Nordic Energy Days
@ Expo 2025 Osaka

17th June 2025

Nordic Circle

Innovation Norway

Business Sweden

BUSINESS FINLAND

ROYAL DANISH EMBASSY Tokyo

Business Iceland

Nordic Council of Ministers

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Welcome by today's Moderator

Elisabeth Svanholm Meyer

Division Director, Strategic positioning, tourism and special assignments, Innovation Norway

Opening statement by 5 Nordic Ambassadors

H.E. Kristin Iglum,
Norway's ambassador to Japan

H.E. Viktoria Li,
Sweden's ambassador to Japan

H.E. Jarl Frijs-Madsen,
Denmark's ambassador to Japan

H.E. Tanja Jääskeläinen,
Finland's ambassador to Japan

H.E. Stefán Haukur Jóhannesson,
Iceland's ambassador to Japan

Session 1

10:15 – 11:45

Preparing resilient energy markets for the transition – experiences from the Nordics and Japan

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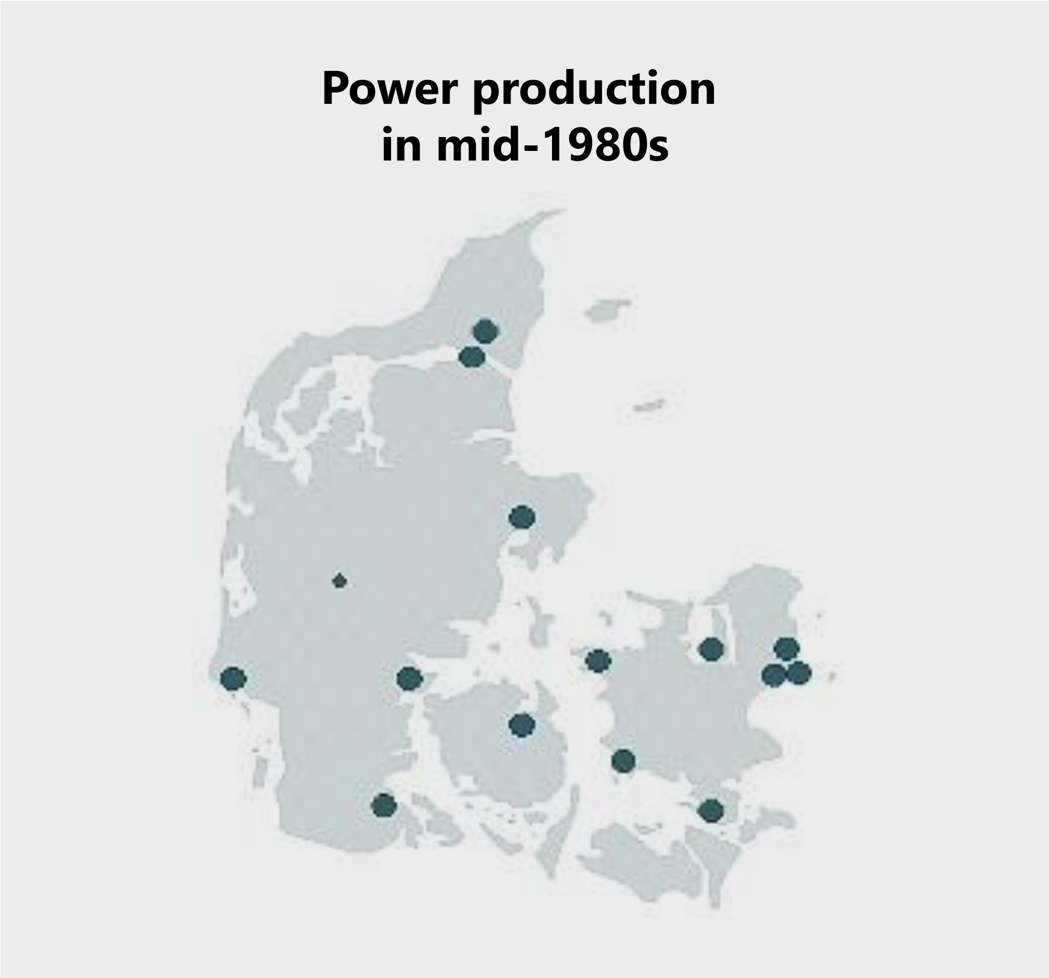
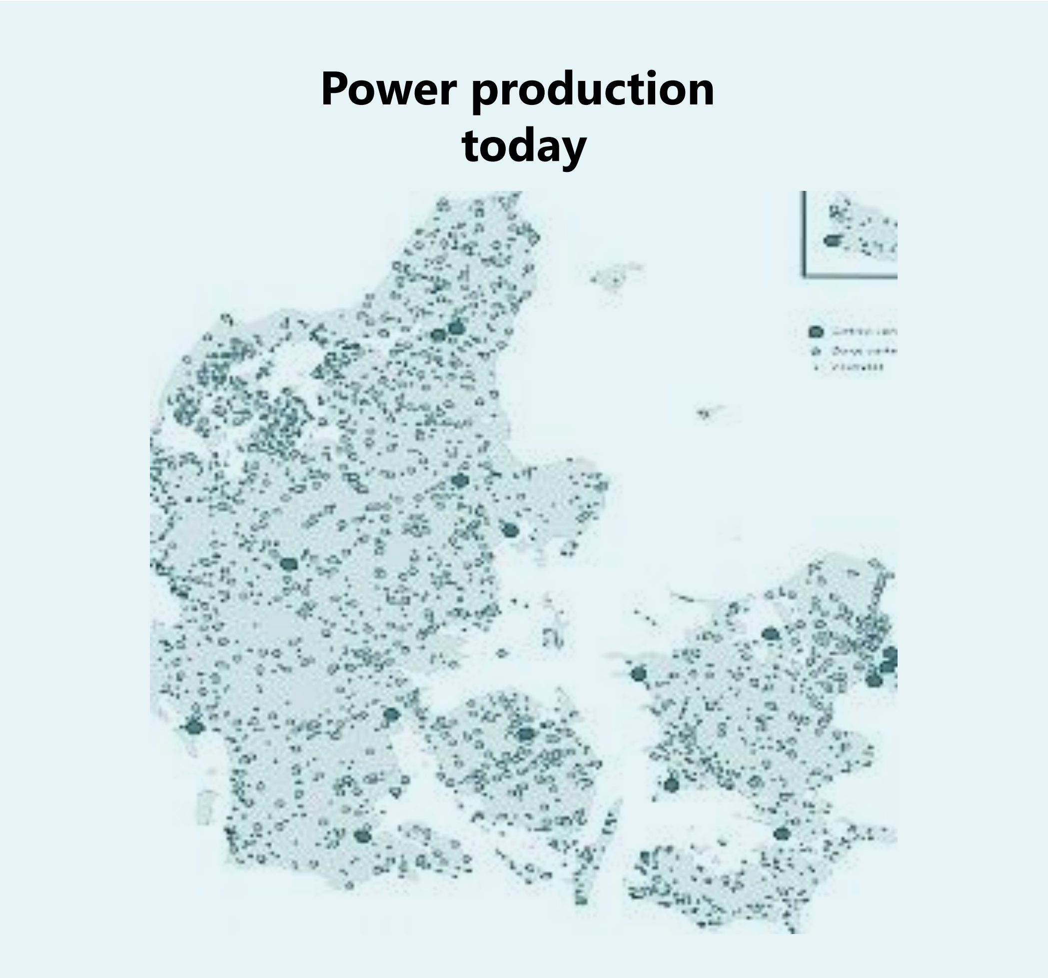
Expanding wind energy to enhance resilience of our power system

Deputy Director-General, Stig Uffe Pedersen

24. juni 2025

Since 1980s Denmark has increasingly decentralized power production





Security of supply is extremely high despite high wind penetration at approx. 40% of total capacity

Offshore wind
2.5 GW

Solar
3.5 GW

Onshore wind
4.8 GW

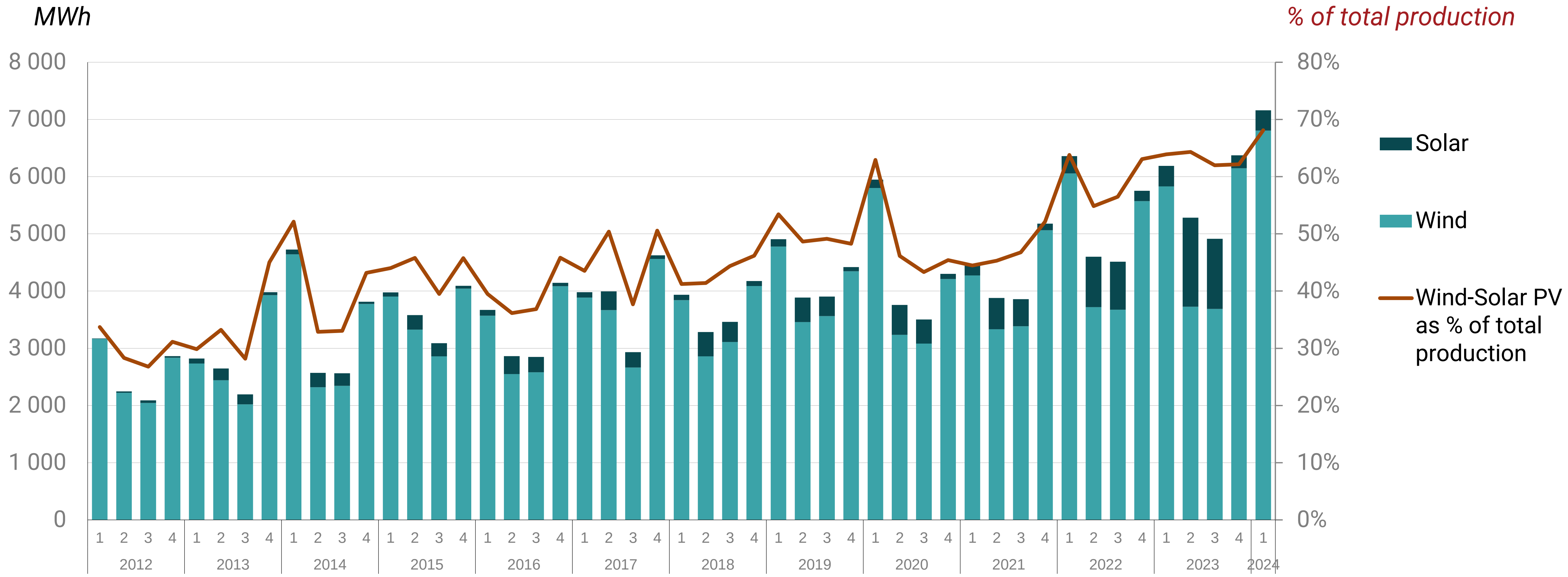
Security of supply
(Transmission)
99.99999796%

Total generation capacity: approx. 18 GW

Source: Energistatistik 2023, https://ens.dk/sites/ens.dk/files/Statistik/energistatistik_2023.pdf

Wind energy has played a central role in Denmark's energy transition journey

Quarterly electricity from wind and solar as % of total production

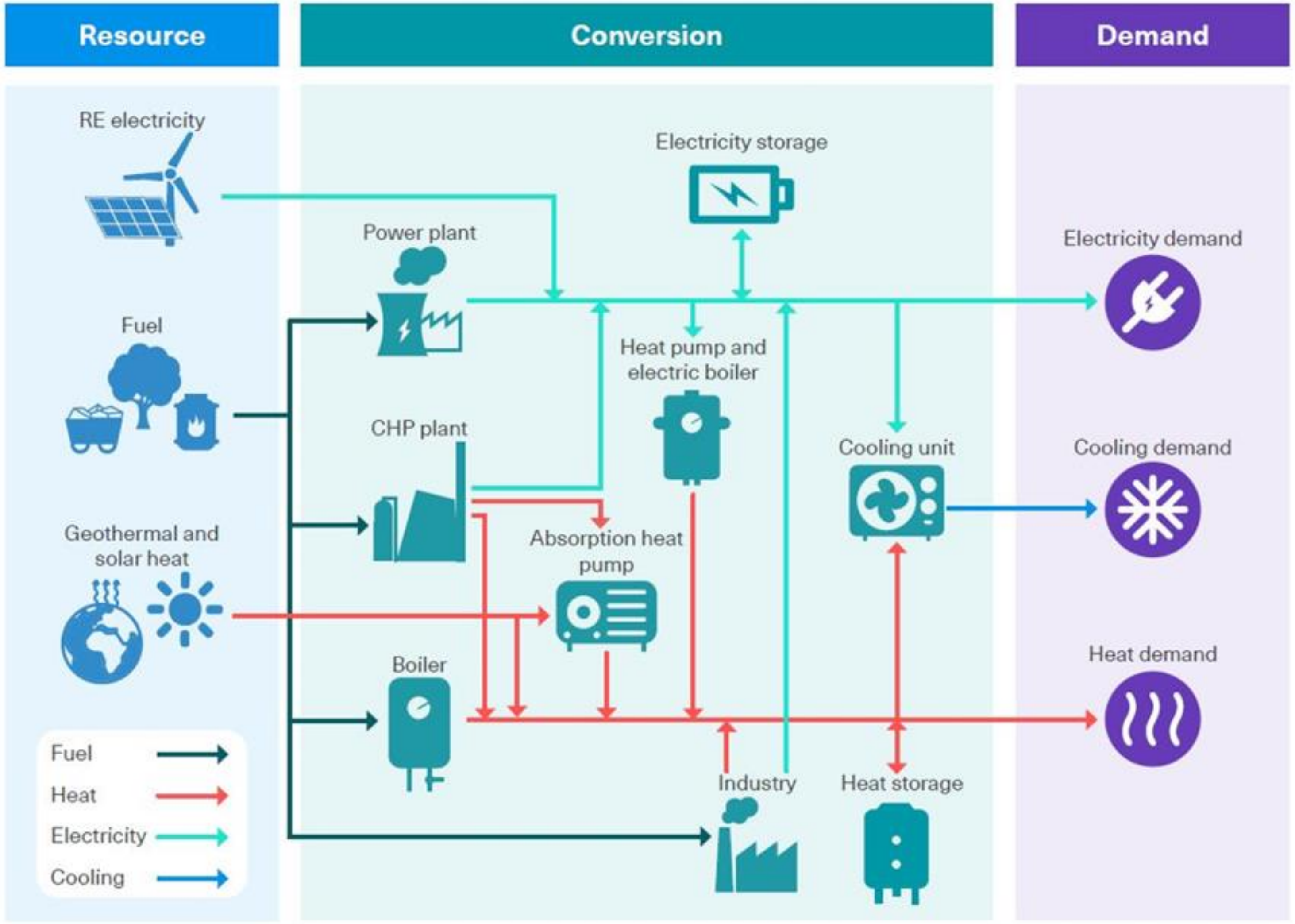


Source: Danish Energy Agency, Energinet

Sector coupling is the secret to increase penetration of intermittent renewables

Essence:

- To integrate **renewable energy** with the greatest possible efficiency between sectors and thus, make better use of our resources
- Going from thinking in silos into looking **across all energy systems**
- The transition requires **collaboration** and knowledge sharing between actors and sectors



Offshore wind will continue to play a prominent role – new tenders underway

Key changes

- Tendering 3 GW, down from 6 GW
- Operational year 2032-2033, from 2030
- Re-introduction of subsidies in form of contract-for-difference

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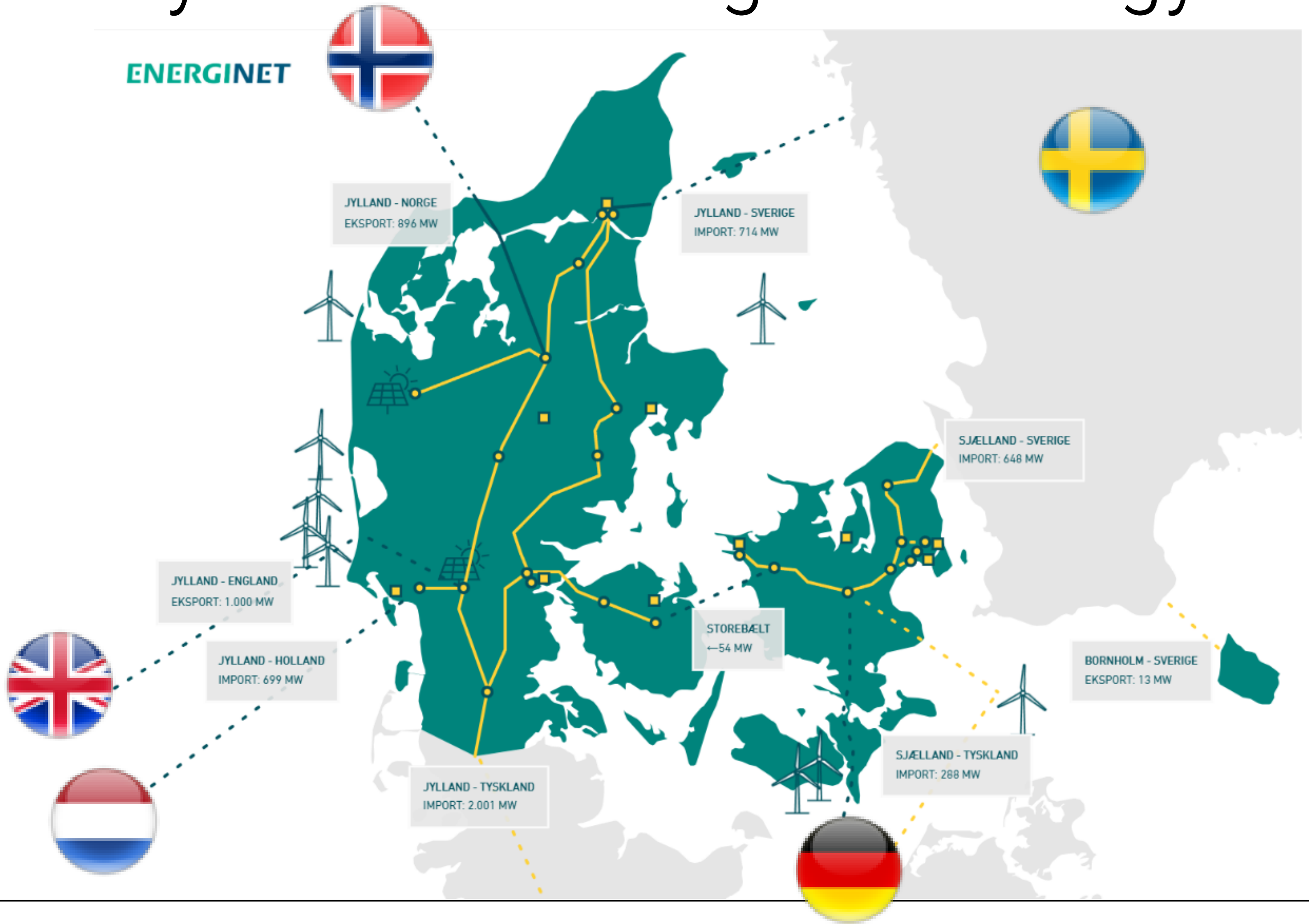
Our neighbours complement us well, adding to a flexible and resilient system built on green energy



Thank you

Danish Energy Agency

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Challenges and opportunities in an increasingly intermittent market

How will the market develop, and which applications will become relevant?

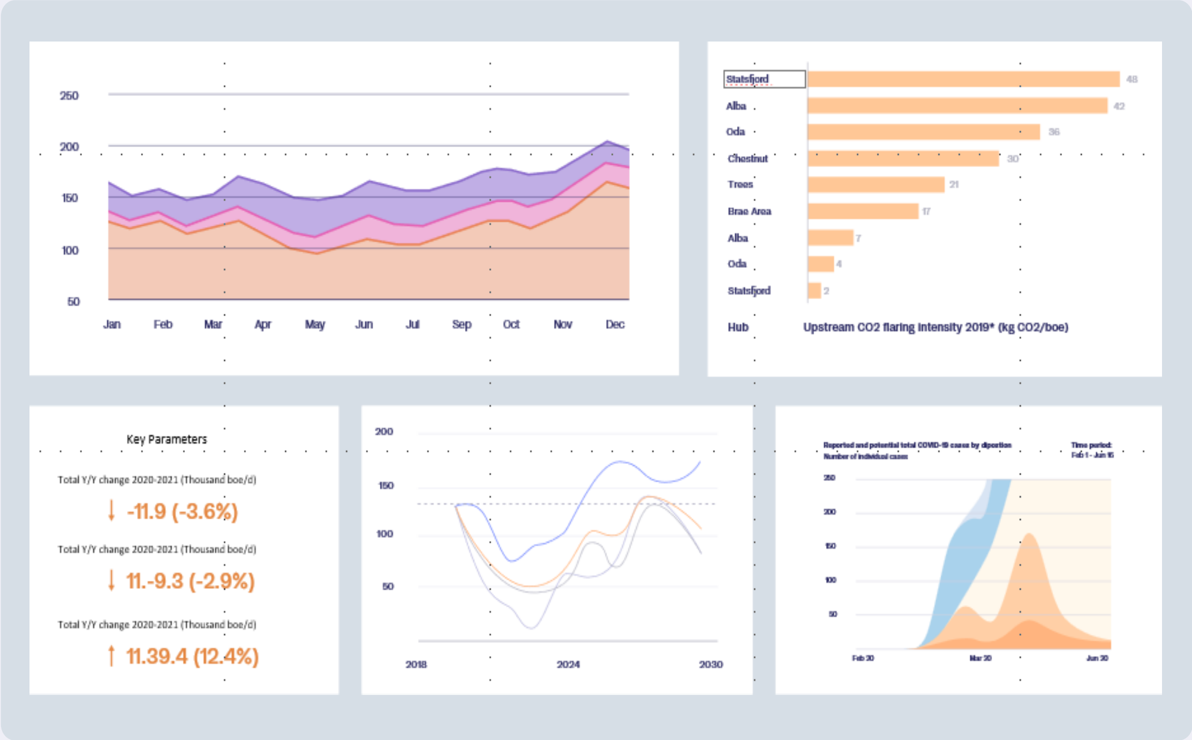
Lars Nitter Havro, VP & Head of Energy Macro Research

What we deliver

Data.
Analytics.
Advisory.
Education.

Putting the pieces together

All data is collected at the finest level of detail and then pieced together to form a complete picture.

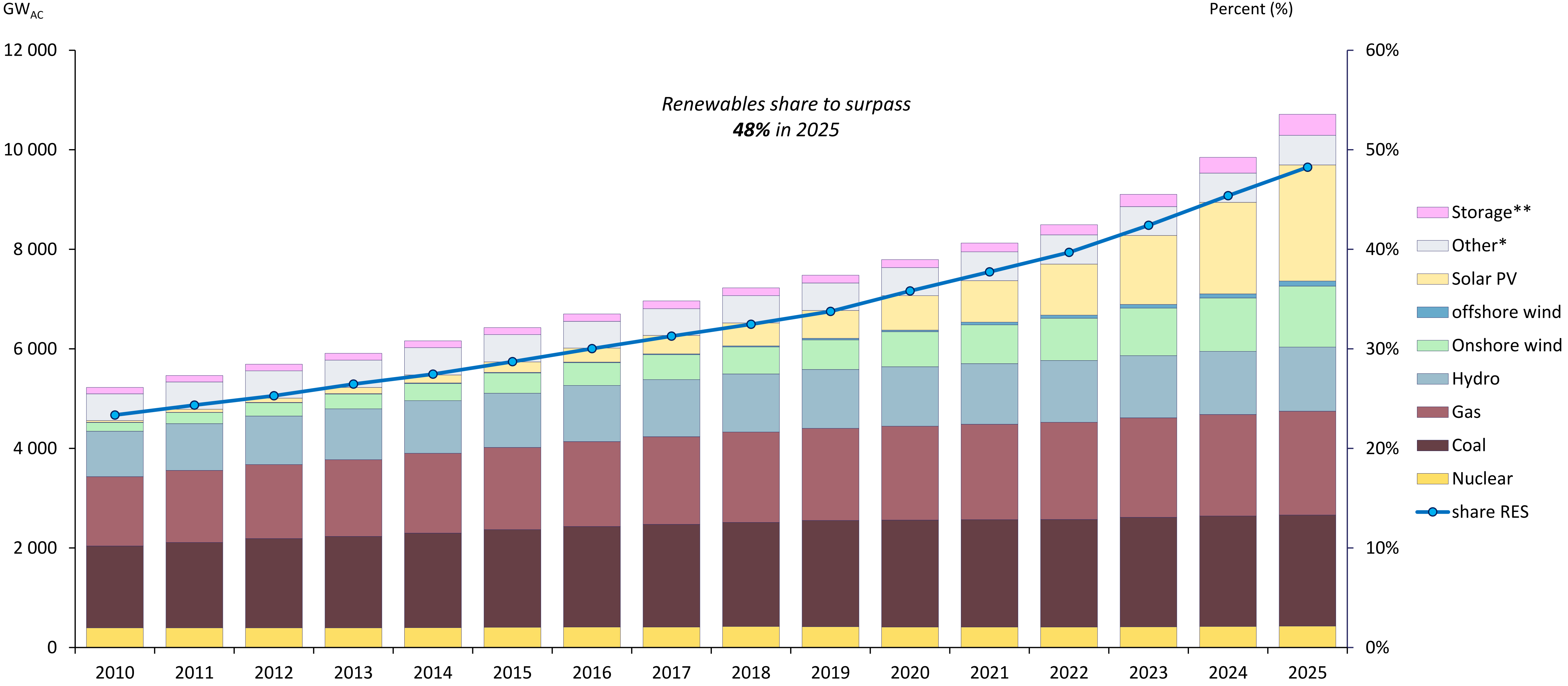


Global energy assets 2024

Source: Rystad Energy PowerCube, CCUSCube and UCube

Global installed capacity closing in on 50% renewable energy...

