Ammonia Project Features

(Tuesday 27 September, 2PM CEST, online via Zoom Webinar)

Renewable ammonia in operation

Marc van Doorn
Head of Green Developments in Hydrogen, Ammonia and Fertilizer, Grupo Fertiberia

Imanol Arrizabalaga Prado
Sales and Business Director South Europe, NEL ASA

In conversation with:

Kevin Rouwenhorst (Technology Manager, AEA)

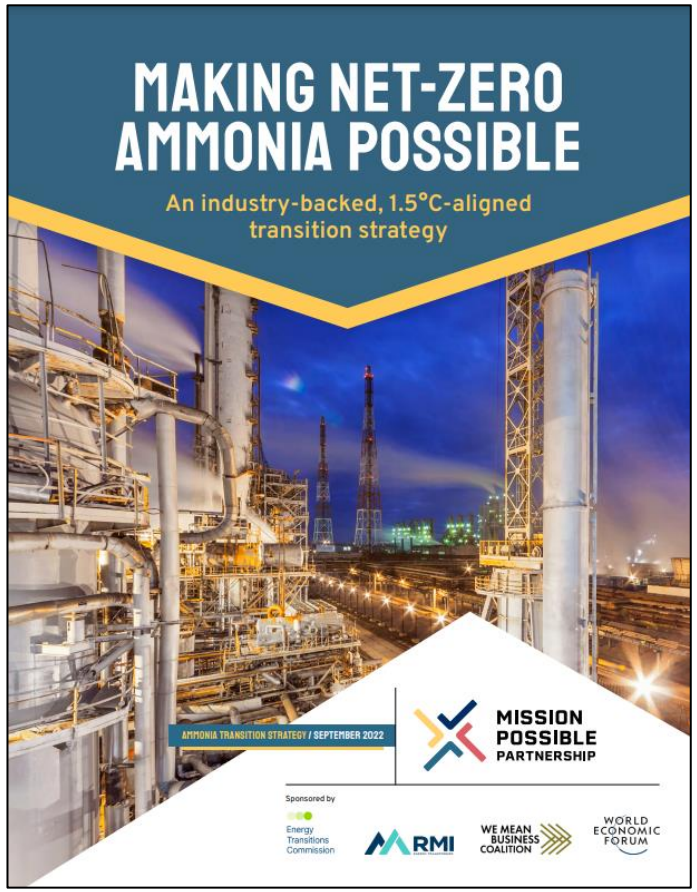
Fertiberia

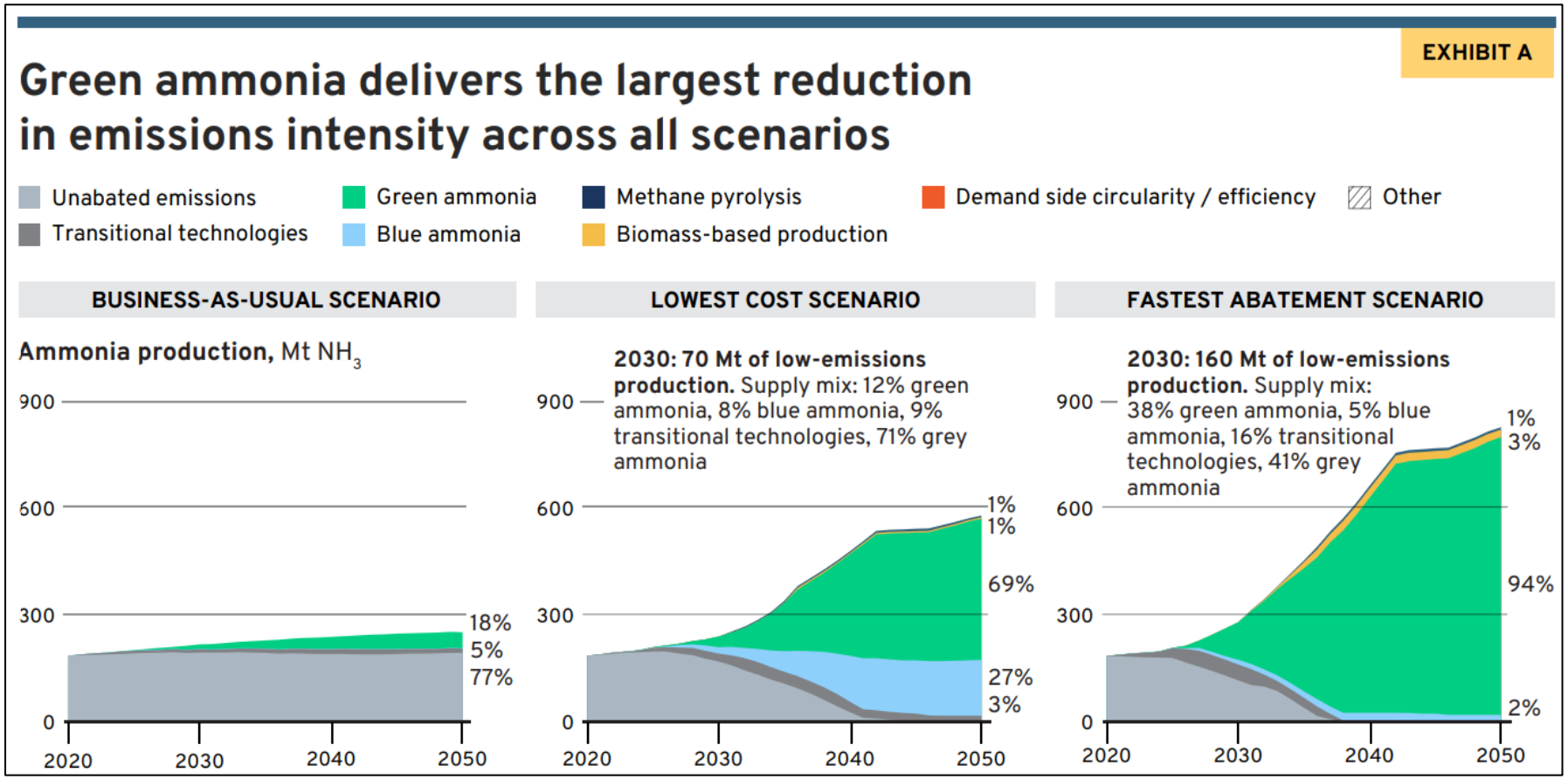
nel

AMMONIA ENERGY ASSOCIATION

Mission Possible Partnership Report

AMMONIA ENERGY ASSOCIATION

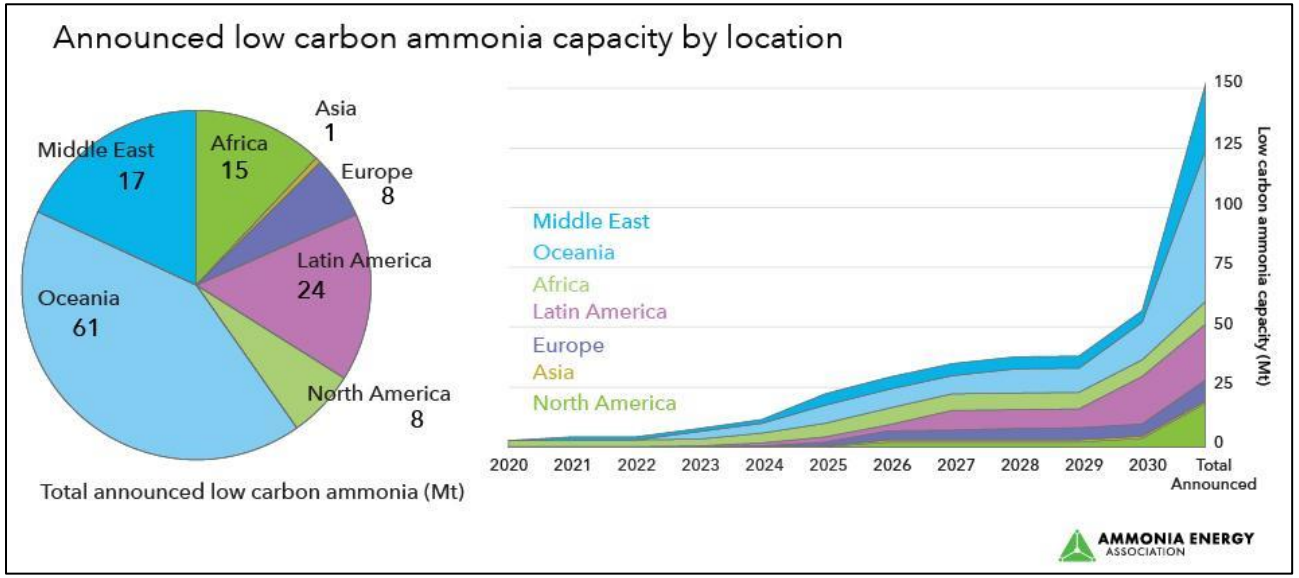




Link: https://missionpossiblepartnership.org/wp-content/uploads/2022/09/Making-1.5-Aligned-Ammonia-possible.pdf

Low carbon ammonia plant list

- AEA is tracking low-carbon ammonia plants in development worldwide
- More than **150 million tons** of potential capacity has already been announced
- **4 million tons** of fossil-based low-carbon ammonia is already in production (primarily byproduct hydrogen or CCU / EOR)
- This volume could expand to **15 million tons** by 2030 (mainly CCS)
- By 2030, **55 million tons of renewable ammonia** has been announced
- In total, beyond 2030, **133 million tons of renewable ammonia** has been announced



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Ammonia Project Features

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Renewable ammonia projects in Northwest Africa

Nouri Chahid
General Manager Morocco & Mauritania, CWP Global

Lloyd Pinnell
Associate, SYSTEMIQ Ltd.

