European Innovation Council

Workshop on Energy systems and Green technologies with Member States representatives

On 26th September 2022, Antonio Marco Pantaleo, EIC Programme Manager (PM) for Energy systems and Green technologies, hosted a workshop to present future EIC challenges to European Union Member States and the Associated States. The online workshop was moderated by the Head of Unit Anne-Marie Sassen. Each part of the agenda was followed by an interactive part in which representatives gave their input and raised questions.

Programme Manager Pantaleo started the workshop by giving an overview of the guiding principles and methodology for the selection of challenges, followed by a description of potential challenges for WP2023 and future research trends in energy systems and green technologies. The potential challenges include *Clean Cooling Technologies* (Pathfinder), *Renewable energy harvesting, conversion and chemicals/materials production* (Transition), *Services and technologies for energy management* (Accelerator), *Energy storage solutions* (Accelerator) and *Low carbon heating and cooling* (Accelerator).

Following this, some promising research trends in the generation of cooling from renewable energy and wasted heat were presented by the PM. He pointed out the crucial role of energy efficiency and demand response solutions in energy demand management, including in particular process systems integrated strategies and energy storage assets to abate industrial sectors or energy communities. It was pointed out by participants that, in addition to heat electrification, there are a number of complementary strategies and technologies that could facilitate the energy transition, the security of energy supply and reinforce the EU technological leadership.

Representatives were interested in understanding the relation between the EIC and the EU Missions in Horizon Europe, particularly Climate-neutral and Smart Cities. The PM explained that Missions have the ambition to facilitate the deployment of research and innovation at the local level through interactions with regions, and local authorities, and putting together key actors (private actors, research networks, service centres). In this regard, EIC can propose its beneficiaries as potential partners, which is particularly the case for Accelerator projects. Pantaleo thanked participants for the discussion and inputs raised throughout the presentation and highlighted that these will be taken into consideration in the formulation of future challenges.

Anne-Marie Sassen closed the session by informing participants that the slides will be made available in the upcoming weeks and reiterated that representatives are welcome to share their inputs by reaching out to EISMEA-D.02@ec.europa.eu

26th of September 2022

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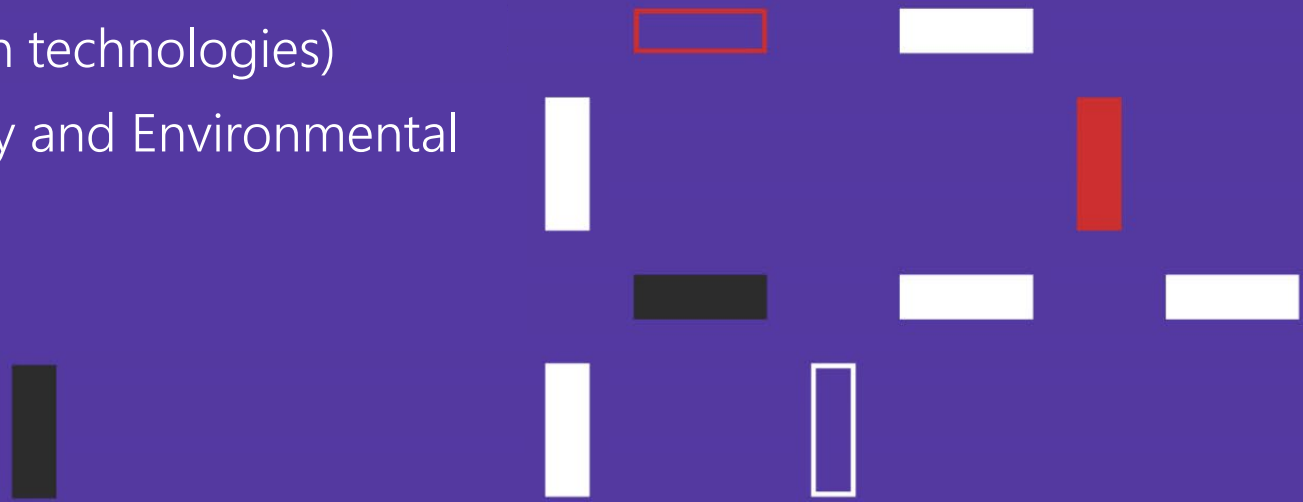
Energy and Environment research and Innovation Key Topics

Energy systems and green technologies

Antonio Marco Pantaleo (Energy Systems and Green technologies)

Francesco Matteucci (Advanced Materials for Energy and Environmental sustainability)



Outline

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- Guiding principles and methodology for selection of challenges
- Overview of challenges launched in 2021 and 2022
- Description of potential challenges for WP 2023
- Future research trends in energy systems and green technologies

The main EIC Support Schemes

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Pathfinder

For advanced research on breakthrough / game-changing technologies

Pathfinder Open: bottom-up approach; no predefined topics

Pathfinder Challenges: top-down challenge-driven calls for tackling specific issues by portfolios of projects

Transition

For transforming research results into innovation opportunities;

follow up results from EIC Pathfinder and ERC Proof of Concept

Transition Open: no topic prescription

Transition Challenges: selected challenges

Accelerator

For individual companies to develop and scale up breakthrough innovations with high risk and high impact

Grant Funding

Equity Funding

Business Acceleration Service

EIC Fund: VC fund – EC shareholder / Bridging equity funding gap at early stage / Crowding in other investors

Business Acceleration Service: access to advice, to business partners and to innovation ecosystems & peers

PM Roles : mix of policy and implementation

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Building strategic intelligence, selection of topics and definition of scope of calls, chair of evaluation panel (pathfinder) and portfolio implementation

Clustering projects in thematic portfolios, enhance cross-sectorial contaminations and serendipity

Scientific knowledge + networking + entrepreneurial vision to transform research into innovation

Scientific intelligence and Proactive Management

Outreach to R&I stakeholders, links to other EU programmes and engagement with innovation ecosystem community

Guiding principles for challenges selection

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Guiding Principles

High innovation potential recognized **industrial interest/market needs**

Relevance for EU **technological autonomy** and **economic/societal impact**

Alignment with key strategic goals: energy and tech autonomy, pandemics, critical supply chains, sustainable goals etc

Synergies/complementarity with other funding programmes (HEU, EIT, Missions etc)

– niche areas -

Programmes

Pathfinder:

Non incremental research

Vision gained from funded and not funded projects

Structured interviews with **scientists**

Data mining, EPO, JRC foresight

Transition

Evidence from eligible projects (ERC PoC and PT)