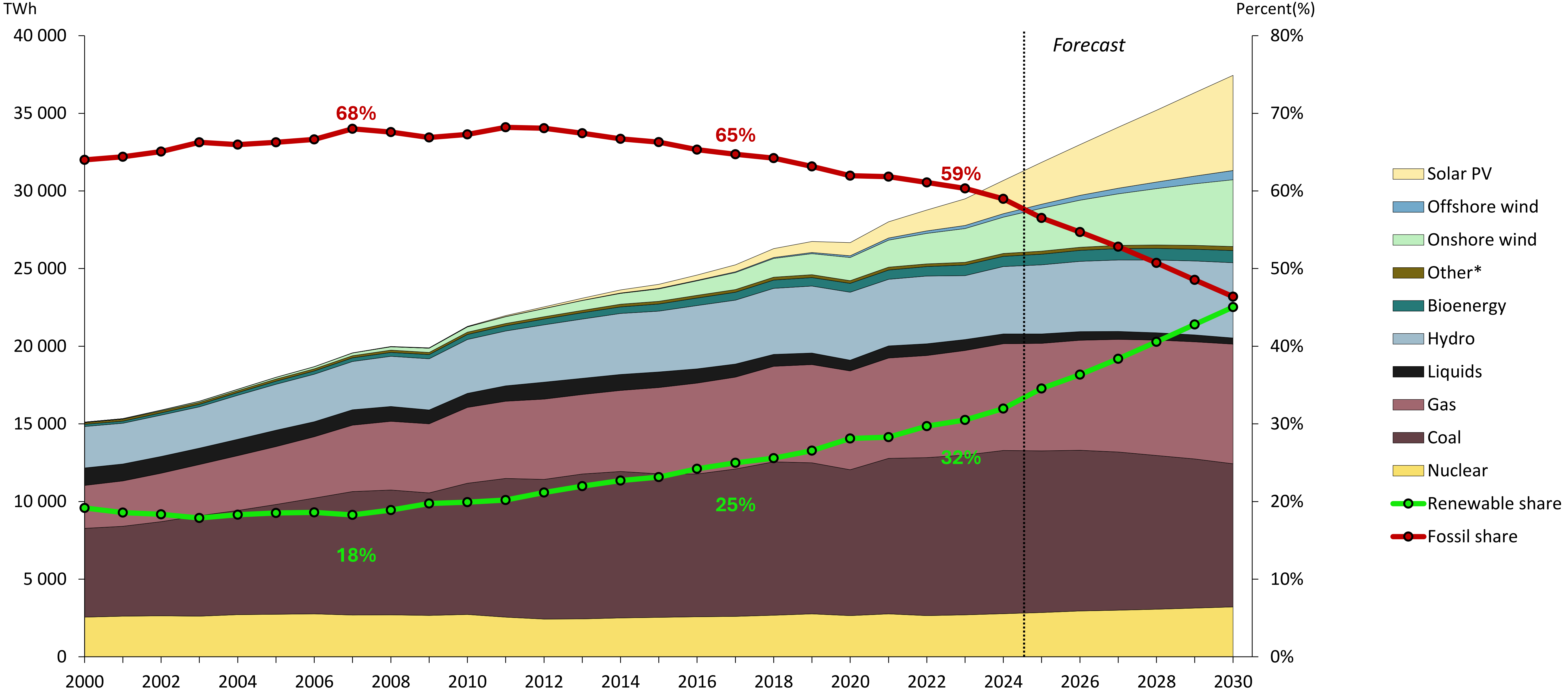
Cumulative installed capacity by energy source (left) and share of renewable energy (right)



*Other contains Bioenergy, Geothermal, Liquids, Marine/Tidal, solar thermal and non-renewable waste. **Storage contains BESS and pumped storage
Source: Rystad Energy Global Powermix Analysis Dashboard, April 2025 release

And generation is climbing steadily, surpassing a third of global generation by end of 2025

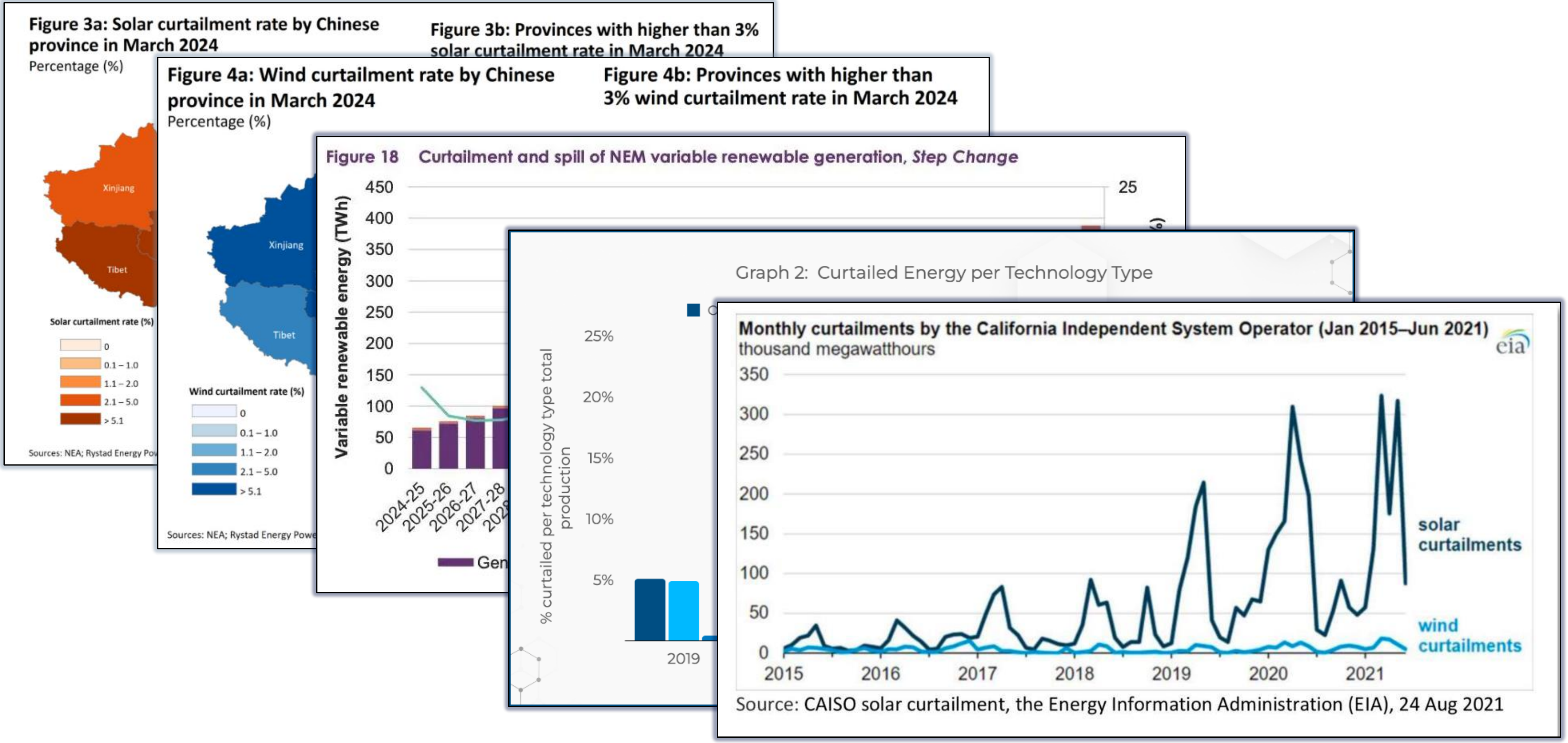
Global power generation mix (left) and share of renewables and fossil (right)



* Other contains Bioenergy, Geothermal, Liquids, Marine/Tidal, solar thermal and non-renewable waste

Source: Rystad Energy Global Power Mix Analysis Dashboard

Curtailment on the rise across all regions with high solar and wind penetration…



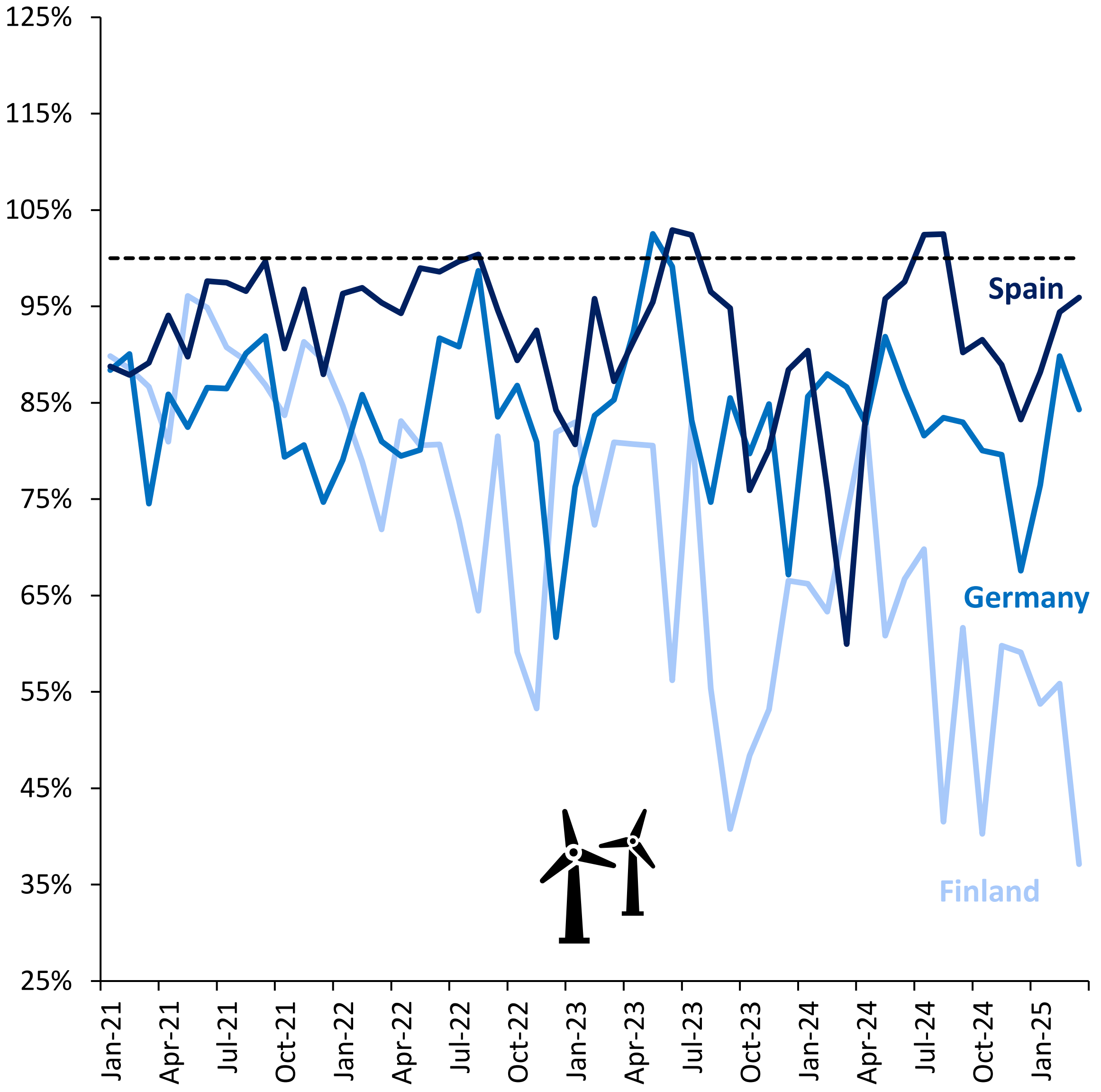
Source: Rystad Energy research and analysis; AEMO ISP, IEA, BNetzA

RystadEnergy

…and in liberalized markets, capture rates are falling…

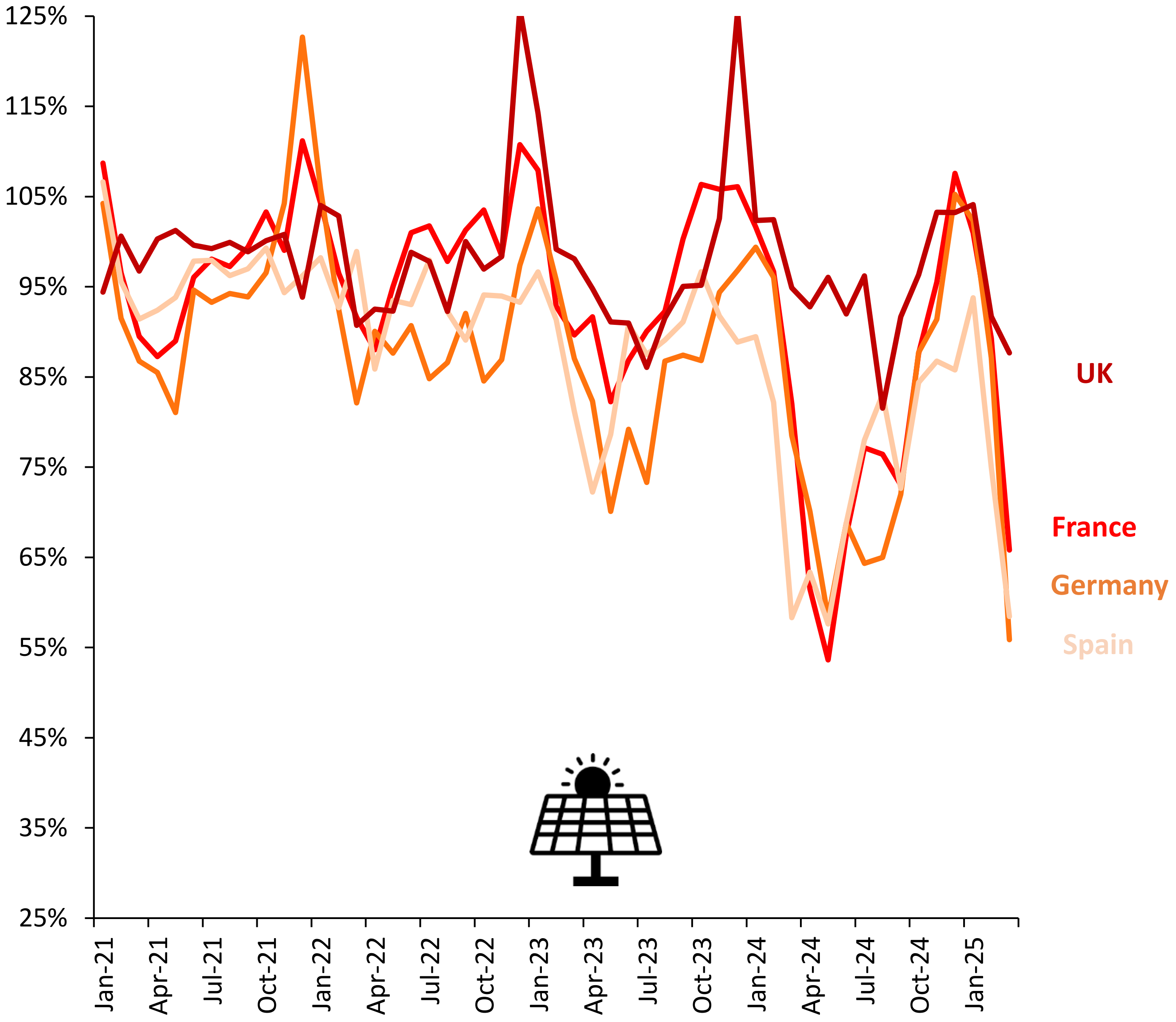
Onshore wind capture rates, 2021-2025

Estimated received prices as percent of monthly spot prices



Solar PV capture rates, 2021-2025

Estimated received prices as percent of monthly spot prices



Source: Rystad Energy Europe Renewables & Power Analysis Dashboard, ENTSO-E

BESS plays a key role as solution in both 'problems'

Merchant revenue

- Wholesale electricity markets
  - Day ahead market (DAM)
  - Intraday market (IDM)
- Balancing services markets
  - Frequency control ancillary service (FCAS)
  - Virtual inertia
- Capacity markets

Contracted revenue

- Retail electricity markets
  - Power purchase agreements (PPAs)
  - Hybrid PPAs
  - Contract for Difference (CfD)

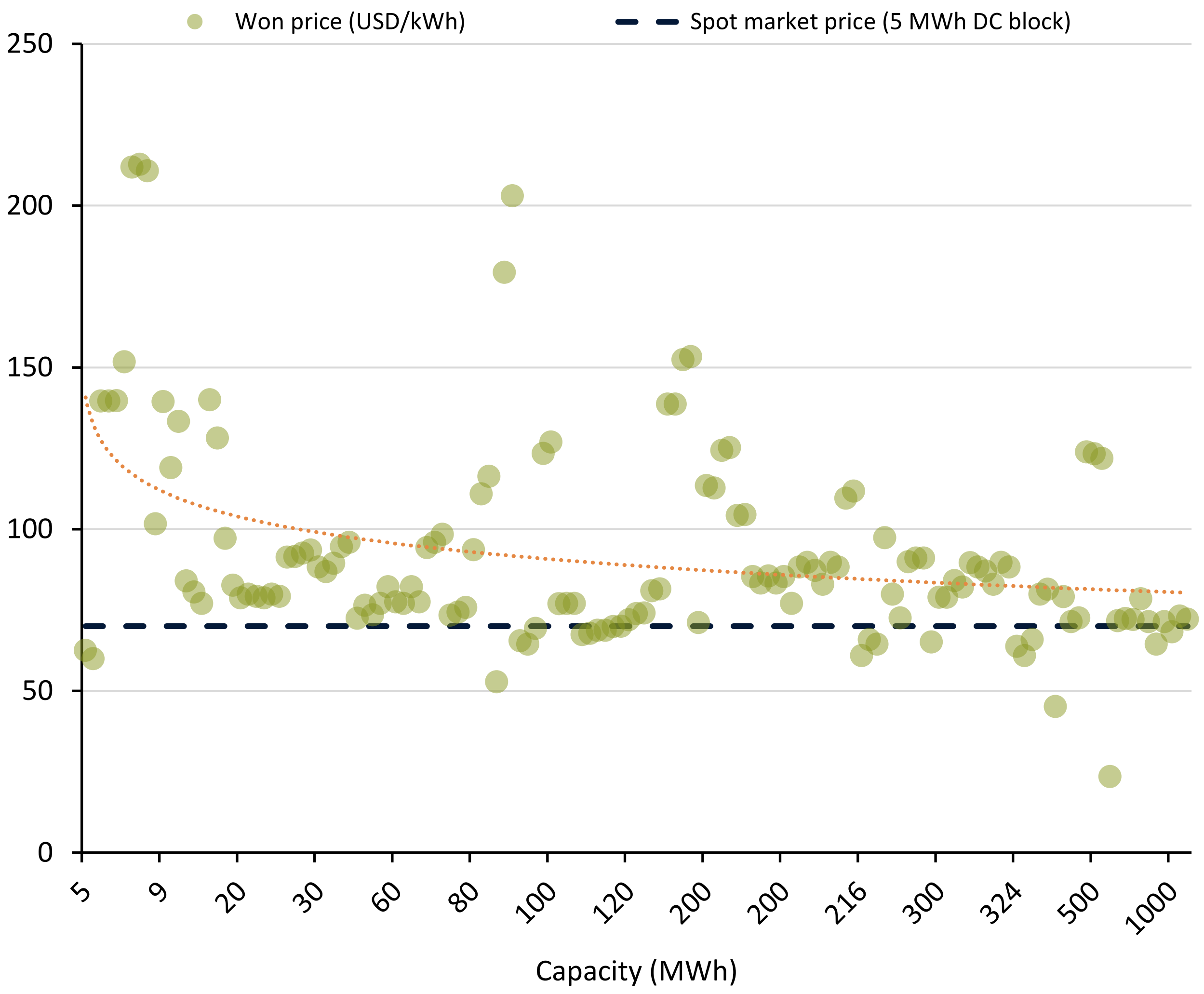
➢ Volatility
➢ High risk and high gain
➢ Required legislations

➢ Stable revenue income
➢ Long term stability
➢ Financing advantage

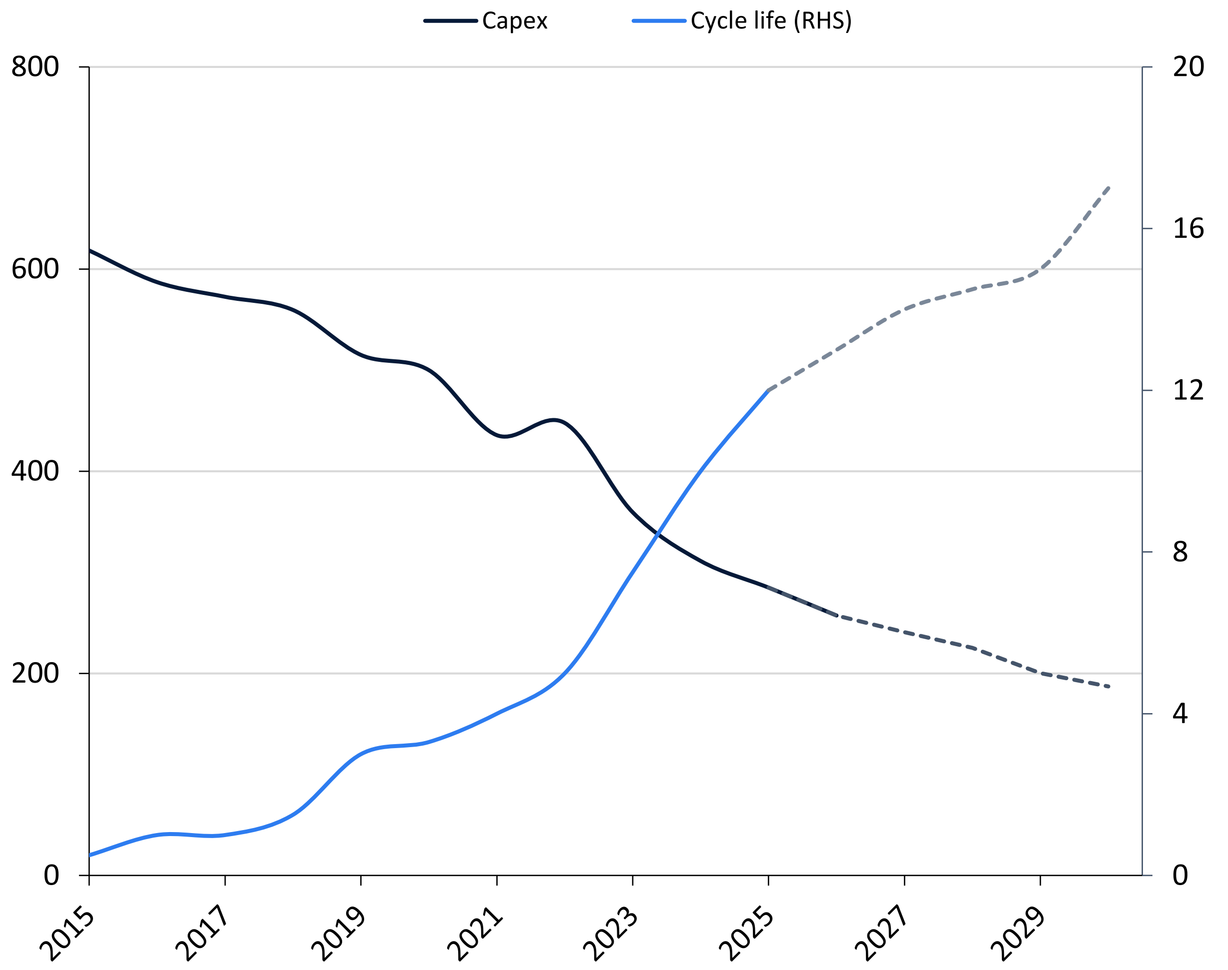
Source: Rystad Energy research & analysis

