

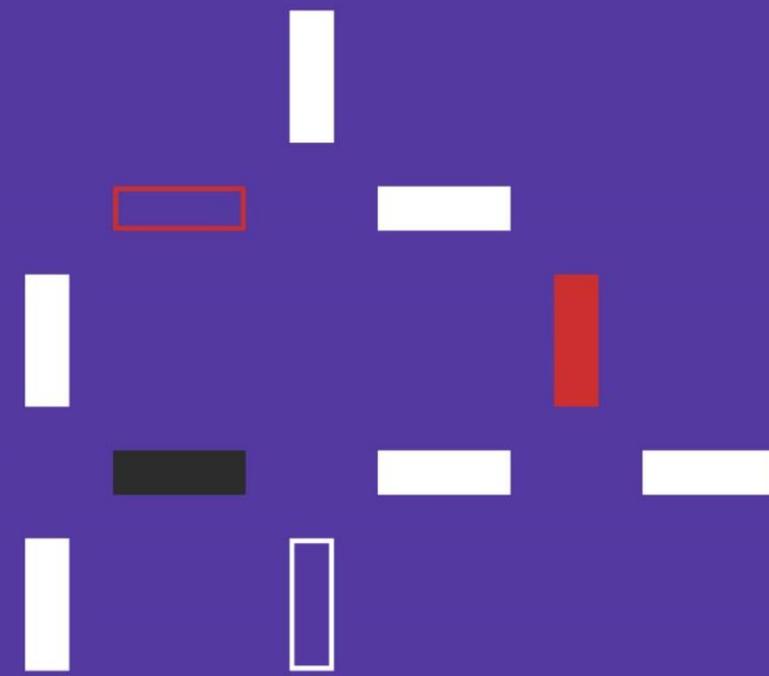


Carbon dioxide and nitrogen management and valorization

EIC Programme Managers

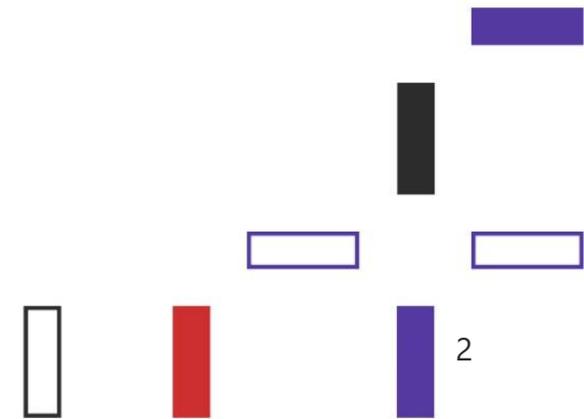
Francesco Matteucci (Materials for Energy and Environment Sustainability)

Antonio Marco Pantaleo (Energy Systems and green technologies)



Outline

- Background to the challenge
- Goal of the portfolio building
- Categories used in the portfolio building
- Portfolio considerations



Guiding principles for selection of challenges



High innovation potential and recognized industrial interest/market needs

Relevance for EU technological autonomy and expected economic/societal implications

