

Green Methanol - Sierra Sur

63rd International Congress Of Naval Architecture,
Marine Technology and Maritime Industry

April, 2024

Agenda

Alkeymia

Why green methanol as a fuel?

Project Sierra Sur

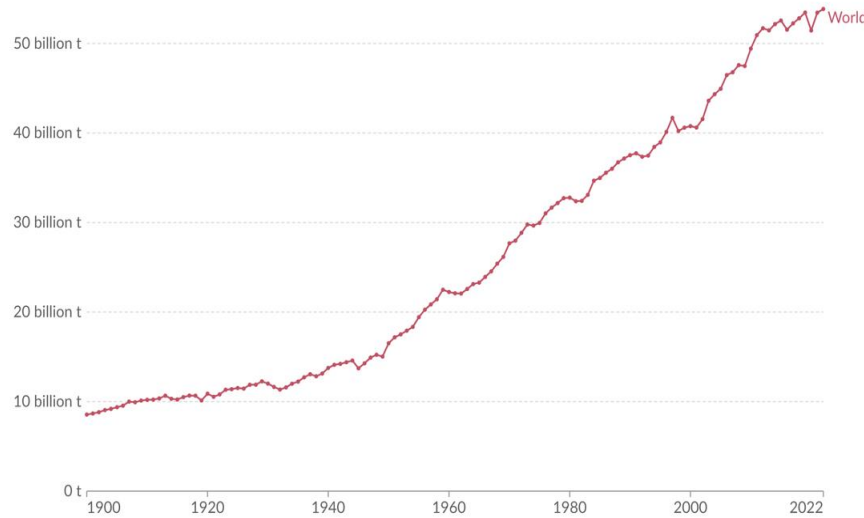
Conclusions



GHG emissions evolution has been growing over decades

In 2022, **53.700 Mton** of GHG were emitted worldwide of which 29.2% came from China, 11.2% from USA; 7.3 from India and 0,55% from Spain

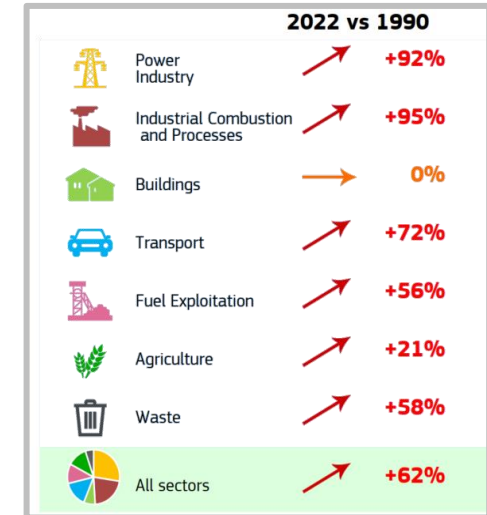
World GHG absolute evolution



Source: Our World in Data

It is urgent to find new decarbonization ways

GHG relative evolution by sector



Source: International Energy Agency

Distribution of GHG in 2022:

- 71.6% Mton from CO₂
- 21.0% Mton from CH₄
- 4.8% Mton from N₂O
- 2.6% Mton from other gases

- The world is still predominantly using fossil fuels (carbon, natural gas and oil) for the electricity generation, transport and industrial processes, which is making difficult to achieve objectives of NET ZERO in 2050
- Global GHG emissions have increased +62% with respect 1990. Despite efforts from some regions (EU has decreased GHG emissions in a relative to 1990 in a -27%), emerging economies such as China (+285%) or India (+170%) continue to increase emissions
- In a sectoral perspective, all industries have increased emissions excepting buildings. Power generation and industrial combustion are the main contributors to the increase

Alkeymia: strategic positioning to lead decarbonization



Electricity market



Green molecules market



Alchemy: to mix different ingredients to obtain something greater than the sum of the parts

Leveraging on our shareholder capabilities to deploy efficient solutions in the green molecules market (spin-off of Capital Energy, IPP with >20 years of history and a main renewable energy player in Iberia)

Our mission

Promote the ecological transition towards a cleaner and more efficient world, where decarbonization is the fundamental value. We are committed to providing innovative and sustainable solutions that enable companies and industries to decarbonize through non-electrified technologies, reducing their carbon footprint and contributing to global well-being.

