduce costs of key technologies for renewable energy conversion*** RES-11, RES-12, RES-13	***Optimize processes and manufacturing*** RES-14, RES-15 ***Provide flexibility to the energy system*** RES-16, RES-17	RES-18, RES-19, RES-20
Renewable fuels for transport	***Drop-in fuel solutions for fossil-fuel substitution*** RES-21, RES-22	***Upscaling renewable fuels production*** RES-23 RES-24	RES-25, RES-26, RES-27
Market Uptake Support	RES-28	**RES-28**	RES-28

•Topics for 2020 are indicative

Renewable energy solutions for implementation at consumer scale

LC-SC3-RES-7-2019

Large potential of applying solar energy for industrial purposes

Industrial processes might need to be adapted

Limited installation, O&M requirements - easy to operate

Solar Energy in Industrial Processes

Cover the highest possible share of the heating and/or cooling demand of one or more industrial processes by means of **solar thermal energy**

In the case of heating, the process temperature shall be **higher than 150°C**

Individual industrial sites and/or industrial parks (coupled to a district heating and/or cooling network) are in scope

Contribution to relevant BREFs under the Industrial Emissions Directive

TRL to 4-5

RIA

EUR 3 to 5 million

SPIRE cPPP

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Renewable energy solutions for implementation at consumer scale

LC-SC3-RES-8-2019

Large potential to integrate substantial shares of renewable energy generation in district heating and/or cooling systems

RE technologies can be combined

Reliable with limited installation and running costs

TRL to 6

IA

EUR 8 to 15 million

Combining Renewable Technologies for a Renewable District Heating and/or Cooling System

Cost-effective solutions for district heating and/or cooling systems which allow **satisfying at least 50% of the energy demand of the system** by the use in the district of one or more renewable energy technologies

Otherwise **wasted excess heat** is in the scope

Solutions should be **demonstrated in real conditions** within an operational district heating and/or cooling system

Operators and final users to be engaged, their requirements to be considered

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Renewable energy solutions for energy system level implementation

LC-SC3-RES-16-2019 1/2

Increase the potential and performance of dispatchable technologies to provide flexibility services to the energy system

TRL 3-4 to TRL 4-5

RIA

EUR 3 to 5 million

Penetration of a higher share of variable output renewables in the energy mix without affecting system stability

Development of solutions based on renewable sources that provide flexibility to the energy system

Bioenergy Development of intermediate bioenergy carriers for energy and transport from biogenic residues and wastes and energy crops from marginal lands not applicable to food or feed production, through feedstock flexible technologies at a conversion cost reduced by at least 25% from the state-of-the-art, with increased energy density storage and trade characteristics and improved GHG performance;

Hydropower Development of low and ultra-low head and sea water resistant equipment (such as for example bulb-pump turbines) guaranteeing at least 70% round-trip efficiency and making low-head seawater storage and other low head applications of hydropower viable for example at unexplored locations (e.g. like at coastal dams and islands), by minimising at the same time potential impacts on fish.

Renewable energy solutions for energy system level implementation

LC-SC3-RES-16-2019 2/2

Increase the potential and performance of dispatchable technologies to provide flexibility services to the energy system

TRL 3-4 to TRL 4-5

RIA

EUR 3 to 5 million

Penetration of a higher share of variable output renewables in the energy mix without affecting system stability.

Development of solutions based on renewable sources that provide flexibility to the energy system

Virtual Power Plant Increase the performance of an integrated portfolio of renewable energy sources to operate together as a Virtual Power Plant, capable of providing flexibility and ancillary services to the energy system. The solution has to be competitive compared to solutions combining variable output renewables with electrochemical storage.

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Renewable energy solutions for energy system level implementation

LC-SC3-RES-17-2019 1/2

Increase the potential and performance of dispatchable technologies to provide flexibility services to the energy system

TRL 5 to 7

IA

EUR 12 to 15 million

Technologies that allow plant and system operators to operate successfully in the modern power markets

Demonstration of solutions based on renewable sources that provide flexibility to the energy system

Bioenergy Demonstration of the most cost-efficient intermediate bioenergy carrier pathways for energy and transport, addressing solid, liquid and gaseous intermediate bioenergy carriers from biogenic residues and wastes with increased energy density, storage and trade characteristics (where relevant) and improved GHG performance. Production at a scale of up to 5000 tons and process feasibility through applications to fuel production including for the heavy duty, maritime and aviation sectors, as well as to combined heat and power generation, are to be included.