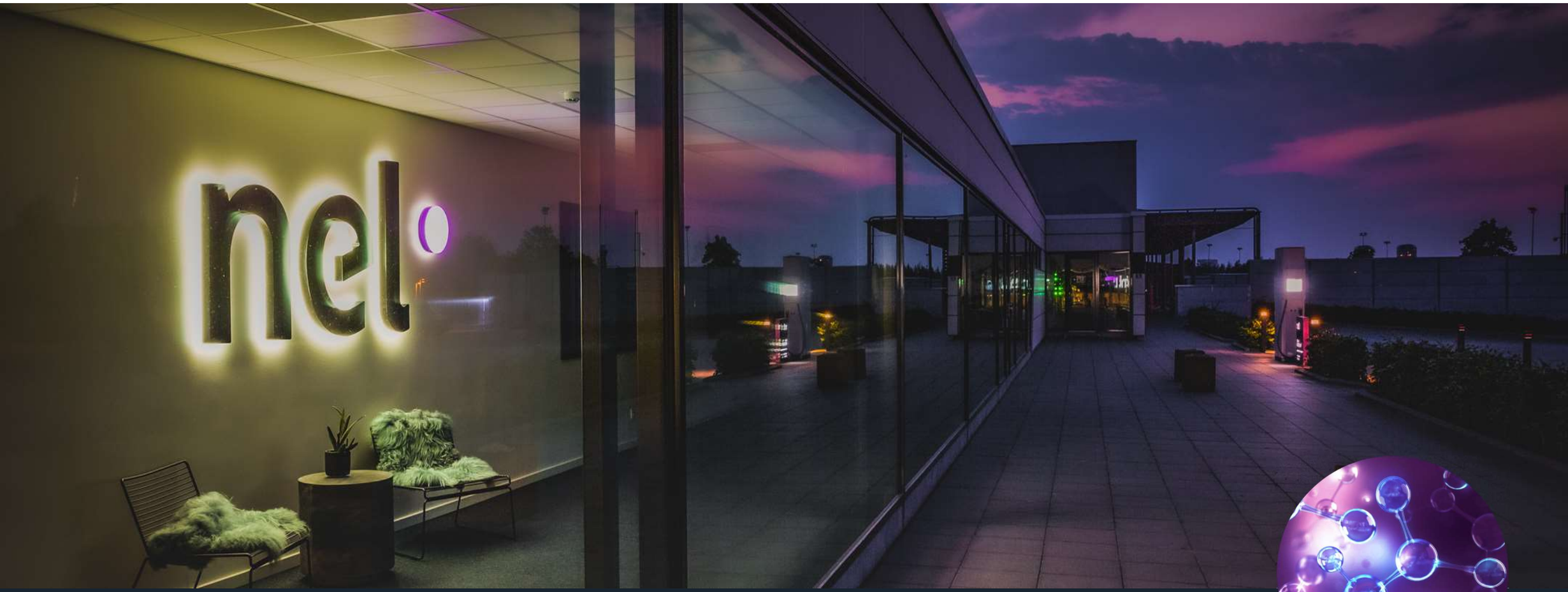
In conversation with:

Andrea Guati Rojo (Stakeholder Relations Manager, AEA)

CWP GLOBAL

SYSTEMIQ

AMMONIA ENERGY ASSOCIATION



Nel Hydrogen Electrolyser

Leading the path to green renewable hydrogen at large industrial scale

imanol@nelhydrogen.com

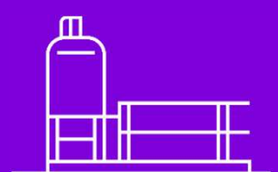
Solutions and Technology offering to enable the green transition

Leading pure play hydrogen technology company with a global footprint

Electricity production

Electricity is generated from wind or solar

Hydrogen production



Electrolysers

Nel expertise using electricity to split water (H_2O) into hydrogen and oxygen

H2Station™

Nel in mobility with hydrogen compressed and cooled in H2Stations™ ready for fueling through the dispenser

Industrial applications

Green hydrogen has a massive potential to decarbonise industries, i.e. ammonia and steel

Fuel Cell Electric Vehicle

Hydrogen fueling is relevant for both light duty vehicles (LDV) and heavy-duty vehicles (HDV)