Accelerator:

EU positioning in the innovation ecosystem;

critical mass of EU stakeholders/researchers/innovators;

Venture Capitalists – Venture Corporate strategies -

Process of Selection (Methodology)

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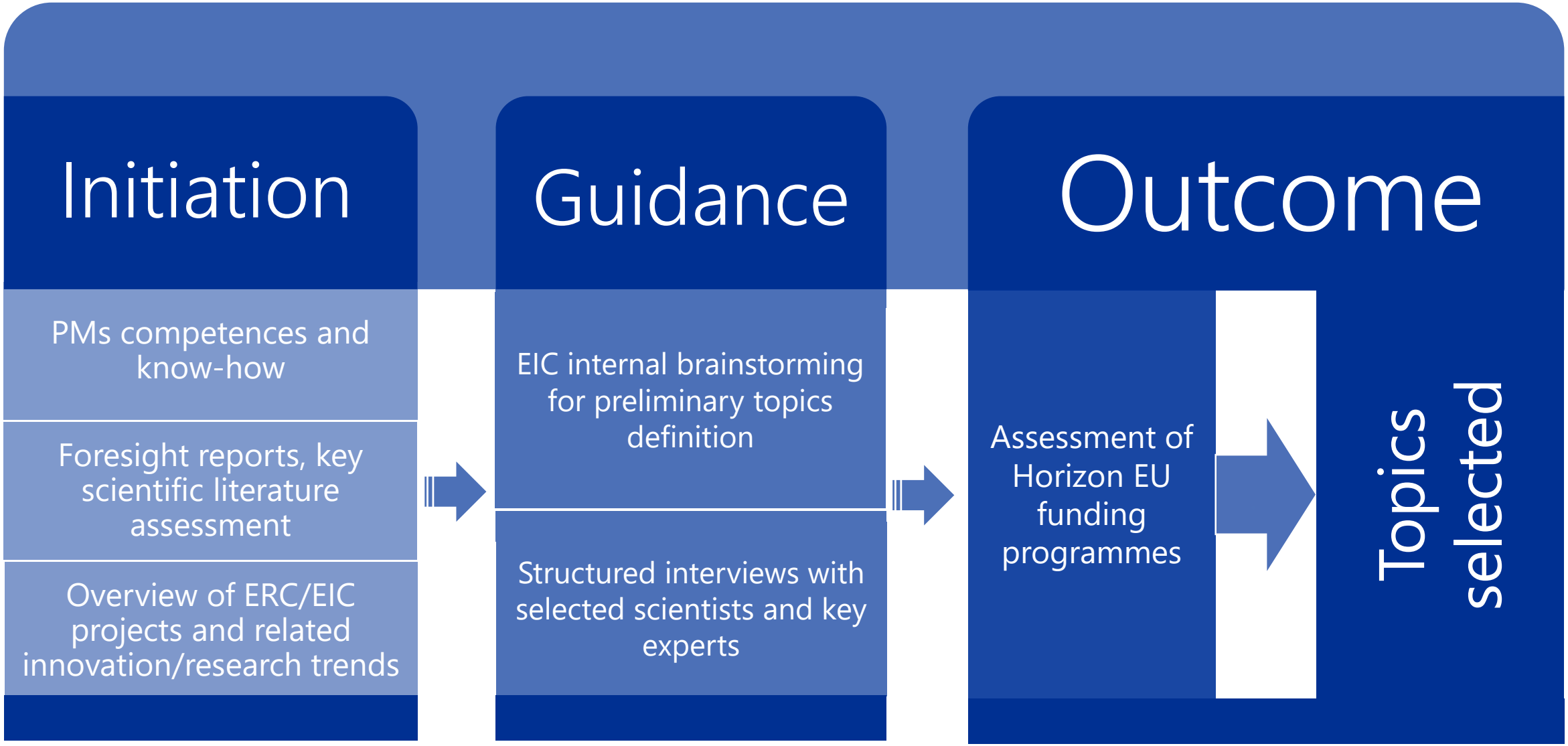

EIC challenges so far

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EIC Challenges 2021			
	Pathfinder (5)	**Transition (2)**	**Accelerator (2)**
Green	• Novel routes to green hydrogen production • Engineered living materials	• Energy harvesting and storage technologies	• Green Deal innovations for the economic recovery
Digital	• Awareness inside		• Strategic Health and Digital Technologies
Health	• Tools to measure & stimulate activity in brain tissue • Emerging Technologies in Cell & Gene Therapy	• Medical devices	

EIC Challenges 2022			
	Pathfinder (6)	**Transition (3)**	**Accelerator (2)**
Green	• Carbon dioxide & Nitrogen management and valorisation • Mid-long term, systems-integrated energy storage	• Process and system integration of clean energy technologies • Green digital devices for the future	• Technologies for 'Fit for 55'
Digital	• DNA-based digital data storage • Alternative Quantum Information Processing, Communication, Sensing		• Technologies for Open Strategic Autonomy
Health	• Cardiogenomics • Healthcare Continuum technologies	• RNA-based therapies and diagnostics for complex or rare genetic diseases	

EIC Pathfinder

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For advanced research to underpin breakthrough / game-changing technologies

Mainly open ("bottom up"), but also Pathfinder challenges (for emerging health, energy and digital technologies)	Mainly collaborative (3 or more partners)	Grants up to €3/4 Mt €3/4 million	Management of portfolios of projects by Programme Managers

The Pathfinder Challenge green hydrogen generation – WP 2021

Novel routes to green hydrogen production

Scope

Hydrogen, actually largely produced from fossil fuels, has the potential to contribute to the development of efficient, sustainable and flexible energy systems.

This Pathfinder Challenge aims at developing **novel processes and technologies to produce green H2** (full life-cycle greenhouse gas emissions close to zero), at **different scales** (from small to large) and **capturing cross sectorial coupling and system integration opportunities**, **entirely based** on (i) **renewable sources** and (ii) **non-toxic, non-critical raw materials**.

It focuses on the potentials of **new biological, chemical, and physical routes for green H2 production** which could also facilitate the implementation of the **circular economy** principles, possibly including the co-production of decarbonised chemicals.

The specific target is to support the development of innovative technologies and platforms for green H2 production, **including both centralised and/or on-demand generation** (i.e. at the premises of the end users and for onsite consumption).