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Renewable energy solutions for energy system level implementation

Increase the potential and performance of dispatchable technologies to provide flexibility services to the energy system

TRL 5 to 7

IA

EUR 12 to 15 million

Technologies that allow plant and system operators to operate successfully in the modern power markets

LC-SC3-RES-17-2019 2/2

Demonstration of solutions based on renewable sources that provide flexibility to the energy system

Hydropower Improvement of the average annual overall efficiency of hydroelectric machinery. Projects are expected to provide high availability and to maximise performance of hydropower plants of all sizes by adapting to variable speed generation and optimising maintenance intervals; digitalisation measures to increase flexibility can be included.

Concentrated Solar Power (CSP) Demonstration of innovative thermal storage systems. The solutions proposed will have to achieve much higher storage densities than current mainstream solutions (i.e. at least two times higher) while guaranteeing similar performance in terms of cycles.

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Market-uptake support

RES-28-2018-2019-2020

Challenges for large-scale deployment of RES: initial high cost, consumer acceptance, legal and financial barriers, competition with incumbent solutions

Support for a broad range of issues, including:

- Recommendation for harmonisation of regulations, life cycle assessment approaches, environmental impact methodologies of renewable energy solutions;
- Development of additional features for RES to be compliant with the electricity market requirements, making them 'market fit';
- Sharing of best practice between public funding bodies for the cross-border participation in RES electricity support schemes
- Increasing the use of the 'RES co-operation mechanisms'
- Development of insurance schemes
- Development of innovative financing mechanisms/schemes
- Support tools to facilitate export markets
- …

Engagement of relevant stakeholder and market actors is crucial!

CSA, recommended EU contribution: EUR 1-3 million/project

Horizon prize for Combined Heat and Power (CHP) installation in a hospital using 100% renewable energy sources

- The challenge: To develop an innovative solution integrating at least three European renewable energy technologies into one energy system in a hospital, while ensuring a 100% secure energy supply.
- EUR 1 million reward to a hospital for innovative solution integrating several technologies into one energy system, which can guarantee uninterrupted energy supply.
- http://ec.europa.eu/research/horizonprize/index.cfm?prize=lowcarbon
- Deadline: 3 April 2019

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InnovFin Energy Demo Projects

- **InnovFin EDP** provides loans, loan guarantees or equity-type financing typically between EUR 7.5 million and EUR 75 million to innovative demonstration projects in the fields of energy system transformation, including but not limited to renewable energy technologies, smart energy systems, energy storage, CCS or CCU
- Technologies shall be at pre-commercial level or early commercialisation stages (i.e. the successful operation of the technologies should facilitate their subsequent commercial deployment)
- The project shall generate sufficient revenues to have the potential to become bankable
- The project should have the potential to be replicated elsewhere

http://www.eib.org/en/products/blending/innovfin/products/energy-demo-projects.htm

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Renewable Heating and Cooling: Main Challenges for R&I

