



Renewable Energies Department



Canary Islands Institute of Technology (ITC)



Technology and Innovation for a Sustainable Development





Renewable Energies

Seeking to maximize the use of renewable energies in islands and isolated regions

Background:

Energy Singularities in the Canary Islands

2,2 million inhabitants +
15 million tourists per year



Isolated island power systems



Significant weight of **transport sector**



Scarcity of water resources.
Importance of the water-energy
nexus (**desalination**)



Strategic needs

To Reduce energy dependence on fossil fuels

To Diversify energy mix

To Maximize the use of endogenous renewable resources



New **employment** opportunities



Competitive advantages of the Canary Islands to develop R&D activities that reinforce knowledge in this technological sector



Sector that contributes to the **diversification** of the Canary economy, and cornerstone of a low-carbon economy



- **Green** Economy

- **Blue** Economy



- **Circular** Economy

To **support** the Regional Government in defining the implementation of policies aimed at the **decarbonization of the Canary economy**

To **overcome** technical (and administrative) barriers in the decarbonization transition

To promote **R&D activities** that reinforce knowledge in RES

To position ITC and the Canary Islands as a **benchmark experimental platform** in the use of renewable energies in the **European Outermost Regions**

To contribute and support the creation of industrial fabric and employment **in the RES sector**

To consolidate the vision "Canary Islands = **Natural Laboratory** for the development of sustainable energy technologies (**Living Lab**)"

To maximize the **use of renewable energies** in insular and isolated and remote regions

To **transfer technology** to developing regions

Objectives

- Seven activity & research lines
- Budget 2021: € 5 M

- Participation in many transnational/international cooperation activities (West Africa, Europe, RoW (focus: islands and remote/rural areas of less developed regions))

Renewable Energies Department

- + 25 years experience developing know-how and technology in renewable energies
- Established in 1999
- + 30 highly qualified engineers and scientists specialized in several energy related areas
- Technological activity in current trends of the renewable energy sector; Outstanding technological facilities
- Participation in more than 300 initiatives (R&D& projects + technological and consultancy services)



Milestones

1997

First wind turbine designed and constructed in the Canary Islands

First design and own construction of a synchronous 20 kW wind turbine, coupled to a 20 diesel genset with flywheel



1998

Wind-Diesel System for electrification of isolated areas

Punta Jandía Project (Fuerteventura), wind-diesel power station (incl. desalination plant) to cover the electricity and water needs of a fishing village



1998

ADAPT-Renovable

Program for capacity building and creation of renewable energy companies in the Canary Islands



1999

Wind - Pumped Storage Power Station for electricity supply of El Hierro island

Kick-start of the project (agreement between the insular authority, the utility and ITC)



2004

LABSOL: First spanish accredited solar thermal collector laboratory

At LABSOL, outdoor tests can be performed all year round



2003

Development of the Canary Islands Solar Radiation Map

First solar atlas of the Canary Islands, based on ITC's weather stations records



2002

First renewable energy powered hydrogen production systems

Design of two green hydrogen production systems, commissioned at ITC facilities between 2005 and 2007



2001

Cooperation with Mauritania

Set up of the training centre of renewable energies, desalination and cold of the University of Nouakchott



Milestones

2005

Cooling system powered exclusively by solar thermal collectors

First installation of this kind in the Canary Islands



2006

Development of the Canary Islands Wind Map

Wind Atlas used for wind energy promotion in the Canary Islands



2006

Biodiesel production plant

Plant that produces biodiesel from used cooked oil; first installation of its kind in the Canary Islands



2010

Sustainable La Graciosa

Conception of the Project (an innovative microgrid was deployed in 2017)



2019

Start of the Project 100% Sustainable La Gomera Island

Project that foresees PV and hybrid micro/mini-grids on La Gomera island on its way to 100% renewable energy supply



2014

Takatona II Project

Eco-villages in Morocco (with innovative energy and water supply systems); two international awards



2014

Commissioning of El Hierro's Wind - Pumped Storage Power Station

In 2018, the system covered almost 60% of the island's electricity demand



2011

Cape Verde: Microgrid of Vale da Custa

Wind/PV/diesel microgrid (with the capacity to connect to the mains grid), installed at a village of 650 inhabitants (101 houses)



2020



Design and assembly of a containerized system for the production of electricity and cold for isolated sites

