CENTRO DE
ESTUDIO DE LOS
RECURSOS
ENERGÉTICOS

1ST LATAM MEETING ON GREEN AMMONIA AND POWER-to-X

Challenges for the industrial development of renewable ammonia in the Magallanes region

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CERE UMAG, January 2024
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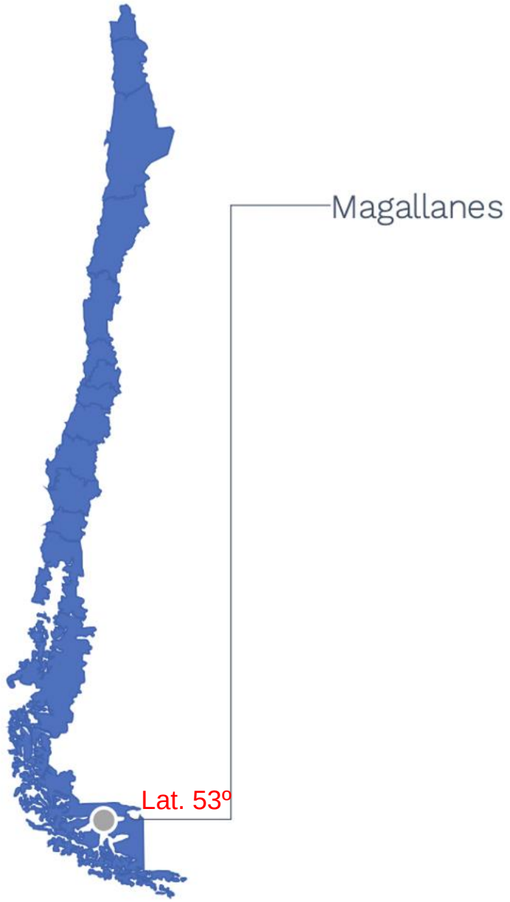
ENERGÉTICOS

UNIVERSITY OF MAGALLANES (UMAG)



Founded in 1982, it is the continuation of the former Universidad Técnica del Estado, which began its activities in the Magallanes region in 1961.

- 5 faculties.
- 31 undergraduate programs.
- 9 graduate programs (2 PhD).
- ~4250 students.

Mechanical and Electrical Engineering are the foundation programs of the institution, with a **strong link to the industry**.

Central Campus in Punta Arenas.

Our research areas:

- Antarctic and sub-antarctic science.
- Energy and environment.
- Human settlement in high latitudes.
- Human development.

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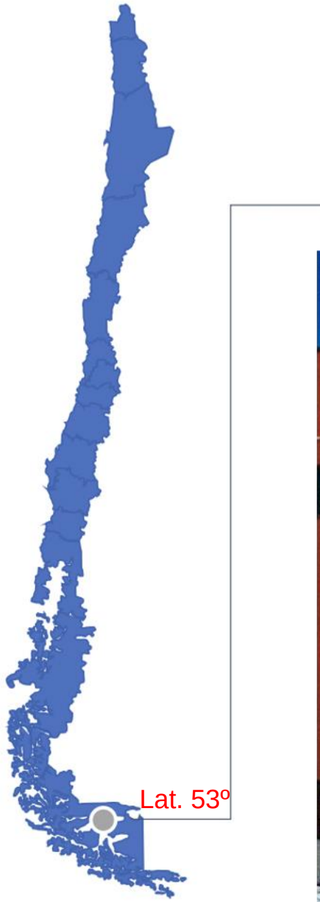
CENTER FOR THE STUDY OF ENERGY RESOURCES (CERE)



CERE was created in 1993 and housed in the Faculty of Engineering of the University of Magallanes.

The center supports the promotion of renewable energy technologies, rational use of energy in residential, public and commercial areas, also assists political decision-makers in the national and local discussions in the most important issues on matters related to energy policy and planning.

Currently, CERE develops applied research projects in 5 areas: Wind, Solar Photovoltaic, Biomass and Biofuels, energetic efficiency and evaluation of green hydrogen and derivatives production opportunities.

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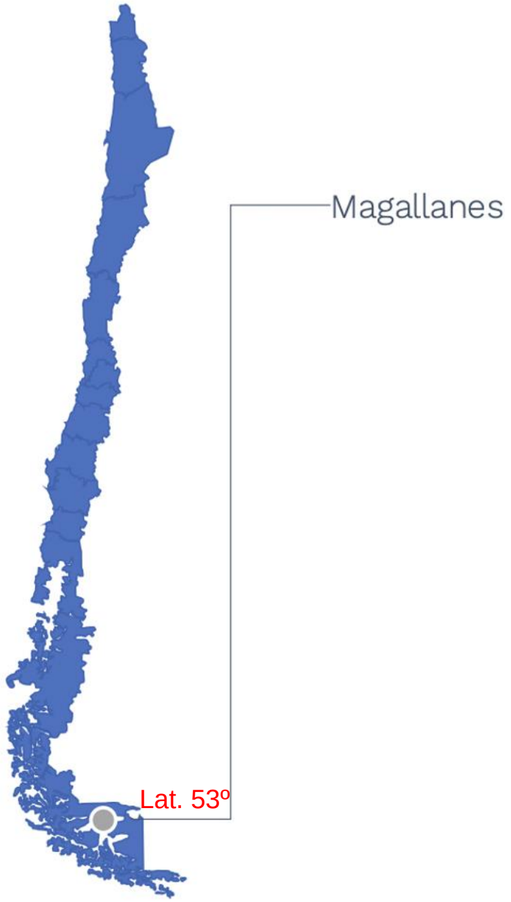