Lower financing and higher use sharply reduce battery storage costs

Winning bids of battery system procurement in China, 2024
USD per kilowatt-hour ($/kWh)



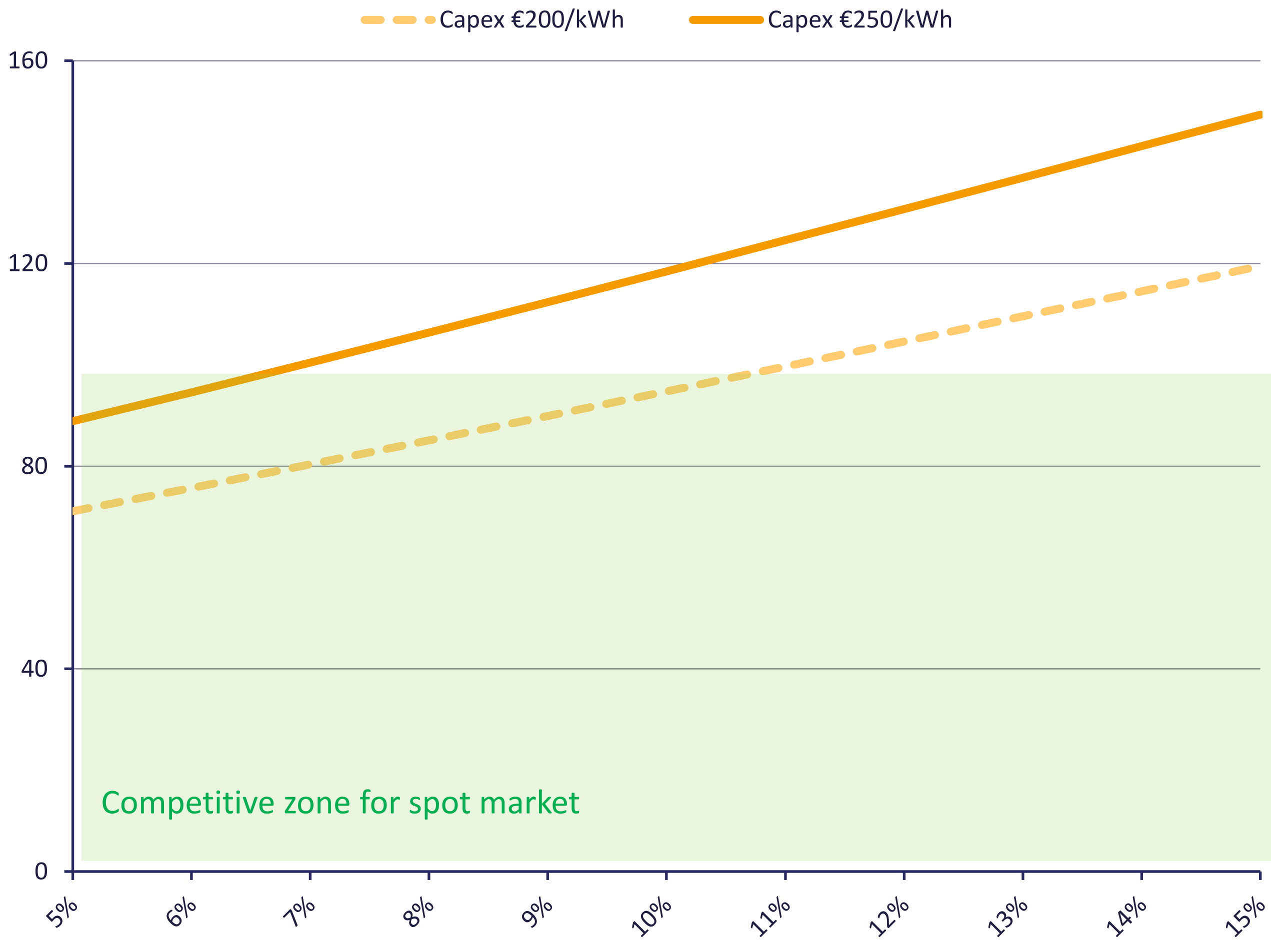
Global BESS price and cycle life developments
Capex ($/kWh)
Number of cycles



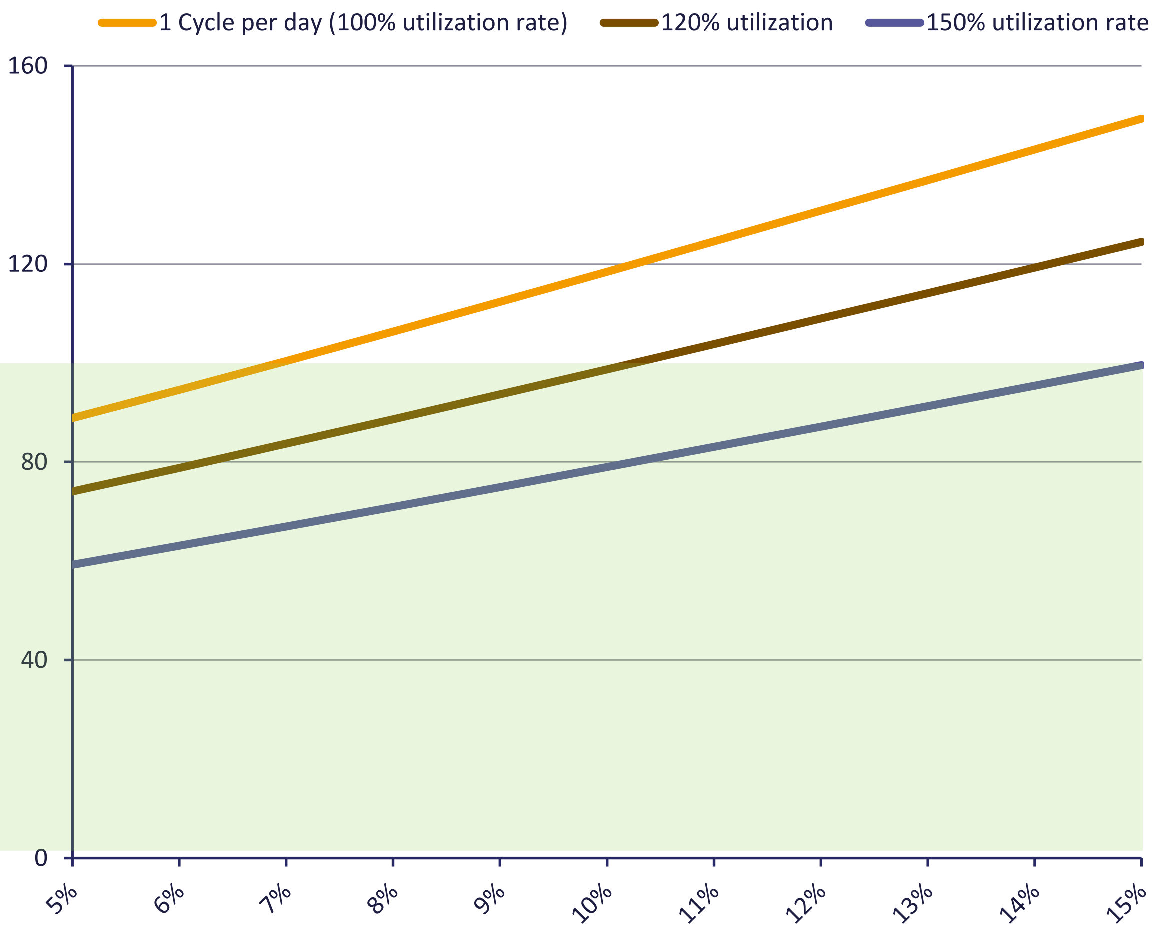
Source: Rystad Energy EnergyStorage Analysis dashboard, Rystad Energy Battery Market Analysis dashboard

Battery storage unlocks value across both volatile and stable power markets

LCOS* on different discount rates – One full cycle per day
EUR per megawatt-hour (€/MWh)



LCOS* on different discount rates by utilization rate (€250 capex per kWh)
EUR per megawatt-hour (€/MWh)

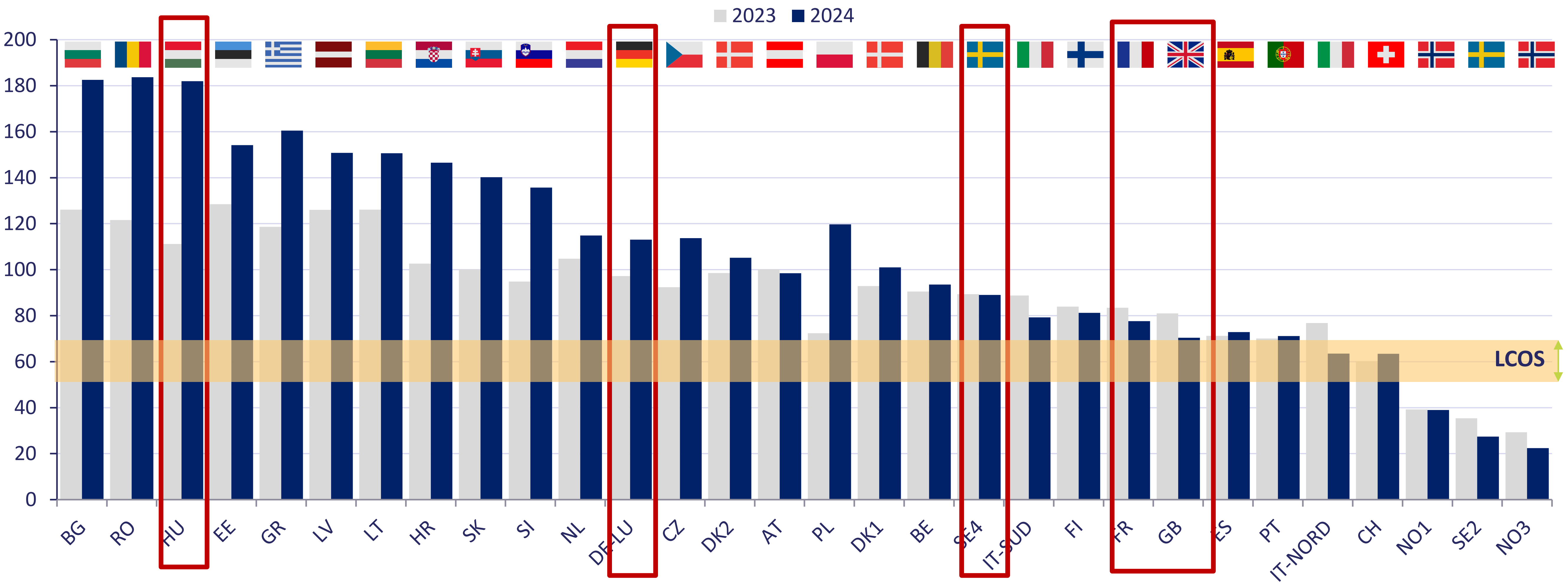


*Opex is 1% of capex per year, one full cycle each day, with 1% degradation rate for system per year, and calculated for 20 years of lifespan, DOD 90%
Source: Rystad Energy EnergyStorage Solution

Europe saw greater wholesale market opportunities in 2024

Energy arbitrage potential for 2-hour system in selected European markets after energy crisis

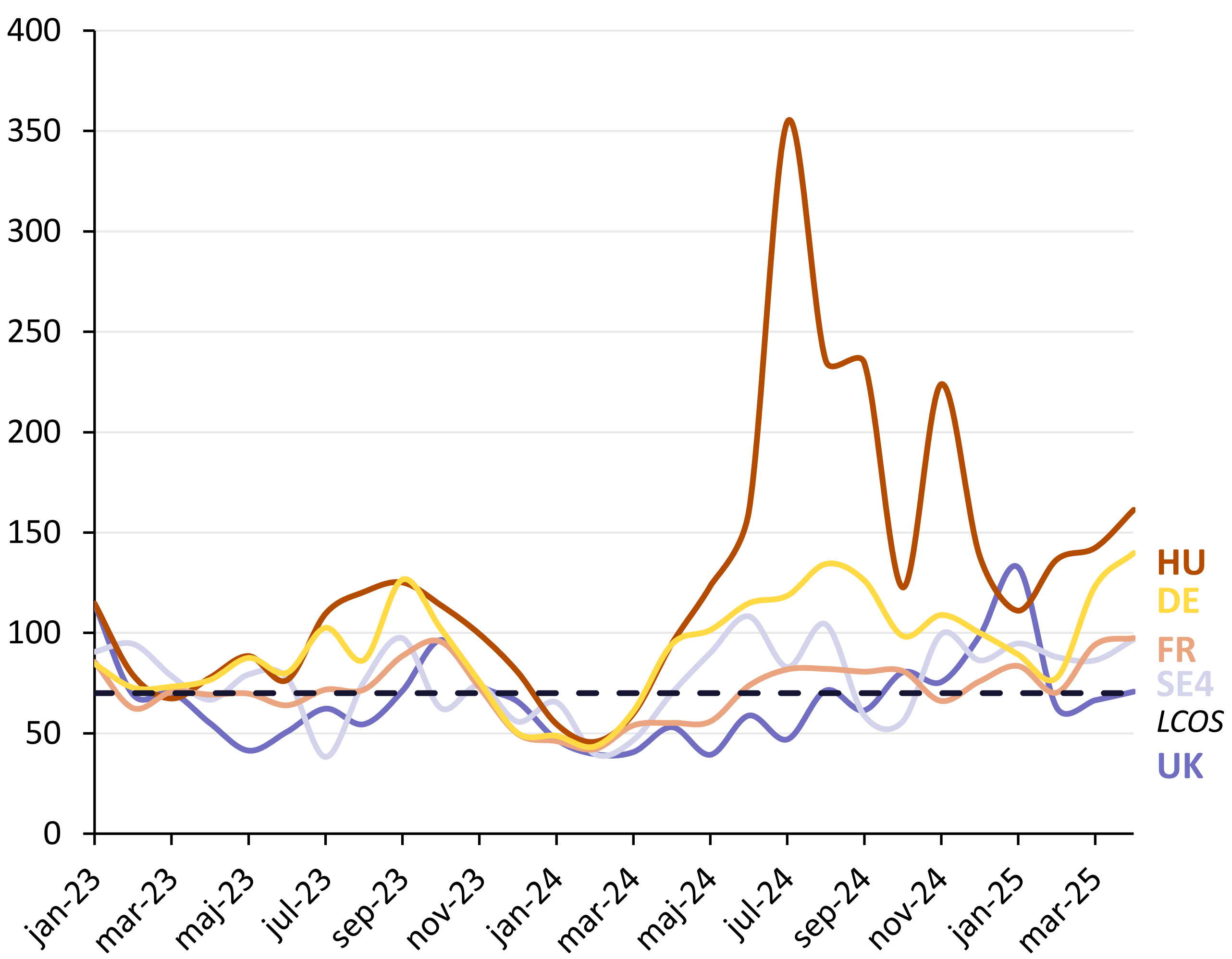
EUR per megawatt-hour (€ per MWh)



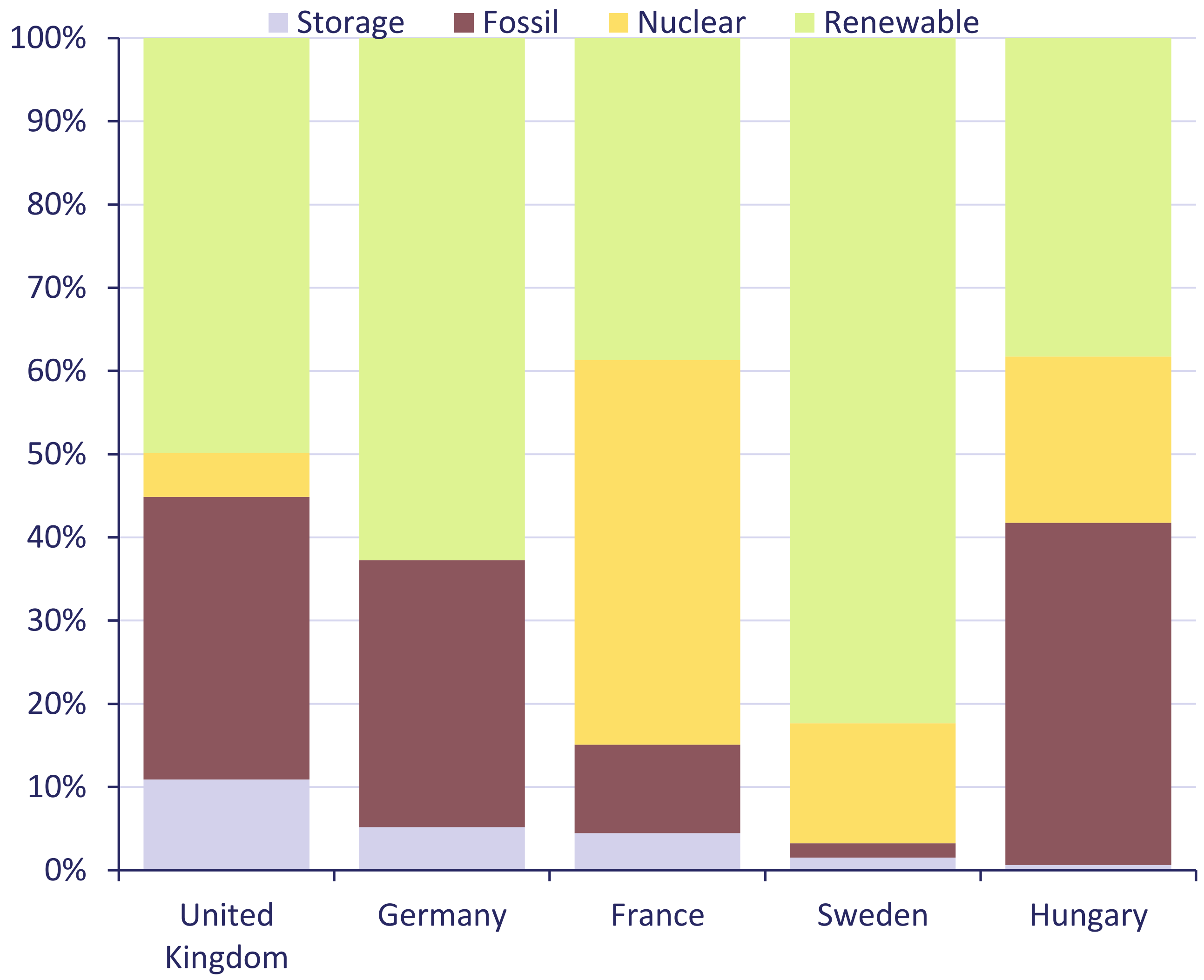
Source: ENTSO-E; Rystad Energy EnergyStorage Solution

Can storage start cannibalizing its arbitrage business?

Monthly average 2-hour price spread in selected European markets
EUR per megawatt-hours (€/MWh)



Share different sources in the power mix as of May 2025
Percentage



Source: Rystad Energy Europe Renewables & Power Solution; ENTSO-e

RystadEnergy

Navigating the future of energy

We are an independent research and energy intelligence company, equipping clients with data, insights and education that power better decision-making.

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EMEA +47 908 87 700
Asia Pacific +65 690 93 715
Email: support@rystadenergy.com

Panel 1

Electricity Trading in High-penetration RE Energy Systems

BD Energy

time2market

MARKET MANAGEMENT SERVICES

.nitor

Moderator: Yasunori Takeuchi, CEO/Representative Director, Corporate Action Japan (CAJ)

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Corporate
Action
Japan
Accelerating climate actions of Japanese companies
to drive sustainable society

Who we are

- Establishment: June 2022, as a general incorporated association
- CEO/Representative Director: Yasunori Takeuchi
- Office: Toranomon Hills Business Tower 15F

- Mission: Drive impactful actions across Japanese companies to address climate crisis
- Vision: Envision Japan as a leader of climate solutions for the people and planet to thrive.

What we do

- Corporate Engagement:
  Focus on industry decarbonization
  Long-term corporate value from risk / opportunity perspective
  Credible transition pathway to Net Zero
- Investor Engagement:
  Partner with global investors for sustainability outcome
  Stewardship throughout investment value chain
- Policy Engagement:
  Incentive for system transform with economic viability
  Enhancement of transparency and traceability

Activities & Partners

- International Conferences
  - COP
  - PRI
  - London Climate Action Week
  - Climate Week New York City
- Partners
  - Accounting for Sustainability
  - Climate Governance Initiative

[Corporate Action Japan (CAJ)]

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BD Energy

Company presentation

BD ENERGY A/S

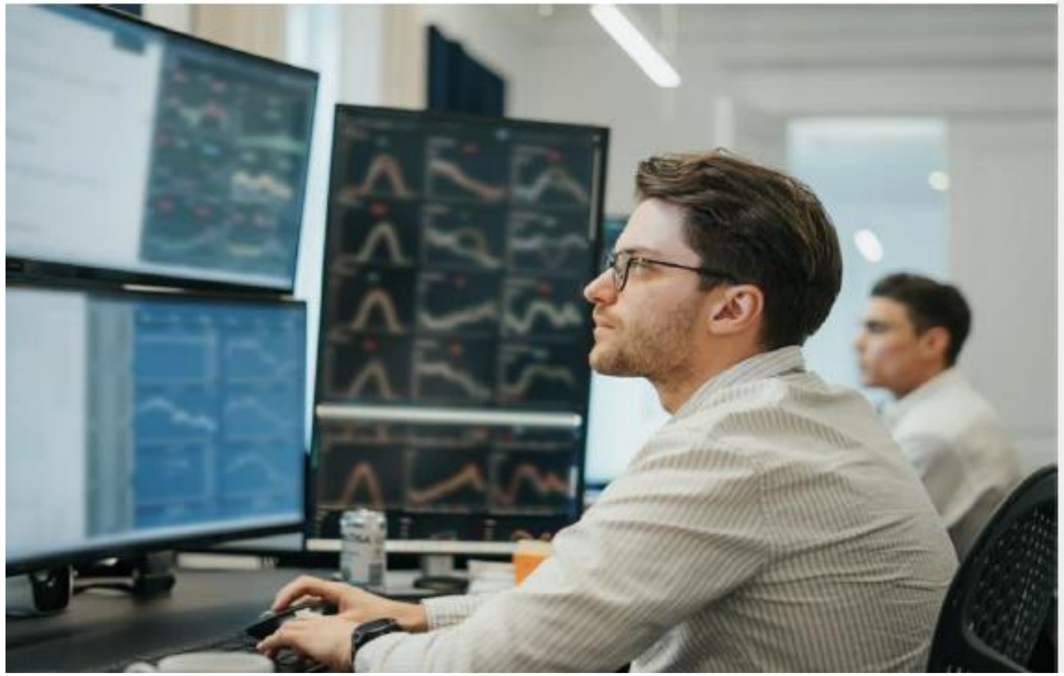
BD Energy

Headquarters
Aarhus, Denmark

Founded
2022

Employees
25

Commodity
Power



BD Energy

The founders

Frederik B. Vinker
CEO & Partner

Nicolaj Storgaard
CFO & Partner

Sergei Kirillov
CTO & Partner

The team

- Grown from 2 to more than 25 employees in less than 3 years
- The team boasts a rich diversity, comprising employees from more than 9 different nationalities
- The team holds some of the most prestigious degrees in various fields, with **three PhDs** in Statistics, Quantitative Finance, and Econometrics, including a professor from Aarhus University renowned for pioneering forecasting research

BD highlights

BD Energy

Founded in June 2022 by a strong team of experts

- Our collective expertise in finance, econometrics, and computer science empowers us to stay ahead in the fast-evolving energy market.