Synergies with other Horizon EU programmes

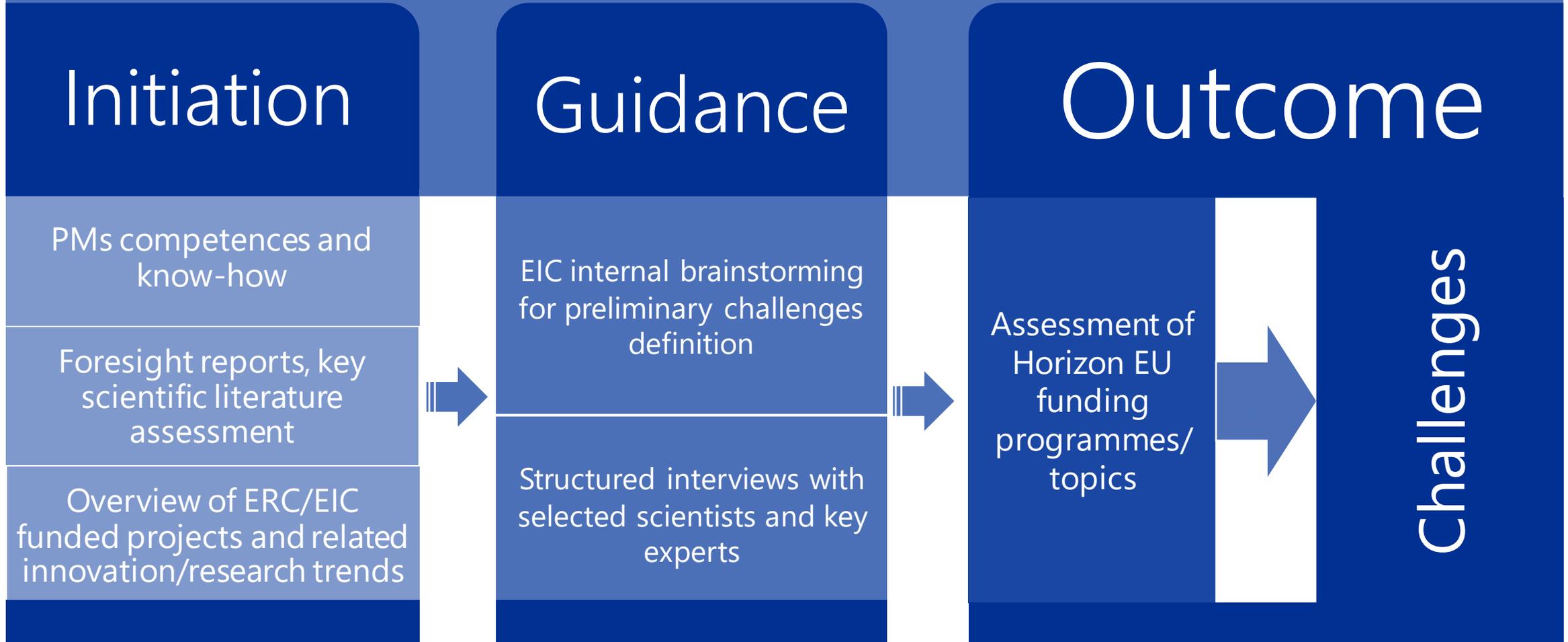
Non incremental research opportunities
(Pathfinder)

EU positioning in the global innovation ecosystem and critical mass of EU stakeholders/researchers

Process of Selection (Methodology)



Programme Manager's Role(s)



Approach for selection of challenges



January-May 2021

- Informal meetings with experts coming from science/business/financial field
- EIC and EC internal Discussion

September/October 2021

- Interservice consultation, opinion of PC, adoption of WP with challenge calls
- Discussion in PC on selection of EIC Challenges for 2022 WP
- External expert advice (workshops etc.)

