ARGENTINA
National Institute of Industrial Technology
R&D Clean Energy Technologies

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1. Introduction

Argentina represents less than 1% of greenhouse gases (GHG) emissions within the United Nations Framework Convention on Climate Change (UNFCCC) countries, but in terms of per capita contribution that number rises to 10 tons of carbon dioxide equivalent[1], which positions us between the first 30 countries in the ranking.

In the recent years, in accordance with the provisions of the Third National Communication on Climate Change[2], Argentina has carried out plans, programs and actions towards the mitigation of GHG in various productive and consumer sectors.

The main contribution to GHG emissions is the generation and use of energy, mainly combustion of fossil fuels to obtain electric and thermal power and transportation. In that order, there were actions implemented in two fundamental axis: energy diversification, including the participation of renewable energy in the matrix and the promotion of rational and efficient use of energy.

With that aim, the Law 27.191 was held in 2015, forcing the large users of electric power to consume incremental percentages of energy from renewable sources, aiming a 25% of consumption provided by renewable resources, and turning the electric power in a tradable product between private companies and between them and the government.

Nowadays the maximum contribution of electrical energy from renewable sources has reached approximately 12%. Despite the COVID-19 pandemic situation, renewable parks have been commercially enabled and can supply electricity to the grid. Besides, great efforts are being made in order to replace the fuels for biomass in industrial heating operations.

In addition, other initiatives are under discussion this year:

- The actualization of the Promotion of Hydrogen law, which will enforce the R&D activities related to the generation from clean energy and several uses including chemical and mobility.
- The actualization of the promotion of the Biofuel law, with the aim to increase the oil mix from 12% to 27% in the case of Bioethanol and from 10% to 27% in Biodiesel.

The government is also working in a brand new law for electromobility with the participation of different industrial sectors.

The National Institute of Industrial Technology (INTI) is a public descentralized institution created in 1957 that is part of the National Science and Technological System. Today under the National Ministry of Production Development, its mission is to promote industrial development through innovation and technological transfer. INTI is also the national reference in Metrology, to strengthen the metrological capacities to spread industrial quality

[1] https://www.cell.com/heliyon/fulltext/S2405-8440(17)31849-2, visited 09/17/2020
[2] https://www.argentina.gob.ar/ambiente/sustentabilidad/cambioclimatico/comunicacionnacional/tercera, visited 09/14/2019.

all over national industry. INTI has technology centers across the country specialized in different industrial sectors.

2. R&D activities related to clean energy technology

INTI Technological Development and Innovation Management through its Energy and Mobility Department (soeym@inti.gob.ar) works for strengthen the competitiveness and sustainability of companies, specially SMEs, through development and appropriation of innovative products and processes that contributes to reduce the GHG emissions and also collaborates as technical reference with the government in order to establish regulations.

The main technologies we address are:

- BioEnergy, Solar Collectors for residencial use, Photovoltaic panels, LP Wind Turbines
- Storage & Conversion of Energy
- Smart Grid Integrations
- Mobility
- Energy Efficiency

3. Specific research activities in next generation energy management systems with batteries, renewable energy, hydrogen, CCUS, and related technologies

The main lines of work of the institute are described below.

- **Fuel cells** fed by low-carbon hydrogen produced by water electrolysis are a good alternative for renewable energy storage. Alkaline electrolyzers are currently developed, including liquid and zero gap devices. A project in portfolio is a microbial electrolysis device, which performs an effluent treatment in a microbial anode along with H2 production in a photo cathode.
- **Nanostructured Materials for Energy.** With the increase in energy consumption, new and more efficient materials for energy generation and storage are required. Moreover, the increasing use of portable electronic devices requires the development of more efficient energy storage technologies. Green, environmental friendly energy sources, intermittent in some cases, like sunlight, tides, wind and waves, present the necessity to store the energy produced. INTI has developed and characterized different nanostructured materials.
- **Mesoporous carbon (MC)** with well-defined porous size distribution to assess its effect as electrode support for fuel cell catalysts and supercapacitors is obtained by polycondensation of resorcinol and formaldehyde (RF) on silica nanoparticles as hard template agents, and subsequent carbonization in an inert atmosphere. The obtained mesoporous carbon products with a high specific surface area (> 400 m2g-1) were used as support for Pt and PtRu catalysts nanoparticles. The modification of the surface allowed 30% reduction of the diameter of the metal particles deposited over the support and a 10% increase of power density of membrane electrode assemblies compared with state of art of DMFC PtRu/carbon supported catalyst.

