EDF ENVIRONMENTAL DEFENSE FUND®

Finding the ways that work

Creating a world fit for the future

RICARDO

Decarbonisation of Shipping: Grasping the Trillion-Dollar Market Opportunity

Webinar with the Getting to Zero Coalition

24 April 2020

www.ricardo.com

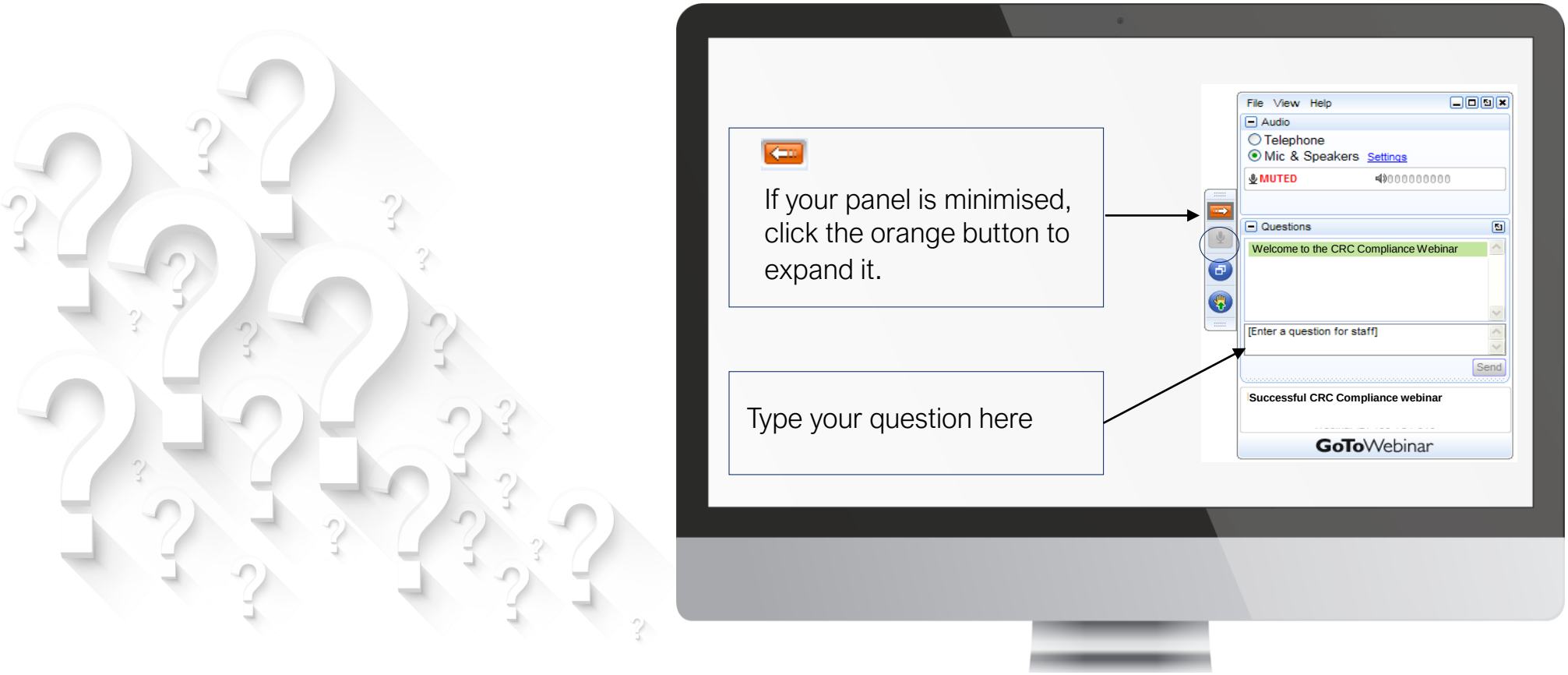
The webinar will begin shortly

Any questions?

You can submit your question or comment in writing at any time during the webinar using the control panel on your screen.

(The control panel is usually located in the top right or top left of your screen.)

Attendee control panel



Getting to Zero Coalition

GLOBAL MARITIME FORUM

FRIENDS of OCEAN ACTION

WORLD ECONOMIC FORUM

Ambition of the Coalition

To have commercially viable Zero Emission Vessels (ZEVs) operating along deep-sea trade routes by 2030, supported by the necessary infrastructure for scalable net zero-carbon energy sources including production, distribution, storage and bunkering

131 Coalition Members

109 Companies
8 Knowledge Partners
11 Supporters
3 Project Partners

14 Supporting Governments

Denmark, Belgium, Chile, Palau, Morocco, Korea,

Ireland, United Kingdom, New Zealand,

Sweden, France, Finland, Netherlands, Poland

Today's panellists

Johannah Christensen
Managing Director
Global Maritime Forum

Nick Ash
Principal Consultant
Ricardo

Aoife O'Leary
Director – International Climate
Environmental Defense Fund Europe

Benjamín Maluenda Philippi
Specialist - Energy Planning and Regulatory Impact Assessment Division
Ministry of Energy, Government of Chile

Tue Johannessen
Senior Innovation Portfolio Manager
A.P. Møller – Maersk

A global strategic engineering and environmental consultancy that specialises in the transport, energy and scarce resources sectors