Jan - April 2022

- Discussion with experts and study of the recent updates in the fields

April/May 2022

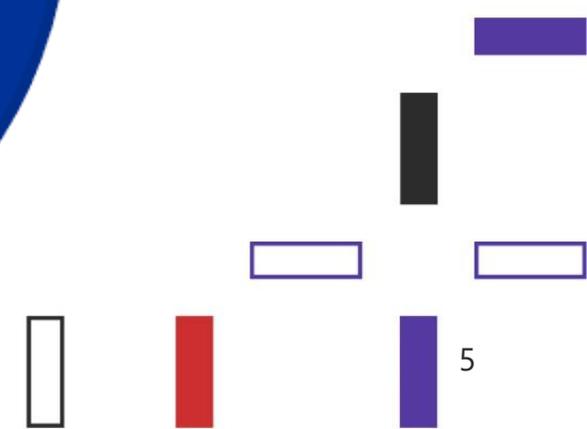
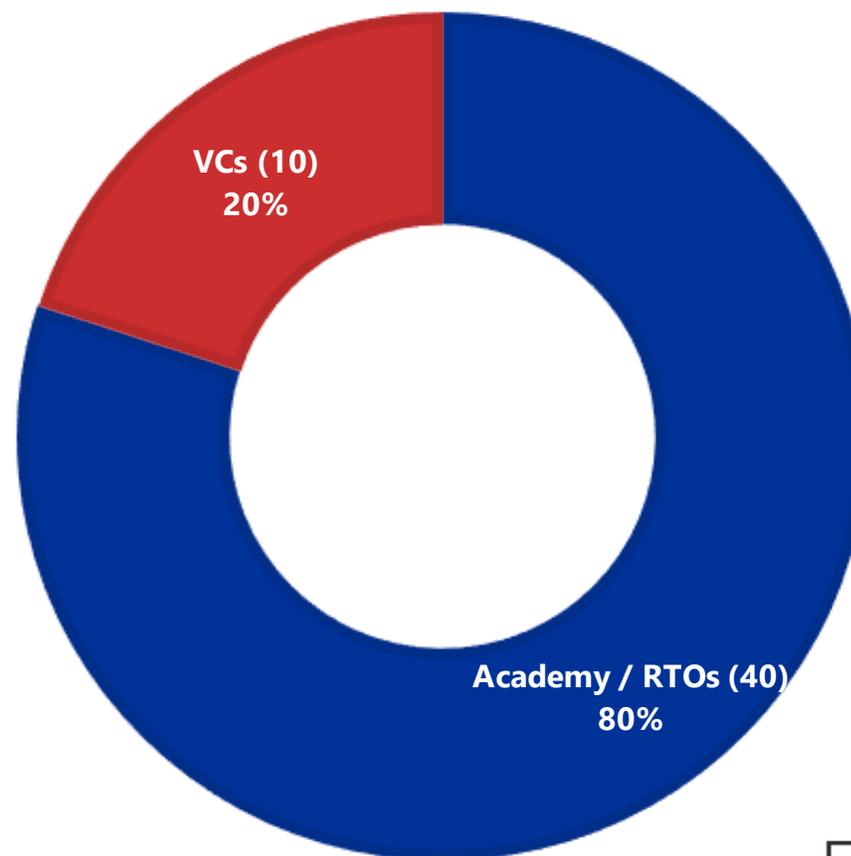
- Challenge guide writing

June 2022

- Challenge guide publication

EXTERNAL EXPERTISE

■ Academy / RTOs (40) ■ VCs (10)



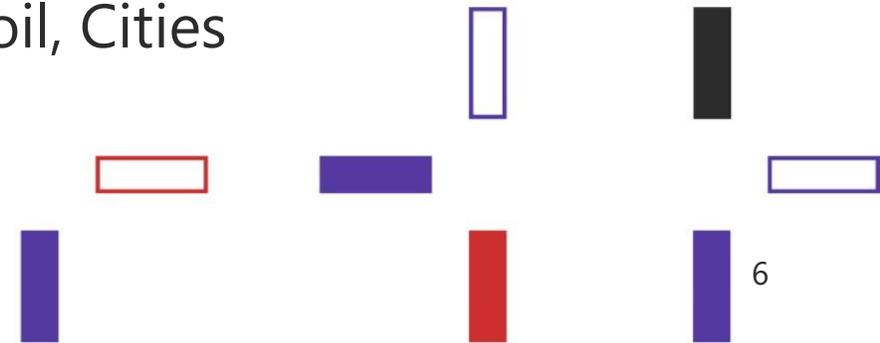


Planet challenges

- Climate change and global warming,
- Eutrophication and modification of the whole structure and function of ecosystems (reach clean air, the hydrosphere and surface water "good status" maintaining biodiversity and setting up environmentally friendly food supply chain).

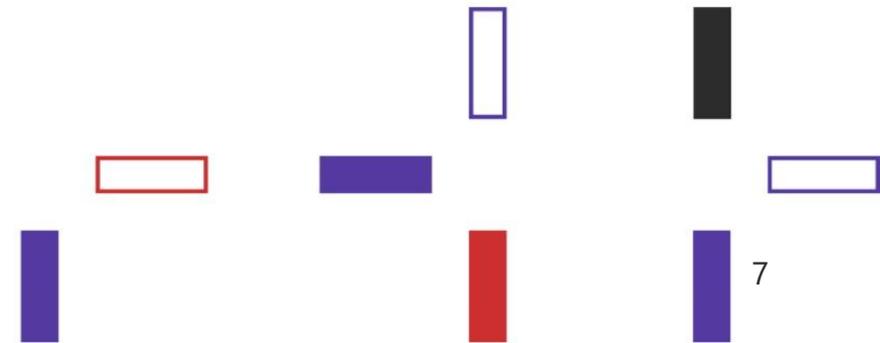
Policy

- EU Green Deal & Fit for 55 package
- Horizon Europe Missions: Climate adaptation, Ocean, Soil, Cities
- IPCC report (March 2022)