Focusing on short term power markets

- Leveraging advanced AI and machine learning models, we've developed a proprietary trading platform that consistently outperforms market averages by 30-40%.
- Leveraging in-house algorithms and software, the system delivers high-accuracy energy price forecasts, allowing for swift and informed trading decisions.

End-to-end trading solution

- Our in-house developed software and trading algorithms are designed to forecast energy prices with unparalleled accuracy, enabling us to make informed trading decisions swiftly. 99,5% of all trades are by our in-house algotrader.
- Cash-flow, collateral, compliance, trade, monitoring-software.

Risk management

- By continuously refining our algorithms and diversifying our market presence, we mitigate the risks associated with market volatility and regulatory changes.

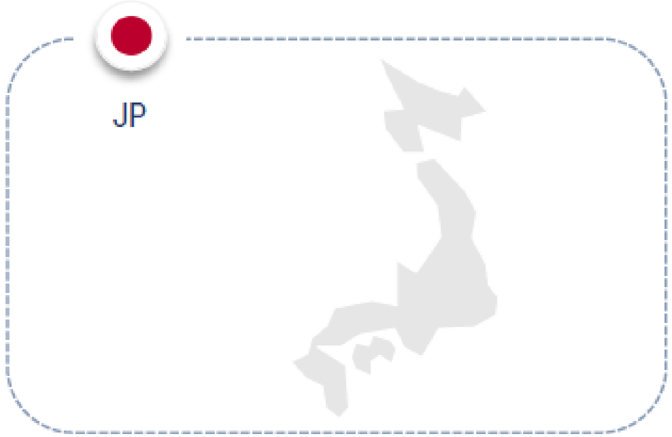
We are currently active in

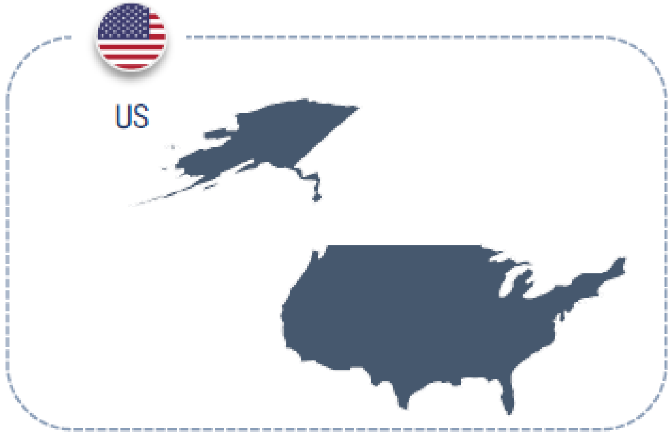
BD Energy

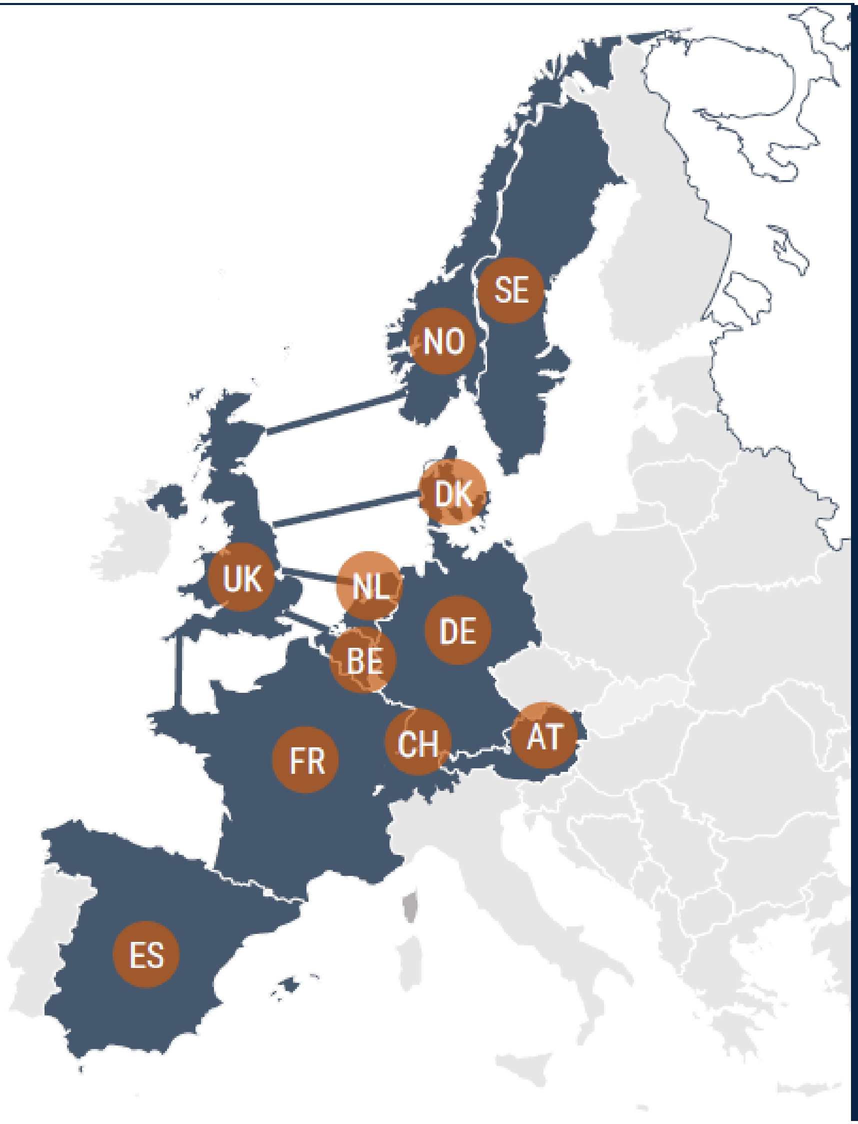
Current market presence (and ambitions)

Existing

Researching







Machine Learning Models

Custom models on dedicated VMs for handling large datasets and frequent hyperparameter updates.

Accurate Forecasts

Producing precise price development forecasts to target profitable European interconnectors and exploit intraday and dayahead price volatility.

Risk Management

Expanding Intraday Market presence to mitigate risks from auction-based trading.

Proprietary Software

Utilising in-house software and tools to stay agile.

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Who is nitor?
Overview

Constant
.Change

Founded 2017 as a Software company

3 Gas Traders

Physical 24/7 trading in gas and power

Own Software

Market Overview

.Europe

Gas and Power

Constant
.Change

.nitor

Market Overview
.Europe
Power

Constant
.Change

.nitor

Market Overview
.USA
Power

.nitor

Performance

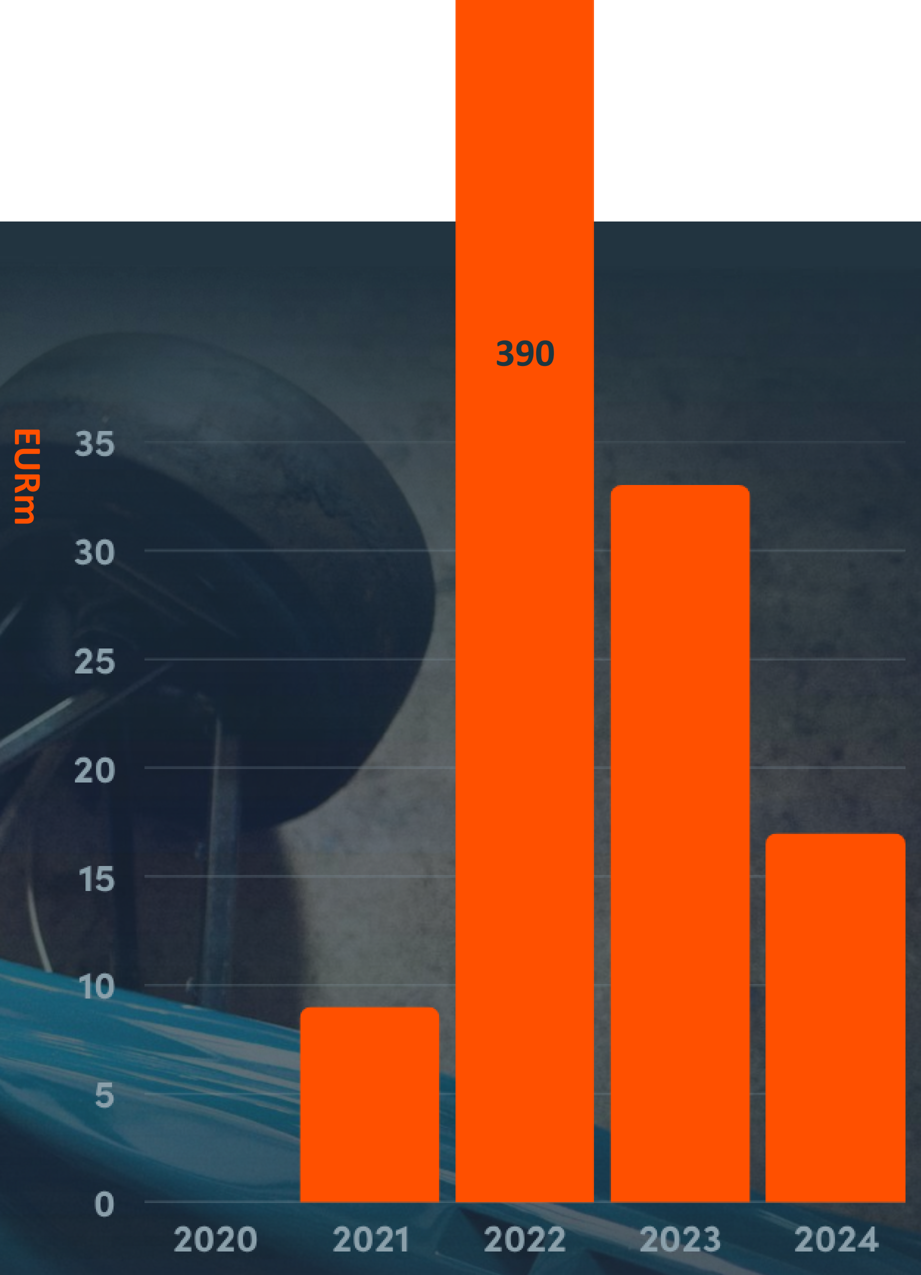
.Financials

2024 End of Year Numbers

Gross Profit
€29.51m

Net Profits
€17.22m

Tax
€4.58m



Constant
.Change

.nitor

Performance

.Trading

2024 End of Year Numbers

Traded Volumes

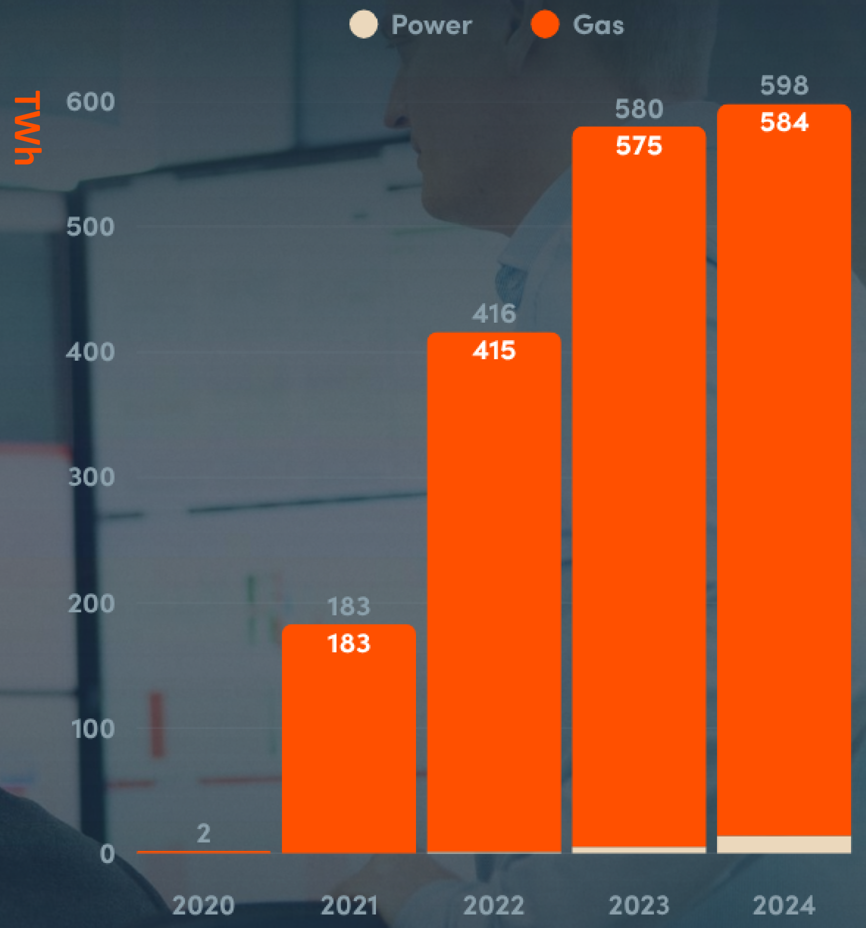
598 TWh

Volumes Across Areas

2024

Actively Traded Markets

30



Constant
.Change

.nitor

Performance

.People

2024 End of Year Numbers

Dedicated People
85

Onboarded in 2024
35

Recruited from University
54%

Constant
.Change

Christian Harr

(CBDO & Co-Founder)

Ask me how we can do business together

Tobias Klit Kronborg

(Head of Intraday Power)

Ask me how we can optimize your assets

Constant
.Change

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time2market

MARKET MANAGEMENT SERVICES

Who's Time2Market?

- Your **external market access department**
- Expert in **liberalized power and gas markets** across the globe
- Specializes in market expansion for **market makers, high-frequency traders, hedge funds, capital managers, and investment banks**
- While **you trade, Time2Market executes** your **full market setup** for wholesale trading

Market Access with Time2Market

Initial setup → License → BRP agreement → Exchange membership → Cross-border setup → Trade

Our Services

Time2Market offers wholesale power and gas market access services in **over 50 markets worldwide**.

Below is an overview of the markets where we've successfully guided our clients' entry.

If your desired market is not listed, let us know, and we will prepare **a scope with a non-binding offer** for you.

Lyngvej 2, 9000 Aalborg, DK
kbe@time2market.dk
info@time2market.dk
(+45) 61 90 00 22

We deliver. You excel.

Panel 2

Electricity Trading in Transitioning Energy Systems

centrica Energy

YGGDRASIL

InCommodities

Moderator:
Peter Markussen, Senior Director, Energinet

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Centrica Energy: Key Figures

Centrica Energy is a leading energy trading company operating out of eight offices across all time zones to move energy from source to use. Our mission is to drive the green transition while offering sustainable and predictable energy costs for suppliers and offtakers. We specialise in optimising the value of renewable and flexible assets, both when dispatching the assets in the physical markets, and by offering long term bankable tailormade hedging structures for asset owners.

Offices
Denmark
UK
United States
Belgium
Germany
Sweden
Singapore

Gas & Power

29	Trading markets
9M+	Gas & Power trades in 2023
50%	Of UK's gas storage capacity in Rough, optimised by CE

Renewables & Flexibility

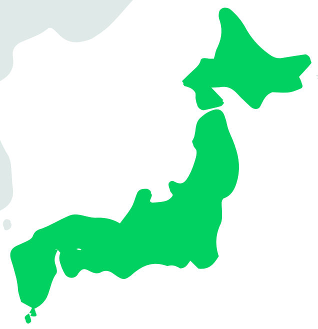
13.2GW	Renewable assets under management
3.5	Flexible assets under management
14	Asset markets

LNG

250+	Cargoes physically traded in 2024
2200+	Shipping charter days in 2024
2.6Mt p.a.	Joint LNG offtake signed with Tokyo Gas

Centrica Energy and the Japanese energy market: Key strengths

Competency Area	Centrica Energy strength	Relevance to Japanese energy market
Liberalized Market Experience	Deep experience in deregulated energy markets across the European continent, as well as U.S., including balancing market participation and bilateral trading.	Supports Japan’s ongoing electricity market liberalisation.
Data-Driven Trading and Grid Optimization	Advanced proprietary trading platform with extensive use of AI/ML tools for demand forecasting, price prediction, and real-time trading decisions. Experts on optimisation of markets with high penetration of renewables.	Improves efficiency for market players and Japan’s electricity grid.
Renewable Integration & Flexibility	Proven ability to trade and optimise intermittent renewables and manage flexible energy resources. Strong renewable sourcing strategies leveraging wind, solar, and battery assets. High engagement level with policy makers and TSOs on shaping market structures to accommodate higher renewable penetration.	Enables smoother integration of solar, wind, and flexible energy resources into Japan’s energy mix. Ability to offer trading and asset optimisation partnerships.
PPAs & Corporate PPAs	Extensive experience structuring PPAs and Corporate PPAs tailored to client needs, including fixed-price, pay-as-produced, and sleeved contracts. Proven track record with multinational clients across sectors, ensuring bankability, risk mitigation, and sustainability alignment.	Supports Japan’s growing corporate renewable procurement and decarbonisation goals.
Risk Management & Hedging	Expertise in managing price, volume, and credit risks using advanced financial instruments and portfolio optimisation on short- and longer-term basis.	Helps stabilise costs and ensure bankability in Japan’s volatile, import-dependent energy market.



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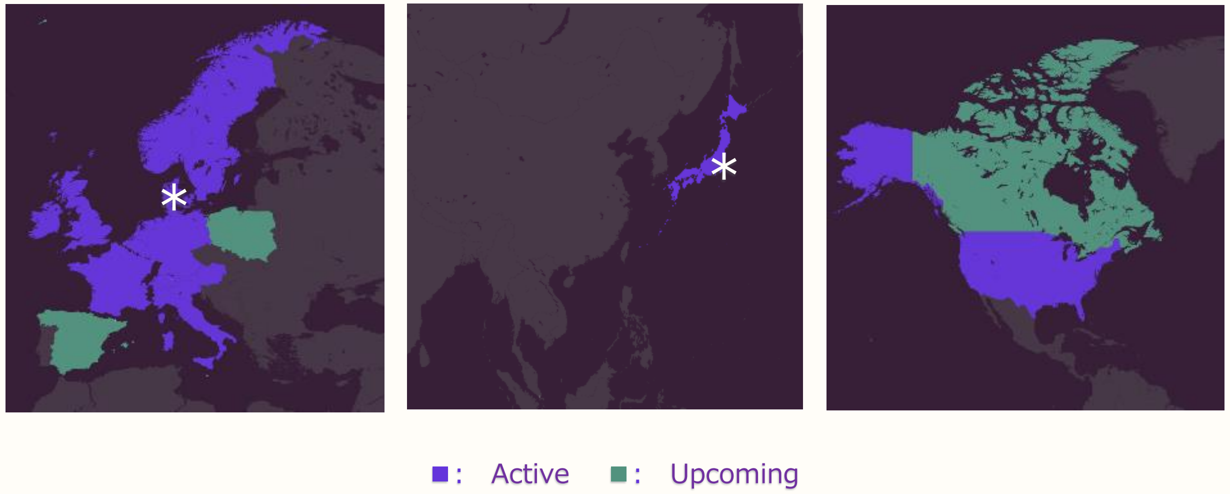
Company Introduction

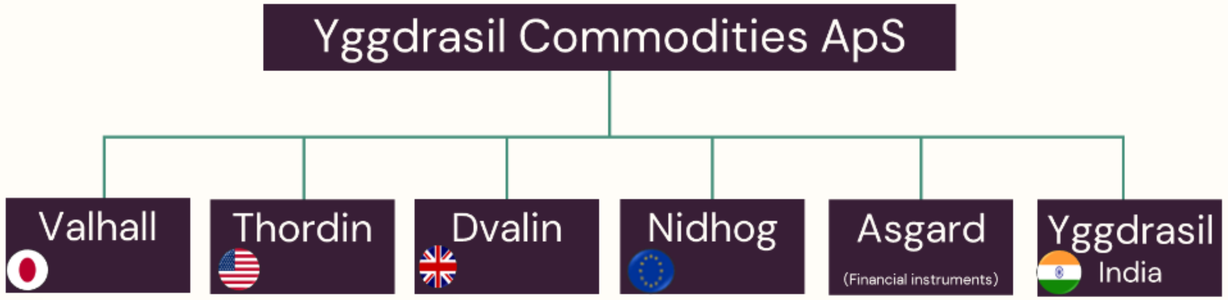
Kei Shiraishi Bech (COO)

YGGDRASIL

Yggdrasil Group

- Trading power worldwide
- Offices in Denmark and Japan
- Focus on algorithms & automation
  - Data-driven approach
  - Only 35 people globally
  - More than 30 markets
- Balancing/Optimization services for asset owners and retailers in Japan





Valhall

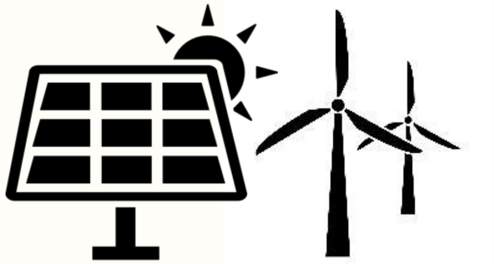
Established Feb 2020 - registered at the Royal Danish Embassy, Tokyo

Local office established in 2022 (Akasaka, Tokyo)

- Enabling 24/7/365 trading desk covering all over the world (Japan, Europe and US)
- Local sales & marketing team to boost the asset management portfolio expansion

Generating additional value for asset owners and retailers

- Managing renewable assets (1.1GW)
- Procurement optimization for retailers
- Battery management



YGGDRASIL

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ELECTRICITY TRADING IN TRANSITIONING ENERGY SYSTEMS

17 June 2025

Peter Markussen, Senior Director, Energinet System Operation

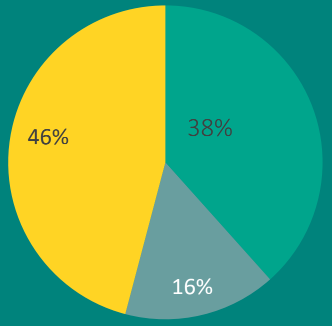
VISION

GREEN ENERGY FOR A

BETTER WORLD

WE BALANCE, OPERATE, DEVELOP AND OWN THE DANISH ELECTRICITY AND GAS TRANSMISSION GRID

Danish gas balance, 2024 (76 PJ)