Proposals evaluation and portfolio approach in the pathfinder challenge

- a coherent set of projects aligned to the topic guide with competing or complementary technologies and research approaches;
- multidisciplinary interactions and exchanges for synergies and serendipity;
- contributing to an overarching medium to long-term market vision and strategic plan
- Projects funded on the basis of the portfolio criteria defined by the evaluation panel after the remote evaluation
- Projects will participate in relevant portfolio activities, driven by the PM

The Pathfinder Challenge on green hydrogen generation

Scope of the call

novel processes and technologies to produce green H2 and capturing cross sectorial coupling and system integration opportunities, entirely based on (i) renewable sources and (ii) non-toxic, non-critical raw materials.
new biological, chemical, and physical routes possibly including the co-production of decarbonised chemicals.

Portfolio criteria

Broad range of technologies, system integration opportunities, circularity approaches, non critical row materials, co-production of H2 and chemicals/materials

Evaluation process

Step 1 (remote evaluation with 3 experts + 1 cross reader)

50 proposals over 104 received above threshold to produce the final score (after cross-reading)

Step 2 (evaluation panel with 9 experts + 2 PMs)

projects ranked in **6 technological categories** (electrolyzers, AEM electrolyzers, photocatalysis, thermoch, biological, hybrid)

In each category, projects were further evaluated according to circularity, systems integration, raw materials criteria

Priority list in each category is defined, considering the final score and the further portfolio criteria evaluation

Selection of the first project in each category according to priority list

9 proposals retained, portfolio management kick of in mid October

Future hydrogen pathways

- **Green H2 generation**: co-electrolysis (wastewater, biomass); direct solar conversion (photocatalysis); natural H2 (geothermal from olivine hydrotreatment); bio-hybrid fermentation (synthetic biology) – critical materials dependency
- **Process systems integration**: materials, chemicals, fuels and circularity across the whole routes
- **Blue H2**: Carbon management/valorization rather than storage - regulatory framework with GoO to be addressed/ innovations in CH4 to H2 and carbon management
- **End uses**: matching heat/cooling and power demand (fuel cells, internal combustion engines, self pressurized combustion, hybrid)
- **Storage/transport:** thermal management (use of hydrides and adsorption/desorption, liquid H2 carriers, waste heat and cooling reuse)

Approach for selection of topics for WP 2022

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May 2021

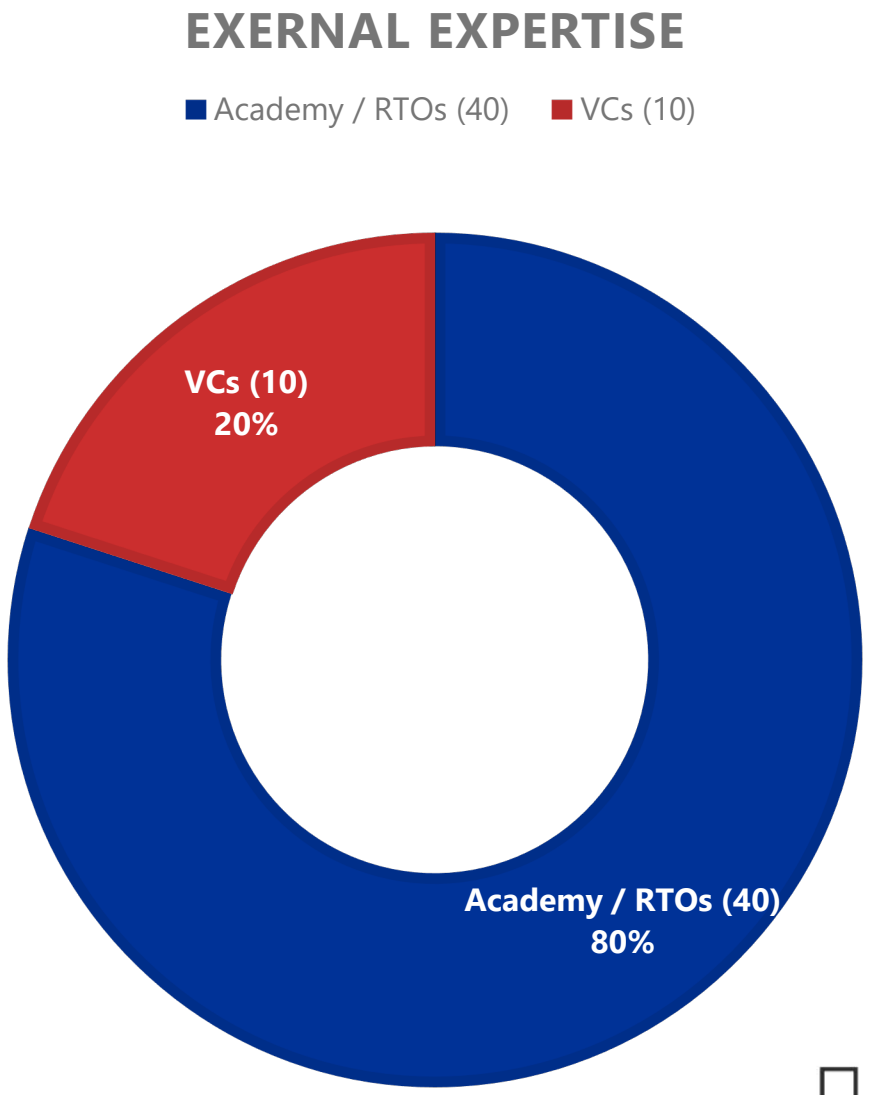
- Informal meetings with experts coming from science/business/financial field

July/October 2021

- Discussions within Commission services (Cluster 5 & Cluster 6 Co-creation groups)

October 2021

- Discussion with Member States experts



WP 2022 Medium long term energy storage rationale and aims

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- increase system flexibility, sectors coupling, smart interoperability
- facilitate high penetration of intermittent renewable energy
- enable energy efficiency - demand response (waste heat/cold, cold chains, etc)

Storage technologies suited to discharge durations ranging **from 4 hours to 200 hours (or longer)** to complement existing technologies for short term and long term (hydrogen, biofuels, pumped hydro etc)

Aims of the challenge

mid and long duration storage (from days to months), processes or systems integrated, for stationary applications

Key aspects: proof of concept using non critical raw materials,

system integrated, combination of storage technologies

WP 2022 Medium-long term energy storage
KPI and challenges

Targets - KPI

Gravimetric/volumetric energy density; scalable; cost; whole LCA

charging/discharging dynamics, durability, stability, safety, leakages (gels etc);

high/low T, non critical materials, (potentially biobased or C capturing materials)