Implementation in transportable containers of energy production systems using renewables and cold storage for use in isolated areas or in emergency situations

2020



Start-up of the BioenergyLAB biodigestion test plant

Within BioenergyLAB, a research laboratory is being set up, which includes a biodigester for the study of biomass of organic origin that can be used for energy recovery through anaerobic biodigestion

2020

Launching of a pilot project on circular and social economy

The technological collaboration agreement with the companies Ecatar and Ayagaures Medioambiente has made possible the implementation of a pilot project for the use of used vegetable oils as biofuel



2020

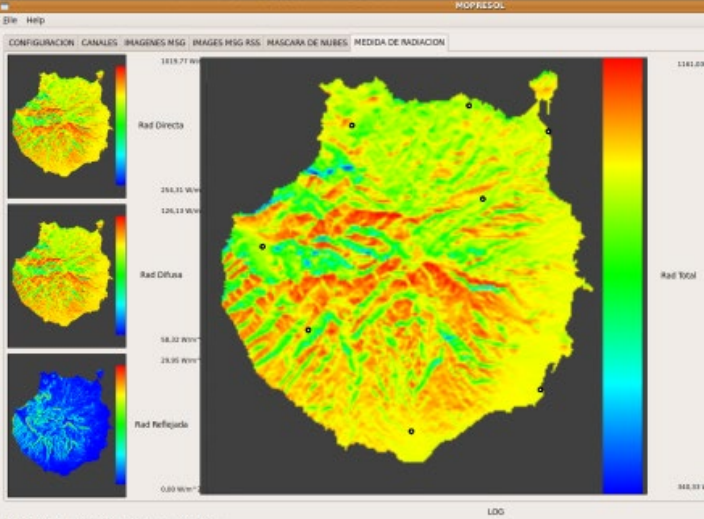
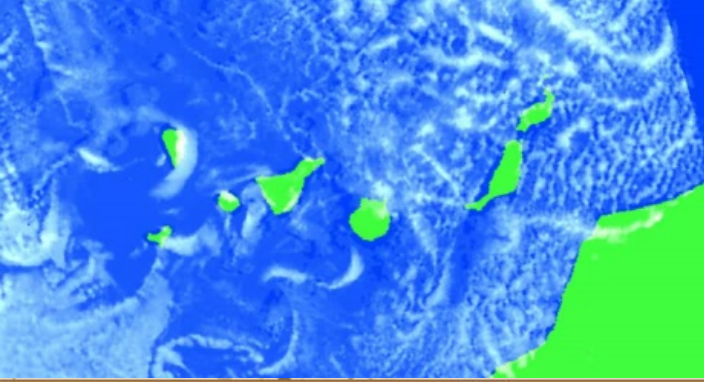
Development of the first Electricity Microgrid in the Canary Islands

At the ITC facilities in Pozo Izquierdo, a system consisting of two microgrids that can operate in stand-alone mode or connected to the external grid is installed in order to investigate the development of these systems as a basis for the extension of distributed generation in the Canary Islands



Lines of Work/Research

- > **Assessment of renewable energy resources**
- > **Design and development of energy generation systems**
- > **Design and implementation of energy storage systems**
- > **Analysis of energy transmission and distribution networks (vs. integration of variable renewables)**
- > **Energy efficiency and saving, demand management**
- > **Energy Planning, techno-economical feasibility studies of energy projects**
- > **Development and testing of renewable energy systems components and complementary technologies**