On the other hand, Ni-Mo alloys electrodeposited over Ni substrate were tested as electro catalysts for the hydrogen evolution reaction in alkaline media, and the influence of the electrodeposition conditions in composition, morphology and HER activity was analyzed. TiO2 Deposition on Carbon Substrates with Tailored Mesoporous Structures for Fuel Cells.

- **Anion Exchange Membranes.** Low carbon footprint hydrogen, a near-zero emission energy carrier, plays a key role in many applications such as road transport, micro co-generation and de-carbonization of several industrial processes. Most of these applications involve fuel cells to convert hydrogen to power, though other fuels like natural gases, methanol or ethanol are employed to feed FCs as well. It is worth mentioning that hydrogen technologies footprint depends on its method of production, and in this sense, electrochemical water splitting is a very favored option.
- Despite their potential, one of the main barriers to the widespread adoption of these technologies is the current costs of fuel cells and electrolyzers. Therefore, alkaline systems, which do not require precious metals as electro catalysts or demand corrosion-resistant components, are a good option for low temperature, membrane-based devices. Consequently, anion exchange membrane fuel cells (AEMFCs) and zero-gap liquid alkaline water electrolyzers (LAWEs) have gained interest recently, demonstrated by the significant increase in the number of publications, particularly since 2010. INTI has prepared anion exchange polymer membranes based in polybenzimidazole, including polymer synthesis, blend with PVA, cross-linked with PVBC/quaternized, hybrid membranes with functionalized graphene oxide and electrospun nanofibers. The membranes are characterized and evaluated in alkaline water electrolysis devices liquid and zero gap. Actually new applications are explored for the membranes developed, like salinity gradient power or redox flow batteries. (Patent INPI-ARG: 180.100-013/2018: Preparation method of a polymeric proton exchange membrane).
- **Biomass Gasification Technology.** In Argentina, the bioenergy sector is made up of many agroindustrial companies that generate waste, primary producers who waste crop residues, and a support sub sector made up of SMEs manufacturers of machines and equipment. To achieve the industrialization of these wasted resources, developments are required in both physical and chemical processes as in the existing machinery to achieve profitable industrialization processes (collection, pelletization, storage, conditioning, pre-treatment, etc.). INTI with industry support seeks to identify opportunities for development of new bioproducts, including biofuels as well as innovation opportunities in machines and equipment that allow reaching new and improved degrees of biomass industrialization.
- **Utilization of pellets of agricultural harvesting and forestry activities residues in biomass combustors.** Many of the agricultural crop residues are suitable to transform into solid biofuels with a correct management. This valorization technique for these mostly unused residues can help the different agriculture industries to diversify their conventional activities and to replace the natural gas for thermal energy. During the validation process, the previous data was compared with the newest standard approved in Argentina for solid biofuels (IRAM-ISO 17225) to establish a quality basis for the industrial process.
- **Materials for the offshore generation and storage of renewable energy.** The development of advanced materials and prototypes for sustainable energy production (solar, wind, wave and tidal) including energy storage through batteries and hydrogen technology in offshore platforms. This also includes the salinity gradient energy applications in argentine lagoons of high salt concentration (reverse electrodialysis) and in oil wells.
- **Internet of Energy. Investors Interoperability.** The interoperability system is a photovoltaic inverter data acquisition system that takes the data and integrates them into a dedicated IoT platform. This INTI´s developed system solves the incompatibility of data that comes from multi-brand inverters. If all the photovoltaic systems were from the same manufacturer, the communication protocols and the way in which the data is shared would be homogeneous among all, with which it would be possible to observe them in the same

place; however, this situation does not occur in practice.