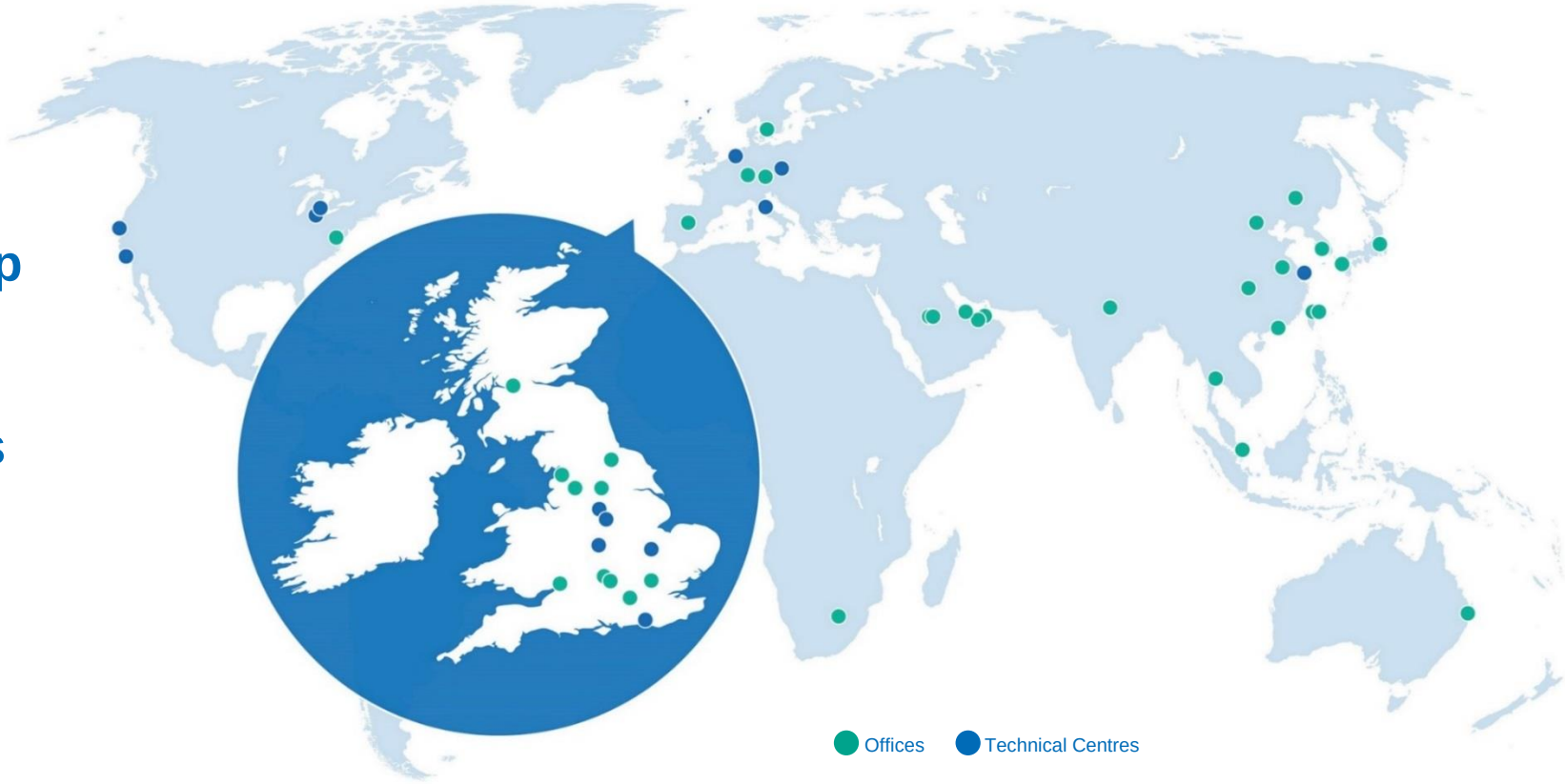
Ricardo Group

3,000+ people

85 nationalities

48 sites

21 countries



EDF ENVIRONMENTAL DEFENSE FUND®

Finding the ways that work

Our mission is to preserve the natural systems on which all life depends. Guided by science and economics, we find practical and lasting solutions to the most serious environmental problems.

Working across the political spectrum

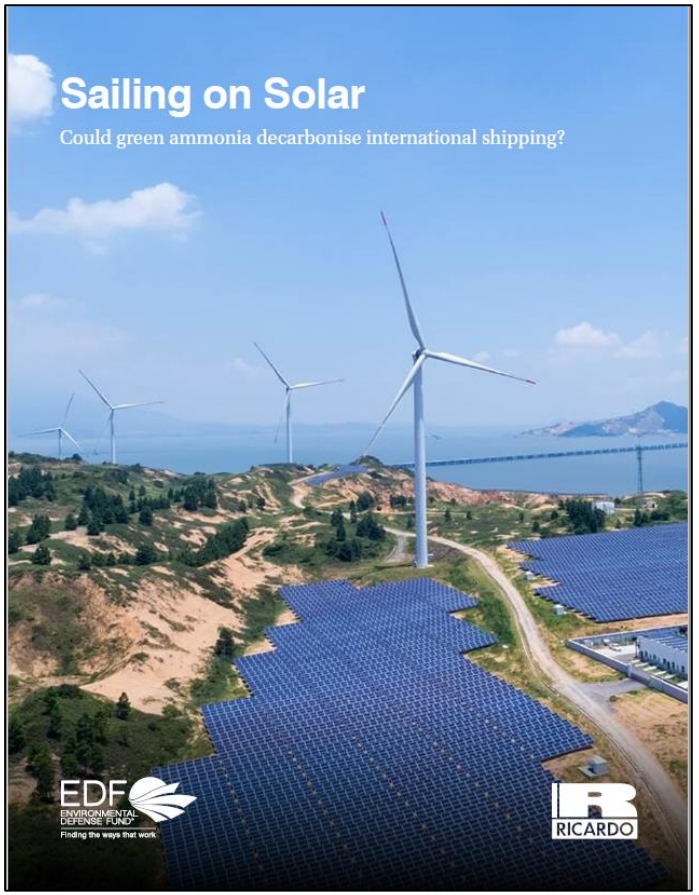
Presenting a positive vision

Investing in science and data analysis

Using legal and economics expertise to design lasting solutions

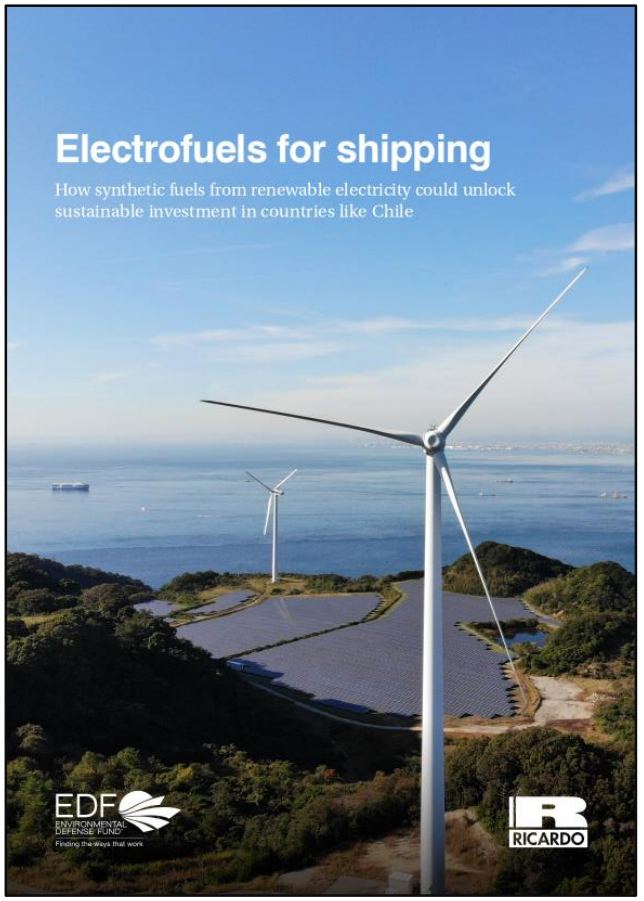
Working with strategic partners across all sectors

This presentation draws on two Ricardo reports for Environmental Defense Fund



Sailing on Solar

Could green ammonia decarbonise international shipping?



Electrofuels for shipping

How synthetic fuels from renewable electricity could unlock sustainable development in countries like Chile

Relevant images reproduced in this presentation © EDF, used with permission

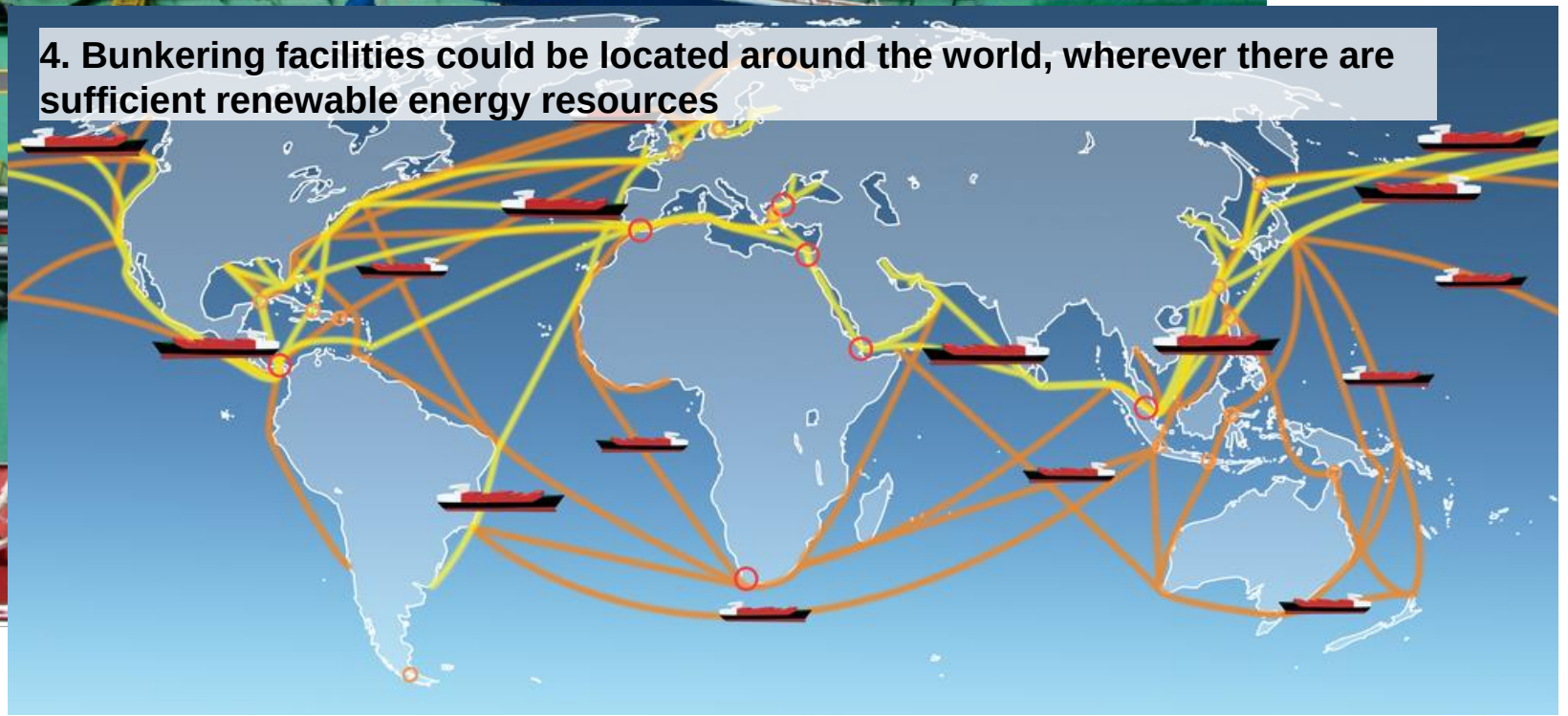
Four co-benefits of using green electrofuels to decarbonise shipping