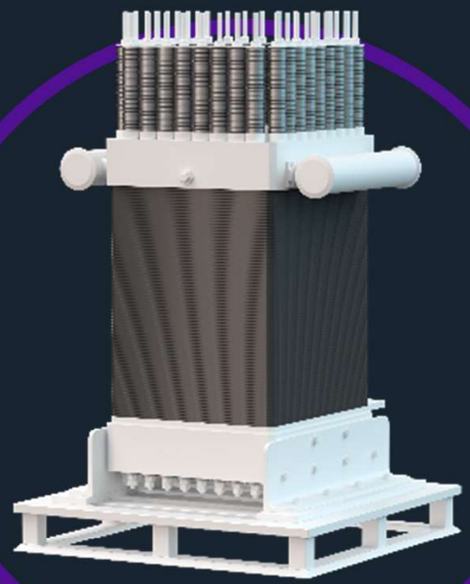
Power-to-X

Hydrogen is expected to become relevant within all forms of industry, energy storage, heating, energy export and new applications

NEL TECHNOLOGIES

A technology leader on two electrolyser platforms

Alkaline



PEM

- Provides flexibility and positions us for growth in different market segments around the world

Broadest water electrolyser product portfolio in the market

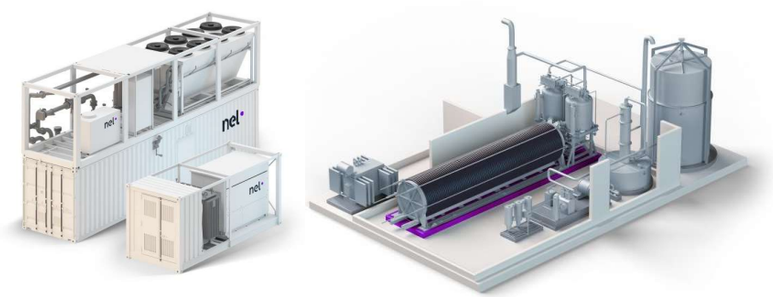
SOLAR WIND HYDRO

Wide proven experience
Alkaline electrolysers since 1927 and
PEM electrolysers since 1996

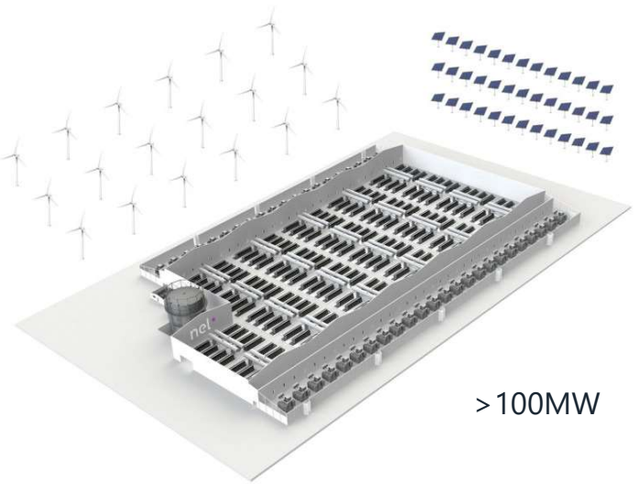
Scalable design
from <1 to >8,000 kg/day production
able to deliver 100+ MW systems

Designed for high volume manufacturing
to achieve large scale plants
with fossil price quality

3 kW – 174 kW



1,25 MW – 20 MW



>100MW

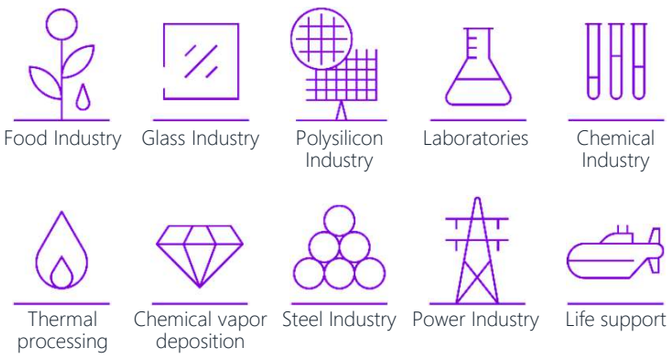
From kW- to multi-MW industrial hydrogen production plants

Nel positioning in the hydrogen market

New green hydrogen market trends and applications in green ammonia.