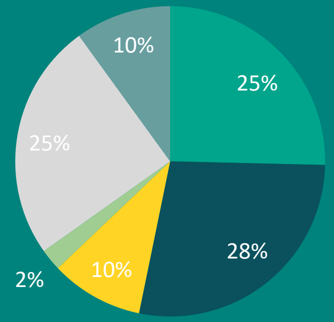


- biomethane
- net imports
- natural gas

100% sec. of supply

38% green gas

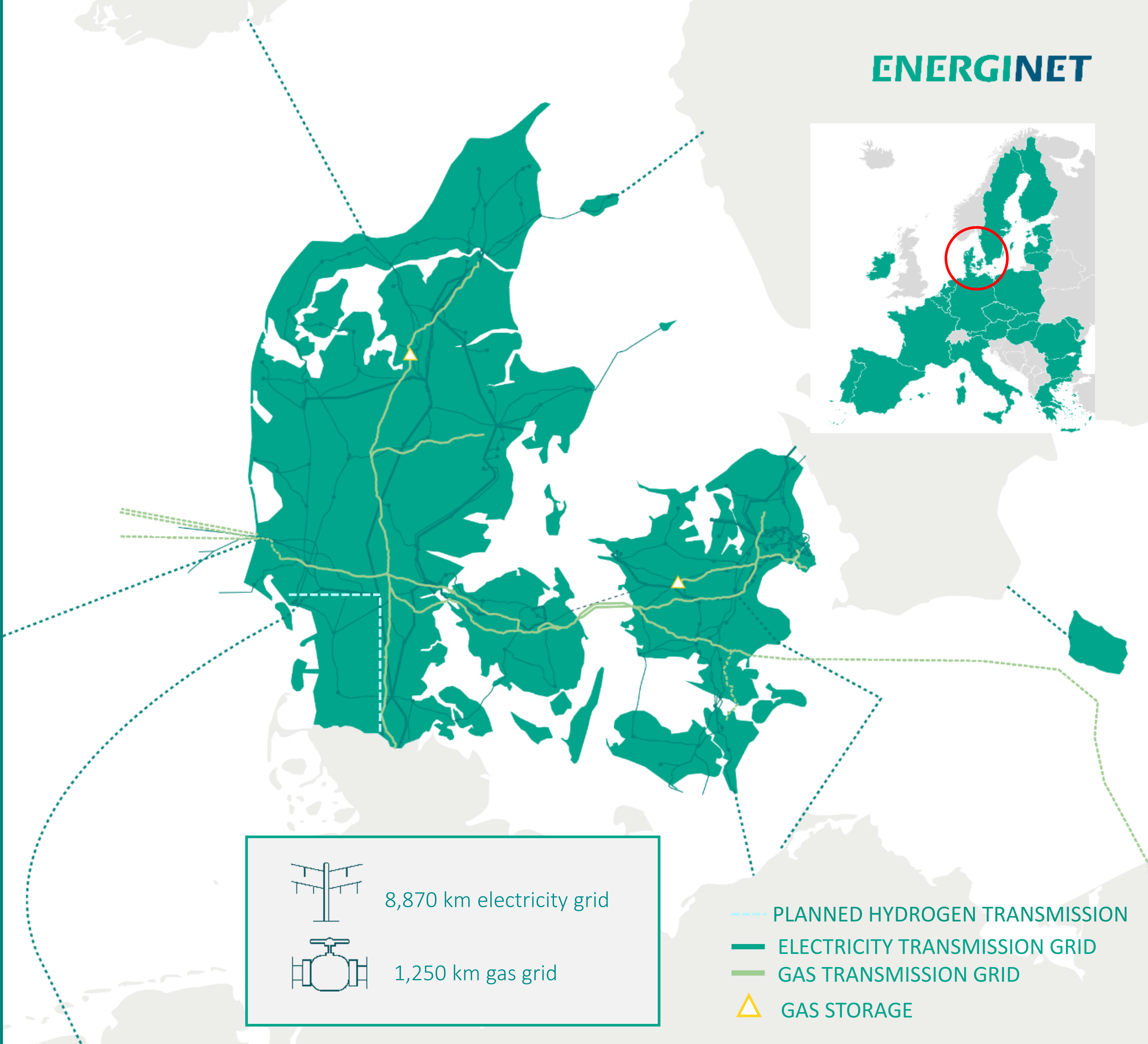
Danish electricity balance, 2024 (37 TWh)



- offshore
- onshore
- solar
- other renewables
- thermal
- import

99.99% sec. of supply (2023)

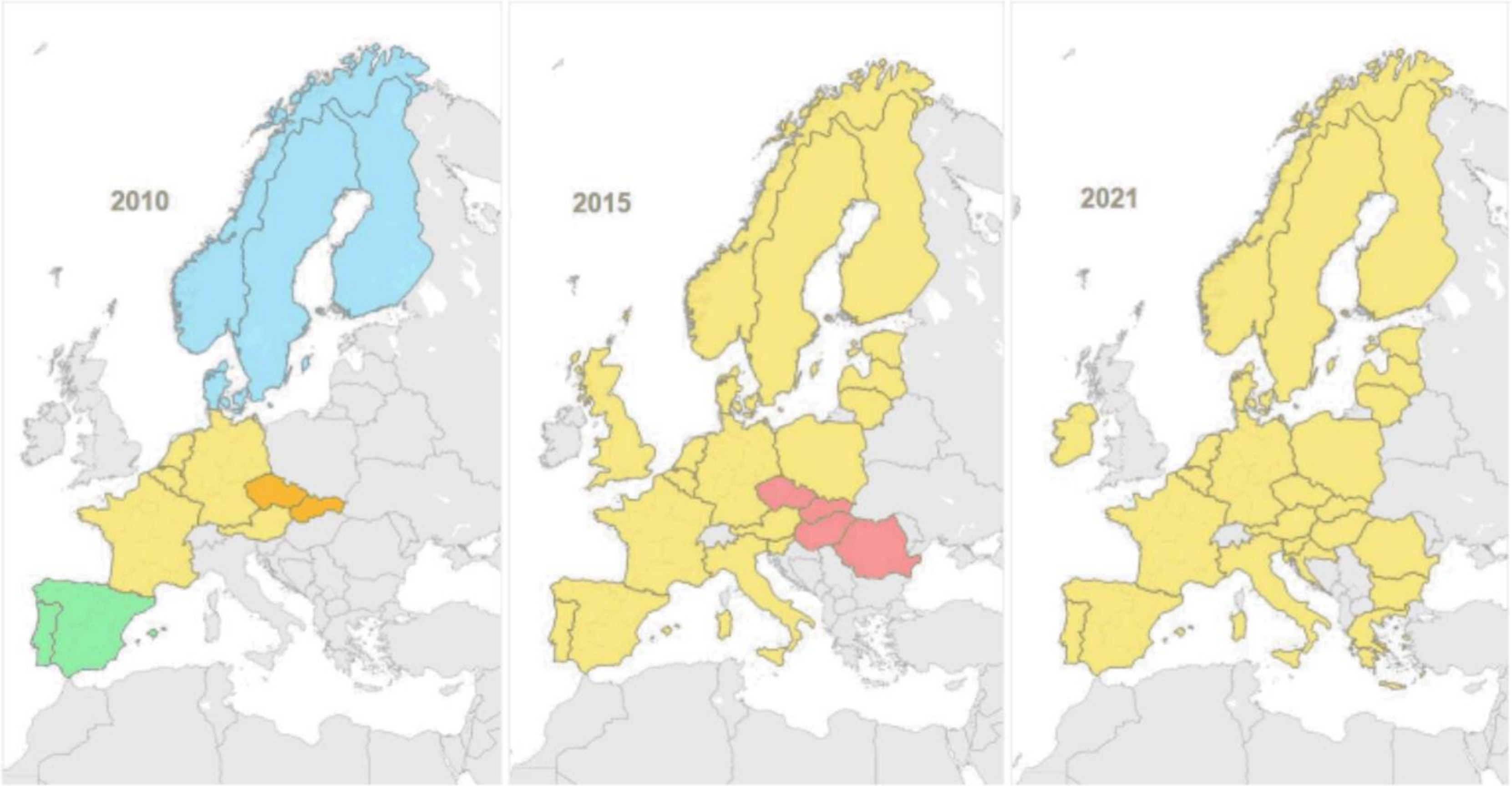
63% solar+wind



ACER
European Union Agency for the Cooperation of Energy Regulators

The benefits of integrated electricity markets

Evolution of EU wholesale electricity day-ahead market coupling, 2010-2021



How large are the benefits from cross-border trade in the EU?

ITEM6MMRandACERDirectorstatement_EN.pdf

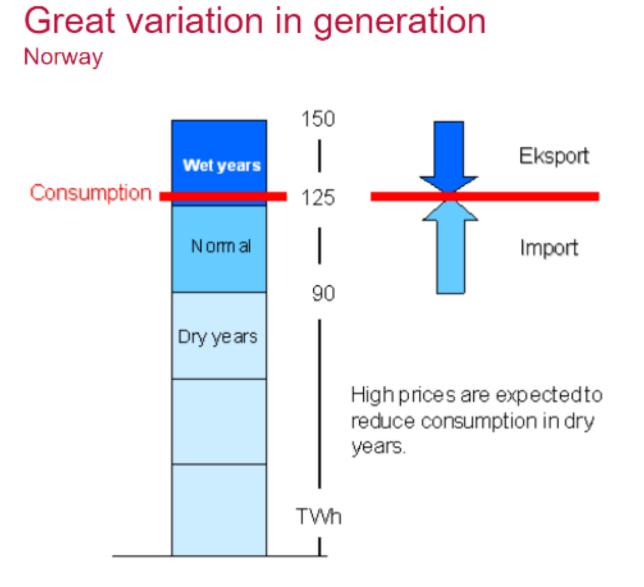
ENERGINET

DAY AHEAD MARKET MAIN TOOL TO ENSURE ADVANTAGES FROM EXCHANGE OF ELECTRICITY

Day ahead

BEFORE 2000

SEASONAL VARIATION



Day ahead

2000-2010

ECONOMIC EFFICIENCY

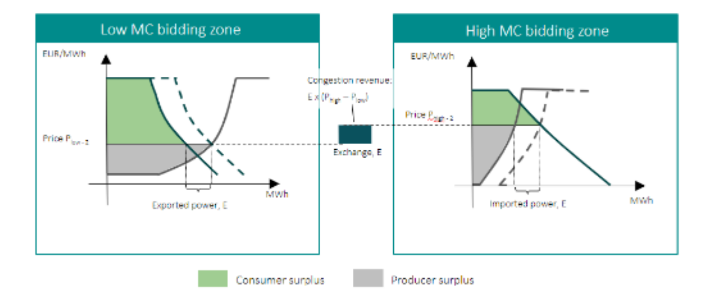


Table 4 Price differences between Nordic spot areas, 2009
Source: Nord Pool Spot

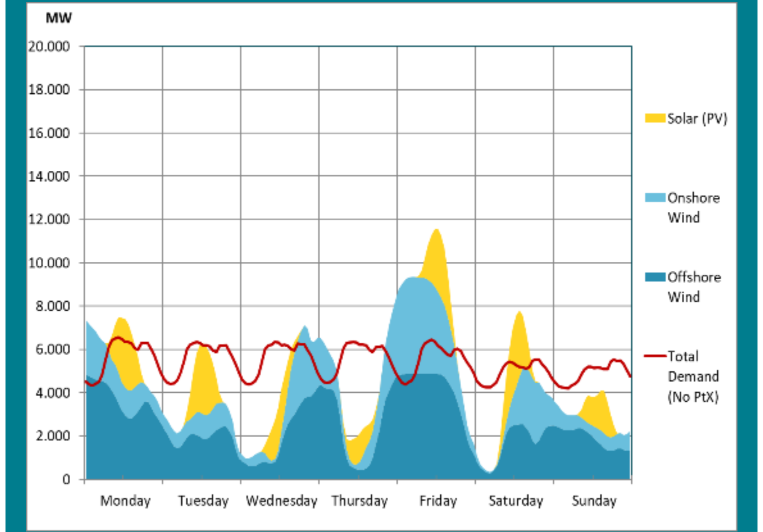
2009		NO1	NO2	NO3	SE	FI	DK1	DK2
		Less than						
NO1	Higher than		15 %	13 %	5 %	8 %	15 %	4 %
NO2		43 %		4 %	8 %	11 %	27 %	8 %
NO3		43 %	4 %		7 %	10 %	26 %	7 %
SE		44 %	23 %	22 %		4 %	25 %	1 %
FI		44 %	23 %	22 %	1 %		25 %	1 %
DK1		40 %	34 %	34 %	19 %	21 %		10 %
DK2		50 %	36 %	35 %	22 %	25 %	37 %	

Day ahead, Intraday Balancing

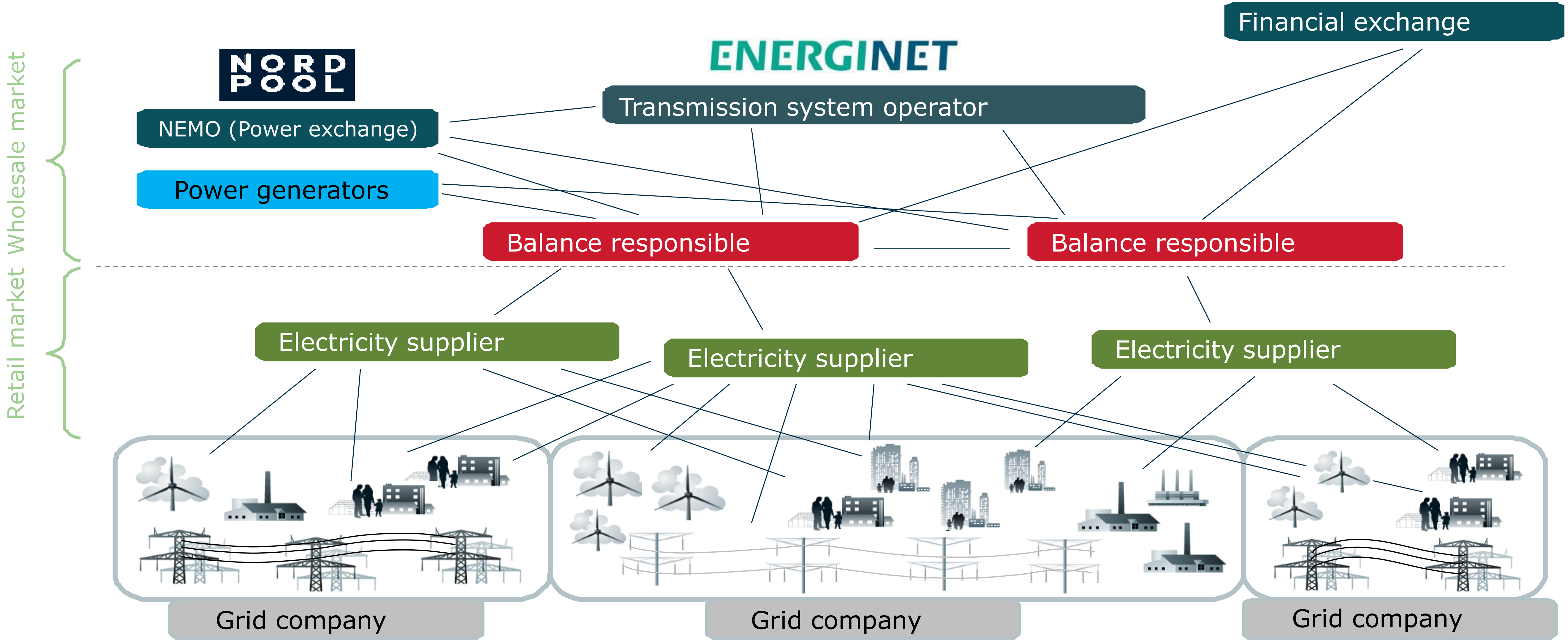
2010-

GREEN TRANSITION

Flexibility from hour to hour



THE ELECTRICITY TRADERS AND BALANCING RESPONSIBLE COMPANIES IMPORTANT ROLE IN REALIZING THE ADVANTAGE FROM ELECTRICITY MARKETS



Session 2

12:45 – 14:15

The Nordic model for Fossil-free Energy Systems

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The Nordics: A Blueprint for Regional Cooperation

INNO

NORDIC ENERGY DAYS JAPAN JUNE 17-18; 2025

BO NORMARK

Nordic power system

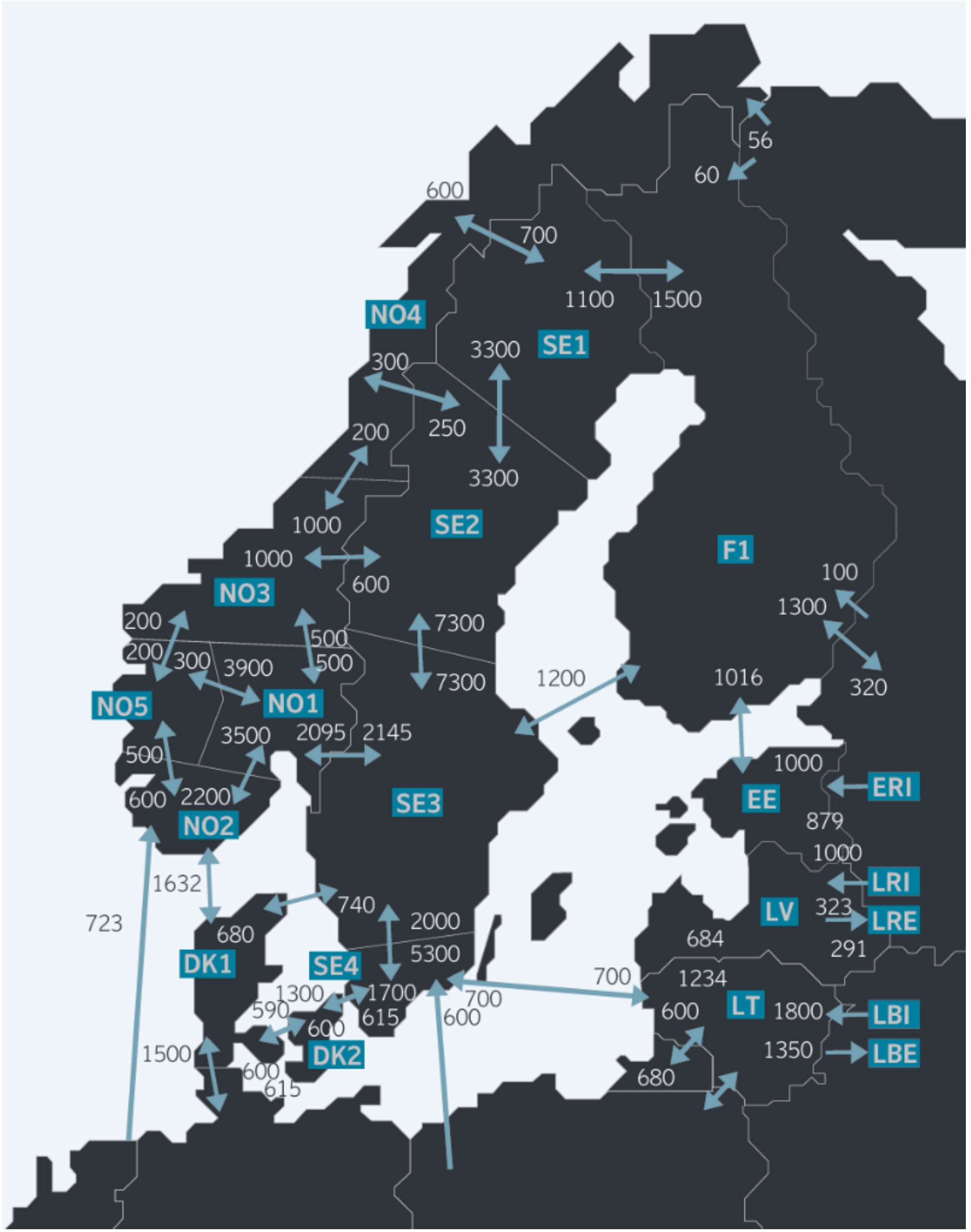
The Nordic region has a well-established, interconnected power grid with significant cross-border power flows. This allows for the efficient sharing of resources, balancing supply and demand, and managing fluctuations in renewable energy production. Key factors driving this integration include:

•**Complementarity in generation mixes**

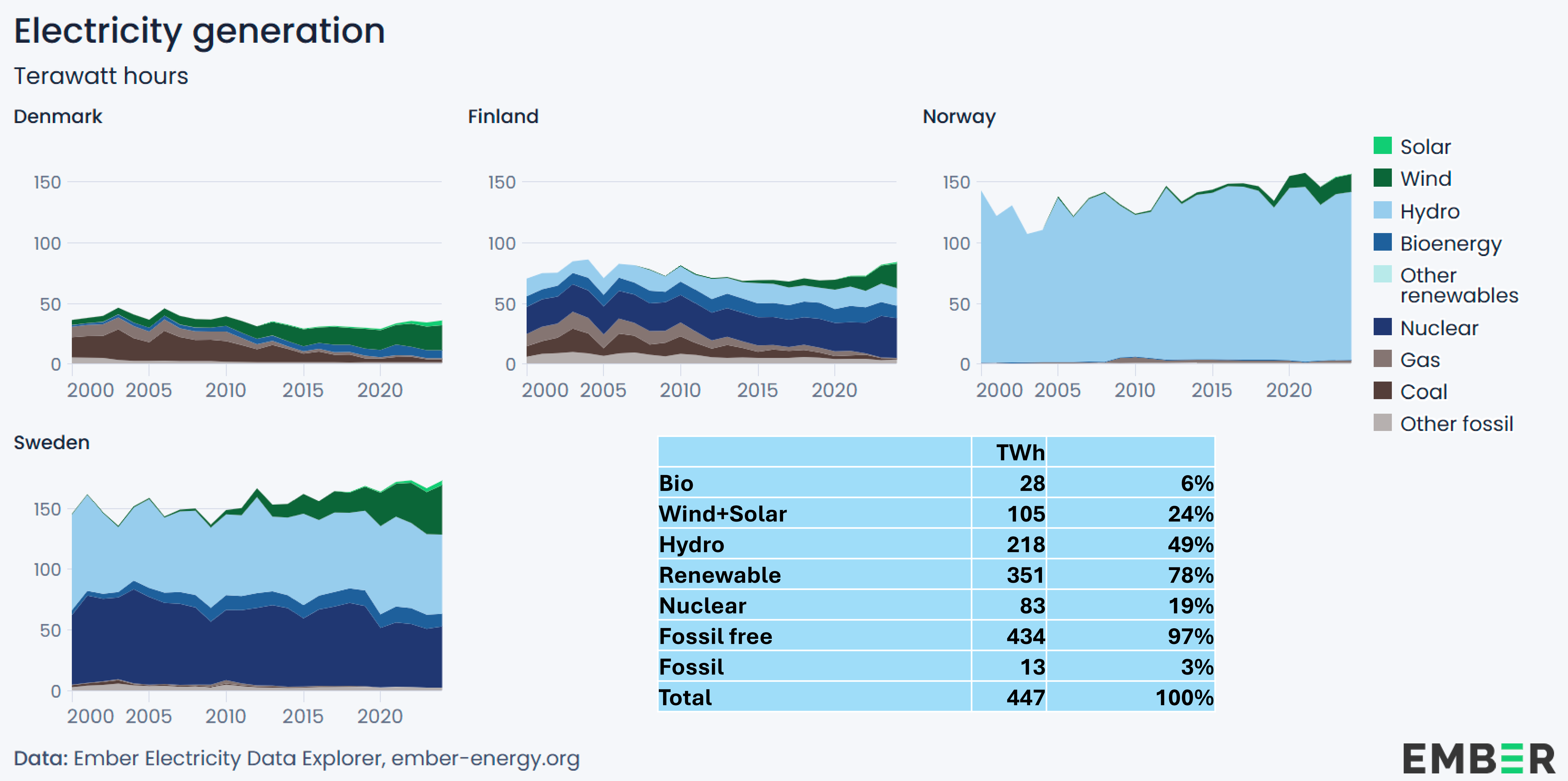
•**Strong cross-border transmission lines**

•**Market integration and cooperation**

•**Cross-border power flows help to reduce overall costs, increase efficiency, and enhance security of supply.**



Complementary generation mix, production 2024



	TWh	
Bio	**28**	**6%**
Wind+Solar	**105**	**24%**
Hydro	**218**	**49%**
Renewable	**351**	**78%**
Nuclear	**83**	**19%**
Fossil free	**434**	**97%**
Fossil	**13**	**3%**
Total	**447**	**100%**

Strong seasonal variation, constant export

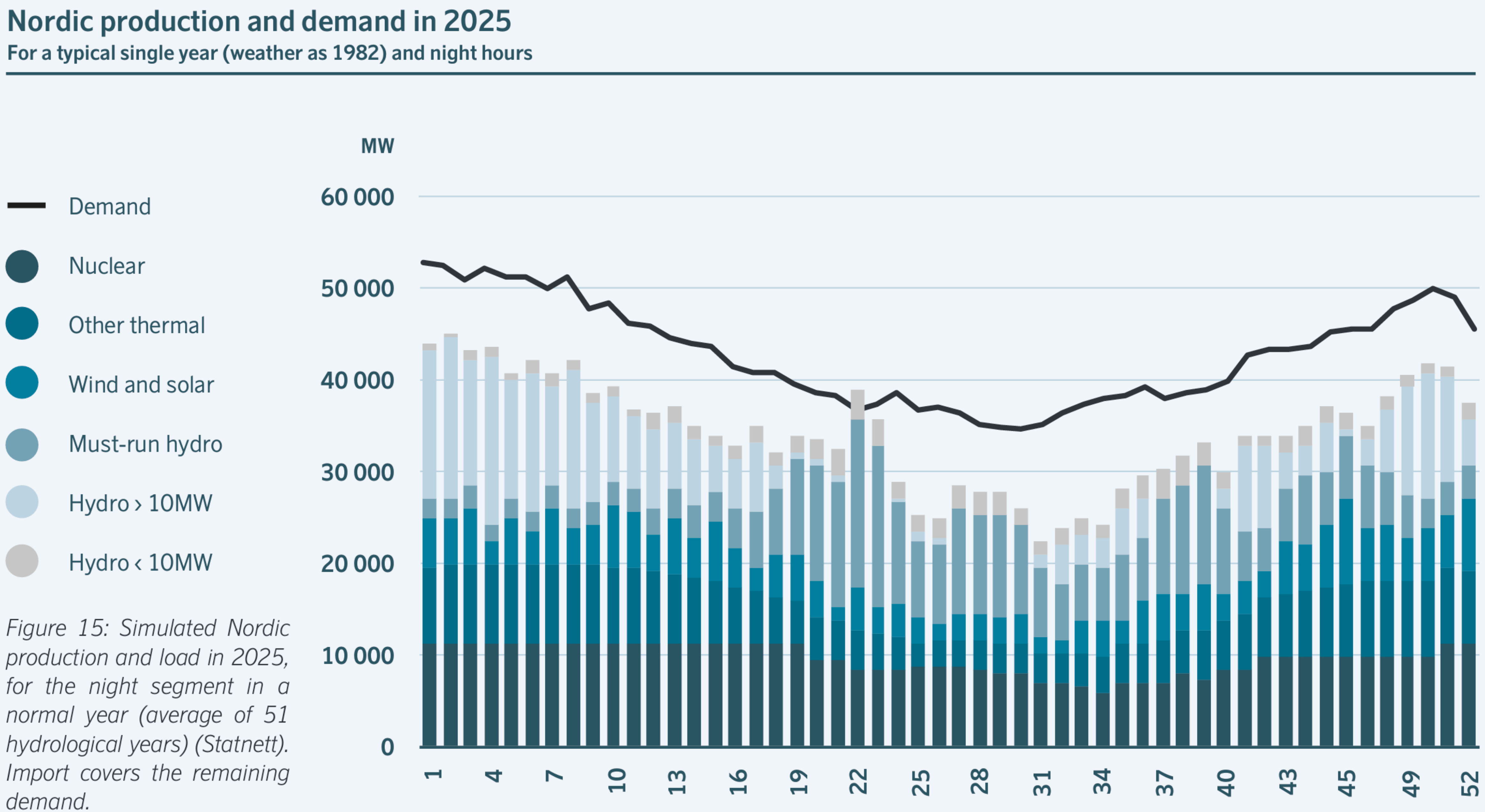


Figure 15: Simulated Nordic production and load in 2025, for the night segment in a normal year (average of 51 hydrological years) (Statnett). Import covers the remaining demand.

