



PhD in CHIMICA INDUSTRIALE E INGEGNERIA CHIMICA / INDUSTRIAL CHEMISTRY AND CHEMICAL ENGINEERING - 38th cycle

**PNRR_351_PUBBL_AMMIN Research Field: LEGISLATION AND POLICY GUIDELINES FOR
PRODUCTION, TRANSPORT AND USE OF HYDROGEN AND ITS BLENDS**

Monthly net income of PhDscholarship (max 36 months)

€ 1325.0

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity

**Motivation and objectives of the research
in this field**

The use of hydrogen as an energy vector has recently emerged as viable pathway towards the transition towards an industrial system where carbon monoxide emissions can be greatly reduced, if not fully eliminated. The use of hydrogen however comes with many questions, related to the safety and sustainability of its production, as well as its transport and utilization (directly as a fuel, both pure and mixed with other fuels, or indirectly, as a liquid fuel precursor).

This is of particular relevance for the Public Administration, who will have to develop new regulations for a technology sector that is in rapid development. The EU commission is presently updating regulations concerning hydrogen usage (https://ec.europa.eu/info/news/commission-launches-consultation-regulatory-framework-renewable-hydrogen-2022-may-20_en) for what concerns the determination of criteria for products that fall into the "renewable hydrogen" category (https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/7046068-Production-of-renewable-transport-fuels-share-of-renewable-electricity-requirements-_en) and the development of a detailed scheme to calculate the life-cycle emissions of renewable hydrogen (<https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12713-Renewable-energy-method-for->



	<p>assessing-greenhouse-gas-emission-savings-for-certain-fuels_en). The use of hydrogen as an energy vector is also explicitly mentioned in the PNRR in the objectives of Mission 2 (M2C2) ENERGIA RINNOVABILE, IDROGENO, RETE E MOBILITÀ SOSTENIBILE.</p> <p>The M2C2 PNRR objectives that are particularly relevant to this proposal are "Promoting the production, distribution and final uses of hydrogen, in line with national and Community strategies" and "Developing an international industrial leadership and research and development in the main lines of the transition".</p> <p>In this framework, and in relation to DM351 criteria for PA PhD programs, the purpose of this research is:</p> <ol style="list-style-type: none"> 1) to get a deep understanding of the regulations, laws and CEN/ISO standards concerning hydrogen production, transport, and use (both pure and mixed with other fuels, or as a liquid fuel precursor) with reference to the Italian and the EU legislation; 2) to develop methodologies apt to build models and measurement methods that may give the necessary information for the development and application of the EU and Italian regulations, as well as to give policy guidelines for what concerns the problematics that may emerge in the application of the regulations as well as in a possible need for their evolution and interpretation.
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The research program will be developed along three different, parallel and synergic lines, effectively exploiting a multidisciplinary strategy. The first line of research will focus on the reconstruction of the legal and voluntary framework of reference for what concerns hydrogen production, transport, and use, with specific reference to the technical instructions of applicative nature. For example, depending on the production methodology, hydrogen can be produced as a blend with other chemical species, such as C2 hydrocarbons or carbon monoxides.</p> <p>Technical information and a related consistent legislation are necessary to define the level of impurities that are acceptable in a hydrogen blend, both for transportation and for utilization. The present legislation and the existing</p>



	<p>CEN/ISO standards are thus investigated in this first line of research, by studying existing publications and contacting directly the interested administrative (EU, Italian administration at the local - Comune, Regione - and national level) and industrial (e.g., SNAM, A2A, ...) stakeholders. In the second line of research, some key aspects related to hydrogen production, transportation and use that emerge from the analysis of legal framework of reference as of key relevance and that require further investigations will be investigated either at the theoretical level through the development of physical consistent models or by direct experimentation, as it is planned to do through the cooperation with "Innovohub - SSI".</p> <p>For example, hydrogen combustion as a pure gas or in a blend with other gases may be investigated in conditions representative of its use in a boiler with the aim of identifying conditions for its safe use, also in light of the existing legislation concerning the limitation of CO₂ production. In the third line of research, the hydrogen production, transport and utilization cycle will be investigated from a broader perspective in order to compare the performances of the different existing technologies, from an economic and sustainability standpoint, with the intent of giving the necessary information for the development and application of the EU and Italian regulations and policies. This objective will be pursued through the creation of a mathematical model that is able to account for all the major impact of the utilization of hydrogen as a pure gas, or as a mixture, also in relation to existing technologies.</p>
<p>Educational objectives</p>	<ul style="list-style-type: none"> • Learn both the legal and voluntary (CEN/ISO standards) framework related to hydrogen production, transport and use, both at the national and international level • Learn how to develop models of transport, use and generation of hydrogen and its blends • Learn how to perform experiments related to transport, use and generation of hydrogen and its blends
<p>Job opportunities</p>	



	<ul style="list-style-type: none"> • Engineering position in the national and international (EU) public administration • Safety and environmental engineer in chemical and energy companies • R&D in chemical and energy companies • Engineering positions in gas companies.
Composition of the research group	6 Full Professors 4 Associated Professors 3 Assistant Professors 15 PhD Students
Name of the research directors	Prof. Renato Rota

Contacts

CFALab Homepage <https://www.cmic.polimi.it/ricerca/elenco-gruppi-di-ricerca/cfalab/>

Additional support - Financial aid per PhD student per year (gross amount)

Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad

Amount monthly	662.5 €
By number of months	6

National Operational Program for Research and Innovation

Company where the candidate will attend the stage (name and brief description)	Innovohub - Stazione sperimentale per i combustibili, Socio Unico: Camera di commercio di Milano Monza Brianza Lodi. https://www.innovohub-ssi.it/chi-siamo/le-aree/area-combustibili.kl
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	RWTH Aachen University. The Industrial Chemistry and Chemical Engineering PhD course of Politecnico di Milano has a well established collaboration with RWTH Aachen uUniversity, with many mutual exchanges of students and researchers carried out in the last years. In particular there are established relationships with the research group of prof. Heinz Pitsch and prof. Karl Heufer.
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Confidentiality: since this is a thematic scholarship, the management of Confidential Information, Results and their publication is subordinate to the restrictions agreed upon with the funding company. Upon acceptance of the scholarship, the beneficiary must sign a specific commitment.



Individual budget for research (during the 3 years): about 5.400 euro

Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial of for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities within the limits allowed by the regulation.