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Gobierno de Chile

- Subsecretaría de Energía
- Comisión Chilena de Energía Nuclear
- Comisión Nacional de Energía
- Ministerio de Agricultura
- CONAF
- MINVU
- CORFO

Ciemat
Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

UNPA
Universidad Nacional de la Patagonia Austral

Agencia de Sostenibilidad Energética

UNIVERSITE D'ORLEANS

TALCA
UNIVERSIDAD
CHILE

usach

Networks & Alliances

vivre les cultures
INSTITUT FRANÇAIS
Chile

NOVIA
UNIVERSITY OF APPLIED SCIENCES

UNIVERSIDAD DE LA FRONTERA
TEMUCO · CHILE

UNIVERSIDAD DE CONCEPCION

CITECUBB

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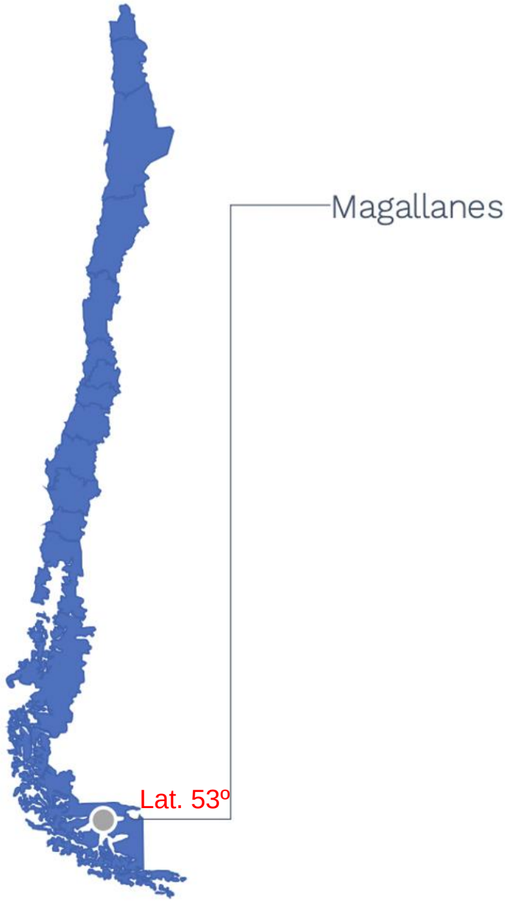

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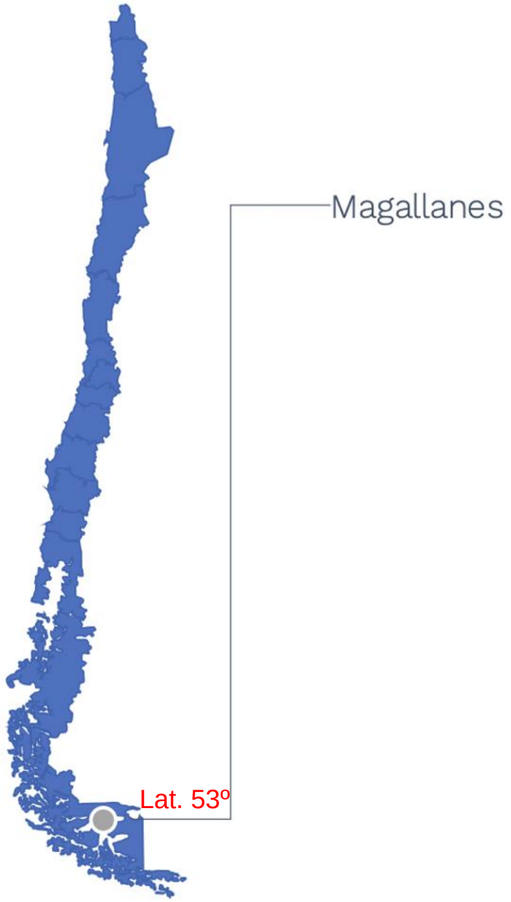