Methodologies and research areas

Molecular modelling (computational materials) integrated to electric/mechanic modelling: from molecules to components to systems

Novel materials i.e. composite change materials, reactive metals, molten metals

Heat and mass transfer in PCM, slurries etc; expanders - compressors design

Diagnostics and measure of thermophysical properties in difficult conditions

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Proposals for S&T subject areas for Pathfinder WP 2023

EIC instrument	Macro-area	S&T subject area
Pathfinder	**Green**	**Clean cold technologies**

Pathfinder	Clean cold technologies

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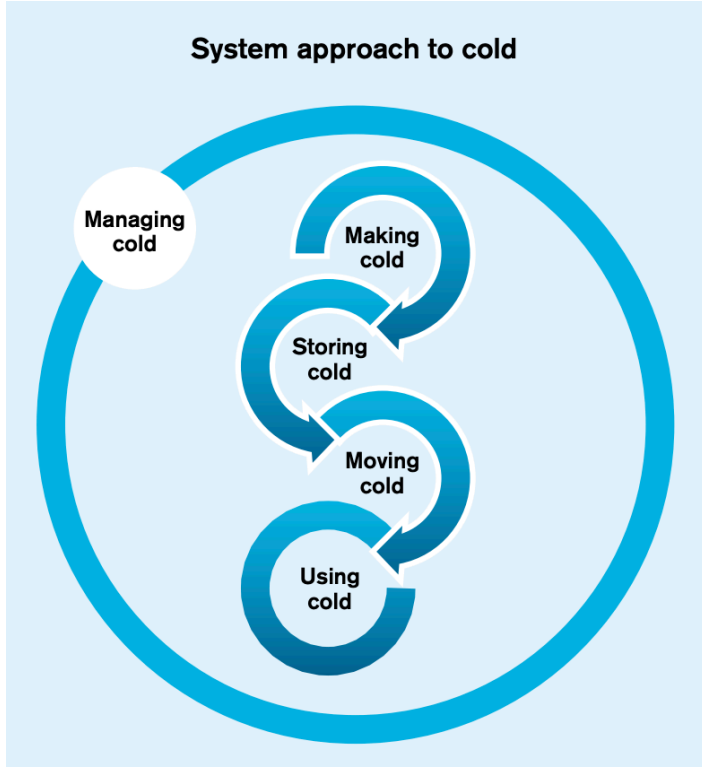
Setting the scene

Cooling is vital for food, medicine, data, industry, urbanization, and almost every aspect of civilization
Dirty process: 10% of CO2 emissions come from cooling and refrigeration (3 times more than aviation and shipping)
Fast increasing: By end of the century global demand of air conditioning only will cover 50% of current global electricity demand
Data centres: around **half of their energy consumption** goes on cooling (up to 100 GW by 2030)
Current/future **energy carriers** (H_2, NH_3, CH_4) are smaller molecules than carbon fuels: need cooling/ compression
Developing countries: the lack of adequate cold storage and refrigerated transport causes two million vaccine preventable deaths each year, and the **loss of 0.2 billion tonnes of food** (and 3.3 billion tonnes of CO2 emissions, making it the third biggest emitter after the US and China).

Clean cold requires a **fully integrated 'cold economy',** with novel clean cold technologies, the integration of waste and under-exploited energy resources (i.e. wasted cold from LNG) and system-level analysis



Need for:

- **transformational research** that could displace existing technologies (i.e. functionalized PCM, laser cooling, reversible combustion materials etc)
- **integration of renewable energy** for cooling (passive cooling, radiative and solar cooling, absorption and hybrid heat pumps)
- new compression-expander mechanisms (scroll, electrochemical compression), mixed refrigerants, novel cycles configurations
- small balance-of-plant for proper sizing and location (higher efficiency at lower scale)
- **store and move cold** (decoupling demand/generation) and system level integration opportunities (ice slurries, liquid air, thermal fuels)

Scope/ specific objectives

Potential applications

1) **data centres**, electronics, batteries and superconductors
2) **built environment**, HVAC, building health and comfort, interoperable urban energy systems
3) **food production** (i.e. vertical farming), processing, storage and refrigerated transport,
4) **cold energy carriers production**, transport and network integration (liquid H2, LNG, ammonia, etc)
5) chemical, metallurgical and **hard to abate industries** (including cryogenic carbon capture) and medical sector.

Research and innovation needs:

1) computational modelling, optimization and validation of heat transfer processes, working fluids, components topology;
2) unconventional refrigeration principles (i.e. thermoelectric, magnetocaloric, electrocaloric, elastomeric or barocaloric, photonic cooling).
3) net zero cooling technologies for industrial/residential sector (solar and geothermal, hybrid pumped heat and heat transformers, interoperability of district networks, etc);
4) ultra-energy efficient operations and logistics along the cold supply chain;

Key objectives of the challenge

Explore new devices, processes, components and materials for cooling, in order to (i) reduce investment/operational costs, (ii) increase efficiency, (ii) operational reliability and (iv) interoperability, (v) avoid the use of critical raw materials or harmful refrigerants and (vi) pursue circularity by design approaches.

Smart interoperability solutions for electricity, heating and cooling networks integration, including reversible heating and cooling infrastructures, or cold-to-power solutions with waste heat and cold energy streams recovery from industrial processes and/or air conditioning of buildings.

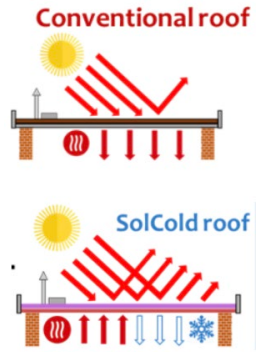
Expected impacts

development of proof of concepts of technologies that could be scaled up towards technological innovations to reinforce the EU technological autonomy and its positioning in the global scenario, and be broadly implemented to:

i. increase the EU competitiveness, carbon footprint and security in strategic productive sectors (such as food production/processing/transport/delivery)
ii. give broad access to building comfort and **health** in living environment (**Mission Cities**),
iii. increase operational security of server and computing facilities (**Chips Act**)
iv. address climate change adaptation (in particular in semi-desertic areas) and **food security**, including possibilities of **international outreach** (EU-Africa cooperation on renewables, Mission innovation and AU-EU Science and Innovation Partnership on Climate Science and Sustainable Energy)

Pathfinder	Clean cold technologies
	Research trends: some examples

OPTAGON - 964698



Using light as a refrigerant: combination of the latest innovations in lighting, photovoltaics and nanotechnologies.

