Enabling Near-Zero CO2 emissions from Fossil Fuel Power Plants

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LC-SC3-NZE-4-2019:

Integrated solutions for flexible operation of fossil fuel power plants through power-to-X and/or energy storage

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What is the issue?

- The share of variable renewable electricity in the grid is growing
- Fossil fuel power plants will have to shift their role from providing base load power to providing fluctuating back-up power
- Generators may even have to be shut down temporarily
- This puts a strain on the plant due to increased wear-and-tear
- It also lowers the efficiency of the plant and therefore increases CO2 emissions

What are possible solutions?

- Improve operational flexibility, i.e. fast ramp-up, optimised efficiency on part load, high load change velocities, etc.
  - Addressed in Calls 2015 & 2017
- Modulating the output through power-to-X and/or energy storage, integrated in the plant
  - Addressed in Call 2019
  - Both options will increase the efficiency of the plant, and thus reduce the CO2 emissions

Power-to-X: the example of hydrogen

- Electricity-only plants are unlikely to be economic, as they will be either operating at part load or be shut down for much of the time
- A plant producing a fixed ratio of hydrogen-to-electricity will have the same disadvantages as an electricity-only generating plant
- A hydrogen/electricity plant should be able to vary its ratio of hydrogen-to-electricity
- This flexibility allows the plant to operate in base-load mode, selling its energy, either as electricity or as hydrogen, into the most profitable market
- Hydrogen can also be combusted to boost the plant output

Plant-integrated electricity storage

- Stored power can be delivered instantaneously
- This allows fast load changes, for example by bridging between stop and restart of a generator, or by providing the needed time to achieve optimal ramp-up/down
- It can also offer spinning reserve in case a generator goes down
- It will allow to smooth the load profile of the plant, thus improving overall efficiency and reducing emissions
- It will allow to boost the plant when needed, which allows the plant to take full advantage of high-value peak power.

Scope and more

- Validation and pilot-demonstration of plant-integrated solutions
- Show reduction of GHG and air pollutant emissions
- Indicative EU contribution EUR 6-10 million
- Call budget EUR 20 million
- Call open, deadline 27 August 2019

LC-SC3-NZE-5-2019-2020:

Low carbon industrial production using CCUS

- Part of ‘normal’ 2019 Call, deadline 27 August 2019
- Part of 2020 cross-cutting call ‘Circular Economy’

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LC-SC3-NZE-6-2020:

Geological Storage Pilots

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What is the issue?

- In order to store meaningful quantities of CO2 to attain targets under the Paris Agreement, new storage sites will need to be characterised and appraised every year for the next 30 years
- We need pilots to:
  - assess the suitability of a storage location
  - demonstrate geological storage to the public as a safe and effective CO2 abatement technology
  - prepare the way for subsequent larger scale activity

What needs to be done?

- Detailed characterization of new prospective storage sites, including 3D architecture of the storage complex
- Accurate estimation of storage capacity, modelling of injectivity and response to pressurization, analysis of faults and stress fields, overall risk assessment…
- Develop optimal strategies for monitoring, pressure management and mitigation of induced seismicity
- Involve end users and societal stakeholders

Impact and more

- A portfolio of promising storage sites can unlock European storage capacity and kick-start CCS
- The pilots will expand European experience of CO2 storage across a range of storage options, provide a baseline for cost estimation, increase public awareness and facilitate the development of operational storage sites
- Indicative EU contribution EUR 7-10 million
- Call budget EUR 14 million
- Call opens 5 May 2020, deadline 1 September 2020

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LC-SC3-CC-9-2020
Industrial (Waste) Heat-to-Power conversion

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Eric Lecomte
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Challenge : Industrial heat recovery potential in EU

Waste heat potential in EU (2015, TWh/year)

T° range	Iron & Steel	Non-ferrous metal	Chemical	Non-metallic mineral	Food, drink & tobacco	Paper & printing	Other industries	Total
<100 °C					1.2			**1.2**
100-200 °C		16.5	3.2	47.9	12.5	20.2	1.9	**102.1**
200-300 °C	52.3							**52.3**
300-400 °C	14.5		1.1	4.0				**19.6**
400-500 °C			6.2					**6.2**
500-1000 °C	77.4			21.3				**98.8**
>1000 °C	23.9							**23.9**
Total	**168.1**	**16.5**	**10.5**	**73.2**	**13.7**	**20.2**	**1.9**	**304.1**
> 200 °C	168.1		7.3	25.4				**200.8**