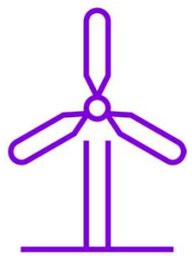
Nel wide experience in industrial markets and positioning in new H2 key market applications

Industrial applications



- Niche industrial applications represents "traditional" hydrogen markets
- Steady demand for hydrogen

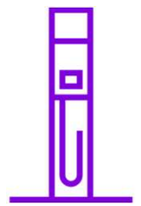
Power-to-X



Renewable hydrogen

- Decreasing cost of renewables and electrolysers is accelerating market
- Vast opportunities within existing & new sectors

Mobility



Transportation

- Key market going forward – both within hydrogen production and fueling
- Heavy duty sector developing faster than anticipated – hydrogen now relevant fuel for all forms of mobility

Steady growing market

Markets expected to see fast growth going forward

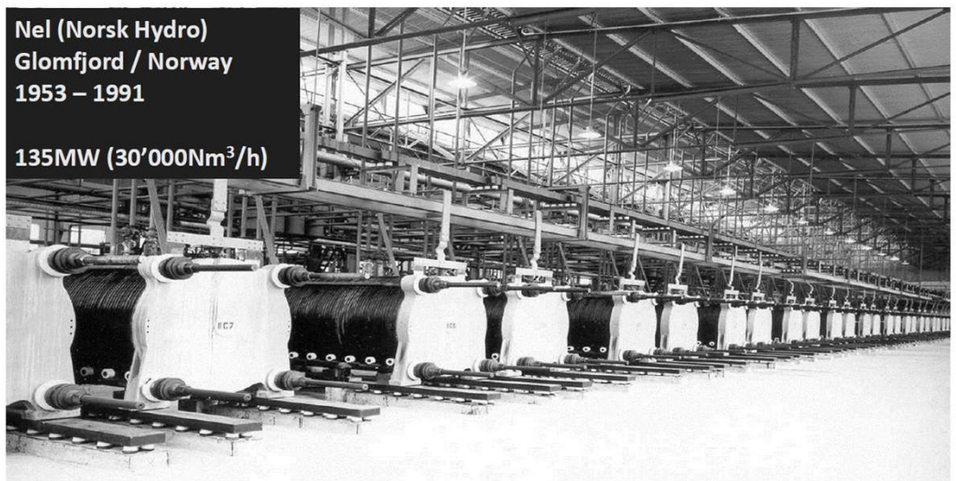
Nel experience in industrial electrolyser applications from a long time ago

Green H_2 for Ammonia

Probably the oldest business for water electrolysis from Hydroelectricity

Nel (Norsk Hydro)
Glomfjord / Norway
1953 – 1991

135MW (30'000Nm³/h)



Polisilicon Plant (Sarawak, Malaysia - 2013)

The world's largest electrolyser plant in operation

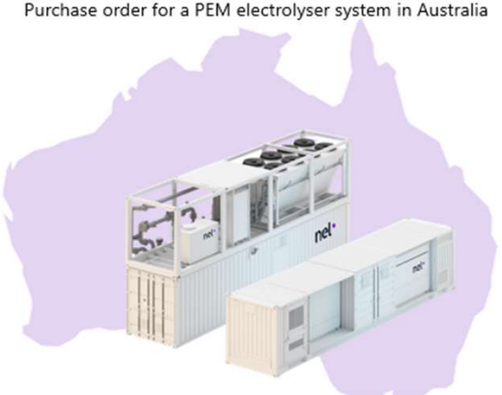
- 5,335Nm³/h – 11.5T/day ~25MW
- Using 100% green electricity from Hydro
- Hydrogen used for Chemical Vapor Deposition process for silicon rods manufacturing
- Hydrogen supply is critical for the plant

CHEMICAL HYDROGEN PEROXIDE - NORWAY - 1988

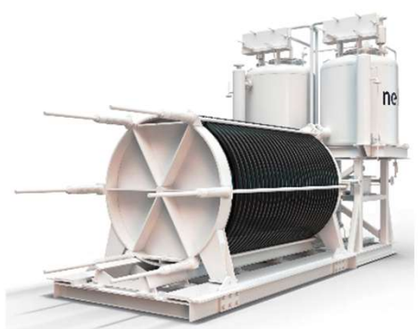
Nel ALK A2000 (4.2T/d, ~9.2MW)

Mining & Nickel Refining:
Purchase order for an alkaline electrolyser system in Norway

Utilities & Fueling:
Purchase order for a PEM electrolyser system in Australia



Steel Industry:
New 20MW electrolyser purchase order to decarbonize the steel industry. Sweden



NEL KEY ELECTROLYSER DEVELOPMENTS

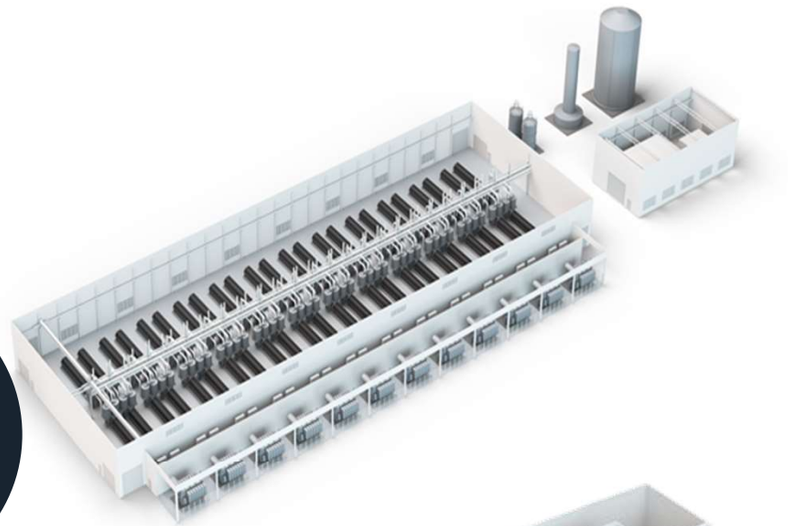
Scaling up for future large-capacity opportunities