Electroluminescent cooling to develop **thermophotonic coolers** (from cryogenic coolers to domestic heat pumps) Nature Photonics, 2020 https://www.nature.com/articles/s41566-020-0600-6.pdf

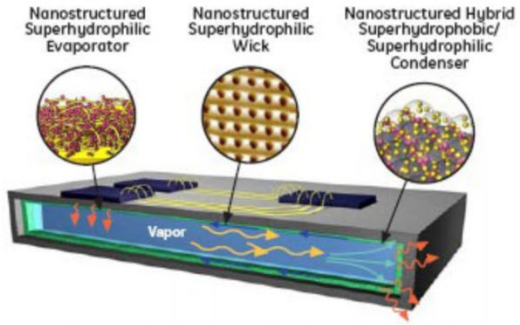
Optical refrigeration via anti-Stokes fluorescence: Monocromatic light absorbed and re-emitted at higher wavelength with high purity materials Optical refrigeration. *Nature Photon* 1, 693–699 (2007)

Heat transfer: materials and topology of heat exchangers: Dropwise condensation (**Harmonic**)

Radiative cooling: meta-concrete that exhibits radiative cooling properties **(Miracle)** and thermal photonics to boost radiative cooling Nature Photonics (2022) https://doi.org/10.1038/s41566-021-00921-9

Innovative coolants for electronics or batteries, with optimal rheological and thermal properties, i.e. viscoelastic liquid carrier matrices with low pressure loss

I-BAT - 899659

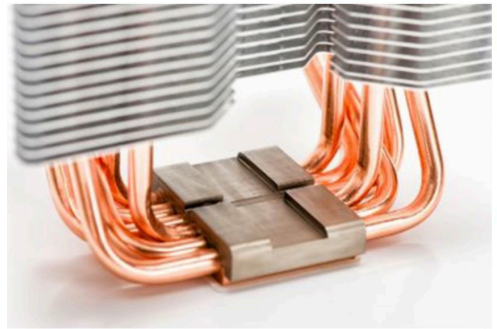


A diagram of GE's advanced thermal material system. Leveraging unique surface engineered coatings that both repel and attract water, GE's system achieves twice the heat conducting properties of copper and can function under extreme forces of gravity. The improved heat properties will enable a wide range of better electronics applications, ranging from faster laptops and more advanced radar systems to better aviation and naval electronic control systems.

Cooling for electronics, batteries

Thermal management
Phase-change based substrate for electronic components cooling mechanism that spreads or dissipates the heat generated in electronic systems to keep components cool.

Heat pipes for electronics



Pathfinder	Clean cold technologies
	Research trends: some examples

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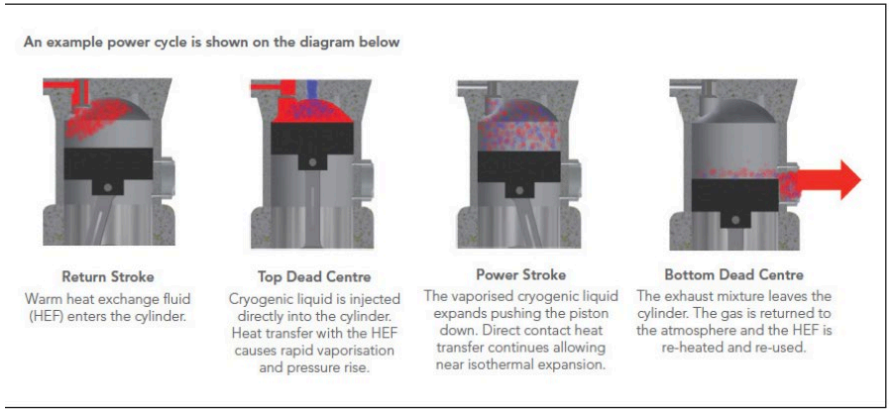
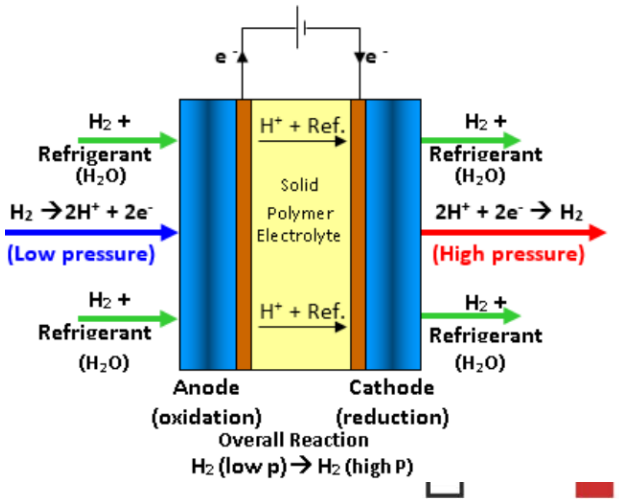
Refrigerated transport: refrigerated truck cooled by a liquid N - Daerman engine

Cryogenic expansion engines: heat exchange fluid (made of water and glycol – just like conventional radiator fluid) to promote rapid and efficient re-gasification inside the engine cylinder.



Waste heat recovery: energy recovery from lower pressure evaporator through ejectors, similar to how a turbocharger recycles exhaust gases in an engine to increase performance

Innovative compressors: Use of external voltage to pump hydrogen, water or other refrigerants. The electric potential gradient governed by Nernst equation and Ohm's law is the driving force