1. Electrofuels will drive investment in renewables

2. The deployment pathway can begin using existing and familiar technologies (i.e. internal combustion engines)

3. There are established safety protocols for storing and transporting ammonia and methanol

4. Bunkering facilities could be located around the world, wherever there are sufficient renewable energy resources



A 1 trillion dollar investment opportunity

"The scale of cumulative investment needed between 2030 and 2050 to achieve the IMO target ... is approximately USD 1.0 - 1.4 trillion."

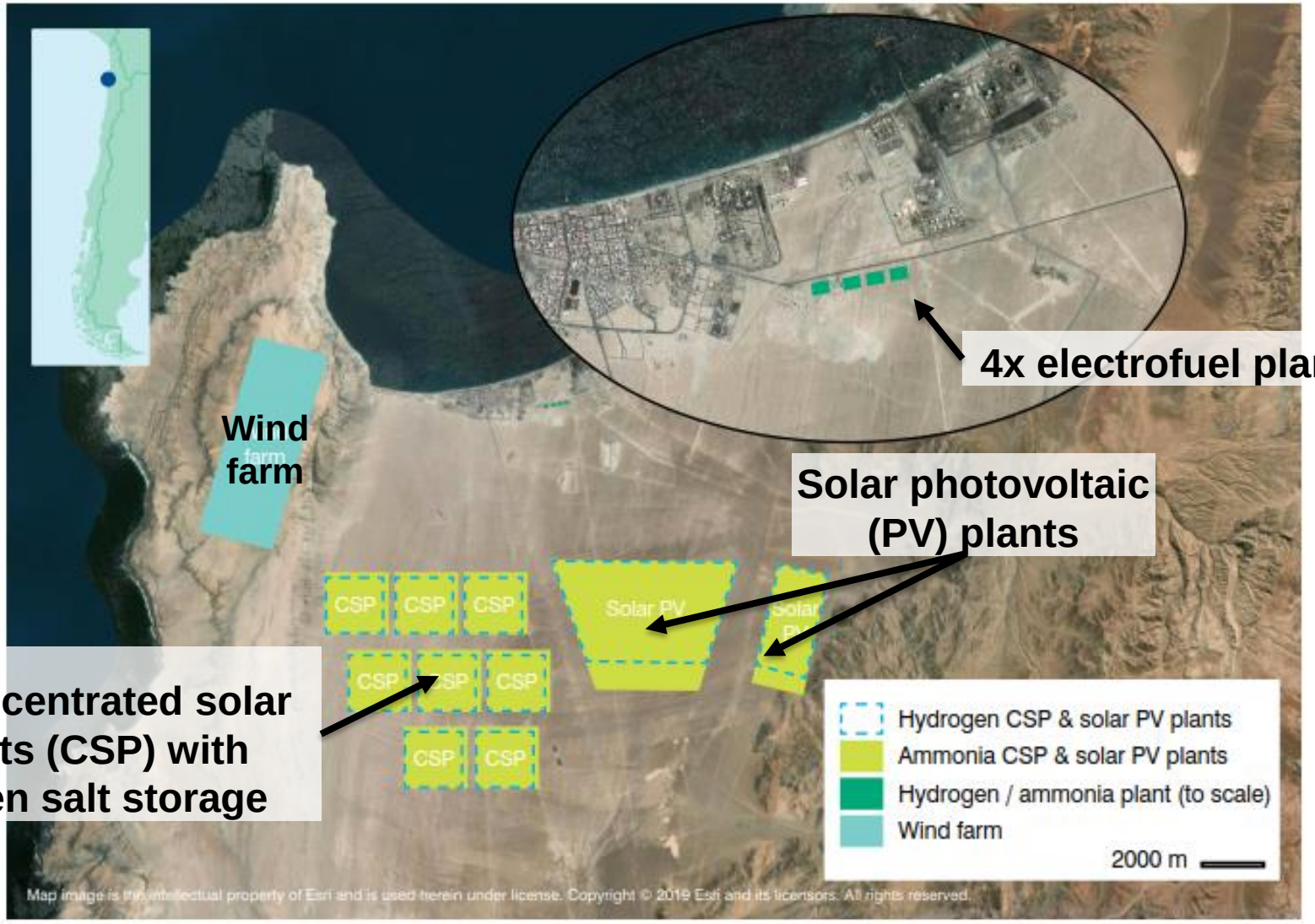
Global Maritime Forum, 2020

“If shipping was to fully decarbonise by 2050, the total investments needed [would be] between USD 1.4 - 1.9 trillion dollars.”

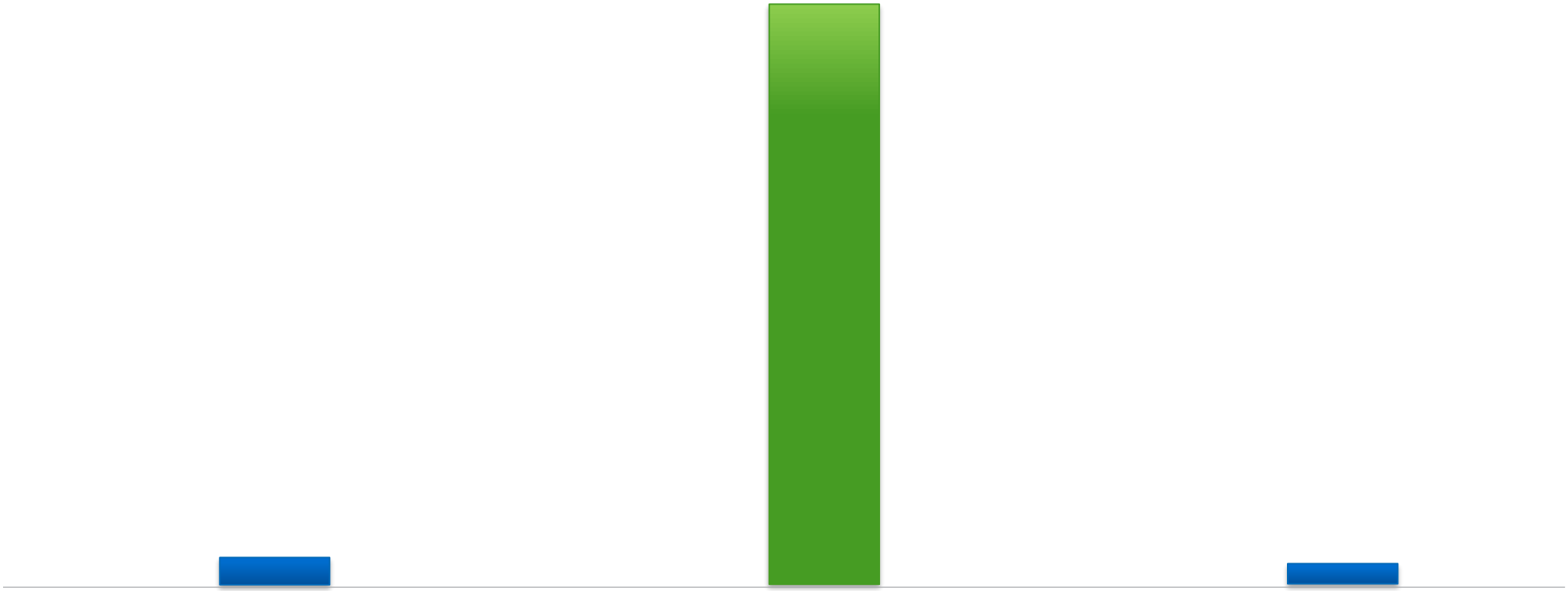
Source: https://www.globalmaritimeforum.org/news/the-scale-of-investment-needed-to-decarbonize-international-shipping

