"Enhancing research in Europe to build a low-carbon industry » - 18.09.2025 - Outcomes of the panel discussions

Event of the France 2030 research program SPLEEN for Industry Decarbonisation

18th of September 2024 ; Brussels (Maison Irène et Frédéric Joliot Curie)

Context

The French government has launched low TRL long-term research programs within the framework of France 2030, a comprehensive investment plan that integrates research, innovation, skills development, demonstration, and large-scale deployment. One of the major areas of focus is the industry decarbonisation.

The purpose of the meeting « **Enhancing research in Europe to build a low-carbon industry** » was to present the research program "SPLEEN", to align it with the challenges identified by the European Union and its associated policies and to contribute to the public debate around the EU decarbonisation goals.

The management of the whole value chain of innovation in the field of decarbonisation technologies is at stake to keep European companies competitive at the international level. In recent months, a new European framework has been established (including the Green Deal Industrial Plan and the Net Zero Industry Act) to pave the way for a sustainable, decarbonised, and competitive industry in Europe. **How can research communities support the declared ambition of achieving a climate-neutral EU industry by 2050?**

"*Decarbonisation is an existential challenge*": this reminder of Mario Draghi, in his report on the European competitiveness[1], was the watchword of the day. Decarbonisation must happen for the sake of our planet. But decarbonisation can also be seen as a lever to strengthen our ecosystems in Europe: acceleration of decarbonisation in a cost-effective way, leveraging all available solutions through a technology-neutral approach, including renewables, nuclear, hydrogen, bioenergy and carbon capture, CO_2 utilization and storage, driven by coherent and coordinated policies.

The event, organized in Brussels, 18th Sept. 2024, in the form of two roundtable discussions, featured academic participants from universities and Research and Technology Organizations (RTOs), industry representatives, members of the A-SPIRE association, and representatives from the European Commission. Two key topics were addressed: the industrial carbon value chain and the development of circular, fossil-free, and energy-efficient industrial systems.

Vangelis Tzimas (Joint Research Center, JRC, European Commission) gave a general overview on the industrial decarbonisation challenge. He also presented the European framework and the associated tools to implement policies to decarbonize industries in Europe (Strategic Energy Technology Plan – SET Plan, Cross-border Adjustment Mechanism – CBAM, Industrial Carbon Management – ICM, Net Zero Industry Act – NZIA, Clean Industrial Plan).

Fabrice Lemoine & António Pires da Cruz, co-heads of the SPLEEN Program, introduced the content and objectives of the France 2030 Plan and more specifically the research program SPLEEN for Industry Decarbonisation, aiming at preparing breakthrough decarbonisation technologies for tomorrow to achieve carbon neutrality by 2050. The program is divided into four complementary research areas: new prediction and monitoring tools, integration of low carbon energies and energy efficiency, process decarbonisation and intensification, storage and utilization of CO_2.

[1] https://commission.europa.eu/topics/eu-competitiveness/draghi-report_en

1) How to better manage the value chain of industrial carbon

Panelists: *Joao Serrano Gomes (European Commission, DG CLIMA), Wim Van der Stricht (ArcelorMittal), Vânia Santos-Moreau (IFPEN/3D Project), Thibault Cantat (CEA)*

Moderation*: Antonio Pires da Cruz (IFPEN, SPLEEN Program)*

"Is Industrial Carbon Management (ICM) a simple rebranding of Carbon Capture Utilization and Storage (CCUS)?" This catchy question laid the groundwork for a panel discussion on the value chain of industrial carbon.