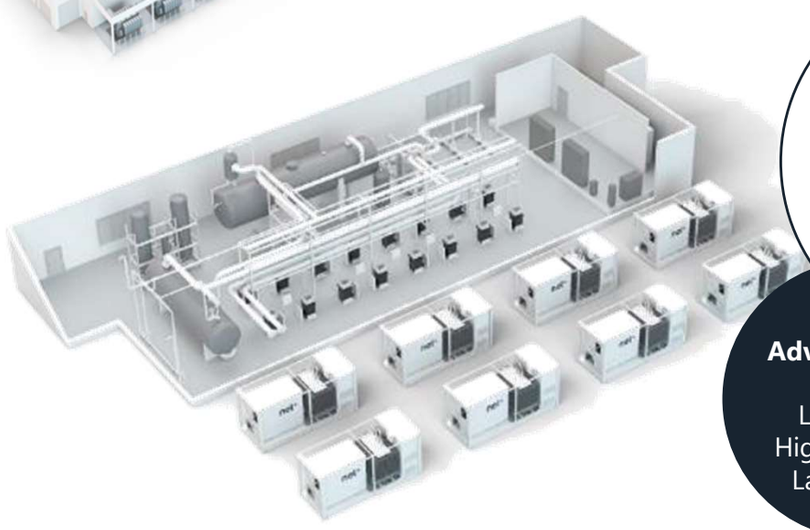
Atmospheric alkaline

Low cost
High efficiency
Large scale

Advanced alkaline

Dynamic response
Intermittent operation





PEM

Dynamic response
Intermittent operation

Advanced PEM

Lower cost
High efficiency
Larger scale

Optimized Designs & Technologies

- Designs for kW to MW
- Patented solutions including gas management and monitoring/controls
- Thorough analysis and mitigation of hazards with multiple levels of protection
- Safety/product certification including third party

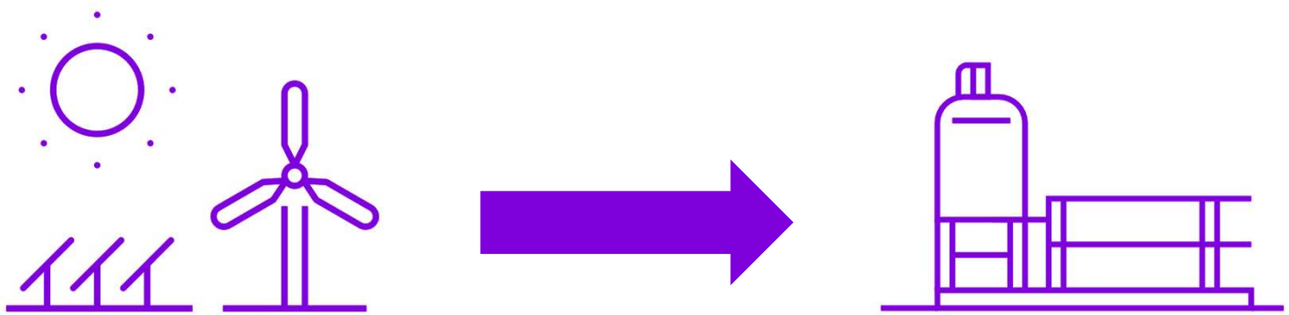
- PEM and Alkaline both have advantages
- Both platforms are developed with equal priority
- Industrial and technology knowledge about PEM and alkaline is beneficial

Scaling up production capacity to attend existing market growth

- Investment decision taken by Nel to build 2nd alkaline production line at Herøya, Norway
- Client contracts going to larger scale is making possible to increase electrolyser production capacity afterwards
- Production Line 2 is expected to go live in April 2024

  Based on main principles from the existing Line 1 of 500MW/yr with continuous improvements implemented
- Increases total Nel annual alkaline production capacity to ~1 GW
- Global technology production capacity expansion in evaluation to address global market dependent on market projects evolution

Renewable & Fertilizers:
Purchase order for electrolyser equipment to the world's first dynamic green ammonia plant