A hypothetical case study at Mejillones Port in Chile

Scale of renewable plants required for four electrofuel plants at Mejillones



There is huge exploitable potential for renewable energy in Chile



Renewable electricity required to supply fuel to the ships visiting Chile's ports on an average day in 2018:

Hydrogen: 270GWh
Ammonia: 290GWh

Solar potential in Chile:

1,261GW*
(~6,000GWh per day)

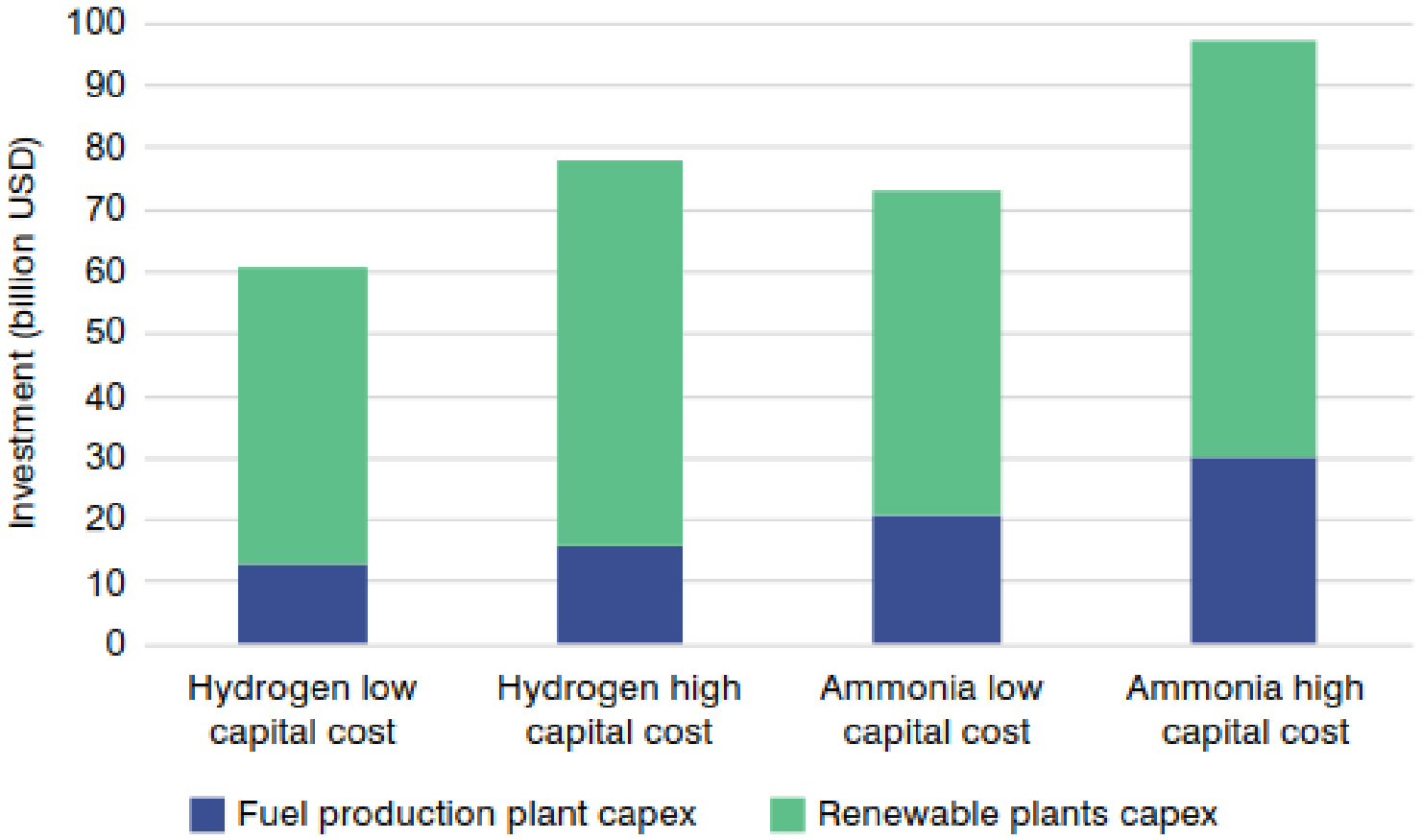
Average daily electricity consumption in 2018:

210GWh**

Sources:
*C. Santana, "Renewable Energies in Chile: Wind, Solar, and Hydro Potential from Arica to Chiloé," Expansion Strategy for Grid Connected Renewable Energy (MINENERGIA / GIZ), Santiago, 2014.
**CNE - Anuario 2018