RESEARCH AREAS

1 **Energetic Efficiency**
- Buildings
- RPC areas
- Ilumination
- Heating
- R&D

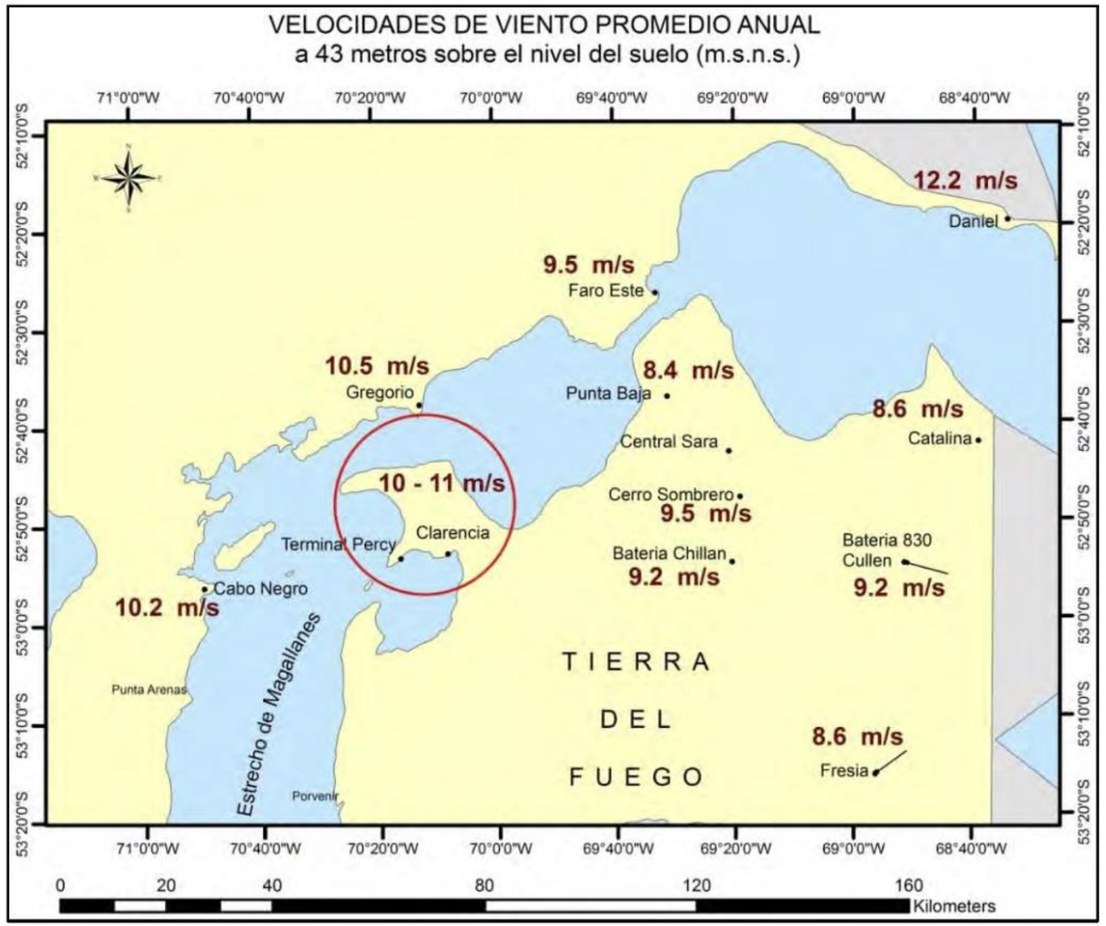
2 **Renewable Energies**
- Wind
- Solar
- Biomass - Biofuels
- Marine energies
- Green Hydrogen and derivatives

3 **Cross-cuting areas**
- Capacity Building
- Linking with communities
- Public policy studies

Green hydrogen and ammonia projects in southern region of Chile

Torres del Paine National Park, Magallanes region

Why Magallanes ?



Annual mean wind velocity (source CERE 2014)

World class potential wind
LCOE < 25 USD/MWh (Magallanes region)

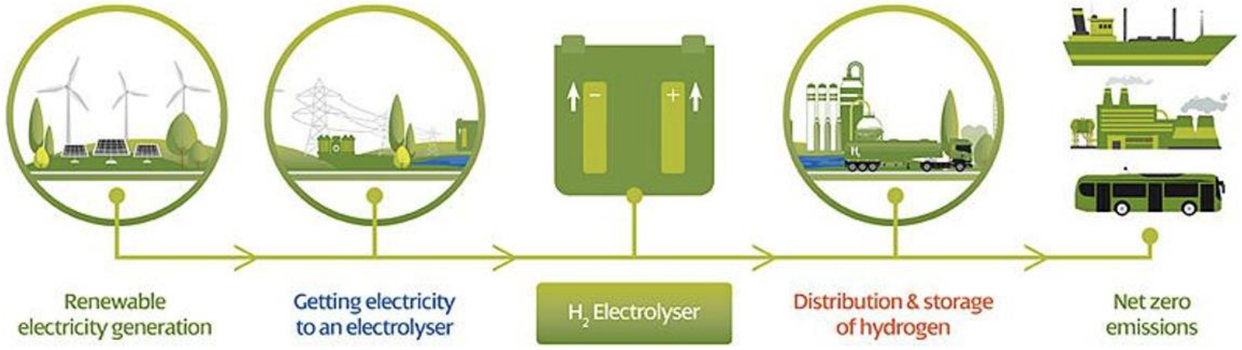
Capacity factor
(52 - 54%)

H_2

Wind park Vientos Patagónicos: Power 10,35 MW

Wind park Cabo Negro: Power 2,5 MW
(operating since 2015)

What is green hydrogen



Production cost of green hydrogen depend strongly of the renewable electricity cost (60% - 70%)

Production expectations of green H_2 and derivatives in Magallanes

Magallanes region could host 6 projects that are known to be planing to begin exports this decade

2025 — TOTAL eren

Green ammonia for export project. Already has secured land and at the moment the environmental baselines are being defined.