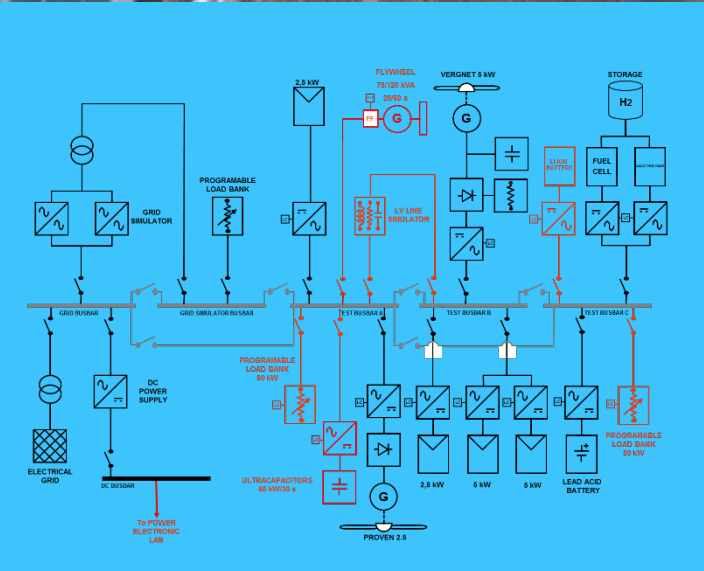
Lines of Work/Research

Assessment of Renewable Energy Resources

- **Mapping of renewable energy resources** (wind, solar, biomass, ocean energies) using numerical techniques and GIS
- **Development of forecasting tools** of meteorological parameters, renewable power, electrical demand and other variables which affect electrical system operation, for different horizons and time resolutions
- **Geolocalization of heating and cooling demand** in urban areas and development of energy demand density maps

Design and Development of Energy Generation Systems

- **Design and development of renewable energy generation systems** (on- and off-shore wind, solar thermal and PV, ocean Energies, biomass, ...)
- **Optimization of existing renewable energy generation systems** (monitoring, repowering, certification, re-conditioning)
- **Design and development of distributed generation systems** (micro- and mini-grids, hybrid systems (incl. energy storage))



Lines of Work/Research

Design and Development of Energy Storage Systems

- **Design and development of electrochemical, thermal and pumped storage systems** for energy applications and to provide complementary adjustment services to the electrical system
- **Design and development of energy management systems** for optimum energy storage operation and extension of its lifetime

Analysis of Transmission and Distribution Networks

- **Analysis and mathematical modelling of electrical infrastructures** for the development of electrical power systems studies
- **Development of studies for the integration of (variable) renewables** in distribution networks and assessment on the necessary additional hardware to provide ancillary grid services
- **Provision of technical assistance** to fulfill the requirements of the grid operator in renewable energy integration



Lines of Work/Research

Energy efficiency and saving, demand management

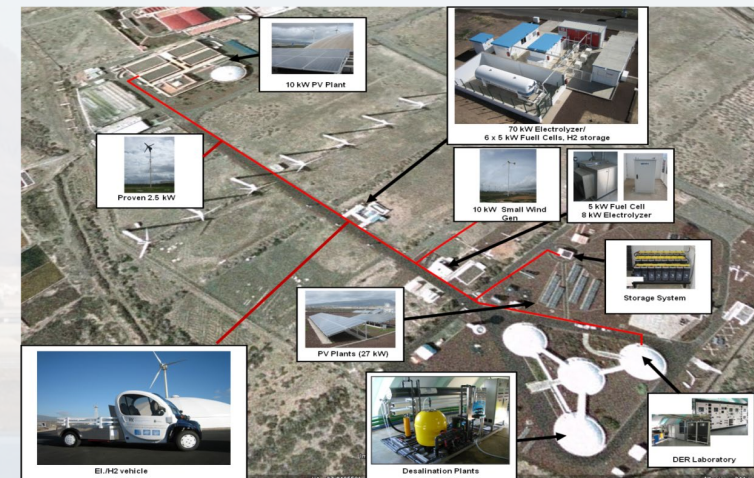
- **Design and development of energy management systems (EMS)** to adapt the renewable energy resource to the applicable tariff
- **Development of demand management solutions** associated to manageable loads, incl. process automatization
- **Deployment of Smart Grid and ICT network solutions** for a coordinated real time management
- **Modelling of thermal loads** for minimization of energy consumption in buildings

Energy (Systems) Planning, Feasibility Studies

- **Development of Energy Planning studies and strategies** (different levels)
- **Development of techno-economical feasibility projects** of energy projects
- **Assessment and promotion of energy saving and energy efficiency strategies**

Development and testing of renewable energy systems components and complementary technologies

- Test of renewable energy systems' components
- Development of electronic devices for renewable energy systems' optimization
- Assessment and analysis of resources of organic origin for the development of biorefinery concepts