- **Grid Network with Renewable Energy**. In Armstrong, a 11.000 inhabitants city, an integrated network of renewable energy with conventional grid system was established (200 kW photovoltaic floor plant, 60 solar roofs in homes and 10 small wind turbines located in the city). With wireless equipment installed in a thousand homes in the city, they can monitor the local electricity service and obtain information remotely to determine the quality of the service, the user load curve and different conditions of the network or consumption characteristics of each residence.
- **Non-conventional vehicle performance.** Argentina is one of the highest biofuels producers and the proportion included in our gasoline is also high (12% of bioethanol and 10% of biodiesel). It is also a very common practice to utilize a 100% biofuel in some farm equipment, public transportation and private vehicles. On the other hand, the argentine electric car is a reality. With this aim, we are exploring the biofuels quality.
- **The Project VERSU** (for their acronym in spanish for Power Valorization for Solid Urban Residues) consists of a cycle-combined equipment with power generation for solid urban residues. It is located in Sarmiento, a city of 22.000 inhabitants in San Juan province. This industrial plant is a demonstrative project unique in Argentina.
- **CCUS Technologies**. As a national institute created to strengthen the national industry, we assist companies to improve their technologies to achieve environmental objectives.
- **Solar Thermal Collectors.** A program of the Ministry of Production Development for the performance improvement of national production companies in which INTI will assist in technical production to increase productivity.

4. International collaboration

4-1 International alliance/networking development

INTI has three main strategies to promote international collaboration:

1. **Industrial Technology Transfer**

   Productive knowledge, innovative technologies and transfer promotion to countries with equal or less industrial development, with the aim of contributing to strengthen their productive and industrial network.

2. **Scientific and Technological Cooperation**

   For the improvement of technological knowledge, participation in joint innovation processes and promotion of industrial competitiveness and productiveness.

3. **SMEs Internationalization**

Assistance for the incorporation of technological innovation that favors the generation of quality employment and the increase and diversification of exports from SMEs.

4-2 International joint R&D activities

- JICA (Japan): Development program for Energy Efficiency technologies and best practices. INTI proposed AIST to participate in a SARTREPS call.
- CENER (Spain): Renewable Energy Technology transfer program, including formation of our professionals and consultancy services for infrastructure build up.
- TNO (The Netherlands): Biomass technology and services development.
- INTI has submitted a project called “Heavy Carbon Industries: A network to look for

approaches to low Carbon Sustainable Processes" for the MSCA-RISE 2020, EU call with the following institutions: Surrey University (UK), Sevilla University (Spain), Politecnico di Milano (Italy), Titan Cement Company (greek company), Mitchell Technical Services (UK company), GVG soltek (Arg company) and Danish Power System (DK Company).

5. Future perspectives (beyond 2030)

In accordance to the Argentina's Third National Communication on Climate Change, our next challenges are aimed at the appropriation, generation and transfer of technology in order to reduce GHG emissions in two different aspects:

- Thermal Energy technologies for industrial activities:
  - **Solar Concentrators** for fluid heating or steam generation aimed at SMEs located in regions appropriated for this technology.
  - **BioGas - BioEnergy:** energy recovery from the organic fraction of urban solid waste
  - **Biofuels** obtained from agricultural and forestry industrial residues. The generation of an industrial and public market is aimed through process standardization.
- Electrical Transportation
  - Production and Reuse of **Lithium Batteries**: Technological assistance to battery manufacturers in component development (separators, electrodes, cells). Spent batteries disposal and recycling, engine testing laboratory for different fuels and electricity.
  - **Green Hydrogen** certification and metrological quantification in a mix of gases.
  - **Engine Testing Laboratory**, for performance evaluation of different biofuels, evaluation of biofuels proportion in gasoline cuts.
  - **Integration Energy Laboratory** for R&D activities related to micro and off grid systems.

About the participant:

Marcelo Marzocchini is an Electronics Engineer graduated from National University of La Plata (Sábato Award 1993) and has a Master degree in Government Economics from Torcuato Di Tella University.

He specializes in industrial and technological policies, international trade and economic integration. He has a long career in both, public and private sector.

At present he is the Operations Director of the National Institute of Industrial Technology (INTI). He was Undersecretary of Industry of the Nation, National Director for Mercosur in the Argentine Foreign Office and Director for Mercosur and Integration in the Ministry of Industry of the Nation. He also was the Provincial Director for International Economic Relations of the Government of the Province of Buenos Aires and Chief of Staff of the Under Secretariat for Technological and Productive Services of the Ministry of Production of the Nation.

In the private sector he was in charge of areas of research and development in important technology companies, such as Omron Nohgata and Multiscan Corp. Besides, he has developed a wide activity as an independent consultant.

In the academic field he has worked as Director of the Master´s degree in Applied Economics at Pontifical Catholic University of Argentina and as a graduate and postgraduate professor at this university, at Buenos Aires University and at National University of La Plata.