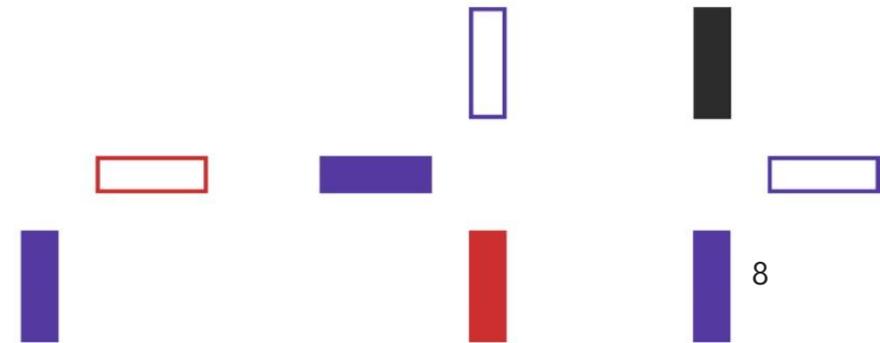
Carbon dioxide and nitrogen cycles belong to the approach of
'make, use and dispose'





Solution:

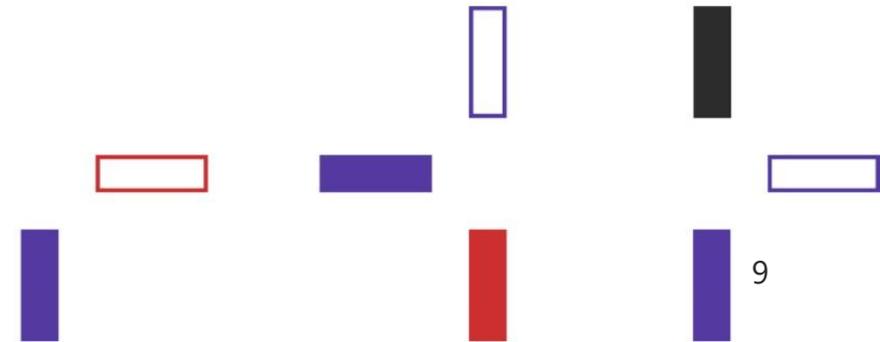
- GHG emissions reduction,
- N losses avoidance, so decreasing impact soil and water deterioration,
- C losses due to energy, industrial, agricultural and livestock practices reduction,





Solution:

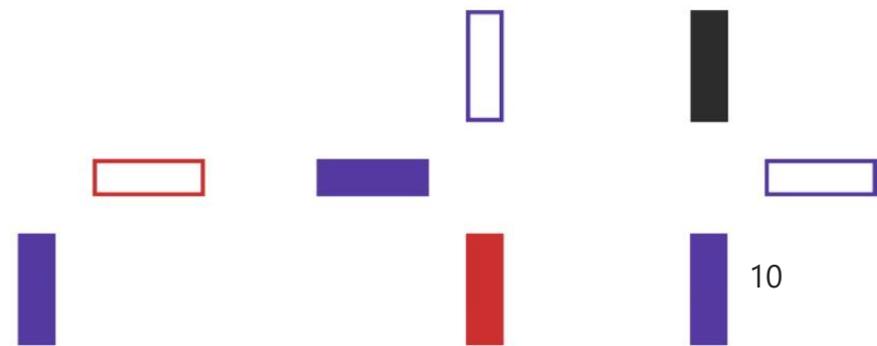
Implementing
Carbon dioxide and Nitrogen sustainable cycle
that means minimizing their environmental impact





- What

new biological, chemical, physical routes that integrate in carbon negative or net zero systems the capture and/or recovery of CO₂ and N species, storage and their conversion into value-added products, and/or net zero commodities (materials, chemicals, renewable fuels and energy vectors)



Carbon dioxide capture and utilization (CCU)

Aims:

- a carbon-neutral cycle involving **conversion** of CO₂ **from various sources and streams** such as atmosphere, biomass or industrial/energy emissions into chemicals, materials or renewable fuels using renewable energy as input. Such a management cycle involves CO₂ **capture/conversion** (directly from air or from flue gases streams, and through photosynthetic, biological, biophysical, or chemical processes), **storage** (e.g. through chemical, electrochemical, biogenic processes), and further **valorisation** (e.g. feedstock for chemical industry, high energy density fuels, energy carriers or other carbon neutral compounds for industrial or agricultural applications).