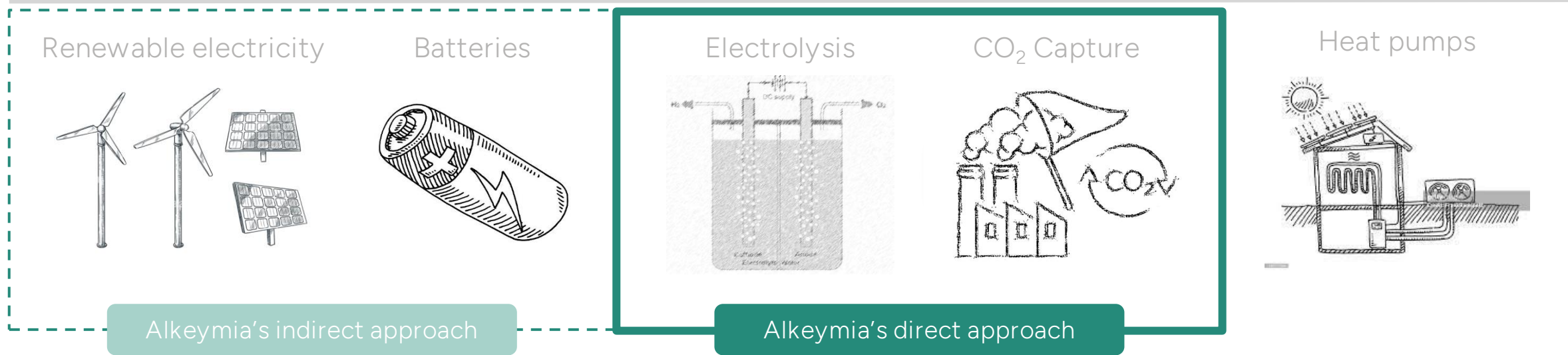
Our vision

We believe that innovation and decarbonization go together, and we are committed to leading the change towards a more sustainable future, where clean energy and electrification solutions are the cornerstone towards a leading and decarbonized world.

We aim to be recognized as a serious, agile, digital and innovative strategic partner.

Alkeymia is covering almost all main decarbonization strategies up to date

There are several ways to decarbonize the world...



...and big players & governments are already taking action

Endesa says goodbye to its historic chimney at the Compostilla thermal power plant

Denmark opens the first imported CO2 cemetery in the North Sea

The Government counterattacks fossil fuels to electrify energy demand as soon as possible

German industry joins forces with green groups on CO2 capture

CUMMINS DRIVES GIGAWATT ELECTROLYZER MANUFACTURING PLANT FORWARD IN SPAIN, EXPANDING ITS GLOBAL CLEAN ENERGY FOOTPRINT

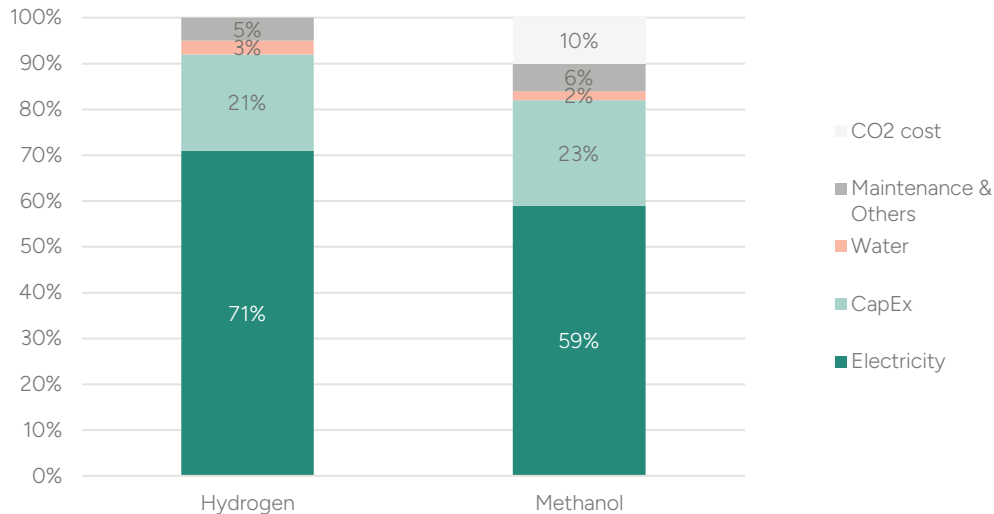
The access restrictions of the M-30 in Madrid: the cars that will not be able to circulate and the fines