2024 — HIF / SIEMENS energy

Green methanol and green gasoline production from wind power and captured CO2 for export to German offtakers Porsche and Mabanaft. Pilot phase begins operations in 2022. Export terminal for the pilot is secured.

2026 — AustriaEnergy

Green ammonia for export project. Already has secured land and has an offtake MoU with Trammo. Export terminal is not clear.

2028 — CWP GLOBAL

Green ammonia plant in development. Land and export terminal not clear.

2030 — Sociedad de Inversiones Albatros / alfanar

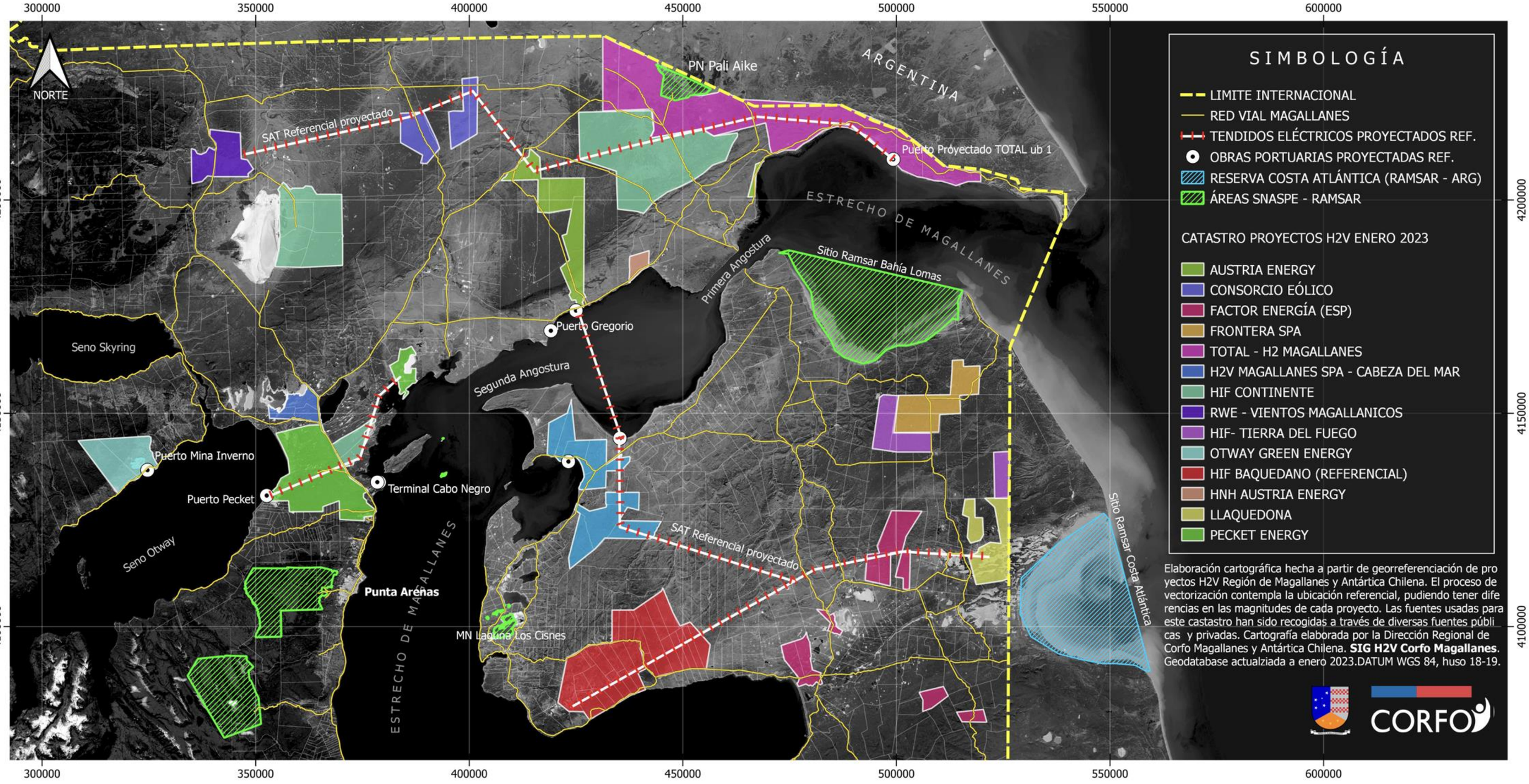
Green ammonia plant in development. Export terminal is not clear.

TEG TRANSITIONAL ENERGY GROUP / HAURA ENERGY

Green ammonia for export project. At the moment, the environmental baselines are being defined at the Tierra del Fuego island.

- If only first commercial phase is developed in each one of these projects, we will have 12 GW of wind power
- At the present, Chile has only 6 GW of wind power
- Most projects are to produce green ammonia.

Green H_2 and derivatives (14 projects in Magallanes region)



Current situation of the projects in Magallanes

Haru Oni pilot plant under operation.... (March, 2023)

First batch of e-fuel, made from green hydrogen and captured CO2, heading from Chile to UK for Porsche testing

Punta Arenas, October 6th, 2023.- HIF Global, the world´s leading eFuels company, and the Chilean gas company Empresas GASCO, today announced the first production of carbon-neutral liquefied gas ("eLG") generated with renewable energy from the strong winds of the Magallanes Region, at the Haru Oni eFuels facility in southern Chile.

