ENERGETICS

ENEA - Techno-economic and environmental sustainability analysis of hydrogen transport and storage technologies for the production of e-fuels

Funded By	ENEA - Agenzia Nazionale per le Nuove Tecnologie, l'Energia e lo Sviluppo Economico Sostenibile [P.iva/CF:00985801000]

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Context of the research activity	The development of a fully decarbonized renewable-based energy system characterized by intermittent production entails the diffusion of reliable energy storage systems. Among the many possible solutions, hydrogen production is one of the more promising. Clean “green” hydrogen can be produced from water electrolysis using surplus electricity, stored, and reconverted again into power when needed. Alternatively, it can be transported and used directly in an industrial process to supply the energy required. Another possible route is represented by the production of carbon-neutral synthetic fuels (e-fuels), such as methanol or gasoline, that are obtained through reaction with waste CO2. In this way, many problems related to hydrogen transportation and storage can be avoided. Furthermore, the obtained synthetic hydrocarbons could represent a solution for the decarbonization of hard-to-abate sectors such as the transportation and aviation sectors. ENEA su commessa H206, Accordo di programma MiTE – ENEA per la regolamentazione dei rapporti in relazione allo svolgimento di attività di ricerca nell’ambito del Piano Nazionale di Ripresa e Resilienza (PNRR) – Missione 2 – Componente 2 – Investimento 3.5, finanziato dall’unione europea – Next Generation Eu, Piano Operativo di Ricerca “Ricerca e sviluppo di tecnologie per la filiera dell’idrogeno”, con specifico riferimento alla tematica: “Analisi tecno-economica e di sostenibilità ambientale di tecnologie di trasporto e accumulo dell’idrogeno per la produzione di e-fuels”, riguardante una filiera integrata dell’idrogeno conapprofondimento sulle tecnologie per l’accumulo e il trasporto di idrogeno in ottica della produzione di e-fuels attraverso impianti power-to-gas integrati con la rete elettrica nazionale.

	This research project will focus on processes for hydrogen production (such as low-temperature and high-temperature electrolysis), storage and transportation/distribution in view of the production of e-fuels. The selected technologies will be evaluated considering their integration in the principal e-

Objectives	fuel production processes (synthetic natural gas, methanol and Fischer-Tropsch synthesis routes) with the aim of identifying the optimal plant configurations in terms of energy, economic and environmental performances. In detail, pathways for the production of e-fuels and their use in hard-to-abate sectors will be evaluated. Different CO2 concentrated (point) sources will be assessed. The case of industrial plants (heavy industries or solid waste incineration plants) capturing CO2 and recycling it in a closed loop to produce an e-fuel that will be used within the industry itself will be be evaluated. Open-loop loop CO2 use cases will be also considered, in which the captured CO2 from a point source is converted to an e-fuel, which is then exploited in a final use resulting into distributed emissions (e.g., transportation sector). Biogenic sources of CO2 will be also included for the production of e-fuels. Especially, the case of biogas upgrading plants will be considered in which concentrated and purified CO2 is available as off-gas of the biome thane plant. The CO2 could be further converted to bio-synthetic methane through electrolytic hydrogen thus maximizing the overall biomethane yield while avoiding CO2 emission to the atmosphere. Each investigated process pathway will be analysed in terms of material and energy balances. Economic and environmental analyses will be then developed.

Skills and competencies for the development of the activity	The ideal candidate for this position has a scientific background in physics, engineering, mathematics, statistics, and software development. The development of the research activity requires a candidate with: • Solid background in statistical methods and simulation techniques • Solid background in mathematical and physical modelling • Background on energy systems • Background in computational methods • Ability to analyze the scientific literature state of the art • Scientific writing and reporting • Proactive, independent, and parallel thinking • Ability to work in a multi-disciplinary team