The roundtable started with presentations from the panelists, highlighting the needs of the deployment at scale of technological solutions to capture, transport, use and store CO_2, and the key role of captured CO_2 as a valuable commodity that should be used. Numerous still ongoing CCS challenges were presented, such as energy penalty reduction, solvent degradation management, solvent and Volatile Organic Compounds (VOC) emissions limitation, CO_2 quality, toxicity and solvent end-of-life management, gas impurities, foaming influence, corrosion impacts or process operability. The need to have homogenized specifications for geological sequestration purposes (impurities, such as CO, H_2 or N_2) and the fact that in process engineering the purity of a product is a cost, were also emphasized. These points steered the discussion towards a carbon circular economy, which should involve a collection of technologies able to convert CO_2 into useful and value-added products, the use of low-carbon emitting fuels and the consideration of a positive environmental and societal impact. That's why research needs to accelerate the emergence of a new industry and to develop innovative technological bricks over the value chain, including carbon capture and CO_2 conversion, to optimize the ensemble. Different sources of CO_2 are available for CCU: fossil (in Europe, accounted for under EU ETS[2]), biogenic (comes from sustainable biomass), atmospheric (CO_2 captured directly from the air), geological (CO_2 stemming from a geological sources and CO_2 previously released naturally) and CCU carbon (CO_2 that has already been recycled once). The CCU technologies are useful to reduce GHG emissions and are expected to contribute to about 8% of the road to net zero emissions in the EU (20% of emissions from the industry could be reduced by utilizing captured CO_2). If the EU is already setting a framework for CCU in recent initiatives and legislation, some improvements could still be achieved, such as the development of incentives using captured CO_2 as feedstock and the research and innovation to make CCU for plastics or chemicals from recycled CO_2 to incent industrials to move away from fossil resources. In addition, it was highlighted that the footprint of the product isn't the same depending on the location of the production process. The development of life cycle analysis tools is therefore necessary to better understand and assess the environmental footprint of products. Initiatives to develop innovative life cycle analysis tools, similar to project LCA-SPLEEN, should therefore be amplified.

Having clear targets to develop infrastructures regarding transport and storage of CO_2, as well as less restrictive specifications on CO_2 purity (high purity requested today is costly and not always

[2] Emissions Trading Systems

justified) could help reducing the uncertainty on the researchers' side and some cautious approaches on the industrials' side.

The development of a circular carbon strategy that incentivizes CCU could pave the way of a more sustainable carbon economy in Europe in the years to come. Enhancing impact of public investment, strengthening innovation, promoting markets take-up and lead markets and incentivizing private investments in R&I are essential to reach such goal.

The present conclusions support Mario Draghi's report recommendations, which highlights two primary objectives that must be pursued in parallel to address the energy competitiveness challenge:

- Lowering energy costs for final users, particularly industries, by transferring or anticipating the cost benefits of decarbonisation.
- Accelerating decarbonisation by leveraging all technologies compatible with climate neutrality (including renewables, nuclear, and CCS technologies) to develop a cost-efficient system that ensures supply stability, flexibility, storage solutions, and adequate infrastructure investments.

2) How research and innovation can contribute to the development of circular, fossil free and energy efficient industrial systems?

Panelists: *Karsten Krause (DG ENER, European Commission), Angels Orduna (A. SPIRE/Processes4Planet), Wouter Nijs (VITO), Thomas Mairey (DECLYC/DOMO), Marianne Boix (Toulouse INP/SPLEEN), Marc Clausse (INSA Lyon/SPLEEN)*

Moderation: *Fabrice Lemoine (CNRS & Université de Lorraine, SPLEEN Program)*

The question of how to reduce the dependency on fossil-based energies and to decarbonise some industrial processes which naturally emit CO_2 was set as a key challenge. This transformation involves decentralizing production, based on renewable energy sources, ensuring grid balance, enabling bidirectional energy and lateral data flows, providing grid services, fostering active market participation, and developing new business models.

Energy is at the heart of this transformation. To help industries exposed to international competition access affordable energy, it is necessary to encourage self-generation by energy-intensive users, promote circular and integrated industrial systems, and gradually decarbonize by transitioning to low-carbon hydrogen and other sustainable fuels where cost-efficient. Process innovation is also essential, contributing to industrial decarbonisation through electrification, the use of low-CO_2 energy sources and processes, implementation of CCU solutions and enhancing resource efficiency and flexibility.