Green methanol and gasoline production from wind power and captured CO_2

Haru Oni Plant

Developer

HIF

Key Partners

SIEMENS energy

MABANAFT

ENAP

enel

Location

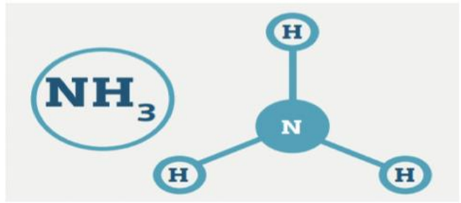
Magallanes region

Export to Germany

+ Grant of 8 MEUR from German government

Source: Siemens Energy

Transforming wind power to green ammonia in Magallanes region



Agua

REVERSE OSMOSIS

Planta eólica

Electrolizador

Compresor

H_2

H_2

BESS

challenge

Red

Unidad separadora de aire

Planta NH3

Almacenamiento NH3

NH_3

challenge

Exportación de Amoniaco

Electricidad Variable → Electricidad → Agua → Hidrógeno → Nitrógeno → Amoniaco

Diciembre 2020

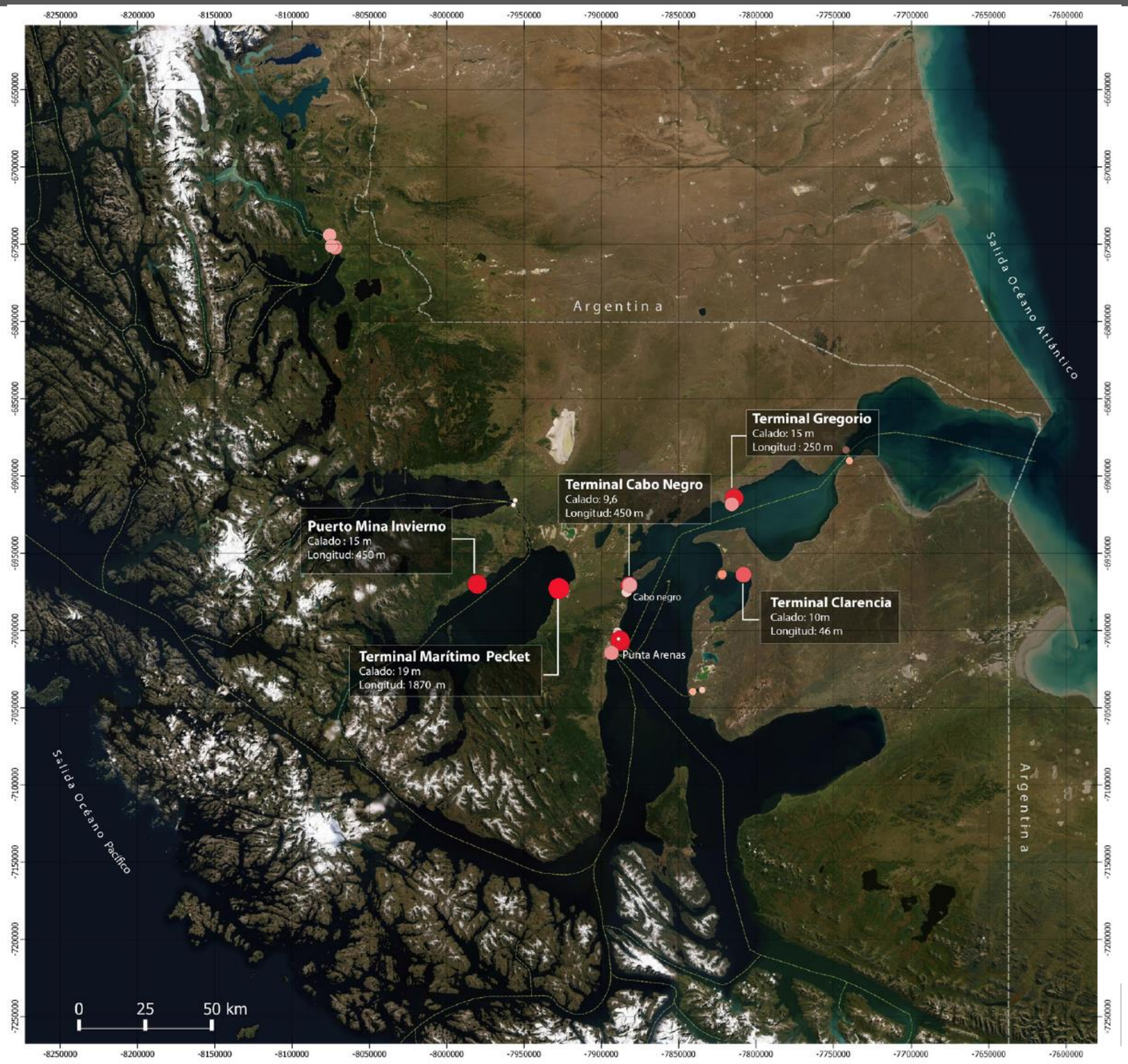
Existence of transport network – (infrastructure challenge)

Existence of gas transport infrastructures in the same area due to former economic activities related to oil&gas.