Green Hydrogen, key to energy transition

- Among different technologies explained, **green hydrogen is among the top**, with great applicability for the decarbonization of sectors relying on fossil fuels, where electrification is not economically viable
- It can be used as a **feedstock**, fuel or energy carrier and storage, and has many applications across industry, transport, power and heat, ammonia or **methanol**
- Countries are **closing the gap between grey and green alternatives** through several mechanisms: CO2 prices (**expected to reach 130€/ton CO2 level** from current level of 60 - 70 €/ton CO2), mandatory quotas for demanding industries and public subsidies

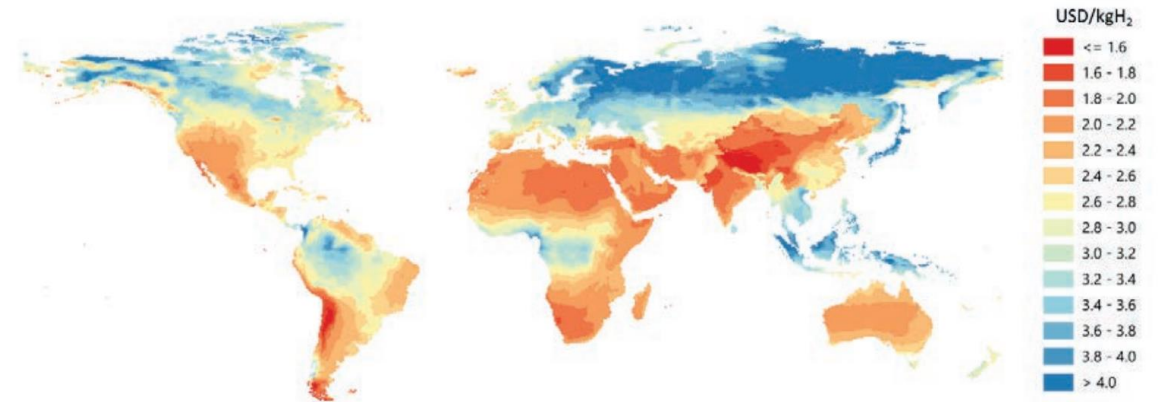
H₂ and derivatives cost is mainly driven by electricity and CapEx

Levelized cost breakdown (€/kg) – Green Hydrogen & Green Methanol



Spain as a premium location for H₂ generation

- **Optimal conditions for H₂ generation:** lowest LCOH in Europe due to high renewable resource, availability of land and industrial and transport development



Spain is positioning itself as a green H₂ generation and export hub due to its optimal conditions as a **renewable resource**, and the **planned regulation and infrastructure**

Total cost is mainly driven by electricity cost and facility's load factor, which diminishes total CapEx

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Methanol as a fuel (I/III)

Shipping accounts for 90% of global trade and 3% of GHG emissions

As regulations on emissions reduction are coming in force, shipping industry is looking for new ways of de-carbonization

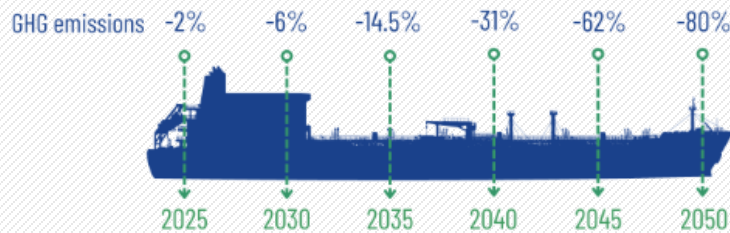
REGULATIONS ON THE GREEN TRANSITION FOR THE MARITIME SECTOR



COMPLYING WITH REGULATIONS DEMANDS A CHANGE TOWARDS NEW ALTERNATIVE GREEN FUELS

- 2018 IMO's GHG Reduction Strategy by 50% by 2050 for shipping industry compared to 2008 levels
- Incorporation to the EU-ETS market for CO₂ emission trading since Jan '24: mandatory report and payment for the emissions of CO₂, CH₄ and N₂O for ships of > 5,000 ton arriving at ports in Europe
- Fuel EU Maritime: mandatory reduction of emissions in the maritime sector in the EU