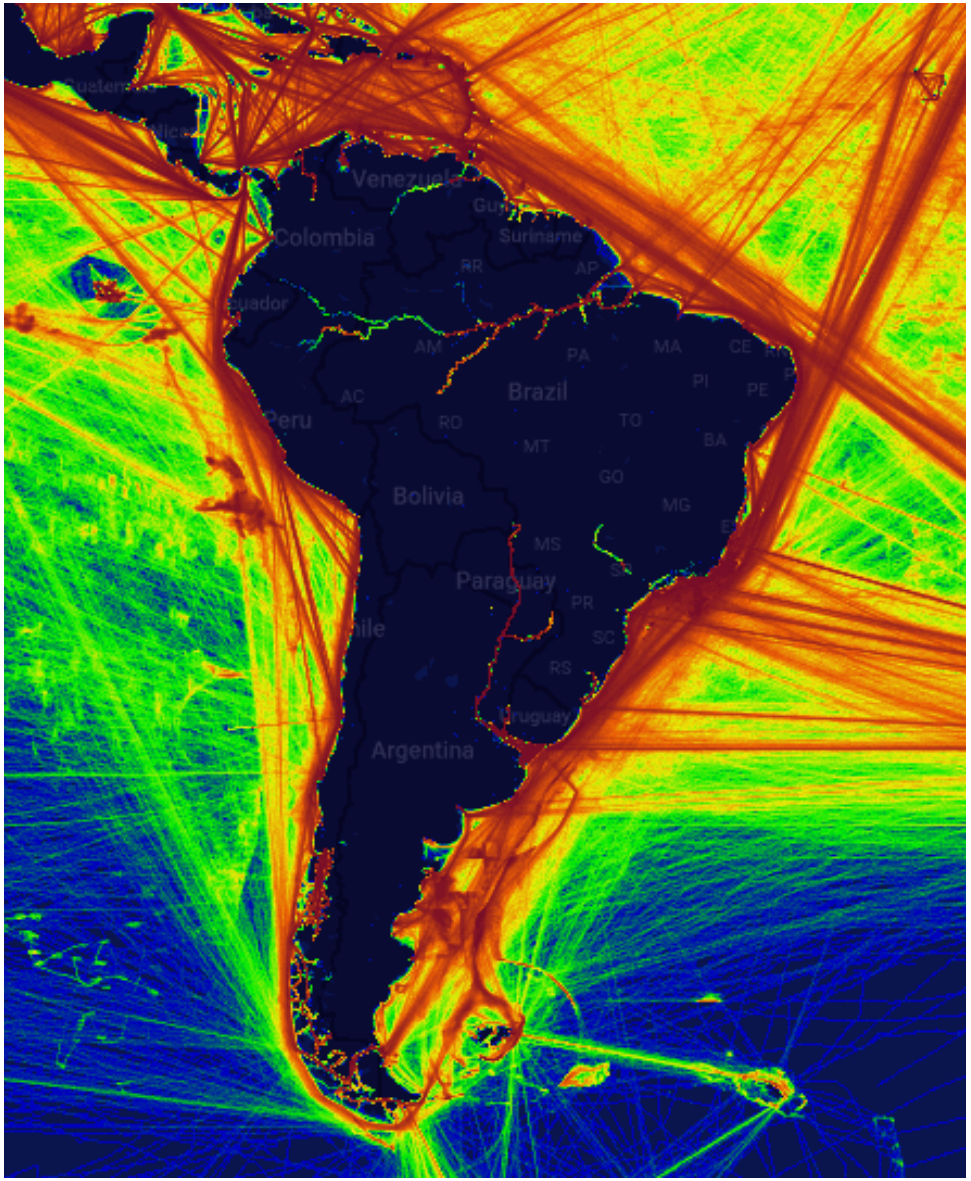
The investment potential in Chile is $60 - 90 bn

Estimated level of investment for hydrogen and ammonia to fuel the ships visiting Chile's ports in 2018



Teaser: Expected in summer of 2020

Study showing how zero-carbon shipping routes could **catalyse investment** in sustainable industrial development within Central and South America.

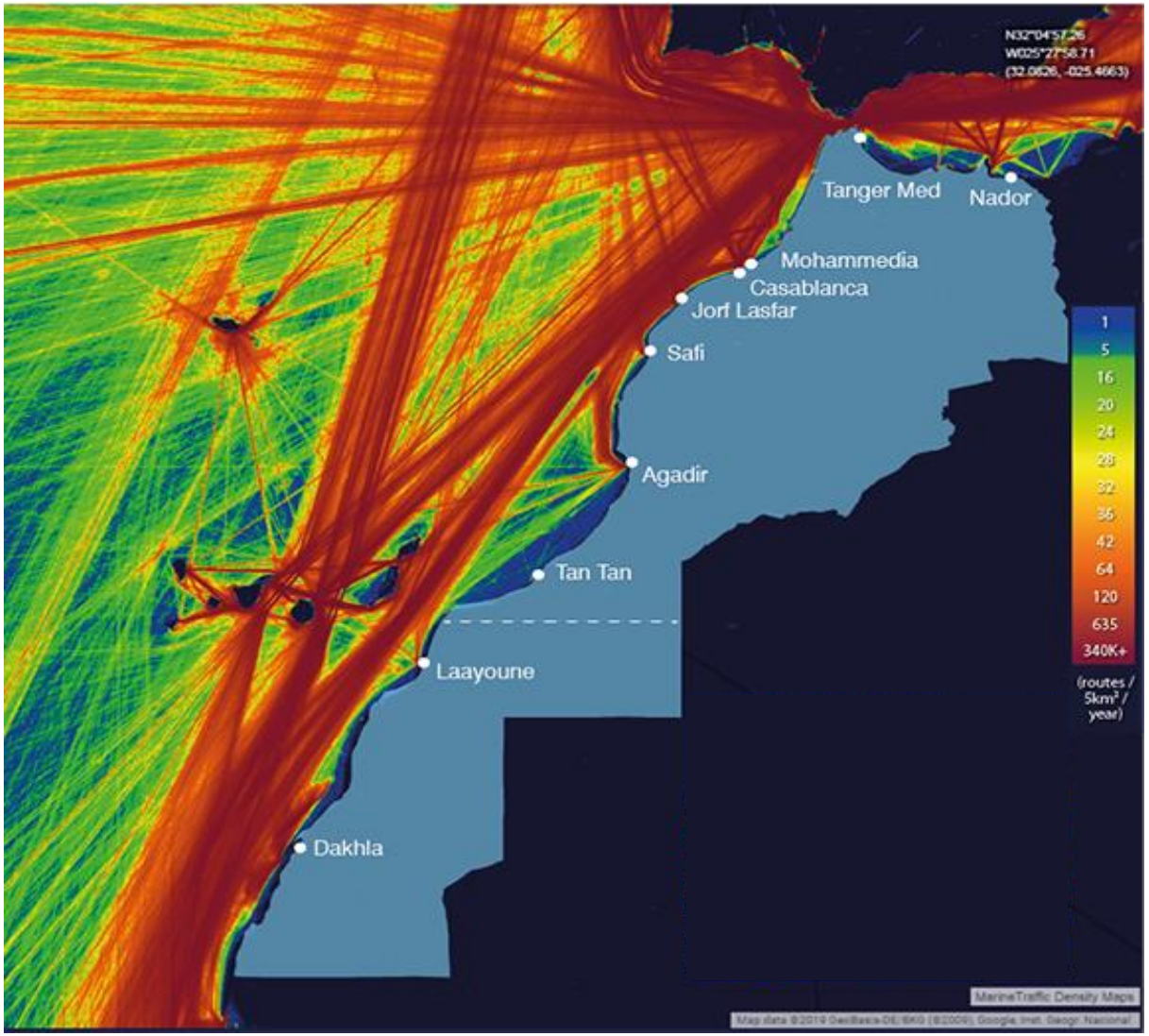


Map taken from MarineTraffic (www.marinetraffic.com)