- **Waste heat: 200 TWh** (at T>200°C) (source: RED-HtP, 2015)
- **Electricity recovery potential** (average conversion efficiency : 40%):
  80 TWh (comparable to the electricity generation in AT or BE)
- Avoided CO2 emissions (0.3tCO2/MWh_{el}) total: **24 MtCO2**
- (*) Source: H2020 project RED-Heat-to-Power Michael Papapetrou, George Kosmadakis, Andrea Cipollina, Umberto La Commare, Giorgio Micale. Industrial waste heat: Estimation of the technically available resource in the EU per industrial sector, temperature level and country, Applied Thermal Engineering, Volume 138, 25 June 2018, Pages 207-216

Challenge: Recovery and Conversion of Industrial (Excess/Waste) Heat to Power (mechanical / electrical)

- high efficiency, low cost and compact systems

- using innovative fluid:
  - Supercritical CO2 (sC02) cycle
  - Organic cycle (like ORC)

Scope:

- Integrate industrial waste heat-to-power conversion system using one type of fluid (supercritical CO2 or organic)
- demonstrate the system operation in industrial environment at an output power level >= 2 MW.
- Bring the technologies to TRL 6 or 7
- EU Contribution: EUR 12 to 14 million (but can be different)

Scope: areas to be covered

- Optimisation of thermal cycles for different temperature and constrained industrial environment, vs. efficiency and economics
- Development/improvement of tools, materials, components
- Integration, demonstration in industrial environment
- Technical and economic life cycle assessment of systems adapted for at least 4 industrial sectors, to demonstrate economic viability and exploitation strategy
- Dissemination Assess potential technology transfer to Energy Generation sector

Expected impact:

- Improved cycles to achieve scalability to higher power levels, higher cost effectiveness, wider input temperature ranges, significantly reduced system size, allowing wider take up of heat recovery from more industrial processes

- Primary energy savings (GWh/year) in industry,
potential primary energy savings in the power generation sector,
assuming full deployment in EU Member States and (as far as data are available for the calculation of the impact) in Associated Countries

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Cross-cutting Call – Circular Economy
NZE-5

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LC-SC3-NZE-5-2020:

Low carbon industrial production using CCUS

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Research and Innovation

What is the issue?

- Hard-to-abate industries account for 20% of global energy-related emissions today
- Some sectors have process emissions than cannot be further reduced without CCUS (e.g. steel, cement)
- CO2 capture technologies exist and are already used at industrial scale…
- …but need to be adapted to different applications and integrated in industrial installations

Scope – aspects to address

- Technical: integration of CO2 capture in industrial installations; scalability; CO2 purity
- Financial: cost of capture; cost of integration
- Safety: transport and storage
- Strategic: business models; link with CO2 hubs and clusters
- Bring Technology Readiness Level to 6-7 (technology/system demonstrated in relevant/operational environment)
- Societal readiness: public awareness; explore barriers to acceptance

Impact and more

- Impact is very much determined by the plan of what to do with the captured CO2,
- …by the potential to form part of a future CCUS cluster,
- …and of course by the TRL reached
- International cooperation is encouraged, in particular with Mission Innovation countries such as China

Final details

- Innovation Action (70% EU contribution)
- Indicative EU contribution up to EUR 15 million
- Call budget EUR 15 million
- Call opens 05 May 2020, deadline 01 September 2020

Please note: topic also still open in 2019, deadline 27 August 2019

- *Indicative EU contribution EUR 10-12 million*
- *Call budget EUR 33 million*

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SSH aspects of the clean-energy transition
- Energy citizenship -

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Gerd Schönwälder
Policy Officer - Strategy
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Context

- SSH aspects are mainstreamed across the Energy Challenge.
- In addition, this topic addresses broader SSH questions relevant in this context.
- In 2020: energy citizenship (following social innovation in 2018 and challenges facing carbon-intensive regions in 2019).

Scope

- Energy citizenship: civic engagement, active participation and interaction with institutional or corporate actors in the field of energy.
- Goes beyond (but also encompasses) “consumer involvement”.
- Goal is to better understand how collaborative goal setting and decision making take place.

Research questions

- Is energy citizenship likely to emerge locally, regionally, nationally, supra-nationally?
- How relevant are internal group processes and external environmental variables?
- Importance of digitization and social media?
- Is energy citizenship conducive or detrimental to reaching broader policy goals?

Expected impacts

- Better understand socio-economic, socio-cultural, socio-political and gender factors and their interrelations with technological, regulatory, and investment-related aspects.
- Yield recommendations for harnessing energy citizenship to achieve the decarbonisation goals of the EU and the Associated Countries.

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European Energy and Climate Modelling Forum
topic : LC-SC3-CC-2020

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European Energy and Climate Modelling Forum (2020-2024)

Specific challenges

- Refine the identification of pathways towards climate neutrality in Europe through model inter-comparison and validation
- Overcome the fragmentation of the European modelling community to better inform EU's Energy and Climate policies in a robust and transparent way.