[9] *Must-run hydro: Production from power plants without reservoirs and power plants with reservoirs that are required to produce power at a specific time for various reasons, including full reservoirs, flow restrictions, reservoir targets etc. Includes all hydropower production with zero marginal costs.*

Page 30

Strong cross-border interconnection lines

Overview of existing HVDC interconnectors and HVDC interconnectors under construction

Existing	
Skagerrak 1–4	1600 MW
NorNed	700 MW
Konti-Skan 1–2	680/740 MW
Kontek	600 MW
Baltic Cable	600 MW
SwePol Link	600 MW
Fenno-Skan 1–2	1200 MW
NordBalt	700 MW
Estlink 1–2	1000 MW
Vyborg Link	1400 MW
Storebaelt	600 MW

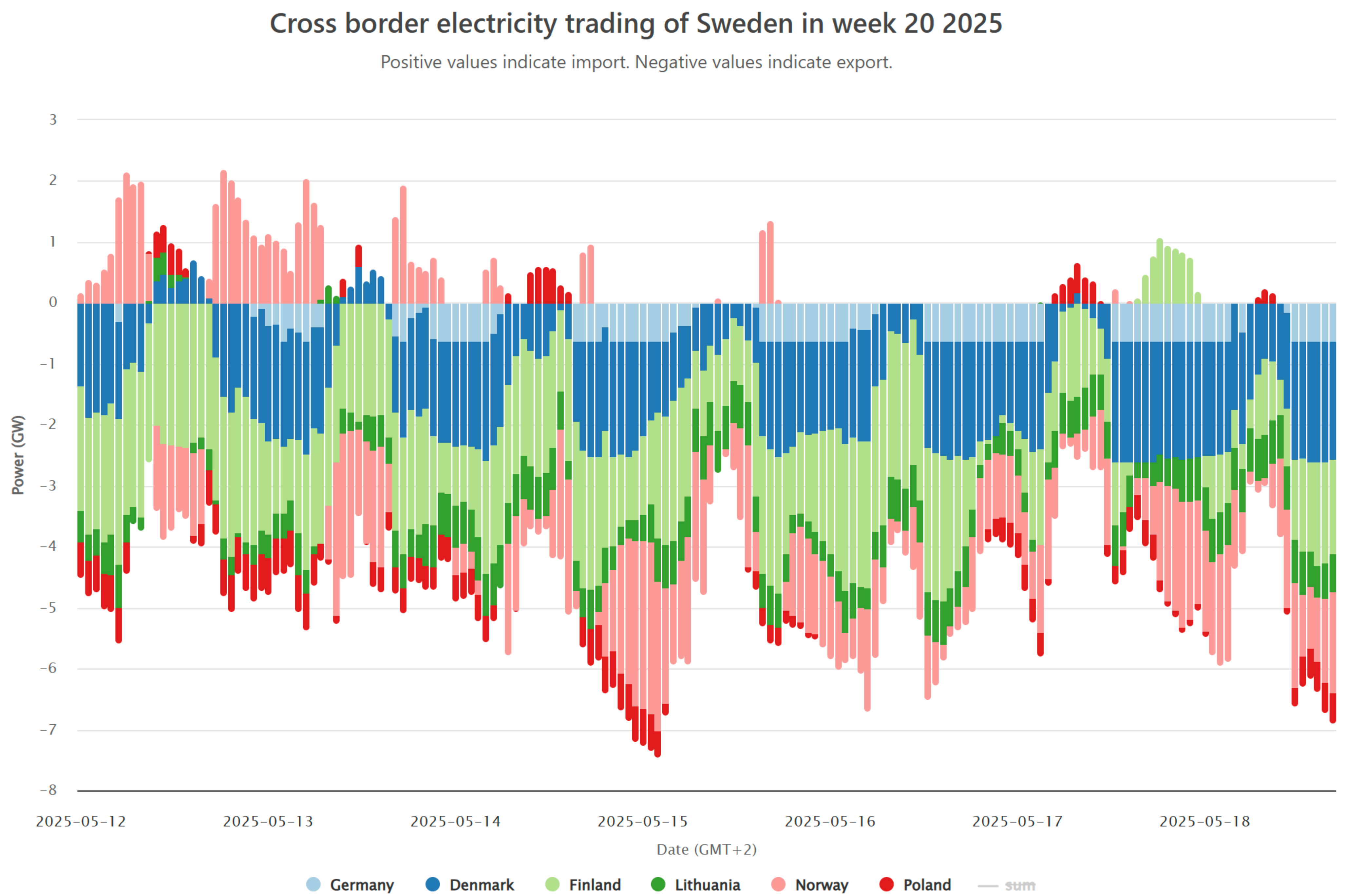
Under Construction	
Cobra	700 MW (2019)
Kriegers Flak	400 MW (2019)
Nord Link	1400 MW (2020)
North Sea Link	1400 MW (2021)

Under development
(not in map, comprehensive list in Appendix 3)

- Viking Link
- DK West – Germany
- North Connect
- Hansa PowerBridge

Source: Challenges and Opportunies for the Nordic Power System 2024

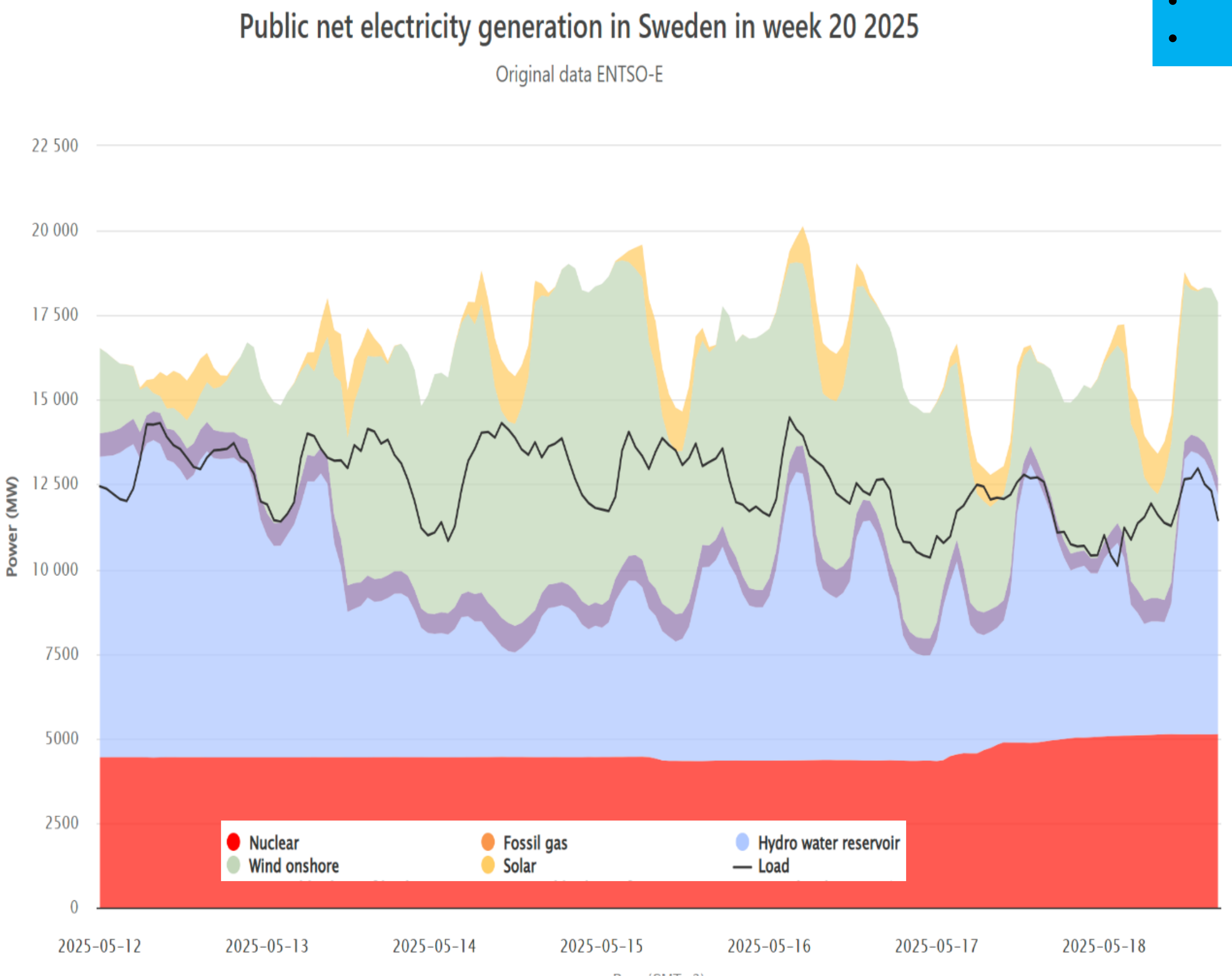
Market integration and cooperation

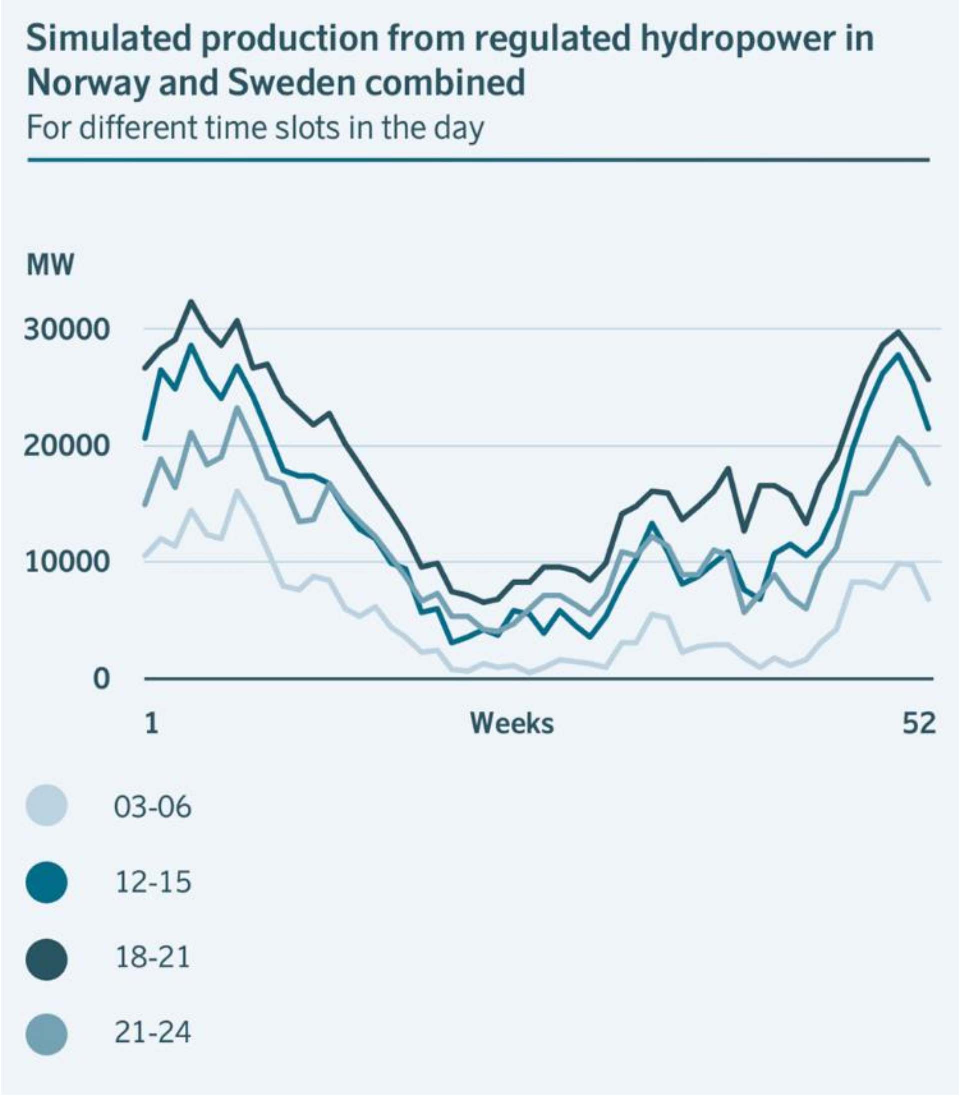


Hydro is balancing power production

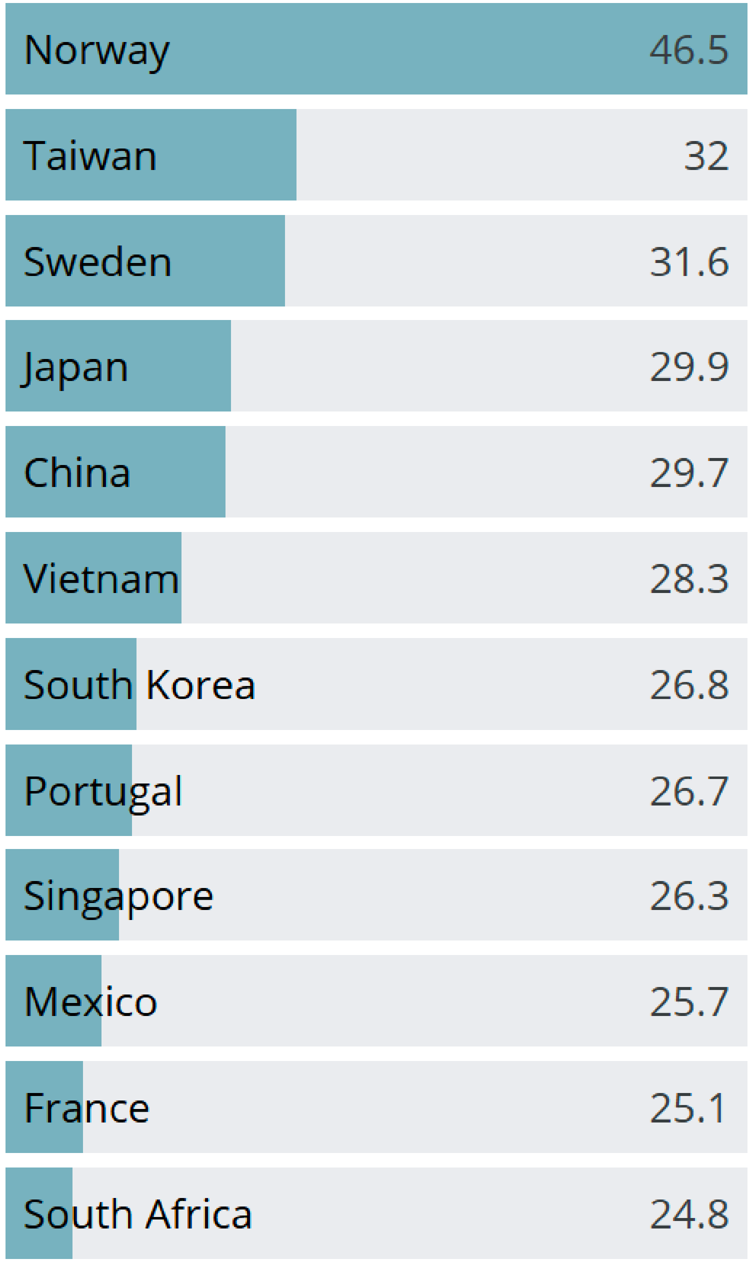
Nordic countries have

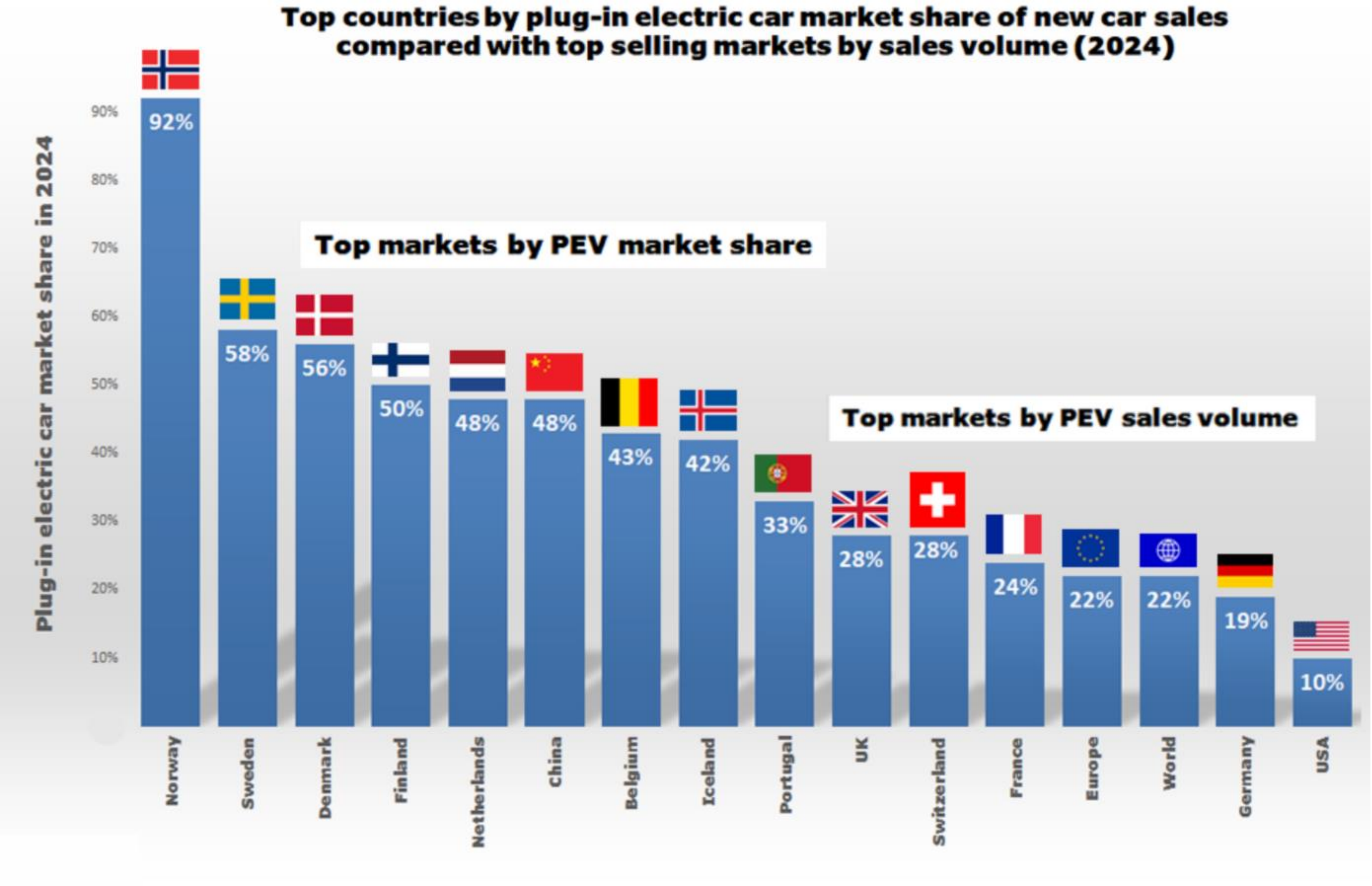
- **33 % of European installed hydro production capacity**
- **60% of European Hydro Storage Capacity**