Morocco case study

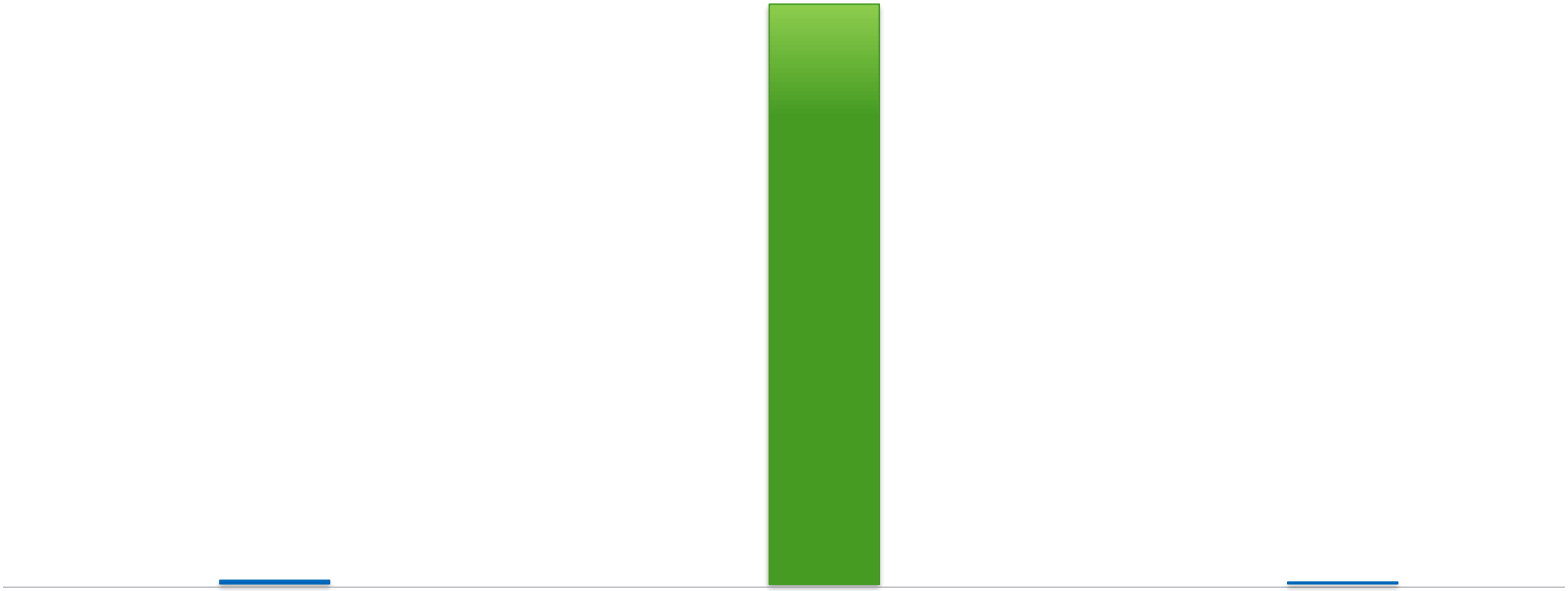
Key advantages

- Located along busy shipping lanes
- Abundant renewable resources with ambitions to expand
- Established inorganic chemistry sector



Map taken from MarineTraffic (www.marinetraffic.com)

There is vast exploitable potential for renewable energy in Morocco



Renewable electricity required to supply ammonia container and dry bulk vessels passing through Morocco's ports in 2017:

300 GWh/day*

Theoretical potential of solar + wind:
~48,000 GWh per day**

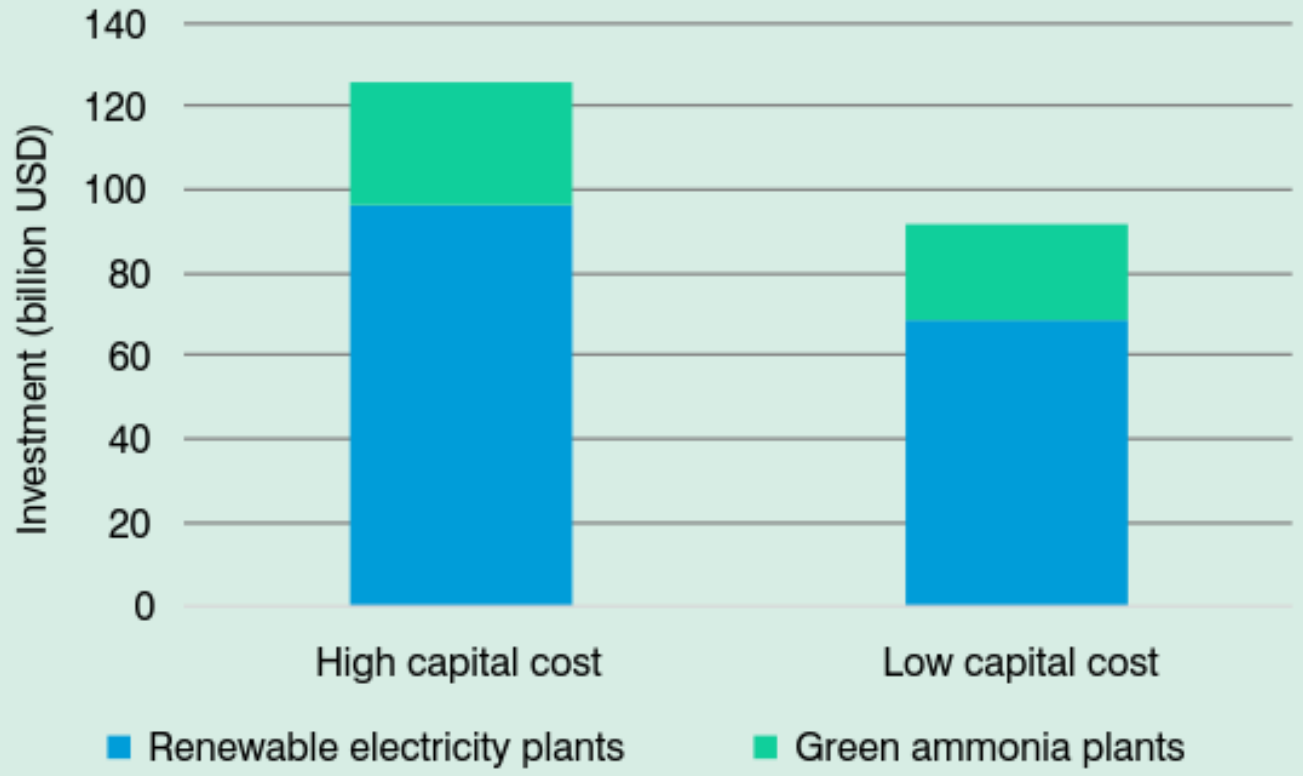
Average daily electricity consumption in 2017:

92 GWh***

Sources:
* Sailing on Solar
** IRENA (2014) "Estimating the Renewable Energy Potential in Africa"
*** IEA (2020) "Key Energy Statistics – Morocco"

The investment potential is about $100 bn in Morocco alone

Estimated investment potential for green ammonia plants and renewable electricity plants in Morocco



Policy solutions for zero-carbon shipping

Aoife O’Leary

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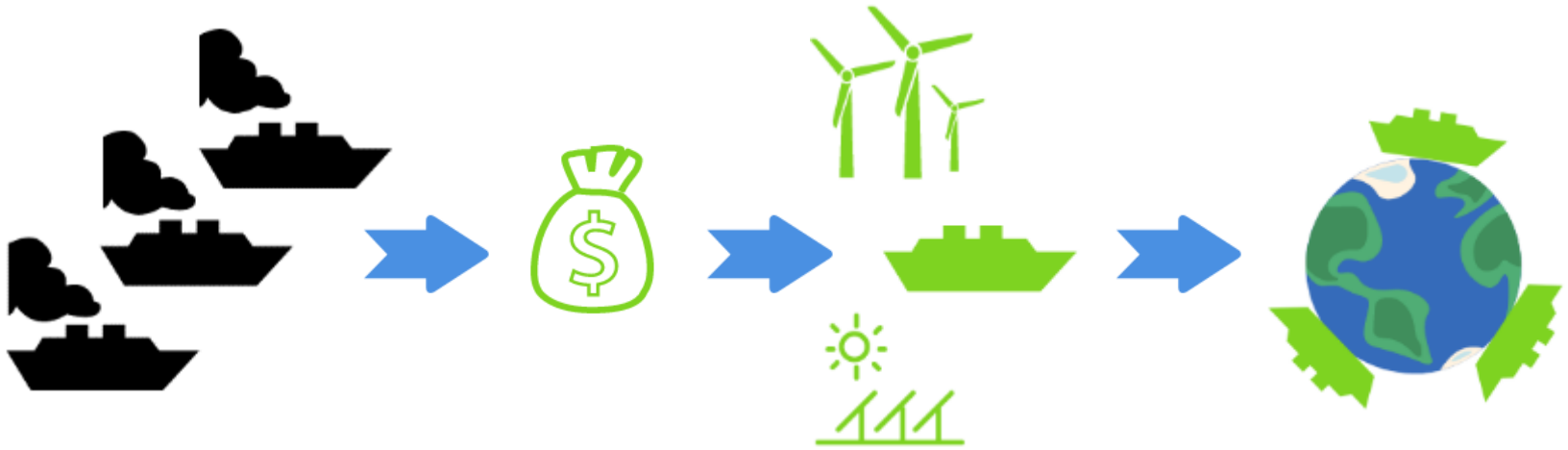
Funding green shipping