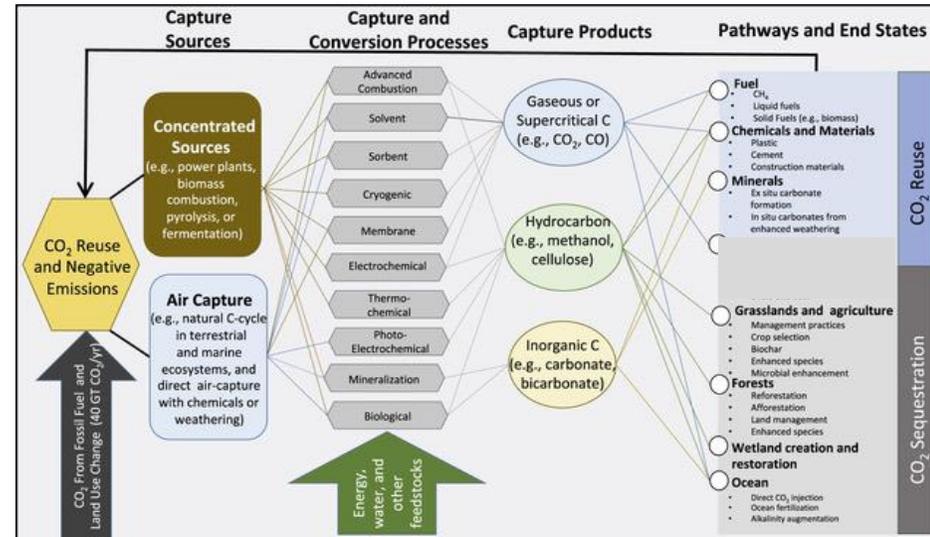
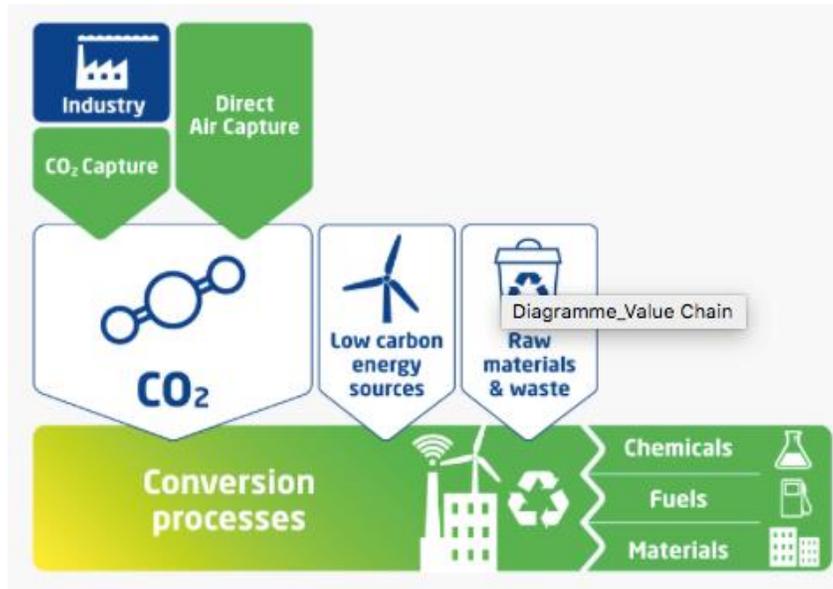