Accelerator projects ongoing – Cooling technology

ID	Acronym	Name	Budget (€)
768264	serverChill	Server liquid cooling for Data Centres... done right!	1.091.125,00
768397	Home of Cool	A novel environment-friendly limited space cooler for high volume food and beverage vending industries.	1.127.000,00
778106	SOcool	SunOyster cooling (SOcool)	1.398.477,50
783959	WHIITE	Waste Heat Integrated Industrialised Trucks and Tractors Engine	1.392.489,00
784050	KoolZone	KoolZone- refrigeration control technology to minimise food waste, avoid food poisoning and minimise energy consumption	1.919.750,00
784172	SmartHeat	SmartHeat – An eco-innovative solution towards zero-carbon household heating	1.110.130,00
805593	HEART	HIGH HEAT REJECTION THERMAL CONTROL SYSTEM	1.864.695,00
805689	Hot chips	Waste heat recovery for industrial heat intensive processes	2.500.000,00
805767	ShellSideJet	Automated System for Total Fouling Removal of Heat Exchangers	1.206.371,25
806766	GasHeatPumpSaltX	Disrupting the European domestic space heating market with the lowest cost, energy-efficient Gas Heat Pump	1.980.212,00
806817	Submer	Highly Efficient, Eco-friendly Immersion Cooling for Data Centres	1.337.305,38
829941	nanoICE	Optimisation and Large-scale Commercialisation of Next Generation Cooling Equipment for Food Industry	1.736.000,00
829943	SensaSticker	Improving the global cold chain with cutting-edge temperature monitoring solution	1.403.283,00
879726	TEM	Teklab Evaporator Management system (TEM) for increasing energy efficiency in Refrigeration and Air Conditioning. Cost effective, highly technological and innovative but easy to understand and install	1.409.685,38
880637	MILDTECH	Affordable, low temperature, rapid and energy efficient dual frequency microwave assisted vacuum system for drying and cooking foods	1.834.682,50
946528	CrioFlex	Cri/oFlex: The missing link towards large scale quantum computing	1.957.036,00
946903	FLAMINCO	FLAmeless, affordable & high efficiency MIcro turbine system for sustainable residential COgeneration	1.346.722,13
960217	CADR	(C)ADR: Novel cooling system for the cryogen-free, continuous, and fully automatic generation of very low temperatures near absolute zero.	1.517.862,50
101009642	T-Sense Cold	Printed temperature sensitive labels for products in cold chain	1.101.800,00
		DAC, DEOS, Magnotherm – funded in 2022	
Total	**19**		**29,3 M€**

EIC Accelerator WP 2023

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For startups & SMEs to develop and scale up innovations with high risk and high impact

For individual companies (startups, SMEs)	Continuously open for applications (also from individuals intending to start a company and investors intend to support a company)	Mainly open but also Accelerator challenges in Green Deal, Strategic Digital & Health Technologies	Mainly blended finance (grant + investment), but options for “grant only” and “grant first” (with investment follow up)

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Proposals for S&T subject areas for Accelerator

EIC instrument	Macro-area	S&T subject area
Accelerator	**Green**	**Energy storage solutions**

Accelerator	Energy storage solutions

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Scope/specific objectives

- The proposal supports technologies to store electric and/or thermal energy at low cost, high density, high charging/discharging efficiency and enhanced durability.
- The proposal focuses on technological approaches (chemical, electrical, electrochemical, mechanical, thermal) for energy storage at different **scales** (centralized at large industrial facilities premises or distributed and at small scale level – mobile electronics), **duration** (short – millisecond to day, medium – days to month and long term – months to seasons) and **uses** (from stationary to mobile). Proposals should focus on technologies that, without using critical raw materials or ensuring their full recycle/reuse, minimize their carbon footprint measured through a life-cycle analysis (including cost and social impact evaluation).

Expected impacts

- To enable a strong penetration of intermittent renewable energy resources by addressing the spatial and temporal mismatches between generation and demand,
- To set up decarbonized, interconnected, sector-coupled and flexible energy systems.

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Rationale

- The development of flexible, sector-coupled energy systems is crucial to achieve the EU Green Deal, Fit for 55 and Repower EU action targets.
- The possibility to store electrical or thermal energy at low cost, high density, high charging/discharging efficiency and for different duration (from short to long) will not only pave the way towards flexible energy systems but will also enable a strong penetration of intermittent renewable energy by addressing the spatial and temporal mismatches between generation and demand.
- To reach these goals, it is crucial to develop a range of breakthrough solutions for electrical and thermal energy storage. The scale-up of these technologies will set up European coupled and flexible energy systems that will realize the highly strategic EU energy autonomy.

Relevance to EU policies and initiatives

- FIT-for-55
- Repower EU
- Partnerships: battery, clean hydrogen

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Other topics not included in WP 2023 draft

EIC Transition WP 2023

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Transform research results into innovation opportunities

New funding scheme to bridge gap between research phase (proof of concept) and innovation application	Mainly open (“bottom up”), but also Transition challenges (for medtech, energy storage)	Single applicants or small collaborations (max. 5 partners)	Grants up to 2.5M	In first phase, only for follow up to results from EIC Pathfinder and ERC PoC

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Proposals for S&T subject areas for Transition WP 2023

EIC instrument	Macro-area	S&T subject area
Transition	**Green**	**Renewable energy harvesting, conversion and chemicals/materials production**

Transition	Renewable energy harvesting, conversion and chemicals/materials production

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Scope/ specific objectives

The scope of the proposal is to support the scaling up and commercialization of breakthrough renewable energy technologies, which present commercial potential but also lower environmental impact/carbon footprints/greenhouses gases emissions/resources deployment in comparison to current renewable energy technologies. Support will be given to proposals focused on the **harvesting and conversion of renewable energy into fuels, materials or chemicals**, or to the direct production of electricity and/or thermal energy. Specific challenges of the proposal include for instance the integration of renewable energy into smart buildings, the production of renewable based fuels (including solar fuels) or storable chemicals, semi or fully transparent PV that can be integrated in windows or greenhouses for combined production of food and energy.

Expected impacts

- development of efficient and sustainable prototypes of technologies for renewable energy harvesting and conversion to electricity, thermal energy, materials and chemicals.
- limitation or avoidance of the use of critical row materials and carbon footprint in the whole production process
- facilitation of the system integration of renewable energy technologies
- solution for the intermittency of renewable energy supply with proper embedded energy storage solutions
- Promotion of the market uptake of proposed solutions and proper commercialization pathways

The concepts proven or validated within projects are expected to contribute to accelerating and reducing the cost of renewable energy generation, included the conversion of renewable energy to chemicals and materials.

Transition	Renewable energy harvesting, conversion and chemicals/materials production

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Rationale

The proposal is to create an EU industrial renewable energy sector which is economically sustainable and competitive in European and global markets in the long-term. For this purpose, this proposal supports the scaling up of breakthrough technologies already available at level of proof of concept. Specific focus will be on the reduction of costs, improvement of conversion efficiency, capability to integrate the technologies into energy systems and address the intermittency of resources availability with embedded storage solutions.