European Energy and Climate Modelling Forum (2020-2024)

Scope (1)

- Develop methods to compare, benchmark and integrate different modelling approaches that underlie EU decarbonisation pathways
- Evaluate costs and benefits of the respective pathways from an integrated economic, social and policy perspective
- Support the development of modelling capacity on energy and climate modelling in Member States/Associated Countries

European Energy and Climate Modelling Forum (2020-2024)

Scope (2)

- Broaden the scope of energy modelling groups to better integrate the climate dimension while considering a wide set of decarbonisation pathways
- Provide robust and transparent evidence to relevant scientific and policy processes

European Energy and Climate Modelling Forum (2020-2024)

Expected impacts

- Improved coherence and robustness of model-based evidence to inform EU's Energy and Climate policies
- A truly integrated modelling approach
- Improved transparency of models and their components
- Structuring of the European climate modelling community

European Energy and Climate Modelling Forum (2020-2024)

Indicative Budget

5 million €

At least 60% of the budget to be allocated directly to modelling activities

Type of action

Research and Innovation Action

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Horizon Prizes

#H2020Energy
info days

Dr. Thomas SCHLEKER
Policy Officer
DG RTD

What are Horizon 2020 Prizes

There are two prize mechanisms in H2020:

- recognize past achievements, so called ex-post awards or recognition prizes
- induce future activities, mainly used to incentivise R&I and deliver prototypes /demonstrators of new technologies- so called inducement prizes that are referred to by the European Commission as Horizon Prizes under Horizon 2020

Prizes in the « Energy Challenge » - Strategic

- To stimulate innovation and come up with solutions to problems that matter to European citizens
- To contribute to the objectives of both the Energy Union and the Strategy Energy Technology Plan.
- To boost innovation leading to greater sustainability and efficiency, while increasing our energy security and supporting the decarbonisation of the European economy

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The Challenge

Launched on 12th December 2017

SOLVE THE CHALLENGE

€5 million

Apply by **3 February 2021**

What are inducement prizes?

- "Challenge" or "inducement" prizes, offering a **cash reward** to whoever can most **effectively meet a defined challenge**

- incentive for innovation by prescribing the goal, but not how the goal should be achieved

Why is it important for Artificial Photosynthesis?

- Create **visibility** and **awareness** of this new « energy conversion » concept
- **Get the science out of the "lab"** in the "field"
- **Get the engineers involved**
- **Stimulate and accelerate** the R&D&I

What is the challenge?

- The focus of the prize is on **proof-of-concept**

- Building of a **fully functional, bench-scale prototype device** of an artificial photosynthesis synthetic fuel production system.

- **Integrate the whole artificial photosynthesis process** from light capture to fuel production that generates a fuel capable of powering a small engine.

Rules of the contest - Eligibility

- The contest is open to all legal entities (…) or groups of legal entities

- Please note that the production of fuel in the form of hydrogen and the use of conventional photovoltaic cells for the light harvesting process or to collect light and electrolysers are not permitted.

Deadlines	
Opening of the submission	**12 December 2017**
Deadline for registration of interest	**29 June 2020 at 17:00:00 CET**
Closing date for submission	**3 February 2021** at 17:00:00 CET
Evaluation	**February – September 2021**
Solution demonstrations by the finalists at JRC Ispra ("Grand Final")	**July – September 2021 (1 week therein)**
Award	**November – December 2021**

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RESPONSIBLE ISLAND prize

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Research and Innovation

What is the 'RESponsible Island' prize?

- This prize will reward achievements in local renewable energy production for electricity, heating, cooling and transport on islands.
- The prize name refers to the combination of renewables (RES) and responsibility.

Prize value

- 1st place: €500,000
- 2nd place: €250,000
- 3rd place: €100,000

Why is there a prize?

- Islands often have high local energy costs, but can benefit from the transition to renewable energy sources in many ways.
- These include, among others, creating local jobs and opportunities for sustainable tourism.
- There are more than 2000 inhabited islands in the EU. They are ideal test labs to develop innovative energy technologies and can serve as energy transition models for small communities in general.

The prize will be awarded based on

- The share of renewable energy produced by innovative energy technologies
- Environmental and socioeconomic sustainability and impact
- Citizen and community involvement
- Replicability of the solution
- The prize should inspire other islands and off-grid communities to show how small local communities can make the transition to sustainable energy systems.

Who can apply

- The contest is open to islands located within the territory of an EU country including overseas countries and territories or countries associated to Horizon 2020.
- It is open to any legal entity or group of legal entities representing the respective island.