Fuel EU Maritime GHG reduction objectives



Fuel type	LHV* [MJ/kg]	Volumetric energy density [GJ/m ³]	Storage pressure [bar]	Storage Temperature [°C]
MGO	42.7	36.6	1	20
LNG	50	23.4	1	-162
Methanol	19.9	15.8	1	20
Liquid ammonia	18.6	12.7	1/10	-34/20
Liquid hydrogen	120	8.5	1	-253
Compressed hydrogen	120	7.5	700	20

Source: Methanol Institute

- When deployed alongside advanced engines, methanol is compliant with the most stringent emission reduction regulations issued by the IMO
- Methanol bunkering is very similar to MGO or HFO bunkering. It can be transported, stored and bunkered with existing infrastructure after relatively simple modifications.
- Methanol has a higher energy density than other alternative shipping fuels including ammonia and hydrogen
- From an environmental perspective, methanol is relatively benign from an environmental pollution perspective compared to other fuels because it is fully miscible in water and biodegradable

Methanol as a fuel (II/III)

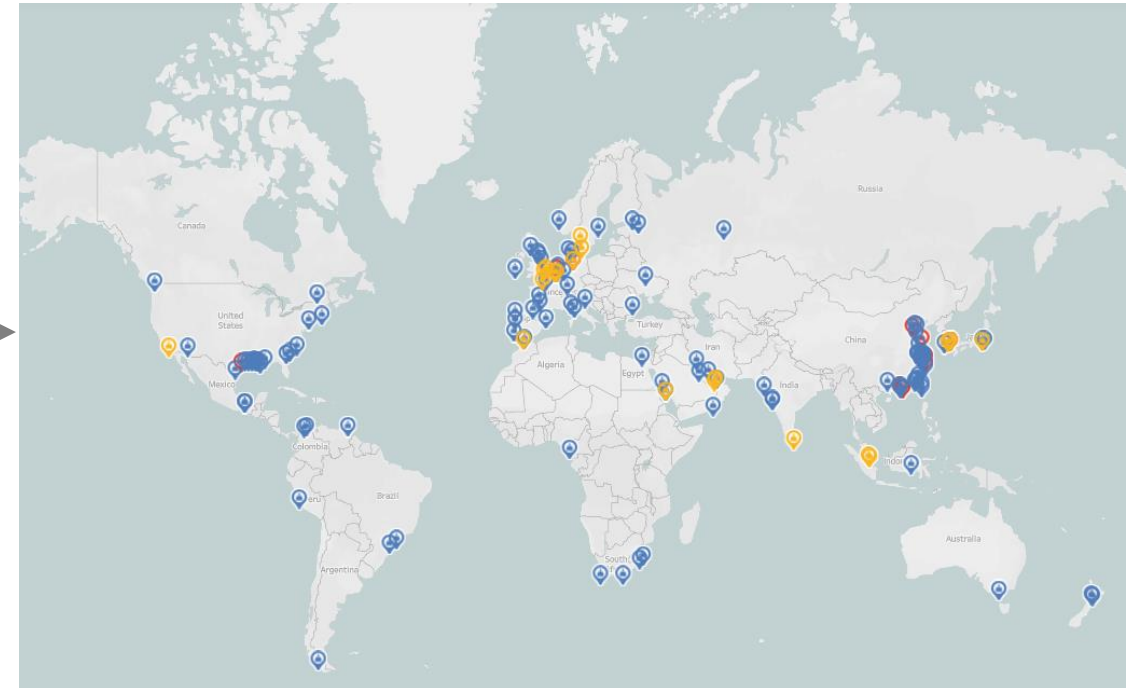
The assessment of technology readiness of methanol as fuel shows that the methanol fuel system consists mostly of well-known components along the whole value chain (bunkering of methanol internal combustion engines, mainly) is ready to be deployed today.