Relevance to EU policies and initiatives

The Energy Union Strategy has set the target for the EU to achieve global leadership in renewable energies. The "Clean Energy for all Europeans" package, the Green Deal, the Fit455 and the RepowerEU action all underpin the EU's ambition to a clean, affordable and secure energy transition.
HEU missions: Soil, Water and Cities
FIT-for-55, Repower EU

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Synergy/ complementarity with other EU programmes

EU missions (Soil, water, cities), Cluster 5 HEU, Cluster 4 HEU,
Partnerships: Built4people, Clean Energy Transition

Underpinning evidence

Assessment of proposals funded in ERC PoC, FET and Pathfinder that could apply for this proposal.
The selected calls in H2020 focused on low TRL researches that could be further supported with this transition call are:

LC-SC3-RES-1-2019-2020: Developing the next generation of renewable energy technologies
LC-SC3-RES-2-2018: Disruptive innovation in clean energy technologies .....
LC-SC3-RES-29-2019: Converting Sunlight to storable chemical energy .....
LC-SC3-RES-3-2020: International Cooperation with USA and/or China on alternative renewable fuels from sunlight for energy, transport and chemical storage .....
LC-SC3-RES-4-2018: Renewable energy system integrated at the building scale .....
LC-SC3-RES-7-2019: Solar Energy in Industrial Processes
LC-SC3-RES-11-2018: Developing solutions to reduce the cost and increase performance of renewable technologies
LCE-06-2017: New knowledge and technologies
LCE-07-2016-2017: Developing the next generation technologies of renewable electricity and heating/cooling

Calls eligible for 2023 – transition energy

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Eligible May 2023

Call ID	# of project	Budget
H2020-LCE-2016-RES-CCS-RIA	5	25.606.313,91
H2020-LCE-2017-RES-RIA-TwoStage	17	79.242.586,00
H2020-LC-SC3-2018-Joint-Actions-3	3	8.806.014,45
H2020-LC-SC3-2018-RES-TwoStages	12	56.852.037,25
H2020-LC-SC3-2019-NZE-RES-CC	2	9.998.783,74
H2020-LC-SC3-2019-RES-TwoStages	5	21.915.247,50
H2020-LC-SC3-2020-NZE-RES-CC	2	7.844.061,25
H2020-LC-SC3-2020-RES-RIA	11	41.492.213,25
ERC-2018/2020-PoC	**26**	**3.899.711,00**
H2020-FETOPEN/FETPROACT 2016/2020	**33**	**116.977.905,25**
Grand Total	**116**	**372.634.873,60**

Eligible September 2023

Call ID	# of project	Budget
H2020-LCE-2016-RES-CCS-RIA	1	5.077.733,75
H2020-LCE-2017-RES-RIA-TwoStage	12	55.731.278,00
H2020-LC-SC3-2018-Joint-Actions-3	3	8.806.014,45
H2020-LC-SC3-2018-RES-TwoStages	12	56.852.037,25
H2020-LC-SC3-2019-NZE-RES-CC	2	9.998.783,74
H2020-LC-SC3-2019-RES-TwoStages	5	21.915.247,50
H2020-LC-SC3-2020-NZE-RES-CC	2	7.844.061,25
H2020-LC-SC3-2020-RES-RIA	11	41.492.213,25
ERC-2018/2020-PoC	19	2.849.711,00
H2020-FETOPEN/FETPROACT 2016/2020	32	108.997.044,00
Grand Total	**99**	**319.564.124,19**

Accelerator	Services and technologies for energy management

European Innovation Council

Scope/ specific objectives

Services and technologies for energy management in residential and industrial sector (and electric mobility), to enable net zero energy communities, smart grids interoperability:

- **demand response services**, i.e. load forecasting, peak shaving/load shifting, big data analytics, AI and data driven models for machine learning and real time control
- **sensors and digital tools** for monitoring and control of decentralized energy systems, enhance cybersecurity
- **energy communities** management (storage, poli-generation, electric vehicles, electricity/gas/heat/H2)
- **digital twins** for predictive maintenance of systems and devices and reduce O&M costs and carbon footprint;

The challenge also aims to foster social innovation, **participative approaches to energy consumption and energy savings**.

Expected impacts

- Enhanced control and management of energy systems to increase flexibility, reduce operational costs, enable facility management and building comfort and automation, smart grids and electric vehicles, dispatching decentralized assets, storage and load control for net zero energy districts.
- social innovations to empower communities to promote **participative approaches for a fair energy transition**, to give access to energy to all, and **increase awareness for a rationale use of energy**

Accelerator	Services and technologies for energy management

European Innovation Council

Rationale

The motivations for this topic are: fast increase of **decentralized generation** (including storage, on site energy production), **electric mobility** and need for its integration in energy systems, availability of advanced **computational tools** to process big data and implement predictive control, need for enhanced functionalities and efficiency of integrated energy systems, demand for facility management and building comfort management services in the built environment, advanced predictive maintenance of industrial energy systems via **digital twins**

Functionalities and novel services for end users offered by smart grid solutions and smart cities require the development of specific solutions to enable the **digital and energy transition**

Relevance to EU policies and initiatives

Green Deal, RepowerEU, Fit for 55, Digital EU, Mobility system,

Accelerator	Services and technologies for energy management

European Innovation Council

Synergy/ complementarity with other EU programmes

Synergies: HEU missions (Cities, Climate Adaptation), Cluster 5 HEU, Cluster 4 HEU, Built4people, co-funded partnerships on Clean Energy Transition and Driving Urban Transition (support to positive energy districts)
Related topics in Cluster 5, draft WP 2023-24:
- flagships on 'Supporting the development of a digitalized European electricity system to enhance resilience, flexibility, and efficiency to enable drastic increase of the renewable energy share' (20 MEur)
- flagship on ' Building stocks for REpowerEU: innovative solutions for cost-effective decarbonization of buildings through energy efficiency and electrification' (25 MEur)

- **Underpinning evidence**

Green and digital transition are pillars of the EU SET plan and key targets of Horizon EU
There is a flourishing market for energy services
the number of start ups that propose demand response solutions (demand aggregators, providers of building comfort and automation services, etc) is fast increasing
The increase of energy costs is a key driver for these services and the fast penetration of on site renewables (i.e. roof integrated PV), electric mobility, availability of artificial intelligence and strengthened capacity on dat management are fast accelerating the strategic interest for such energy management services

Accelerator	Low carbon heating and cooling

European Innovation Council

Expected impacts

Expected impact includes the reduction of carbon footprint in the residential, industrial and tertiary sectors, security of supply and EU autonomy, diversification of energy sources, increased development of decentralized energy generation

Rationale

Heating and cooling represents the **world's largest share of energy end use** and covers the largest source of carbon emissions when compared with power and transport.
The main motivation for this proposal is to address **energy security**, rising cost of natural gas for heating, increased demand of cooling.
Smart heating/cooling technologies also enable the integration of energy storage and demand response strategies to increase the flexibility of energy systems, facilitate decarbonization, maximize the use of existing energy assets, reduce cost of energy.