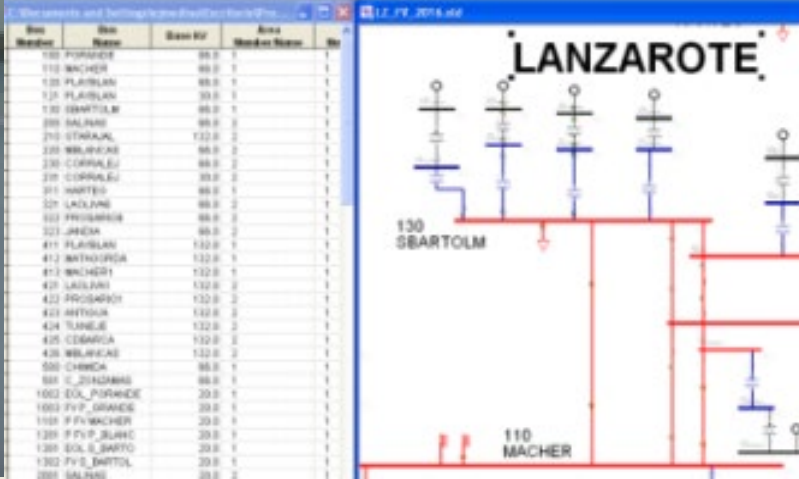
- > Power Electronics Laboratory **LABEP**
- > Solar Thermal Collectors Testing Laboratory **LABSOL**
 - > Distributed Generation Laboratory **DERLAB**
- > Biomass Laboratory and Biodiesel Production Plant **BioenergyLAB**

- > Renewable Hydrogen Facilities
- > 800 m² Workshop
- > Experimental Microgrid that integrates wind, PV, hydrogen systems, batteries, desalination plants, EV charging points, etc.



Technological Infrastructure

Pozo Izquierdo Facilities (Gran Canaria)



Renewable Energies

Department

Equipment

Software

- > Equipment for solar thermal and PV systems testing, incl. performance/quality control

- > Equipment for battery analysis and monitorization

- > PSS@/E: electrical grid (stability) analysis

- > Solar absorption cooling system

- > TRNSYS: thermal energy systems modelling

- > 125 kVA Grid simulator, inductive/resistive loads, and equipment for micro-, mini-grids analysis

- > Variety of programs/software packages (incl. own/customized developments) for energy systems modelling and energy planning

- > Electric and Hydrogen Powered Vehicles

- > Power/Grid Analysers

- > Inverter test bench

- > **Assistance/Consultancy to public institutions:** energy planning and technical support in the definition of energy policies (focus: islands, remote areas, less developed regions)
- > **Electrical grid stability analysis** (aimed primarily at determining maximum RES penetration levels, particularly in weak electricity systems), and solutions to increase RES penetration
 - > **Grid modelling** using PSS/E
 - > **Development of power electronic components** to optimize RES integration in weak/small/isolated electrical grids
- > **Design of innovative energy generation systems** (distributed generation, micro- and mini-grids, hybrid systems) integrating technologies related to renewable energy production, energy storage and Demand Management.





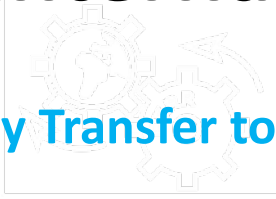
Technological Services

(cont.)

- > Energy Planning, Thermal and Electrical **Energy Systems Modelling**
- > **Monitoring and Quality control** of PV systems
- > **Test** of solar thermal, PV-systems, and its components
- > **Test of energy systems** which include variable renewables and manageable and non-manageable loads (e.g. pumps, RES driven desalination systems, electric vehicles, electrolyzers, etc.)
- > **Characterization of renewable energy resources and meteorological forecasting**
- > Study of the **integration of variable renewables** in (weak) electrical grids, aiming at maximum renewable energy penetration
- > Study of **energy storage** solutions
- > **Training / Capacity Building**

International Cooperation

Technology Transfer to less developed regions/countries



+20 years experience in

Africa and insular regions worldwide

- > Wind atlas, Creation of RES & desalination training centre, installation of desalination plants (**Mauritania**)
- > Energy Efficiency and Renewable Energy Plan, electrification of villages, installation of RES powered desalination plants (**Morocco**)
 - > Identification of CDM projects in Sub-Saharan Africa
- > Energy Plan, Support to the creation of a RES training centre in the University, quality control of PV plants, installation of a microgrid (**Cape Verde**)
 - > Capacity Building (**Morocco, Senegal, Cape Verde, Mauritania**)
- > Collaboration with the ECOWAS Center for Energy Efficiency and Renewable Energy (**ECREE, ECOWAS**)

ITC also participates in excellence projects funded by the European Commission

- > El Hierro 100% RES, CDM for sustainable Africa, RES2H2, ISLE-PACT, TILOS, SINGULAR, etc