How to apply

- Participants can apply for the contest online. You can find full details in the following documents.
- Rules of contest
- Application guide
- Horizon 2020 work programme 2018 - 2020
- **Deadline: 26 September 2019**

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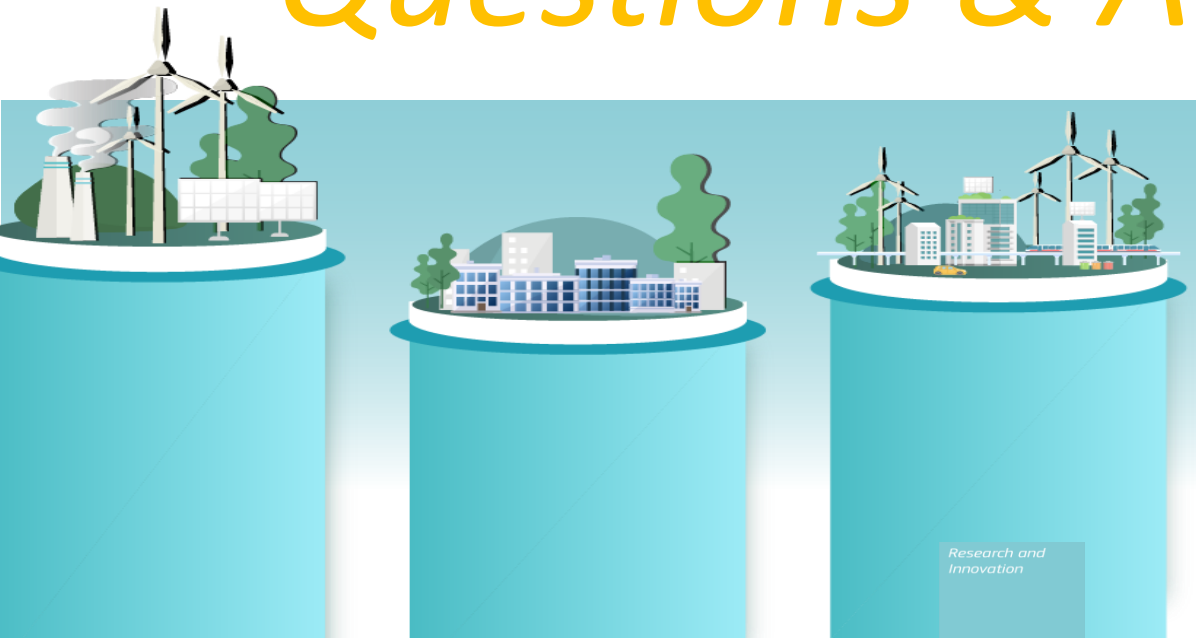
Questions & Answers



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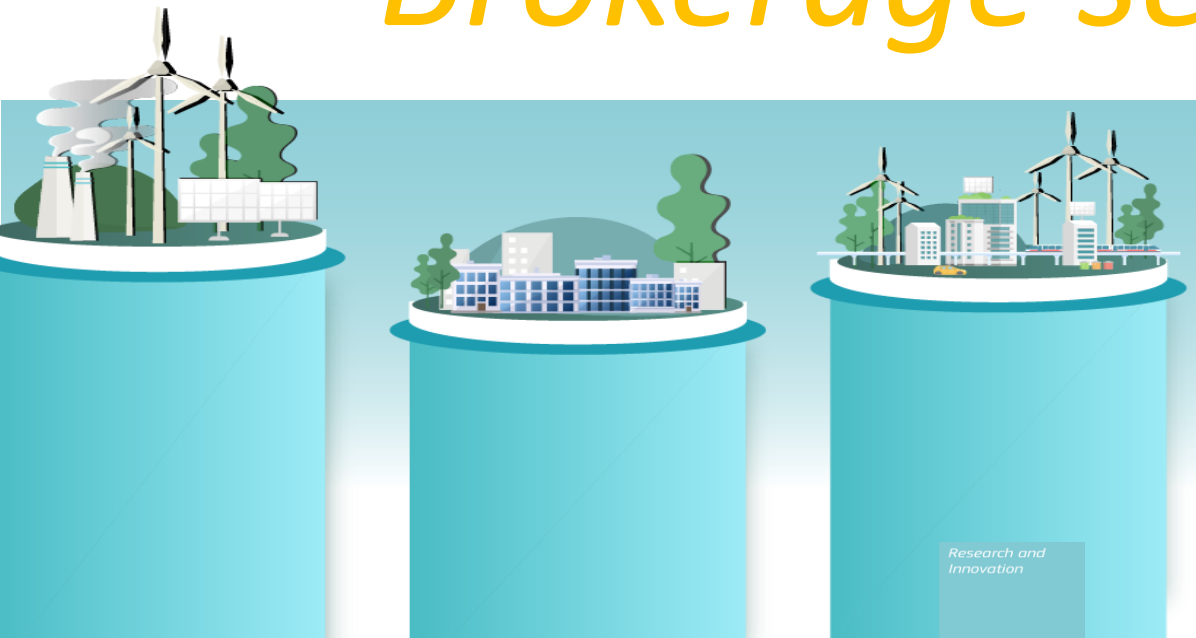
Brokerage session



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