In this context, industrial urban symbiosis is a concept that requires deepening. It calls for more integrated collaboration between industries and urban areas to optimize resource use, reduce waste, and foster sustainable development. Such interconnected systems, where by-products of

one industry serve as inputs for another, can minimize environmental impacts while improving economic efficiency. In urban settings, this can involve the integration of energy, water, and material flows between businesses, local governments, and communities. By nurturing these symbiotic relationships, cities can significantly reduce their ecological footprint while improving the resilience and sustainability of both industrial processes and urban life. This aligns with circular economy principles, where resources are continuously reused, reducing the need for new materials and minimizing waste. The implementation of hubs of circularity combining manufacturing circular products process, recycling process and sorting process could pave the way for new sustainable value chains and redefined key players interactions (such as Aragon's Regional Hub for circularity in the European project Redol). Calls for projects to support industrial regions in their transition can also help defining decarbonisation strategies to reduce CO_2 emissions and environmental footprint of industrial areas and surrounding areas (such as the DECLYC Project). The development of systemic approaches dedicated to evaluation, diagnosis and optimization of resource flows in industrial areas could also be helpful to meet this objective (research project ACT-4-IE of the SPLEEN program).

However, scaling up technologies remains a significant challenge. While some solutions work effectively in pilot projects, their deployment at large scale requires substantial capacity building and infrastructure expansion. To make the transition a reality, it is essential to focus on scaling up successful innovations while collectively reflecting on the necessary actions. This includes fostering stronger connections between research and industry, ensuring the optimal use of resources such as raw materials, energy, and labor, and addressing challenges related to standardization and market adaptation. Some specific barriers also have to be addressed to develop new technologies at a large scale, such as lack of uniform standards, interoperability issues, regulatory uncertainty or barriers to investment in R&D.

Moreover, the transition to a sustainable society hinges not only on technological advancements but also on key social and organizational aspects. To succeed, it is crucial to engage citizens by clearly communicating the challenges and consequences of the transition. Social scientists play a central role in creating compelling narratives that raise awareness and build broad engagement among stakeholders. The research project SESAME of the SPLEEN program contributes for instance to developing a framework for public debate with stakeholders to foster the emergence of carbon capture and storage projects in France It is also vital to create favorable framework conditions to attract investment. The current system must evolve into a more cohesive structure that fosters innovation.

Public policies play a critical role in supporting this transition. They must not only guide investments but also provide a clear direction for integrating the private sector and civil society. The European Union, by committing to large-scale investments and establishing both a robust regulatory and incentive framework, can stimulate an ambitious industrial decarbonisation initiative. With coordinated efforts and significant investments, it is possible to achieve substantial progress. For instance, large-scale projects could lead to the development of more integrated infrastructures and the creation of sustainable industrial systems. Such investments will help reduce the costs of decarbonisation and encourage wider adoption of green technologies.

Conclusion

Christophe Yvetot's (*United Nations Industrial Development Organization*, UNIDO) conclusion broadened the perspectives to a global scale and called for an aligning European and global efforts to reconcile industrial development and decarbonisation. Mr. Yvetot made the connection between the round tables and the Deep Industrialization Initiative of UNIDO, aiming at accelerating industrial transformation in developing countries by promoting sustainable, inclusive, and green industrialization. This initiative focuses on enhancing the capacity of industries to adopt advanced technologies, improve energy efficiency, reduce emissions and integrate into global value chains. It emphasizes creating policies, frameworks, and infrastructure that foster innovation, digitalization, and the circular economy, while ensuring the equitable distribution of benefits. The initiative seeks to drive economic growth, reduce poverty, and improve social inclusion by empowering industries to contribute to sustainable development goals (SDGs). The inspiring presentations and exchanges of the day were a good milestone to make concrete the definition of the French word "spleen", according to Mr. Yvetot: "*desire to live in idealism*". The SPLEEN program is a dynamic entity, much like a plant that thrives on its environment. It feeds on new projects that also draw their origins from the exchanges and ideas presented during events like this one. Considering this, the gathering of the 18th of September 2024 could represent the first step in fostering exchanges and presentations with the European Commission and European stakeholders on R&D issues related to the research and development challenges addressed in our SPLEEN program.