Challenge: 500 kms of pipeline unused by Enap could be a network for transport renewable ammonia to the export terminals.

Fuente: Corfo Regional)

Existence of port infrastructures (adaptation challenge)



Terminal associated with industries of:

- Oil and gas
- Methanol
- Coal mining

Developing the infrastructure necessary to transport and export ammonia derivatives in the Magallanes Region, presents substantial challenges.

Existence of port infrastructures (adaptation challenge)

ENAP’s port development plan (source Enap)

H2V Magallanes association (coordination challenge)

Creation of the green hydrogen association in Magallanes (March, 2023)

Union of green hydrogen producers with presence in the Magallanes Region that will seek to create a space for coordination and dialogue with local actors to promote the sustainable development of this key industry for the energy transition.

HIF Global → Inglaterra
TEG Chile → Inglaterra
Total Eren → Francia
EDF Andes → Francia
EDF Renewables → Francia
HNH Energy → Austria

Generation of local demand: economical challenge

- Current economical model of the renewable hydrogen and ammonia industry is oriented to the exportation.

Challenges

- To produce local value in the communities and regions where hydrogen or ammonia is developed.
- Enable the development of manufacturing and services to capture increased shares of the market value domestically.

Integration with local economies – economical challenge

Piloto: Celdas Combustible y Almacenamiento H2

Objetivo: reducción 24% consumo diesel

Salmon transportation (Source: Wellboat, Ltda)

Futuro: Turismo Austral - Antártico "Cero Emisiones"

Social and environmental challenges

Challenges

- A social impact assessment, similar to Environmental Impact Assessment should be conducted to evaluate the local capacity building potential.
- Understand the communities concerns, aspirations and expectations.
- To prepare the city, towns and communities for the arrival of so much equipment and personnel.

Developing wind farms in harmony with nature and ecosystems (land uses, migratory routes, Ramsar sites, etc..)

Mitigation of environmental impacts of desalination processes through use of the different brine management techniques.

Electrical scenario of the Magallanes region

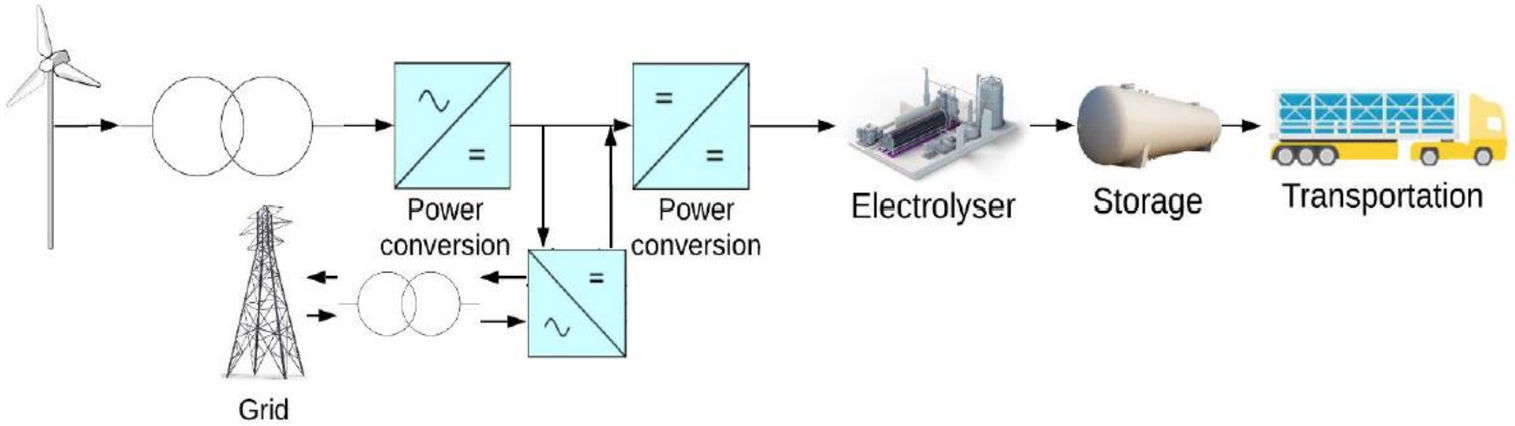
-La región de Magallanes cuenta con cuatro sistemas medianos de distribución eléctrica, sumando un total de 104 MW, y un peak de demanda máxima de 53,5 MW.

-Punta Arenas no alcanza los 90 MW de potencia instalada.