Relevance to EU policies and initiatives

Green Deal, RepowerEU, Fit for 55, Mission innovation, EU-Africa cooperation on renewables, biomethane and H2 accellerator (RepowerEU targets)

Accelerator	Low carbon heating and cooling

European Innovation Council

Synergy/ complementarity with other EU programmes

Synergies: HEU missions (Cities, Climate Adaptation), Cluster 5 HEU, Cluster 4 HEU, Built4people, co-funded partnerships on Clean Energy Transition and Driving Urban Transition (which specifically addresses positive energy districts)
Related topics in Cluster 5, draft WP 2023-24:
- flagships on 'Demonstration of innovative, large-scale, seasonal heat and/or cooling storage technologies for decarbonization and security of supply' (30 MEur)
- industrial manufacturing for lower cost solar thermal components and systems (6 MEur)
- innovative solutions for heat pump systems (7 MEur)
- advanced manufacturing of PV and solar thermal components and systems (27 MEur)
- next generation renewable energy technologies (30 MEur)

Underpinning evidence

One of the major EU strategic dependencies is on energy (now at 60%, with target of 15% by 2050)
The IEA. Heating. See https://www.iea.org/reports/heating
The IEA. 2020. Heat Pumps tracking report. See https://www.iea.org/reports/heat-pumps
https://ec.europa.eu/eurostat/web/products-eurostat-news/-/edn-20220211-1
Roadmap for heating and cooling: https://www.rhc-platform.org/content/uploads/2019/04/RHC_Common_Roadmap.pdf

Pathfinder | Ongoing thematic portfolios

European Innovation Council

- **Renewable Hydrogen** (production, storage, logistics, end use)
- **Energy storage** (electrical, thermal, chemical, mechanical and electrochemical)
- **Solar conversion technologies** (solar-to: thermal, fuel, electricity)
- **Energy harvesting and conversion**
- **Nature-derived technologies**
- **Climate and Environment** (air/water/soil monitoring/depolluting, environmental intelligence)

Research topics of potential interest

Solar fuels and solar chemistry (Pillar II, challenge 2021, 2022)
Solar energy conversion (agro-PV, transparent solar, solar to X..) – previous calls already
Carbon capture, negative emission technologies (challenges of Pillar II and challenge 2022)
Natural H2 (georeactors) - Super high temperature materials - functionalized materials for energy
methane leakages abatement – phytomining/sustainable mining
Mixed energy nexus: water/energy – food/energy – environmental remediation/energy
Bio-inspired and biobased solutions for energy harvesting and conversion

Pathfinder (I): food-energy nexus

- **Topic**: circular technologies for food, energy and biobased materials
- **Scope**: (i) use of light for plants, energy, water (transparent PV, tunable wavelength PV, hybrid heating/electricity/desalination, etc); (ii) low energy input for food in vertical farming, cellular agriculture (evapotranspiration and thermal energy, intracanopy/high intensity/pulsating lights, bioluminescent proteins for greenhouses, etc); (iii) increased crops yield and climate adaptation with low energy input (speed breeding of crops, extended photoperiods, engineered chloroplasts to enhance photosynthesis) and co-production of biomaterials;
- **Key objectives, expected impact**: address in a synergic and integrated fashion a secure and clean production of energy, food, water, materials
- **Rationale**: Green deal, RepowerEU, food security, energy diversification, circular economy targets;
- **Underpinning evidence**: start ups in agroPV, vertical farming, cellular agriculture, engineered photosynthesis; breakthrough research in this area
- **Synergies**: Mission Climate Adaptation, Mission Soil, Mission Ocean, Cluster 5, CBE JU
- **Scientific domains**: biochemistry, biotechnology, photonics, plant physiology, microbiology, biophysics, thermal engineering, food technology

Pathfinder (II): biotic/abiotic solutions for energy and chemicals

Topic: biotic/abiotic systems to produce energy, materials, chemicals and/or capture CO2

Scope: (i) Processes and devices based on living microorganisms and/or bio-inspired technologies to harvest and convert energy and/or CO2 into fuels, materials and chemicals; (ii) energy-to-chemical conversion via biohybrid systems to produce bio-materials from CO2 and energy (i.e. integrating micro-organisms and inorganic catalysts to convert electricity, light and CO2 into complex chemicals, proteins etc);

Key objectives and expected impact: PoC technologies and materials integrating biotic/abiotic systems to generate renewable energy and/or capture and use CO2 (linking material science, chemical engineering, biophysics, microbiology, bioelectrochemistry etc); biohybrid technologies and synthetic biology for chemicals and materials production

Rationale: Green deal, RepowerEU, energy diversification, circular economy

Underpinning evidence: research on biobased and bio-inspired solutions for energy, materials, CO2

Synergies: Mission Climate Adaptation, Mission Ocean, BCE JU

Scientific domains: photonics, biochemistry, bioelectrochemistry, biotechnology and synthetic biology, biophysics

Pathfinder (III): Living architecture

- Topic: **nature based solutions for built environment**
- Scope: (i) living materials and technologies for buildings and built environment, to enable CO2 removal, air emissions capture, wastewater/biowastes treatment, energy efficiency (thermal insulation), indoor lighting (bioluminescence etc), energy harvesting and conversion; (ii) production of food/energy in buildings: integrating vertical farming and circular food chains, urban agriculture
- Rationale: Green deal, RepowerEU, energy diversification, circular economy,
- Underpinning evidence: increase of population in urban areas, functionalization and circularity in buildings
- Synergies: Mission Cities, Mission Climate Adaptation, portfolio on living architecture
- Scientific domains: material science, biochemistry, biotechnology, biophysics, architecture, thermal engineering, chemical engineering

Discussion

- Feedback on the proposed approach and challenges
- Key research needs to mobilize innovation
- Niche areas that would deserve special attention
- Strategies to build the research program (portfolio approach)