- To increase technological performance
- Cost reduction
- System integration

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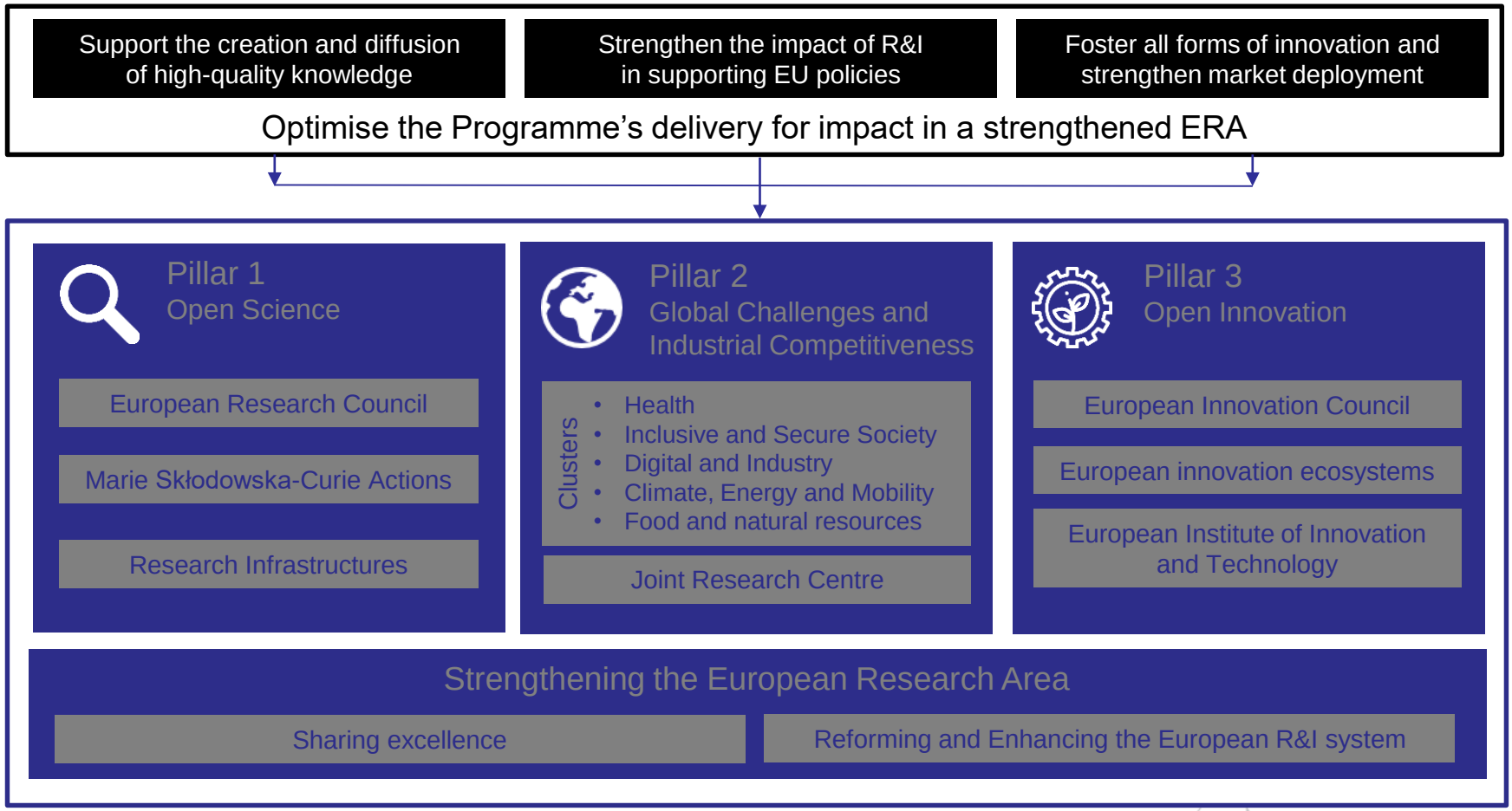
Horizon Europe (2021-2027)

Specific objectives of the Programme



Horizon Europe Pillar 2

Global Challenges & Industrial Competitiveness:

Clusters implemented through usual calls, missions & partnerships	Draft Budget (€ billion)
Health	*€ 7.7*
Inclusive and Secure Societies	*€ 2.8*
Digital and Industry	*€ 15*
Climate, Energy and Mobility	*€ 15*
Food and Natural Resources	*€ 10*

Lessons Learned
from Horizon 2020 Interim Evaluation

Key Novelties
in Horizon Europe

Support breakthrough innovation	European Innovation Council
Create more impact through mission-orientation and citizens' involvement	R&I Missions
Strengthen international cooperation	Extended association possibilities
Reinforce openness	Open science policy
Rationalise the funding landscape	New approach to Partnerships

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Next steps

Ongoing — Parliament and Council negotiations on Union budget 2021-2027, including budget for Horizon Europe

Ongoing — Parliament and Council negotiations on the basis of the Commission proposal for Horizon Europe

2nd half 2018/2019 — Strategic planning to prepare first work programmes under Horizon Europe, including co-design of missions and setting up of partnerships

1 January 2021 — Envisaged start of Horizon Europe

Updates on: Horizon Europe

Thank you!

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www.ec.europa.eu/research

http://ec.europa.eu/research/participants/portal/desktop/en/home.html

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Technology Readiness Levels (TRLs)

TRL 1: **Basic research.** Principles postulated and observed but no experimental proof available.

TRL 2: **Technology formulation**. Concept and application have been formulated.

TRL 3: **Applied research**. First laboratory tests completed; **proof of concept.**

TRL 4: **Technology** validated in **laboratory**

TRL 5: **Technology** validated in **intended environment**.

TRL 6: **Prototype** tested in intended environment **close to expected performance.**

TRL 7: **Demonstration system** in **operational environment** at pre-commercial scale.

TRL 8: **First-of-a-kind commercial system**. Manufacturing issues solved.

TRL 9: **Full commercial application**, technology available for consumers.