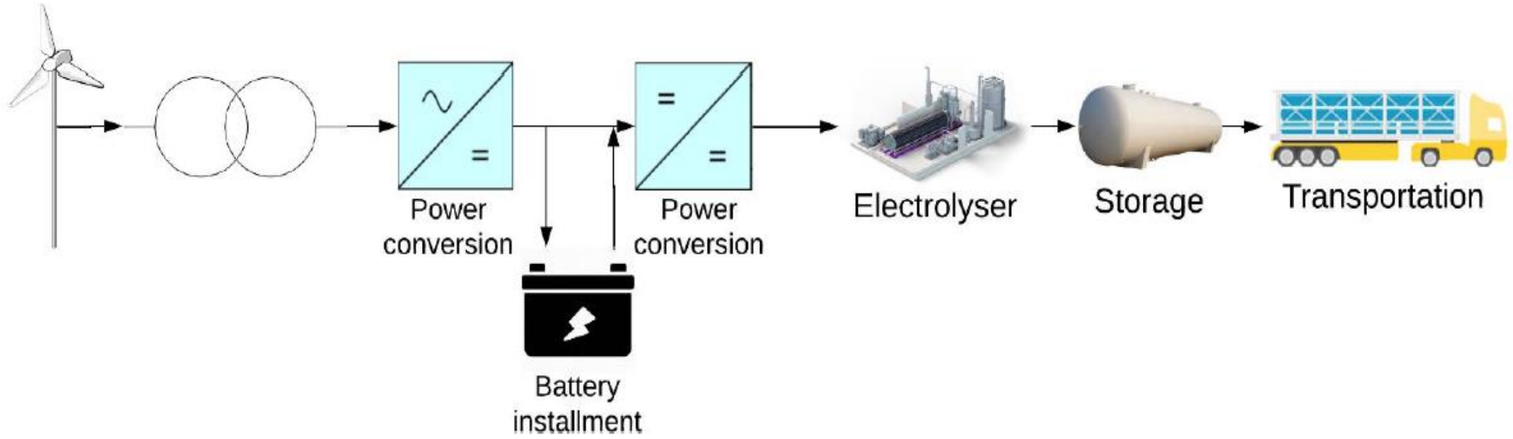
-Sistema eléctrico mediano totalmente aislado del SEN (Sistema Eléctrico Nacional)

Isolated electrical system
(not connected with the national electrical network)

Big scale wind farms operating in off grid mode – technical challenge



H2 production assisted by grid



H2 production assisted by BESS

• One of the main gaps lies in the operation, reliability and stability of the internal electrical systems; in other words, in keeping the production plant in operation, given that due to its location and size, the project would operate as an electrical island and this situation could affect the LCOAs.

- The power requirement for the electrolysis process must be quite stable for avoid shutdowns preserving the lifetime of the electrolyzer and maintain a high degree of hydrogen purity.
- The design of wind farms to feed the electrolysis process must include some technical solutions to deal with the intermittences of the renewable energy.
- A back-up energy source must be incorporated due to the the absence of an electrical grid that can absorb periods of low wind generation.
- The back-up could consist of hydrogen fuel-based electrical generation or a battery energy storage system (BESS), because it is looking for the projects that are completely renewable.

Local capabilities gaps for the green hydrogen and derivatives

Develop local talent and technical capabilities to accelerate project deployment and generate jobs opportunities.

Given this is a new industry, it is crucial to work in a forward-looking manner, to provide training and build networks with the study centers that will provide the technicians and professionals that will be needed.

Financiado por la Unión Europea

Assessment of capability gaps and development of a strategy for the training of human talent for Power to X – Magallanes region
2023

Proyecto 2023-2024

Evaluación de brechas de capacidades y desarrollo de estrategia de formación de talento humano para POWER-TO-X Región Magallanes

CERE - UMAG

Concurso GIZ – EUROCLIMA 2022


Serie de Documentos Técnicos
Evaluación de brechas de capacidades y desarrollo de estrategia de formación de talento humano para power-to-x- región Magallanes
H2
www.euroclimaplus.org
Global Gateway
Euroclima
Cofinanciado por
cooperación alemana
Implementado por
giz

Wind-power to Hydrogen Interregional Synergies in Education and Research

(WHISPER)

2023

Objectives

- Joint course co-created to raise awareness and build capacity about wind energy and green hydrogen
- Mobility between 2 universities (students and professors)

Through the design and pilot implementation of a course on wind energy and green hydrogen the objective is **to increase knowledge and technical capacities to support the development of the hydrogen economy in both regions.**

Collaborative Research and Knowledge Exchange in Sustainable Energy

(CRKESE)

University of Louisiana at Lafayette

Universidad de Magallanes

2024

Goals

→ Reciprocal visits and virtual exchange programs

→ Collaborate in program classes, workshops, and final projects

→ Develop cross-cultural competencies

Activities

→ Collaborative hybrid module

→ 10 days exchange program

→ Training program at UL Lafayette

Strengthening capabilities in green hydrogen and derivatives

Strengthening capabilities in combustion using e-fuels

vivre les cultures

INSTITUT FRANÇAIS Chile

UNIVERSIDAD DE MAGALLANES CHILE

Santiago, 29 de septiembre de 2021
N° SCIEN 31/2021

Accord de Coopération
Bourses pour séjours de recherche
Programme de financement Chili-France
Année 2021

Convenio de Cooperación
Becas de estadías de investigación
Programa de financiamiento Chile-Francia
Año 2021

UNIVERSITE D'ORLEANS

Laboratorio Prisme
Universidad de Orléans

- Estadía de estudiante del Magister en Energías Renovables y Eficiencia Energética. Nov 2022
- **4 becas** para 2023