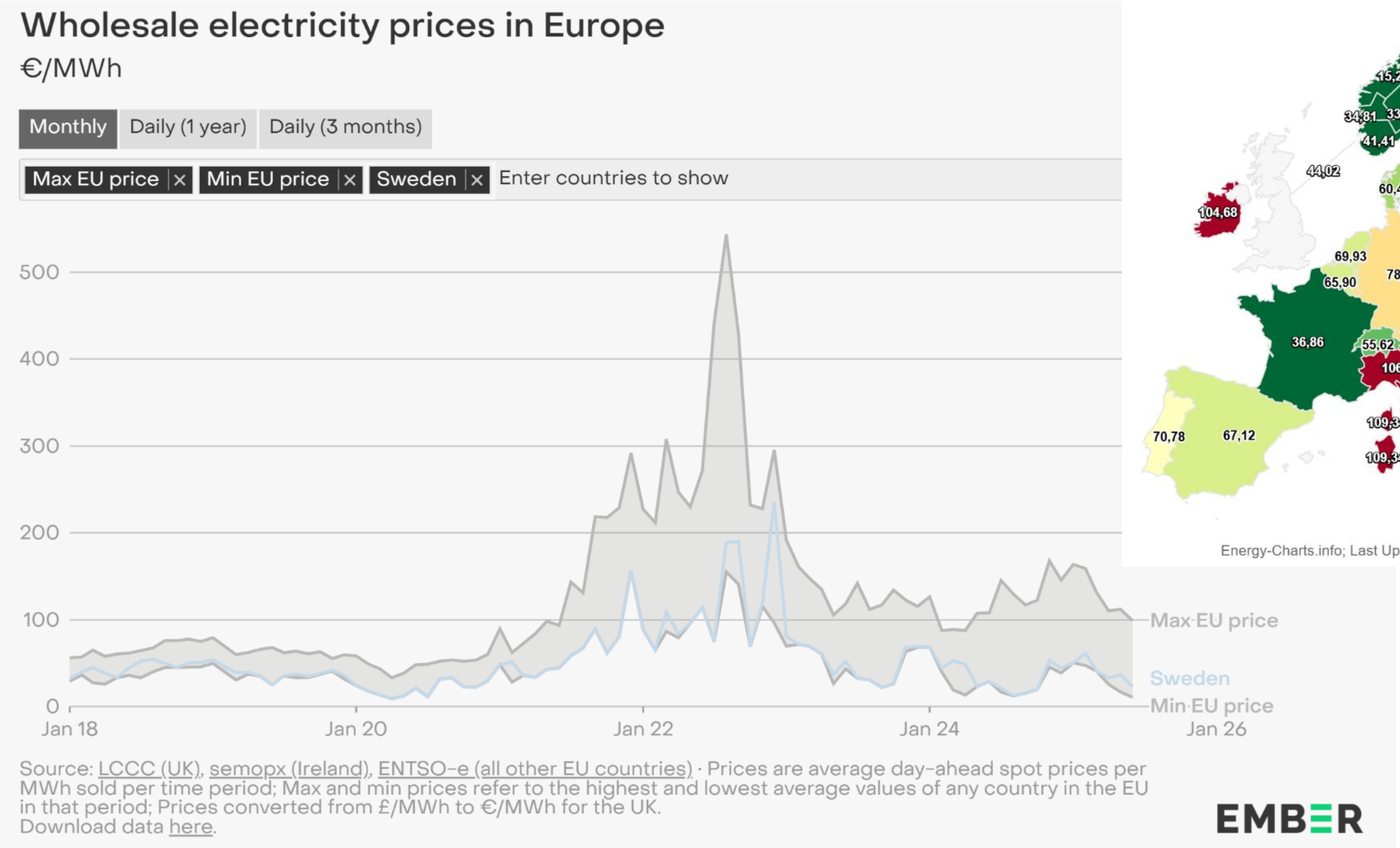


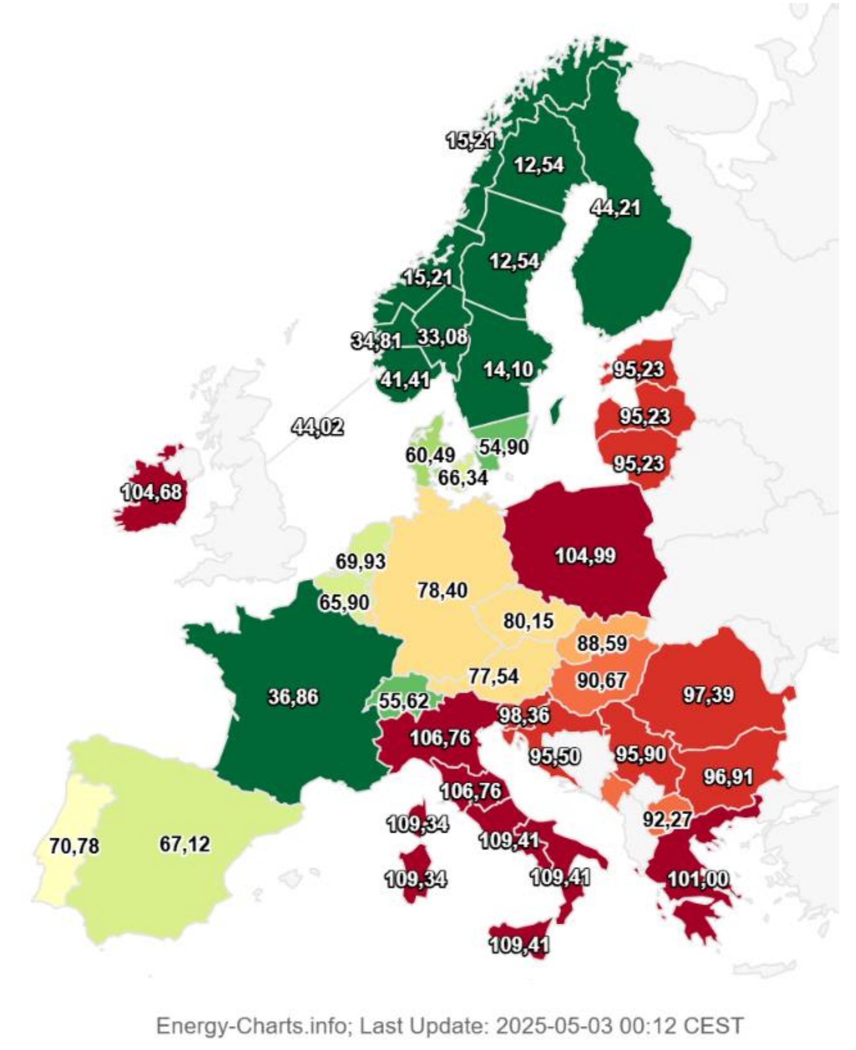
Nordic countries leading in electrification





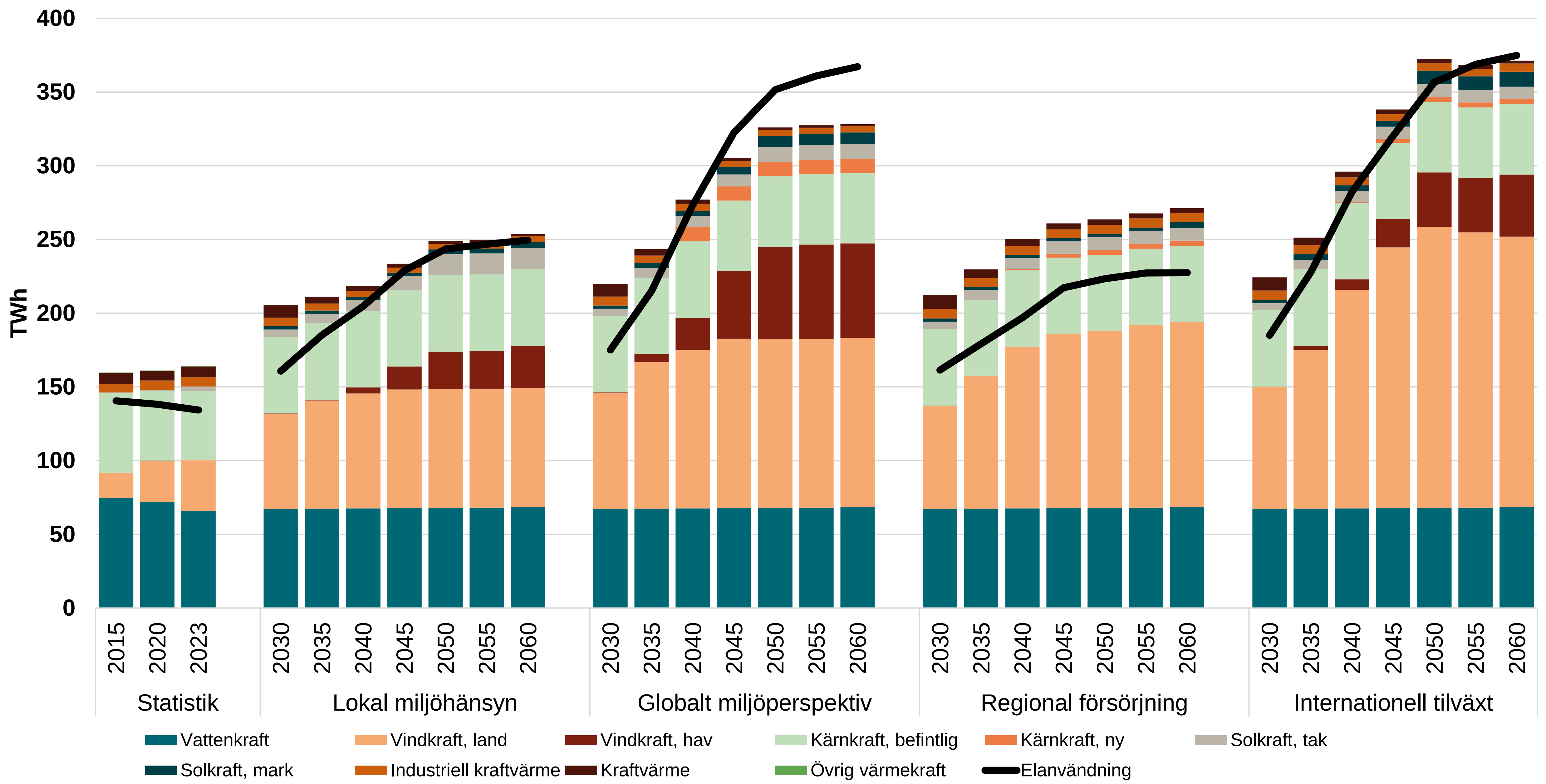
Consistently low electricity prices





Going forward
Sweden

Four scenarios for Sweden



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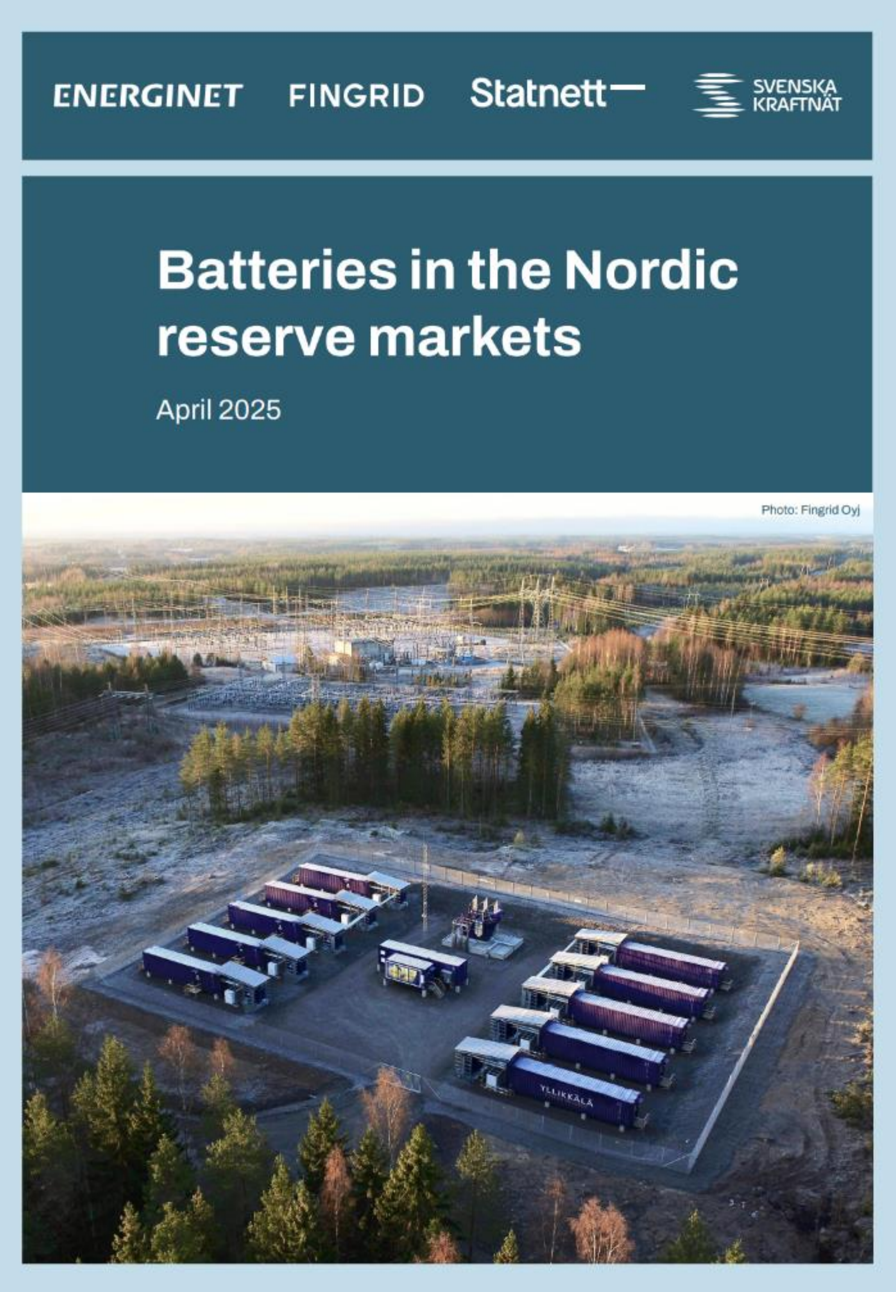
More flexibility is needed



Flexibility from batteries is valuable to the power system

There is an increasing need for flexibility in the energy and reserve markets

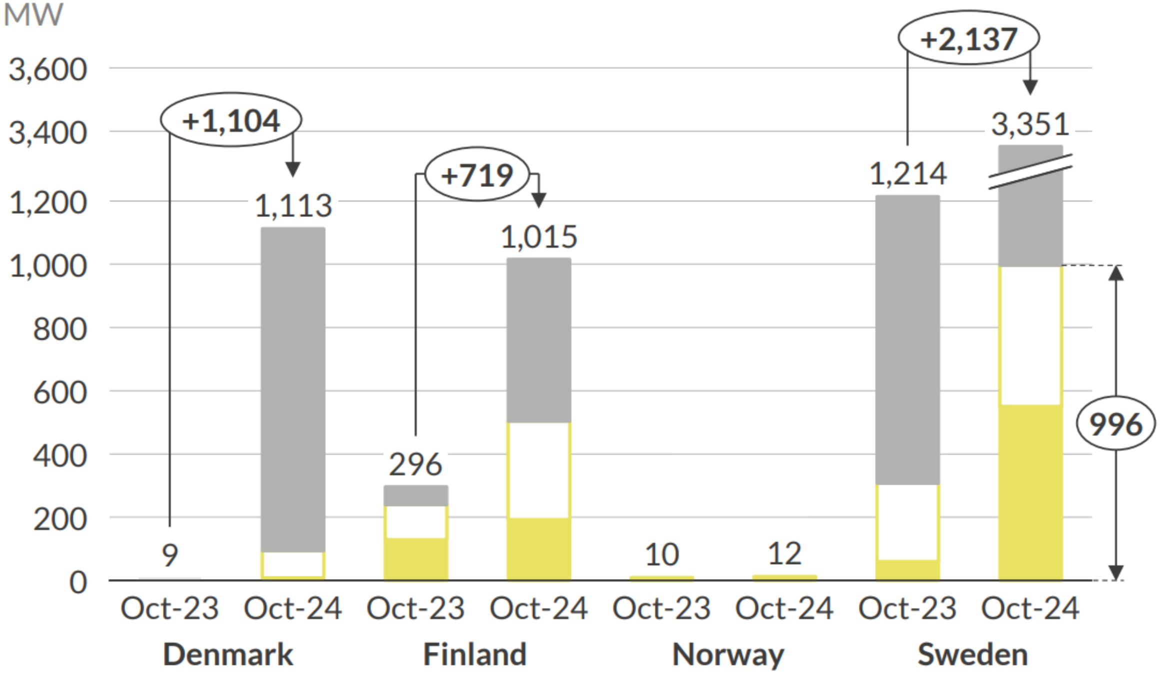
Batteries have the capability to participate in all energy and reserve markets

Batteries are booming in the Nordics

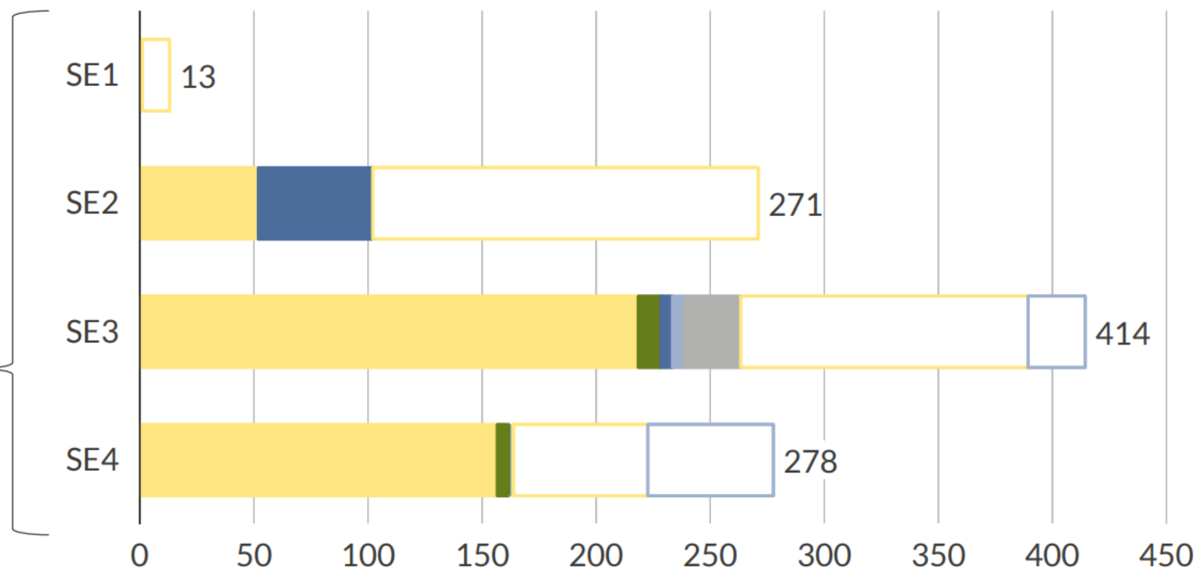
Nordic BESS capacity has skyrocketed over the last year, with 4GW added to the pipeline; the fleet consists mostly of stand-alone batteries in SE3 and SE4

AURORA

Nordic battery capacity by status and location
MW



Operational and under construction batteries in Sweden
MW



- Over the last year BESS[1] capacity in the Nordics grew by over 600MW and the total pipeline by around 4GW. The largest growth is in the established Finnish and Swedish markets, while Denmark is quickly ramping up.
- The current Nordic fleet is over 750MW. Additionally, 850MW of projects are under construction and another 3.9GW have been announced. Sweden is the biggest market with 3.3GW in the pipeline and over 500MW operational.
- 80% of the operational Swedish BESS capacity is situated in SE3 and SE4, the zones with undersupply of energy and higher power prices. SE2 has the largest amount of capacity under construction.
- Over 80% of the capacity consists of stand-alone assets. SE2 has 50MW of assets co-located with hydropower. Projects co-located with other energy sources have started to come online in SE3 and SE4.

1) Battery energy storage system.

Sources: Aurora Energy Research, Company announcements, EC DG ENER

Heat pumps key resouce for fossil free heating..

Sweden is a global leader in heat pump technology and utilization, with a high percentage of homes using them for heating and cooling. Over 70% of Swedish homes have heat pumps, and they cover nearly 30% of the total heat demand in the country's buildings. This widespread adoption has significantly reduced reliance on fossil fuels and CO2 emissions from buildings.

According to the European Heat Pump Association, heat pumps in the EU, with Sweden as a major contributor, reduce CO2 emissions by 9.16 million tons annually. In Sweden alone, heat pumps produced 16.8 TWh of thermal energy (approximately 9% of the EU-21 total), significantly lowering the carbon footprint of heating.

Heat pumps enable flexibility in the energy system by utilizing surplus electricity (e.g., from wind or solar) for heat generation, especially in district heating systems with heat storage.

Electric vehicles will become a major flexibility resource..

Vattenfall is involved in a pilot project testing vehicle-to-grid (V2G) technology with 200 Volkswagen electric cars. This project, a collaboration with Energy Bank and Scania Volkswagen Dealers, explores how electric car batteries can be used to both charge the car and deliver electricity back to the grid or household.

Göteborg Energi is involved in three V2G projects

- Together with Volvo Cars, bidirectional charging for home use it is tested how homeowner can contribute power from their electric car battery to the local electricity grid.
- The testing phase of Polestar's V2G project PAVE, which includes a large fleet of Polestar-3 cars, will begin in the spring of 2024. In addition to Göteborg Energi Nät and Polestar, the project also includes Svenska Kraftnät, Vattenfall Eldistribution, charging provider Easee and Chalmers University of Technology.
- The collaborative project PEPP, Public EV Power Pilots, is investigating how vehicles, through bidirectional charging, can be used as energy storage to balance the electricity grid.

Local flex markets show the way

“Effekthandel Väst”

LongFlexTM

You who can plan your business's flexibility
are compensated for being available.

- We buy availability to bids
- Contracts over longer periods of time such as days, weeks, months or season (Nov-March)
- You receive accessibility and activation compensation

MaxUsageTM

Suitable for those who want to participate in a simple and smooth way with minimal administration.

- Contract-based where you reduce your power consumption to a certain level during specific hours and days
- Ongoing compensation as long as you stay below the agreed level.

ShortFlexTM

The solution for those who want to be active and bid on an hourly basis

- Compensation for matched bids.

State of today Nordic Power System

- Power System is 97% fossil free
- Large exporter of clean electricity
- Consistently low electricity prices
- Large price variations

Challenges going forward

- Large expansion of production required
- Uncertain demand growth
- Debate on new power sources
- Grid expansion lagging

- **Solutions**
- Continued regional cooperation
- Flexibility will be key
  - As alternative to grid expansion
  - To reduce peak loads
  - To reduce price variations

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Accelerating Energy Transition in Japan

17 JUNE 2025

Mika Ohbayashi, Director
Renewable Energy Institute

Japan’s power system snapshot

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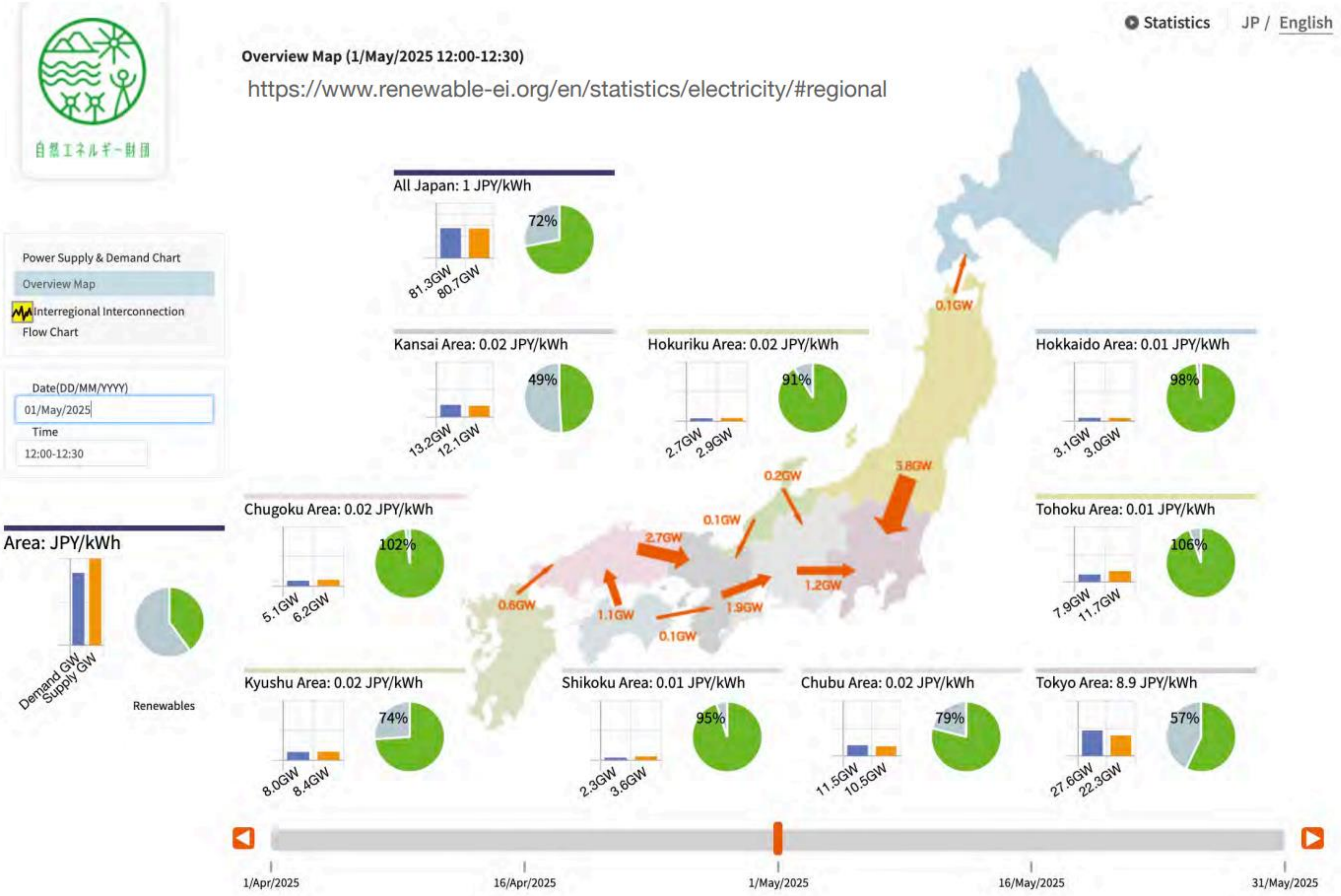
Japan's electric power system consists of nine power areas (plus the Okinawa region, with a maximum power of 1.6 GW).