Image source:
Internet site, CO2 value Europe

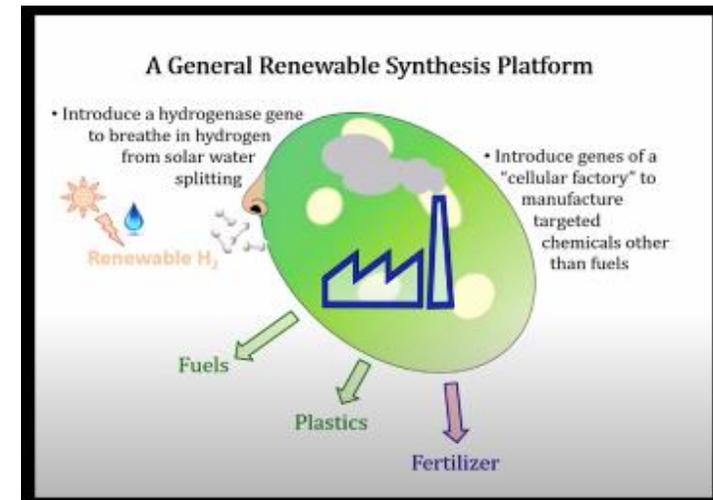
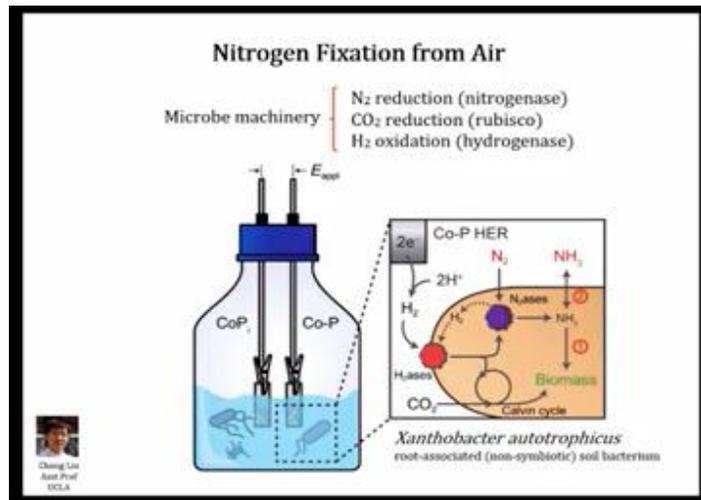
Image source:
A. Majumdar, et al., Research opportunities for
Co2 utilization..., Joule 2, 801-09, 2018

N integrated management cycle (N circular economy)



Aims:

- a nitrogen circular economy or an N integrated management **avoiding or minimizing its release** (e.g. from combustion, livestock, and wastewater) in conjunction with the **conversion** of N-compounds **to inert N₂** or N-compounds **recovery** (e.g. using chemical, electrochemical, physical or biological systems) and **recycle or reuse** as feedstock for added-value products or for biological fixation (e.g. into agriculture, as ammonia, as renewable fuels and energy vectors, as liquid hydrogen carriers).

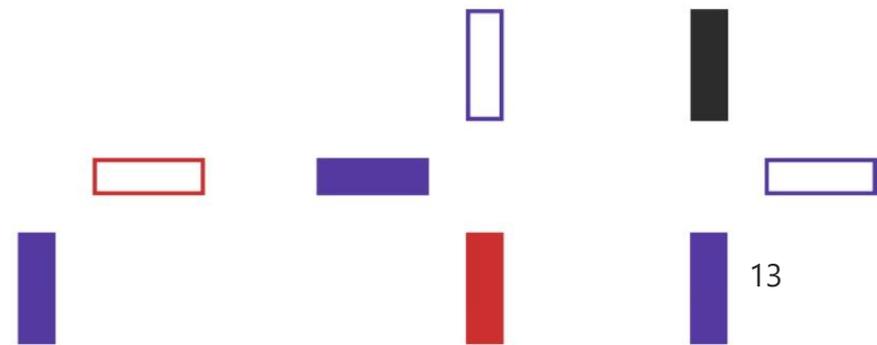


Images source:

Prof. D. Nocera, Harvard University, 2017, Molecular Frontiers Symposium, Chalmers Univ. of Technology

The proposals, through non-critical raw materials (CRM)-based, systems integrated, life cycle and circular thinking driven approaches, should develop a proof of concept (PoC) or lab-scale validated innovative technology that, using renewable energy as input and not being harmful to the natural ecosystems, will manage and valorise CO₂, N, or contemporary both into value-added commodities, materials, chemicals, renewable fuels, and energy vectors.

The safe and sustainable use of non-critical raw materials is mandatory, and the projects should include a full life cycle analysis of the proposed solutions and their impact on Europe's decarbonisation goals.