Trajectory





boost



Services to the Public Sector

2

Ministry of Ecological Transition, Fight against Climate Change and Territorial Planning of the Canary Islands Government



MICROGRIDBLUE



DESAL+

innomaroc

Projects 19

Renewable Energies Department



SOCLIMPACT



reflect africa



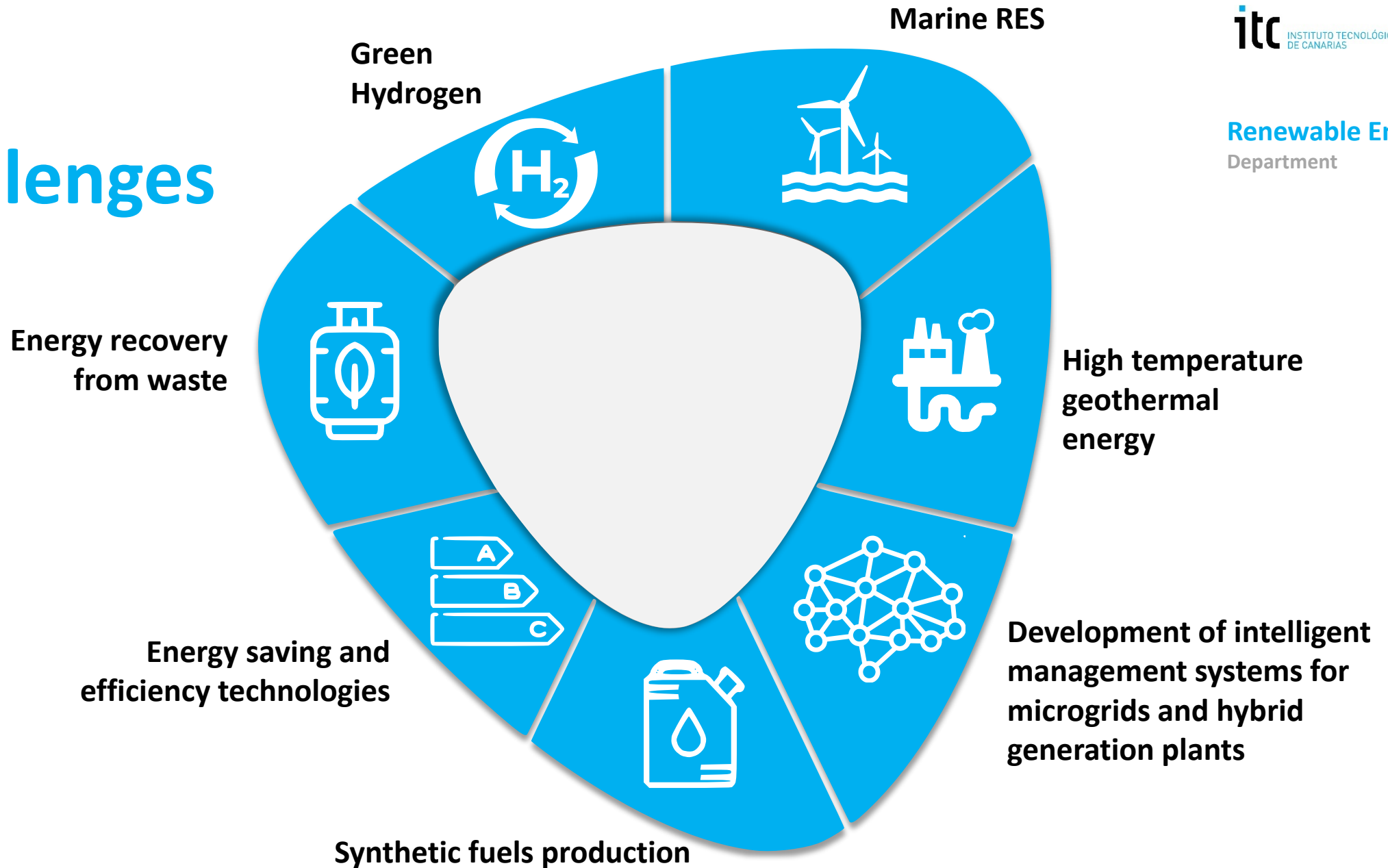
Different companies and entities

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Services to the private sector

Currently...

Challenges



Marine RES



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