GREEN HYDROGEN PRODUCTION – LAB SCALE

Wind generator
VAWT, 700W

H2 generator
Electrolyzer 500 cc/min

Metal hydride hydrogen storage
MyH2® 900 liters

Fuel cell 1 kW, 36 V

FDI EE Emprendimiento Estudiantil 2020

Objective : Implementation of a Lab-Scale Green Hydrogen Production System with vertical axis wind turbine (CERE's test field)

Collaboration agreements with developers

Collaboration agreement between University of Magallanes and Highly Innovative Fuels Company (HIF)

Collaboration agreement between University of Magallanes and Total Eren Company

First synthetic fuel laboratory of Chile installed in UMAG

Lab was funded by
Highly Innovative Fuels Company (HIF)
800.000 USD

- Built next to existing laboratory of solid fuels
- 1 M USD Investment for liquid and gas fuels
- In collaboration with HIF and Gasco
- The laboratory serves HIF pilot plant
- It is available for other R&D endeavours.
- The facility with all its equipment will belong to UMAG in 4 years.

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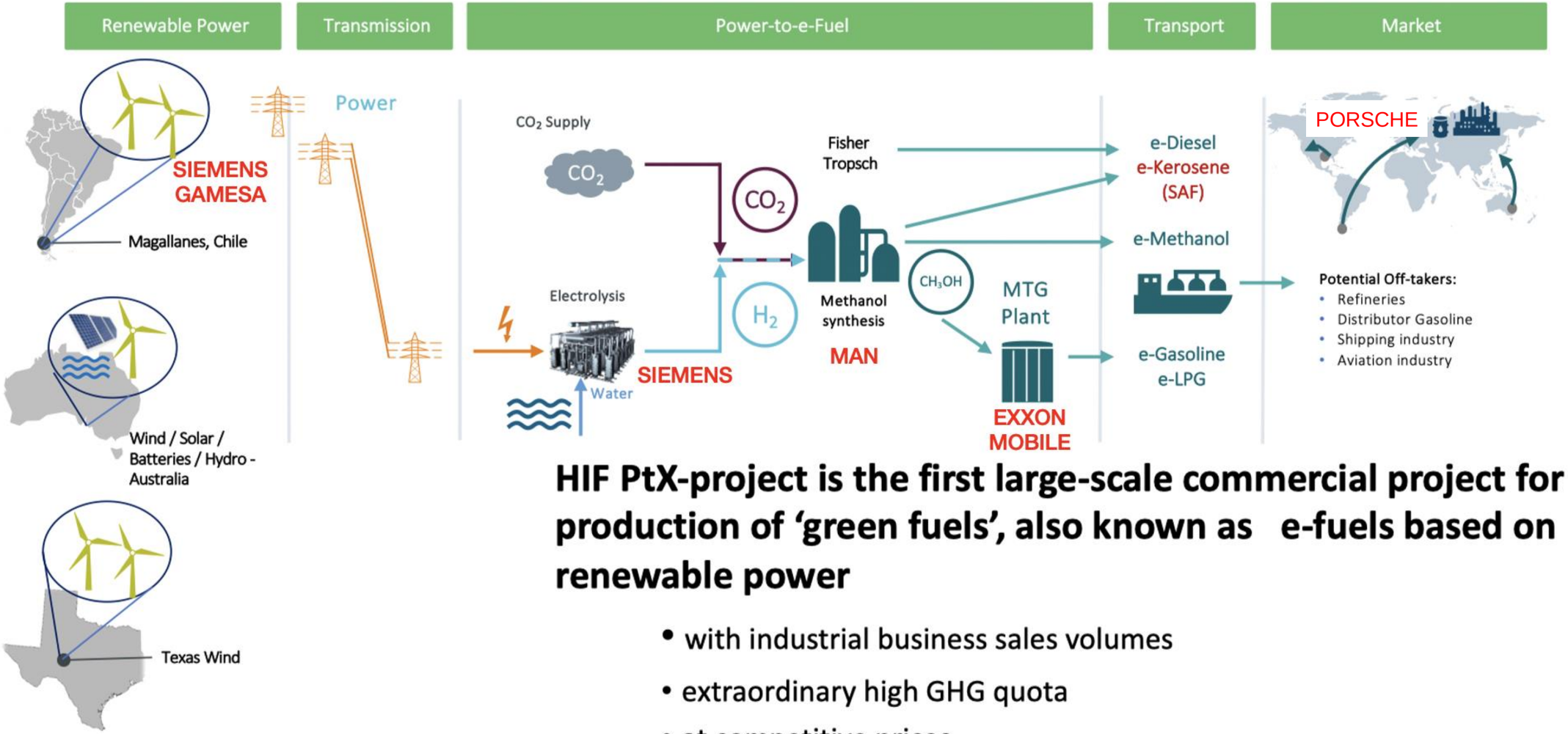
Thanks…

Wind power to e-fuel : the process



HIF PtX-project is the first large-scale commercial project for production of 'green fuels', also known as e-fuels based on renewable power

- with industrial business sales volumes
- extraordinary high GHG quota
- at competitive prices
- high up-scaling capability