Driven by the industry

Marine Environment Protection Committee
75th Session
Agenda Item 7

MEPC 75/7/4
18 December 2019
Original: ENGLISH
Pre-session public release: ☒

REDUCTION OF GHG EMISSIONS FROM SHIPS

Proposal to establish an
International Maritime Research and Development Board (IMRB)

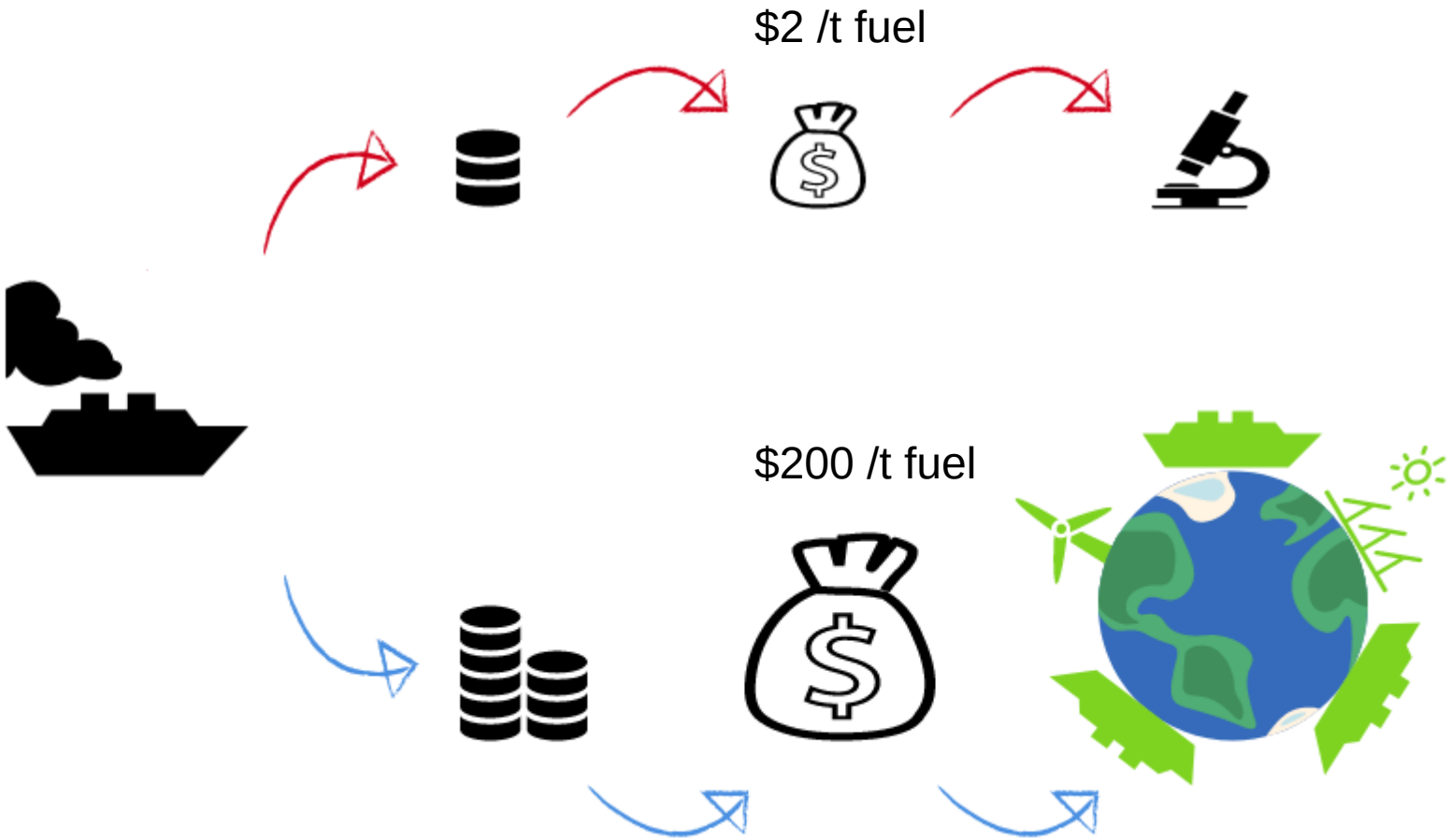
Submitted by
BIMCO, CLIA, ICS, INTERCARGO, INTERFERRY, INTERTANKO, IPTA, and WSC

SUMMARY

Executive Summary: This document proposes the establishment of an IMO GHG reduction research and development programme to accelerate the introduction of low-carbon and zero-carbon technologies and fuels as identified in paragraph 4.7.9 of the IMO Initial Strategy on the Reduction of GHG Emissions from Ships. The proposed action is considered critical to achieving the levels of ambition for 2050 and beyond set forth in the IMO GHG Strategy. The co-sponsors propose that core funding would be provided via a *mandatory* R&D contribution per tonne of fuel oil purchased for consumption which will be necessary to maintain an appropriate level of funding and to maintain fair competition between shipping companies. The co-sponsors propose that core funding of approximately five billion US dollars over the life of the programme would fundamentally alter the current level of investment in maritime R&D focused on the development of low-carbon and zero-carbon technologies. An effort of this scale is expected to be successful in identifying one or more technical pathways that can lead to the introduction of zero-emission vessels across the maritime sector by 2030 and beyond.

Source: https://www.ics-shipping.org/docs/default-source/Submissions/IMO/final-imrb-submission-to-mepc-75.pdf?sfvrsn=6

Cost vs opportunity



Ambitious enough for Europe?

Today's panellists

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A.P. Møller – Maersk

Ministerio de Energía

Gobierno de Chile

24.04.2020

Chile as a Supplier of Green Fuels for the Maritime Industry

Renewables Success Story in Chile

Attractive for clean energy investments

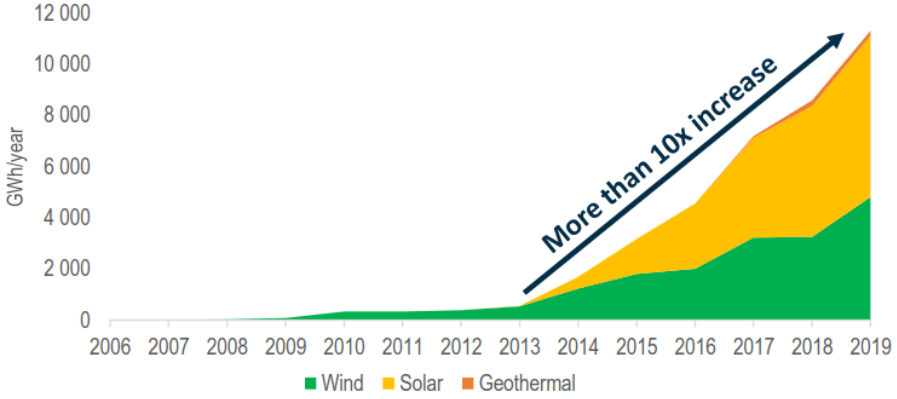
- Renewables energies are developing at an accelerated pace in Chile
  - During 2019, 44% of electricity was generated using renewable energy sources.
  - 14% of this generation was wind and solar energy.
  - Government target is to reach 70% of renewable energy generation by 2030.
- The Country has a huge renewable potential of more than 1.7 TW, 70 times Chile's installed capacity.
- More than 70% of the investment pipeline is wind and solar generation.