SKOVGAARD ENERGY

TOPSOE Vestas

- Client: Skovgaard Energy
- PO in 2022
- Delivery: Q3-2023

- The project in Denmark will be the world's first dynamic green ammonia plant where renewable electricity from wind and solar will be connected directly to the electrolyser
- This is a demo plant that will test how an ammonia reactor can fluctuate operations based on renewable power input

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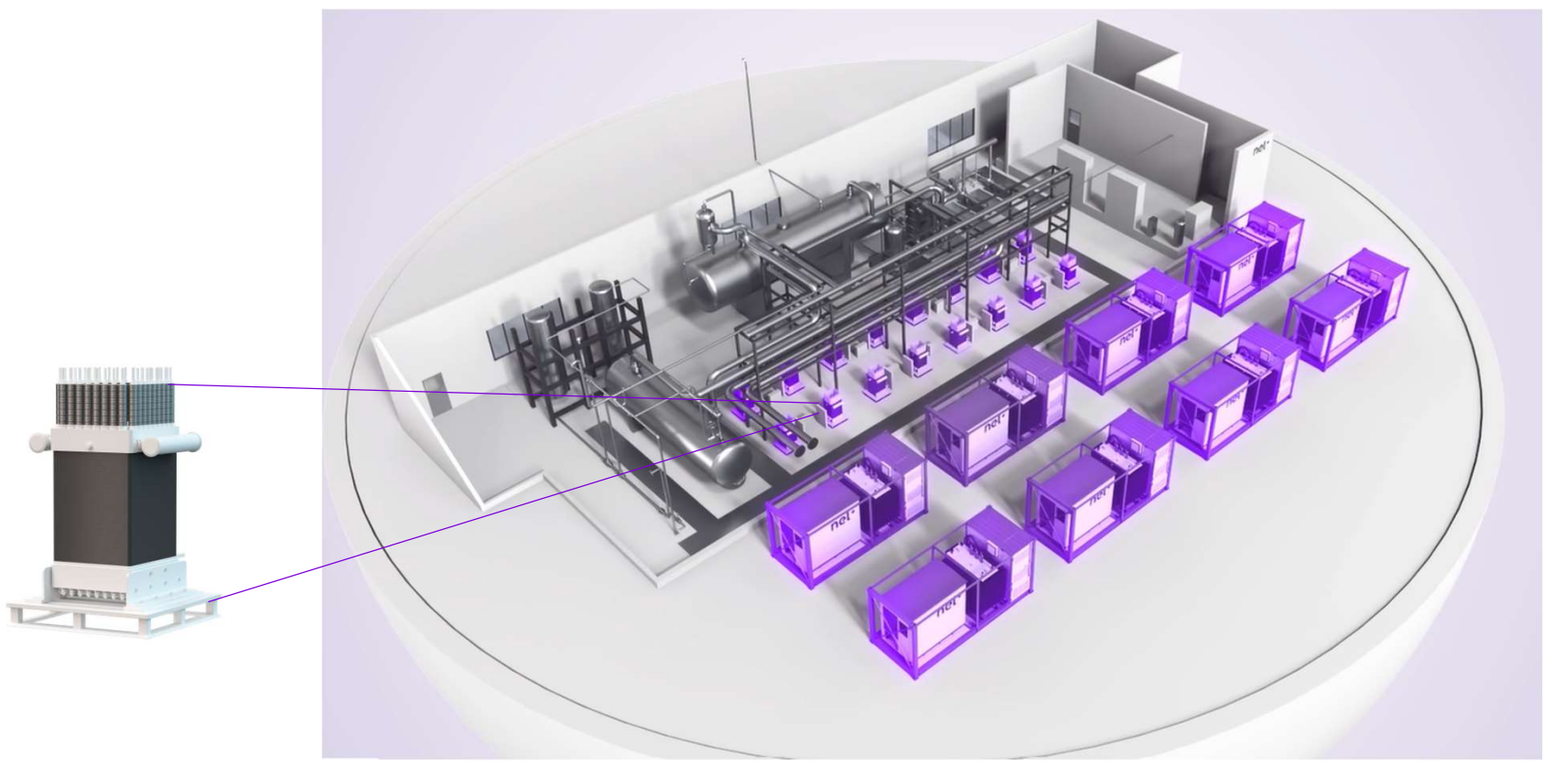
KEY DEVELOPMENTS

Renewable PV & Fertilizers:
Contract with Iberdrola for a 20 MW PEM unit to support a green fertilizer project.
End user Fertiberia Spain



- Client: Iberdrola (Fertiberia)
- Green Ammonia
- Puertollano, Spain

Iberdrola, one of the largest electricity renewable utilities in the world, launched a project for the world leading fertilizer company **Fertiberia** to establish the largest green hydrogen PEM plant in Europe

The Project includes 100 MW photovoltaic plant, a 20 MWh e-battery and a 20 MW water electrolyser system

Nel value proposition to customers

Global presence

World-class Safety & Experience

Strong financing

Reliability / Scalability & Leadership

Nel value proposition

Preferred partner / De-risk projects

Technology front-runner


nel
number one by nature

Grupo Fertiberia
Puertollano

grupofertiberia.com

Introduction

Grupo Fertiberia is a Spanish company with half a century of experience and expertise.