In contrast, key technology and safety regulations for other cryogenic fuels are yet to be developed

METHANOL BUNKERING

- Methanol bunkering is very similar to Marine Gas Oil or Heavy Fuel Oil bunkering because it does not require cryogenic storage. So the disadvantage of the lower energy density of methanol compared to traditional fuels is mitigated by the fact that methanol can be stored in conventional fuel storage tanks, unlike fuels such as LNG and H₂
- Furthermore, methanol is subject to the same bunkering guidelines and safety standards as conventional marine fuels.
- As one of the world's most widely shipped chemical commodities and fuels, methanol is currently available at over 120 ports worldwide.
- Deploying methanol as a marine fuel lowers emissions of sulfur oxides (SO_x), nitrogen oxides (NO_x) and particulate matter (PM) compared to Heavy Fuel Oil (HFO) or Marine Gas Oil (MGO)
- Ship operators can immediately comply with the IMO's most stringent SO_x and PM emissions regulations by switching to methanol.

WORLDWIDE PORTS WITH METHANOL BUNKERING INFRASTRUCTURE



Source: Methanol Institute

- Storage + bunkering
- Storage + bunkering
- Storage + bunkering



Marine methanol emissions reductions vs HFO/MGO

SO_x -99% PM -95% NO_x Up to -80%

Source: Methanol Institute

Methanol as a fuel (III/III)

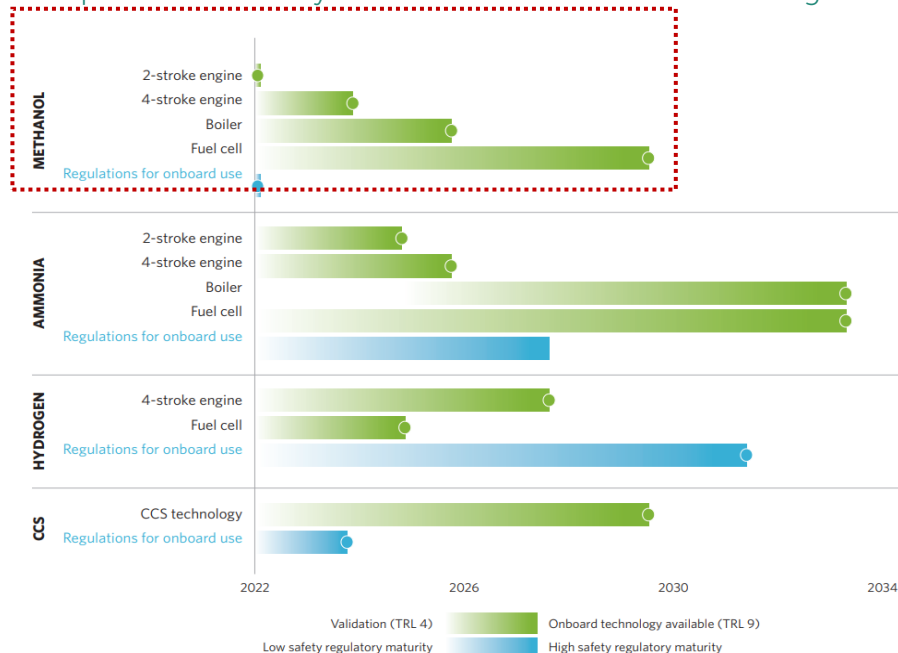
The assessment of technology readiness of methanol as fuel shows that the methanol fuel system consists mostly of well-known components along the whole value chain (bunkering of methanol; engines; methanol handling towards main engine, in the main engine and after the main engine) and is ready to be deployed today.

In contrast, safety regulations for other alternative fuels such as ammonia are yet to be developed

METHANOL INTERNAL COMBUSTION ENGINES

- Two-stroke main engines and four-stroke methanol auxiliary engines are already commercially available. Manufacturers such as MAN Energy Solutions are already commercializing dual-fuel, methanol-ready two-stroke engines, some of which have been operating since 2016
- For these dual-fuel engines, no modifications are needed inside the engine to run on methanol, in contrast to other alternatives that require safety regulations (toxicity for ammonia) and key technology developments

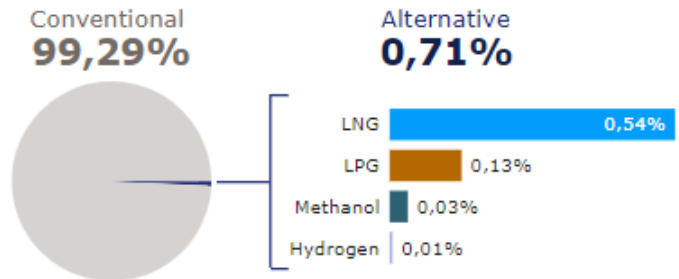
Expected availability of alternative marine fuel technologies



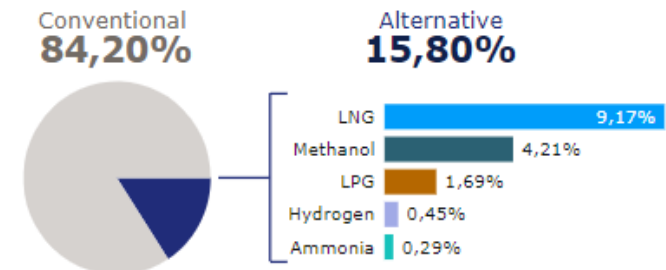
Source: Methanol Institute

% OF CURRENT AND FUTURE FLEET ALREADY USING METHANOL AS A FUEL

In operation



On order



Source: DNV, Alternative Fuels Insight

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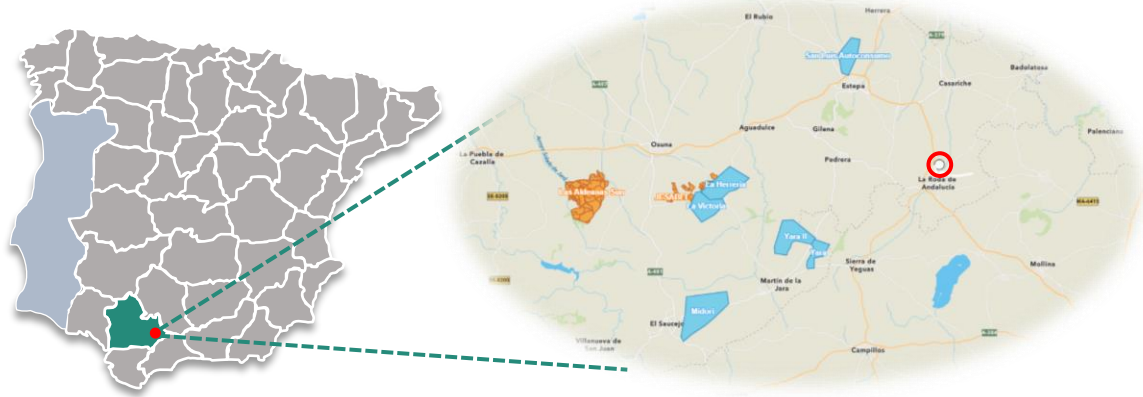
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Sierra Sur green methanol project

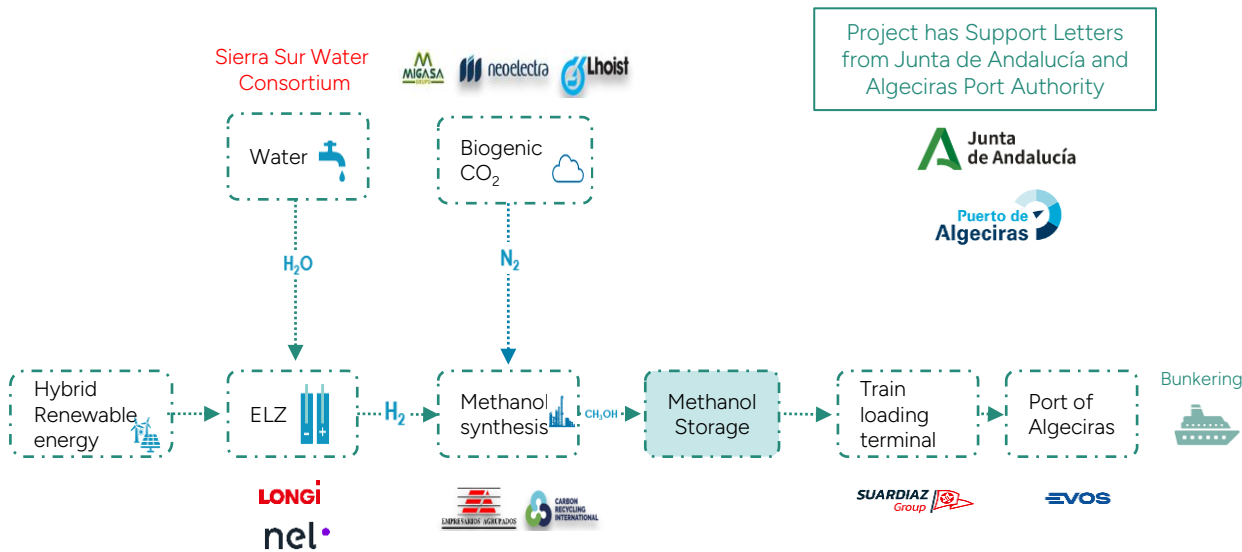


○ Sierra Sur Project
 ■ PV projects
 ■ Wind projects

Renewable energy projects

NAME	Technology	MW	Yield (est.)
La Herrería	Wind	41	2,519h
La Victoria	Wind	30	2,521h
Midori	Wind	35	2,823h
Pinarejo I	Wind	32	2,529h
Pinarejo II	Wind	18	2,738h
Yara I	Wind	18	2,254h
Yara II	Wind	47	2,254h
Hinojosa	Wind	41	2,455h
San Luis Autoconsumo	Wind	24	2,111h
Jesabel	PV	89	2,182h
Pinarejos I Solar	PV	41	2,147h
Pinarejos II Solar	PV	30	2,197h
Las Aldeanas Sun	PV	178	2,204h

General project scheme

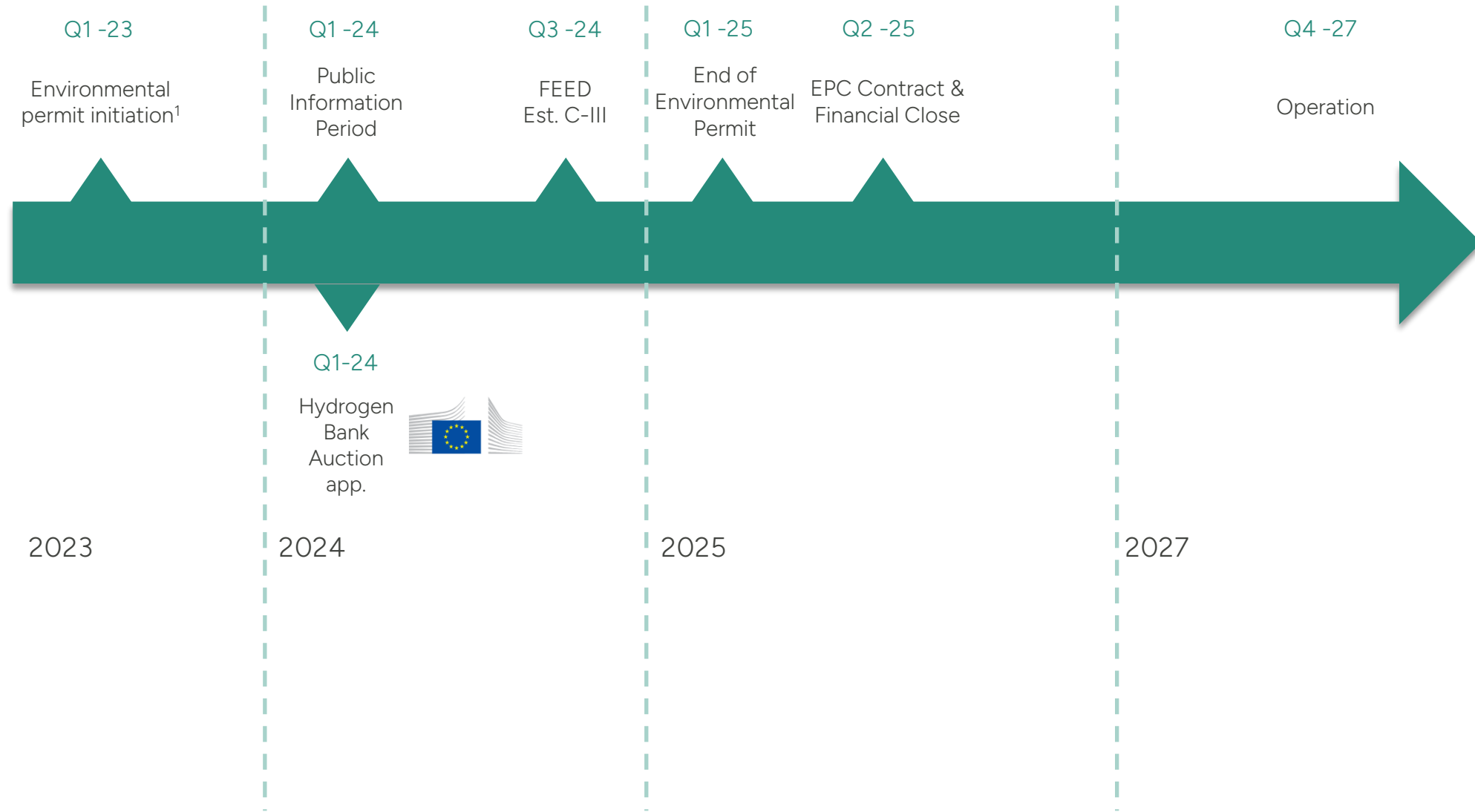


Industrial plant main KPIs and permitting status

POWER H ₂	PRODUCTION H ₂	PRODUCTION CH ₃ OH	CONSUMPTION H ₂ O		
170 MW	20,000 Tm/y	130,000 Tm/y	60 m ³ /h		
BASIC PROJECT	ENVIRONMENTAL	STRATEGIC INTEREST	GRID POC	WATER	LAND
Done INERCO	In progress ¹	In progress	Ampliation submitted ²	Confirmed	Secured

1) Project was launched to Public Information on March-23
 2) Project already has 10,5MW of consumption. Alkemyria has requested up to 244 MW of consumption capacity

Sierra Sur preliminar schedule



¹AAI (Autorización Ambiental Integrada)

Financing strategy

Alkeymia is already discussing several opportunities for the financing of the project. Based on preliminary conversations with financial institutions and our experience with project's financing hypothesis, a % of the project Capital Expenditures will be financed through senior bank debt and the remaining percentage would be contributed in the form of equity.

Status of conversations regarding both financing pathways are the following:

- **Equity:** several conversations are being carried out with equity investors
- **Loans:** conversations with Tier 1 banks in Spain have already taken place

Sierra Sur Project has been submitted Hydrogen Bank Auction on Feb-24, whose objective is to support manufacturing projects of innovative clean technology components for the production/consumption of hydrogen, renewable energy and energy storage.

- **IF 2023 Auction - RFNBO Hydrogen**, auction with a budget of 800 M€ and closing date of February 8th. The auction will grant a **fixed premium** for each kg of H₂ produced for 10 years with a limit of 4.5€/kg of H₂ and EUR 266.7M per company.



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The world is transitioning towards **new decarbonization pathways** apart from renewable electricity. These new alternatives demands supranational policies and sectorial regulations that force players to reduce emissions.

The **shipping industry has already begun the race for decarbonization**. Regulations such as IMO, the EU-ETS and Fuel EU Maritime will take out of the market those players who do not comply with the objectives.

From a cost-perspective, **low carbon fuels are likely to remain more expensive than fossil fuels**, suggesting that the widespread adoption of low carbon marine fuels requires policy interventions such as the increase of price on carbon.

Regarding supply, as the **methanol is a globally traded commodity**, shipping operators would have no problem on sourcing.

At Alkeymia **we aim to substitute the current methanol production by new green processes** that do not generate GHG emissions, helping consuming industries to decarbonize its activities and contributing to a cleaner world.



Gracias / Thank you

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