Large renewable energy potential yet untapped

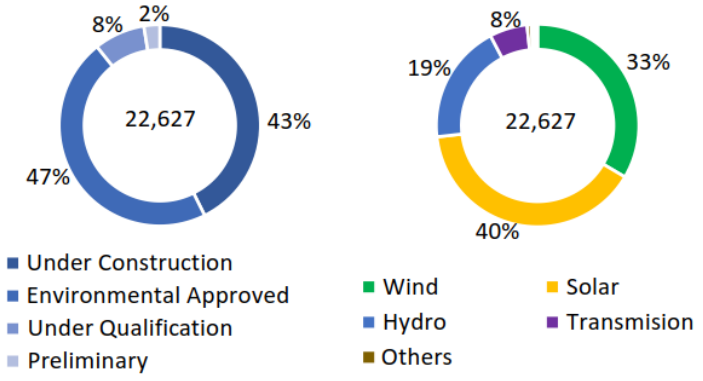
Technology	Potential (GW)
Wind	37
Solar - PV	1,194
Solar - CSP	510
Total	1,741

>70x Chile's installed capacity
>8 times Germany's capacity

Wind & Solar reached 14% of total generation in 2019

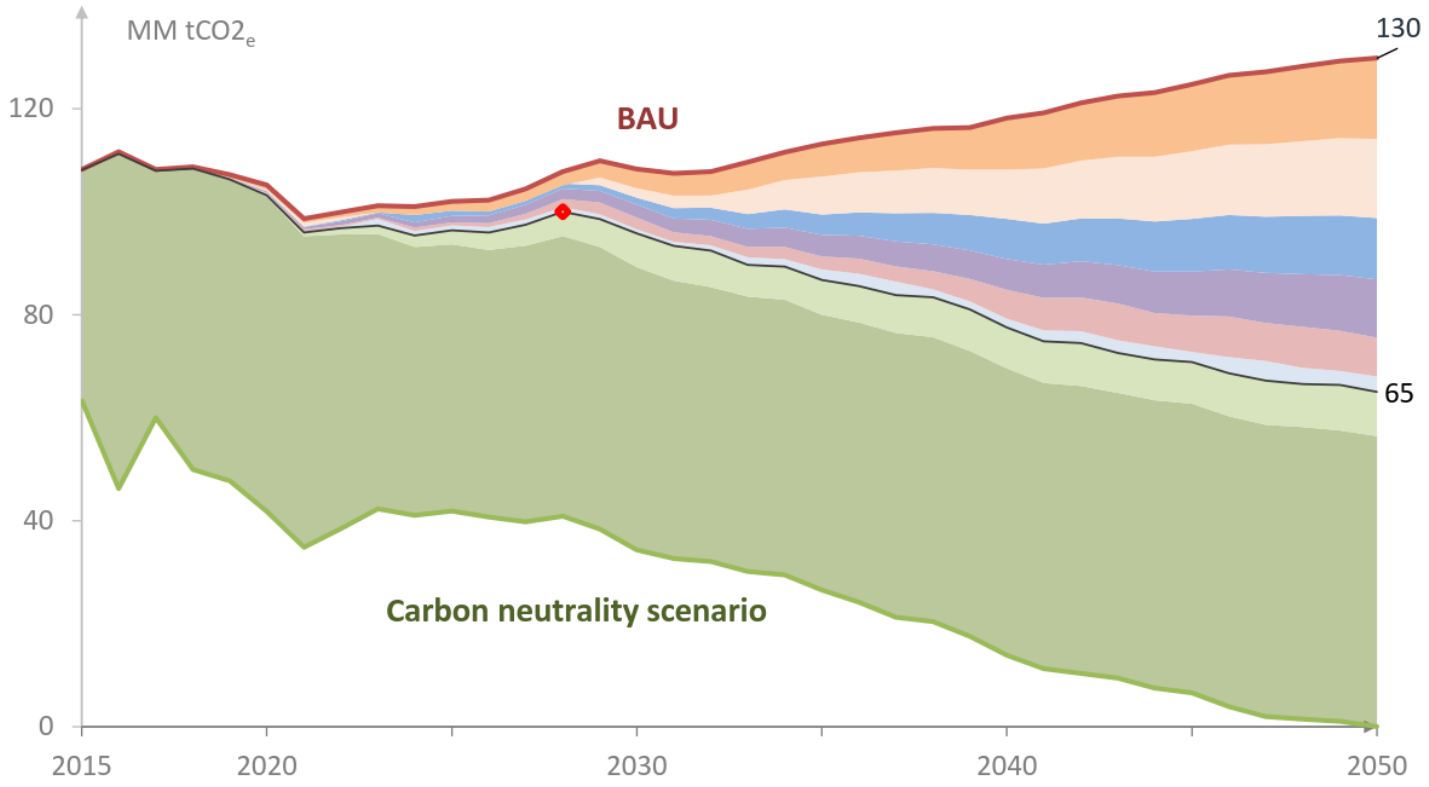


Investment pipeline (MUS$)



Green hydrogen: Key for the carbon-neutrality 2050 strategy

Measures to reach carbon neutrality by 2050



Cost-effective measures for carbon-neutrality by 2050

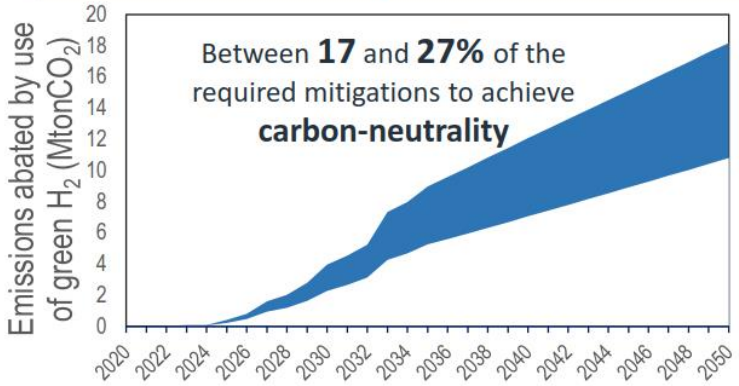
- Sustainable industry (25%)
- Green hydrogen (21%)
- Electromobility (17%)
- Sustainable building (17%)
- Coal plant phase out (13%)
- Energy efficiency (7%)
- Forestation

Existing forest sinks

Two key opportunities to be harnessed by Chile

Ministerio de Energía
Gobierno de Chile

Enable carbon-neutrality



Generate growth and value

Green hydrogen production cost estimates 2030, IEA

1 trillion US$ H_2 sales market by 2050 (Hydrogen Council, 2019)

160 Mton potential production of green H_2 in Chile (IEA, 2019)

National Green Hydrogen Strategy in development

→ **to enable and promote**

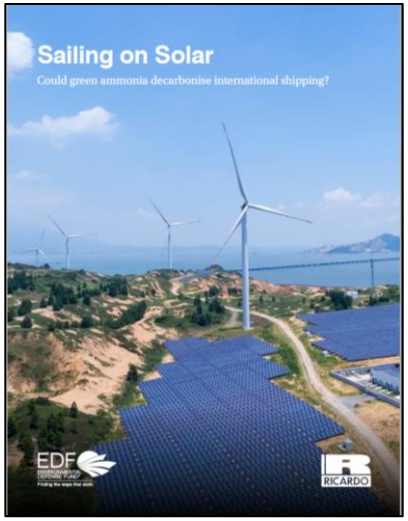
A national and export industry for green H_2 and its derivatives as clean fuels for the global energy transition

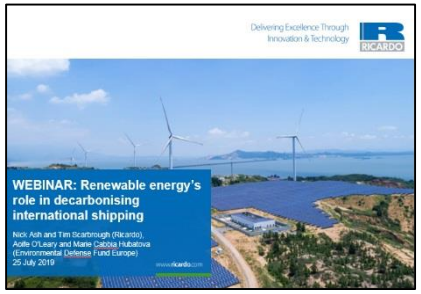
24.04.2020

Chile as a Supplier of Green Fuels for the Maritime Industry

You might be interested in further information, which can be found by clicking the icons below:

Sailing on Solar report and webinar recording:





Electrofuels for Shipping report and webinar recording: