THE RTO INNOVATION SUMMIT

THE 2ND RTO INNOVATION SUMMIT

Industrial technologies for the future

Enabling the deployment of low carbon hydrogen

White paper

Global warming is a vital threat, which requires a rapid energy transition towards a carbon-neutral economy. Hydrogen will be a key element in this transition, enabling the decarbonisation of sectors that are difficult to electrify (industry, heavy mobility…) while bringing flexibility to power grids. The European Commission recognizes the importance of hydrogen through its European Hydrogen Strategy (COM(2020) 301 final). Research and Technology Organizations (RTOs) strongly support this ambitious strategy, which will require the development and deployment of new technologies for low-carbon hydrogen production, storage, infrastructure and use.

The European Union needs to seize the opportunity to be a leader on the yet-to-emerge low carbon hydrogen market. To develop the required hydrogen technologies and to assess their potential, RTOs have an essential role to play, in support of both the public authorities and the European industry.

Based on their experience and expertise, RTOs would like to emphasize the following points.

- The transformation and decarbonization of the energy system calls for a systemic approach and science-based assessment of different technologies paths, policy measures and market mechanisms. RTOs can deliver solutions based on their technology neutrality, their cutting-edge methods and tools and their long-term future oriented strategic thinking. RTOs have the expertise to support European authorities in assessing the potential of hydrogen as well as its limits. Their action is needed to design deployment strategies that maximise hydrogen contribution to the decarbonisation of the European economy in a holistic and non-biased way with the mission to achieve carbon neutrality by 2050.

- The large-scale implementation of hydrogen-based technologies and systems will require profound accompanying research to speed up the innovation process and learning cycles to address barriers. Hence, research and innovation programs with a long-term orientation will help to enable this transformation that will surely not happen from one day to the other.

The technological development path needs to leverage on a kind of "smart optionality" by creating options through smart experimentation on pilot initiatives, maximising the learning of every pilot initiative put in practise, and applying that learning in an extensive way to every new initiative. Pilot projects and demonstrators need to be gathered in hydrogen hubs so that complex interactions among different ingredients can be approached, such as low carbon and variable renewable power generation, competing grid flexibility options, gas infrastructure/blending, charging infrastructure, and heat electrification.

From a territorial perspective, a technological change linked to hydrogen has the potential to be distributed. There is no single model for the energy transition, so it must be adapted to the reality of each economy, without losing the joint European vision. Regions become protagonists when designing and implementing transformations in their local environments. Each territory can obtain its part in the creation of economic activity aligning the industrial policy and local economic drive with the energy transition strategy. Hydrogen pilot projects have the potential to boost the energy transition at a local scale, as shown by the rising number of "hydrogen valleys", either projected or under development.

European RTOs, with their multidisciplinary approach to technologies, are key to support our industries with the development and scaling up of technologies. They are therefore essential for the European Union to achieve the European Green Deal's ambitious goals.

- The research facilities and infrastructure of RTOs are a highly necessary asset for reducing investments risks that are usually associated with large-scale innovative implementation projects (see EU Innovation fund). Particularly in the field of hydrogen, it is important to upscale solutions from lab-scale to large-scale pilots and demonstration level (e.g. electrolysers, storage, pipelines, vessels, hybrid modules). This includes the combination of both the physical hardware and the virtual representation of the technologies, modules and systems to be tested ("digital twin") under real operating conditions by means of advanced approaches, such as hardware-in-the-loop concepts. Furthermore, the impact of such hydrogen technology integration into the surrounding energy infrastructure needs to be assessed clearly in order to capture the benefits for grid management and balancing of energy demand and supply. New experimentation

infrastructures (such as regulatory sandboxes, trial-error pilots, simulation frameworks…) are also needed to develop and test, in real controlled environments, new technologies whose adoption is strongly conditioned by the regulatory context and by the behaviours of social agents. Here, RTOs are a crucial player in the innovation chain to bridge this gap and provide scientific testing facilities, both physical and numerical, in order to pre-assess technologies, modules and system before or during the implementation in the industrial field and therefore reducing investment risk significantly.

It may require complex partnerships of research organizations and industry to enable technological options to reach the high TRL levels needed for scaling up and diffusion in the market and society. For both the development of new technologies as well as of scaling-up technologies, RTOs play an essential role in supporting the kind of collaboration needed. For example, RTOs orchestrate complex consortia in multi-stakeholder projects requiring a high degree of public-private partnership agreements. In addition, RTOs have proven to be very effective developers of pilot initiatives and demonstrators that enable technological solutions to reach the high TRL levels needed to enter the diffusion phase in the market and society.

- RTOs have expertise on hydrogen that will be essential to enable the emergence of a European low carbon hydrogen industry. For the European hydrogen ecosystem to benefit from this expertise, the governance of the newly established Clean Hydrogen Alliance has to include RTOs. The foreseen activities of the alliance should not only be set-up from an industry perspective but also innovation-driven with RTOs as a driving force and co-lead with industry.

The recently launched European Clean Hydrogen Alliance is a highly welcomed platform for bringing together key stakeholders in the field of hydrogen, aiming at building global leadership in this domain. RTOs can contribute significantly to the success of the platform by carrying out cutting-edge research and innovation activities on multiple hydrogen technologies and systems and by pooling national resources and priorities towards a joint European vision. Through their roles in the national and European innovation ecosystem, RTOs are at the frontier of knowledge development for a better understanding of how to accelerate hydrogen technology integration based on the individual national and European needs and regulatory frameworks.