+ 1,600 professionals

At Puertollano

+ 50 years
producing ammonia and different nutrition solutions.

Importance of fertilisers and the climate change challenge

The world **need fertilisers**

> The demand for fertilisers will increase by 40% by 2050.
> **So…**

How do we make a growing demand for food compatible with its decarbonised production?

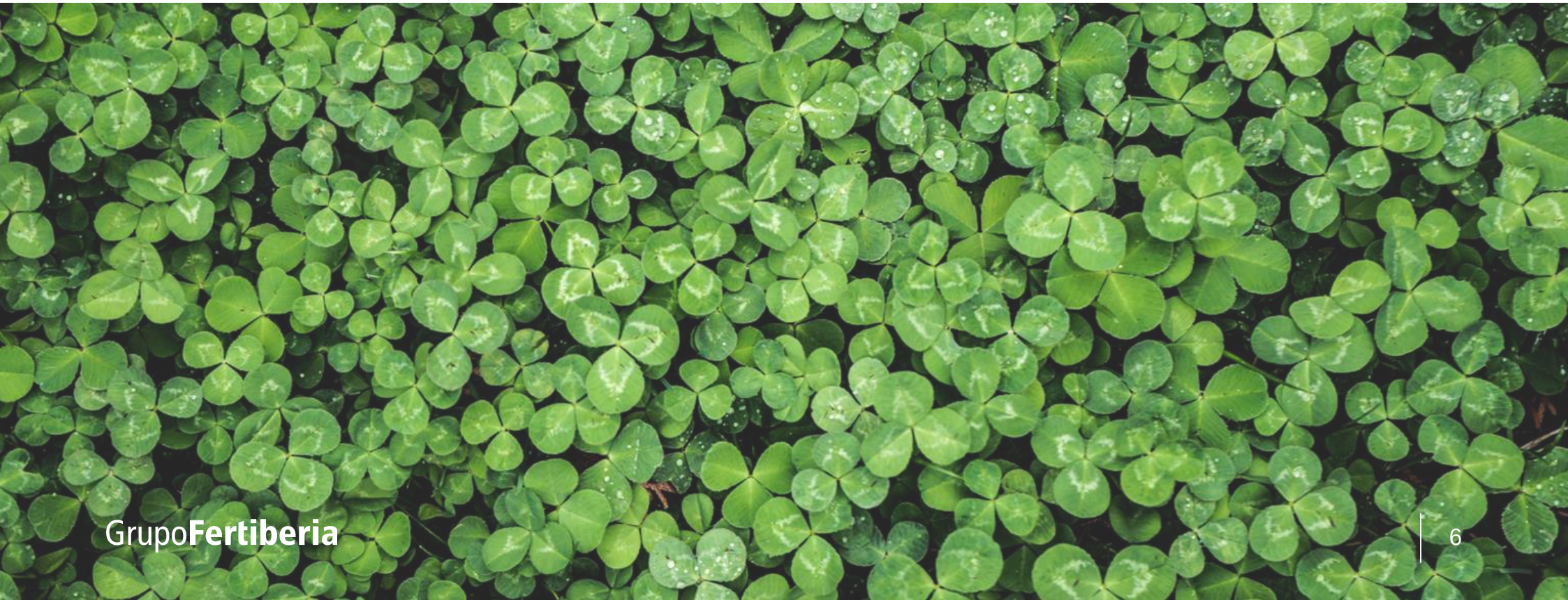
Project description and our Net Zero strategy

With the startup of the **new green fertiliser and ammonia plant at our Puertollano factory**, with the guidance of Iberdrola.

Project description and our Net Zero strategy

We are not talking about the **future**;
we are talking about the **present**.

Puertollano, with the commencement of large-scale **green ammonia** production worldwide, becomes the **kilometre zero of sustainable fertilisation of the future**.



Fertiberia is fully committed to maintain its global leadership in the transition of the fertiliser sector

Location	Name of the project	Existing ammonia production	Existing fertilizer production	Low-carbon power source	Intended timeline
Sweden, Norrbotten	Green Wolverine	No	No	Grid connected	2027
Spain, Palos & Puertollano	Puerta Europa	Yes	Yes	Solar + grid connection	2022-'27
Spain, Avilés	Hydeal	No	Yes	Solar	2025-'30
Spain, Sagunto	Catalina	No	Yes	Wind + Solar + grid connection	2026

NETZERO
BY 2035 GrupoFertiberia

GrupoFertiberia

Creciendo juntos.

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