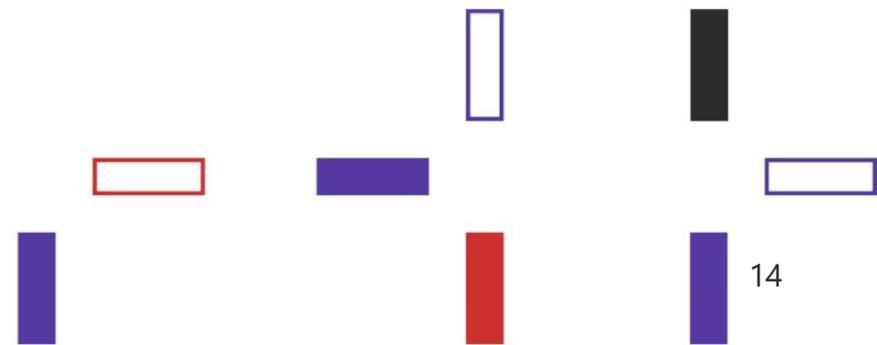


Specific conditions

Proposals that focus only on capture and/or storage and do not include the final use are out of the scope of the call.

Proposals that aim at spatially decoupling the capture of CO₂/N and their final valorization should specifically address the storage/transport issues and the potential integration with existing or new infrastructures by demonstrating the minimization of the whole process impact.

CO₂ use in the fossil fuel-based economy, such as for enhancing oil recovery (EOR), is out of scope of the call.



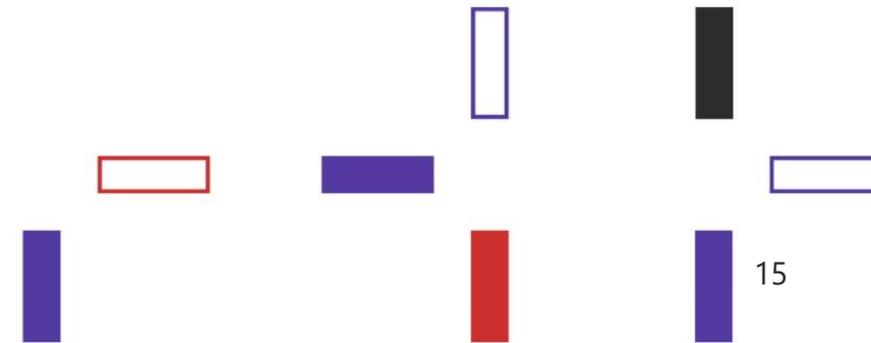
Specific conditions

Proposals should highlight the potential collaborations with key stakeholders during the project implementation and should mention their deployment strategy and the steps required to scale up the process.

Proposals should be flexible in modifying project targets and key directions, if needed, also recurring to the DBTL (design-build-test-learn) cycle.

Proposals are strongly encouraged to apply the life cycle thinking including the recovery and recycling of by-products.

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Coherent portfolio:

group of projects that can interact, reinforce or compete with each other to increase the overall impact.

The EIC Carbon dioxide and nitrogen management and valorization portfolio activities will encourage synergies with other funded projects, national and European innovation ecosystems and actions funded by the European Commission in the same field.





The portfolio building process will be based on a balance of complementarities and diversities among the proposals.

The evaluation committee will firstly identify a sufficiently broad range of diverse and competing approaches and technologies classified in categories.

Secondly, it will look for shared components among proposals within such categories.



Portfolio building categories



- Molecule removal
- Type of stream from which CO₂ and N are recovered
- Scale levels of the applications
- Removal/valorization of CO₂ and N processes
- Final use
- Secondary added benefits
- System integration
- Methodologies for materials and components selection/optimization





The Evaluation Committee will aim at composing a portfolio of projects taking into account the following considerations:

- compose a portfolio of proposals for removal of CO₂, N, or both molecules with a diversity of recovery and valorization technologies, sources of recovery, and scale/size levels.
- The portfolio will be built from proposals diversifying the final use, secondary added values and approaches for materials/components selection/optimization.
- While building the portfolio we will aim at including complementary proposals, covering all the aspects of systems integration.

Challenge Portfolio roadmap



The roadmap will integrate the activities and milestones of the individual projects into a shared set of objectives and cross-project activities.

The roadmap serves as a common basis for implementing the projects - including possible adjustments, reorientations or additional support to projects - and can be updated in light of emerging results or difficulties during the implementation.

In particular, the Challenge roadmap will include activities on the transition to innovation and commercialization, and to stimulate business opportunities. These activities may be supported and reinforced during the implementation with additional funding and expertise through pro-active management.





Thanks for the kind attention