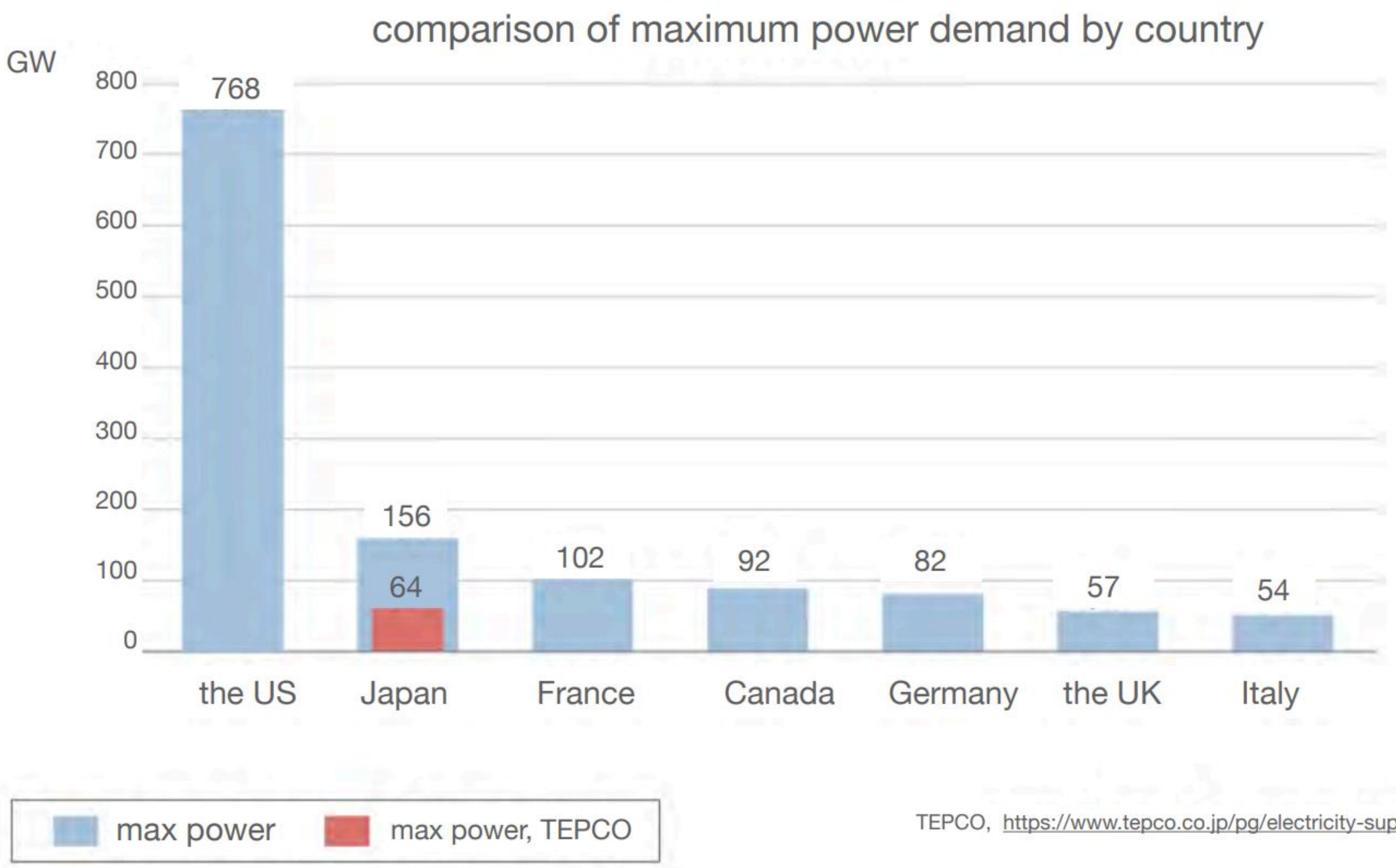
Three TSOs in the eastern region (50 Hz), six TSOs in the western region (60 Hz).

While individual connections - such as Tohoku–Tokyo, Chubu–Tokyo, Chubu–Kansai, and Kansai–Chugoku—are relatively well connected, the overall connection between the eastern and western blocks remains insufficient.



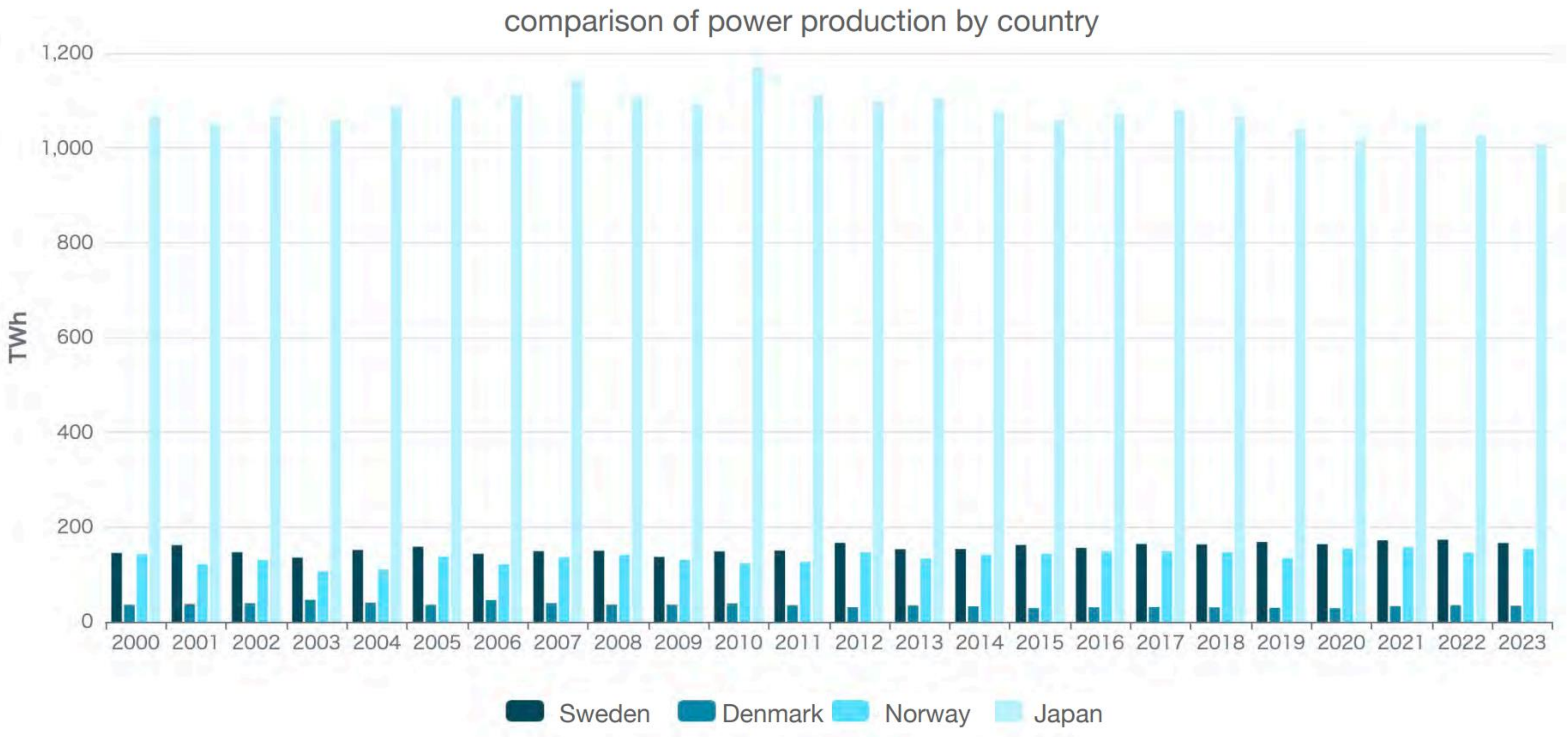
Japan's power system snapshot

2012 record, Japan's number is total of 10 power companies



TEPCO, https://www.tepco.co.jp/pg/electricity-supply/quality.html

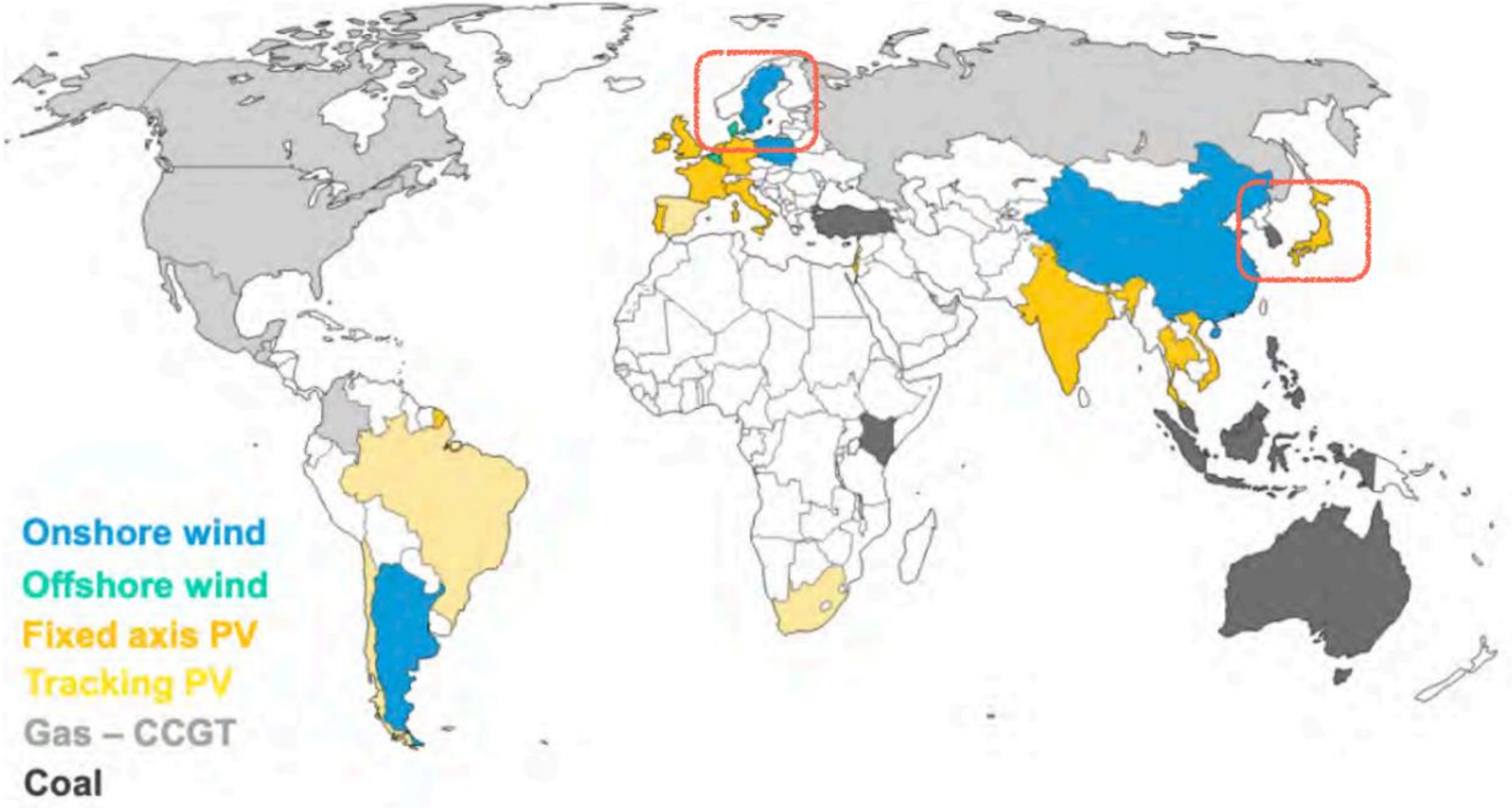
Japan's power status snapshot



https://yearbook.enerdata.jp/electricity/world-electricity-production-statistics.html

Cheapest power sources in 2024
– new solar, wind vs existing coal, gas
–BloombergNEF, FEB 2025

source: 2025 LCOE Update BloombergNEF,



In Japan, too, RES is becoming the competitive power source vs existing fossil power generation.

Source: BloombergNEF. Note: The map shows the technology with the lowest levelized cost of electricity (or auction bid for recent delivery) for new-build renewable plants or short-run marginal costs for coal and gas-fired power plants in each market where BNEF has data. LCOEs exclude subsidies, tax credits and grid connection costs, and include a carbon price where applicable. CCGT is combined-cycle gas turbine. Mapped data are for distinct economies.

Global RES status

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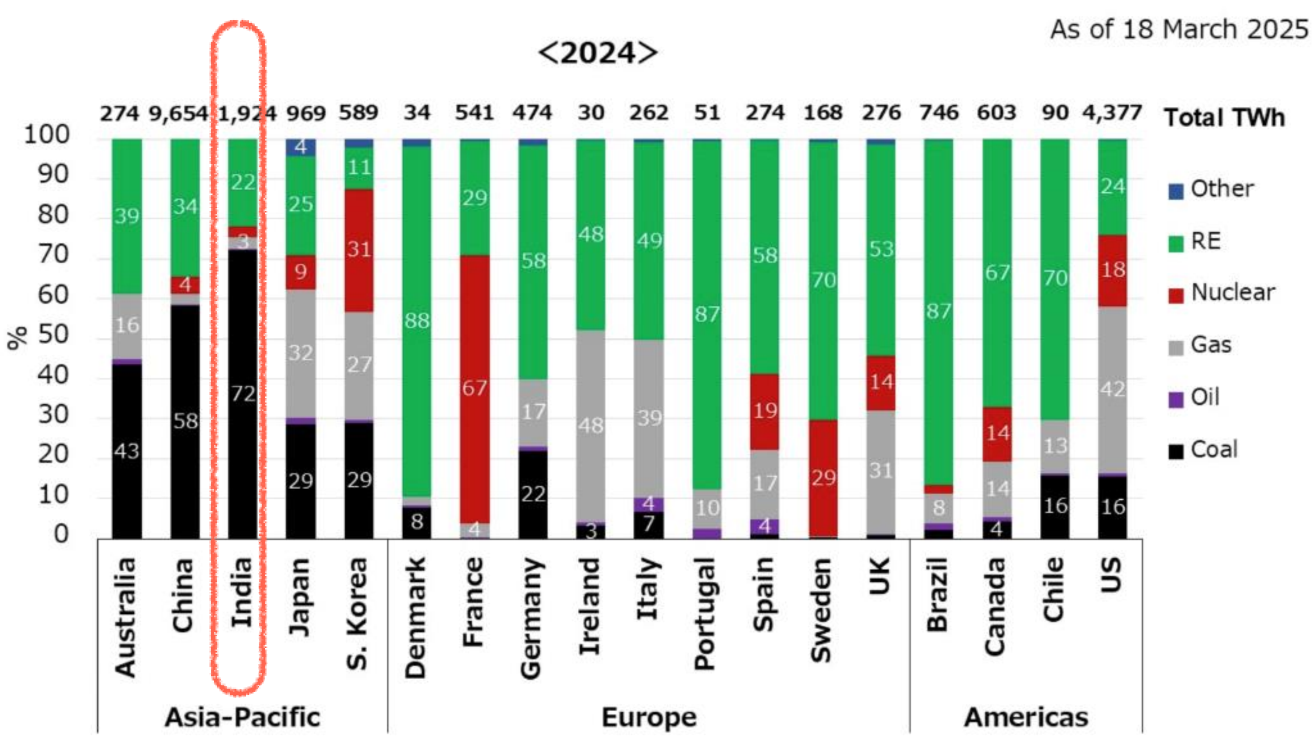
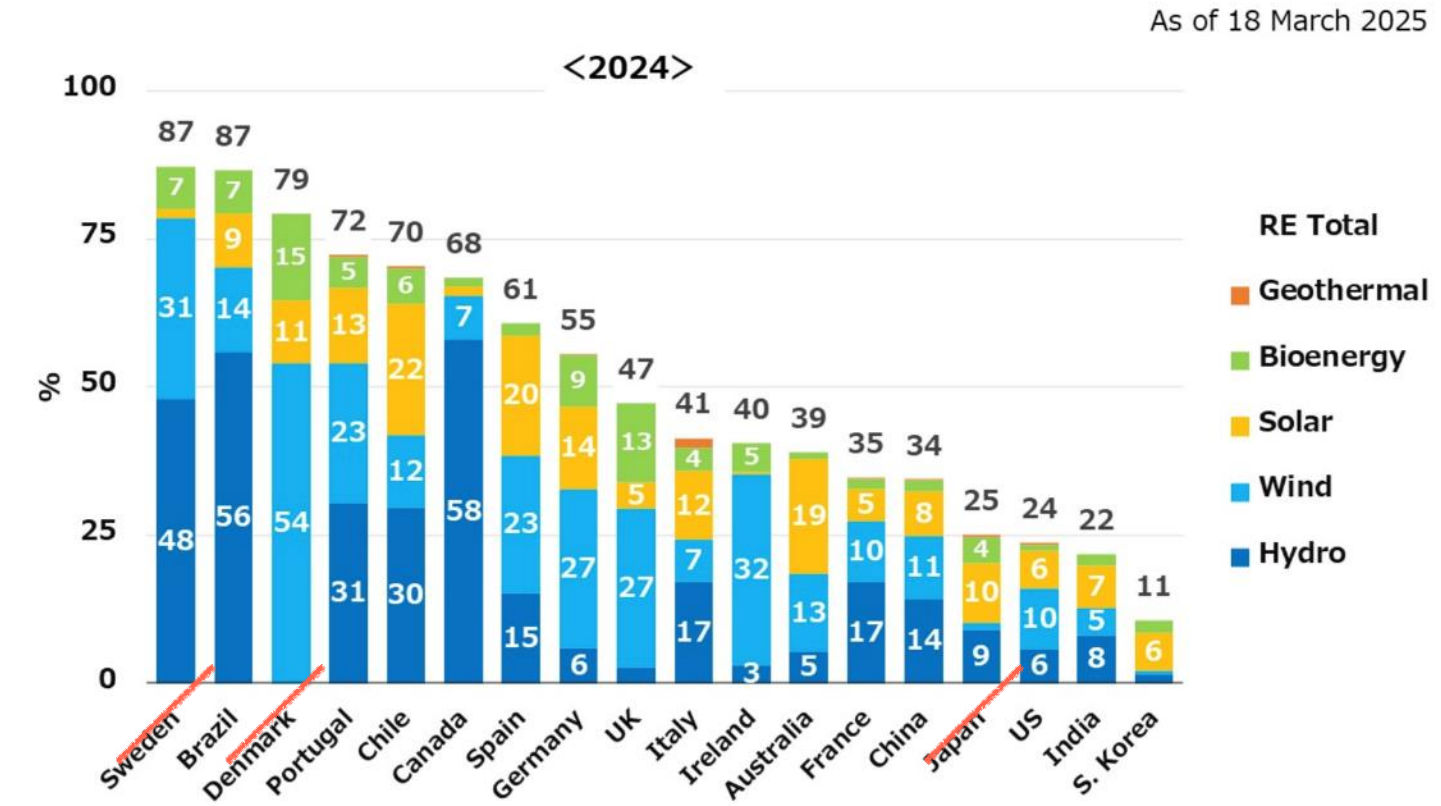
Electricity Generation Mix (%)



Notes: "RE" (renewable energy) includes hydro, wind, solar, bioenergy and geothermal. "Other" includes non-renewable waste and non-specified sources. Based on "net" generation.

Sources: Based on International Energy Agency, Monthly Electricity Statistics: Data up to December 2024 (March 2025) . Modified by Renewable Energy Institute.

RE Share in Electricity Consumption



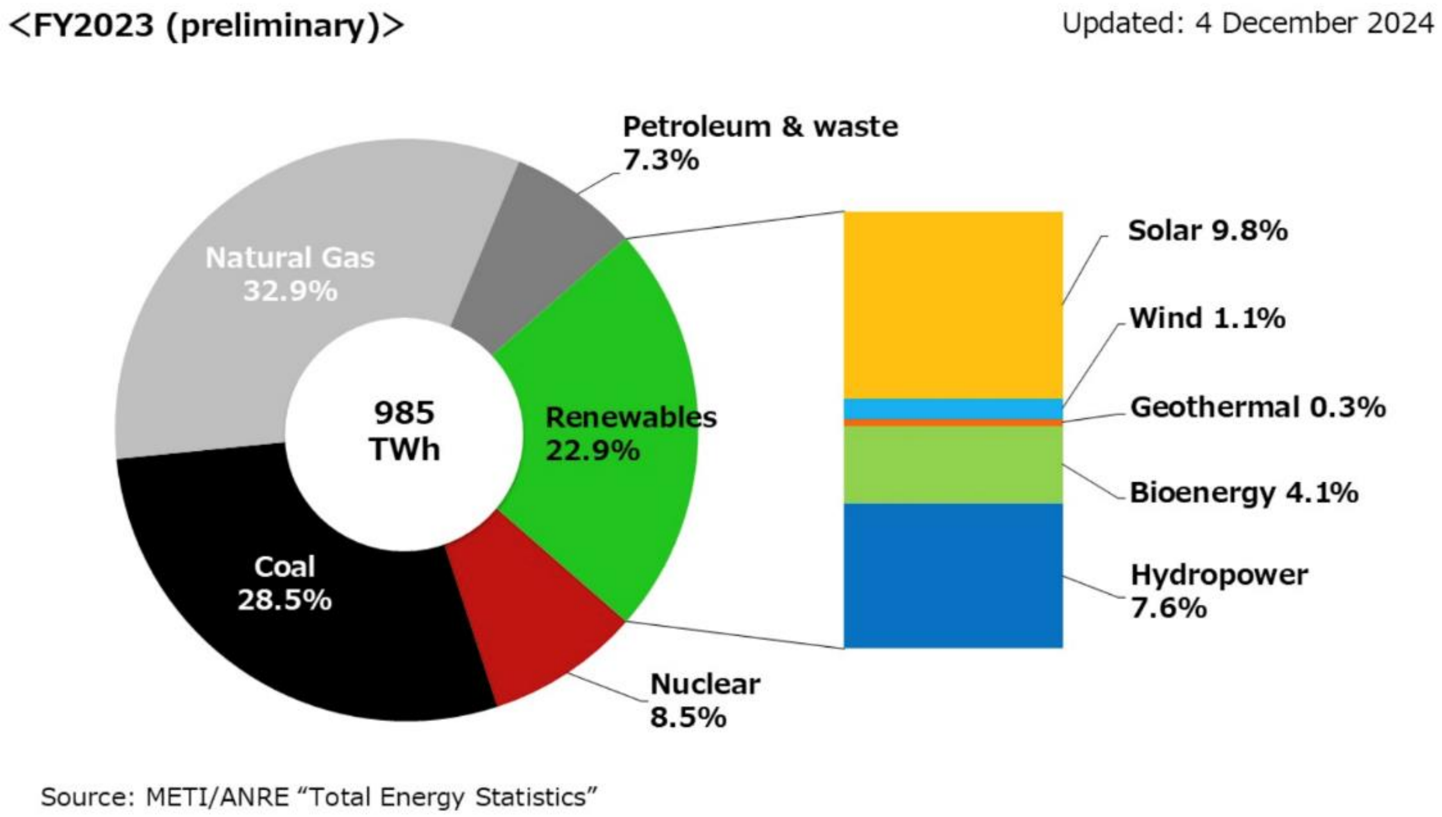
Notes: Electricity consumption = electricity generation + imports - exports. Based on "net" generation.
Sources: Based on International Energy Agency, Monthly Electricity Statistics: Data up to December 2024 (March 2025). Modified by Renewable Energy Institute.

自然エネルギー財団 WEBサイト統計ページより
https://www.renewable-ei.org/statistics/international/

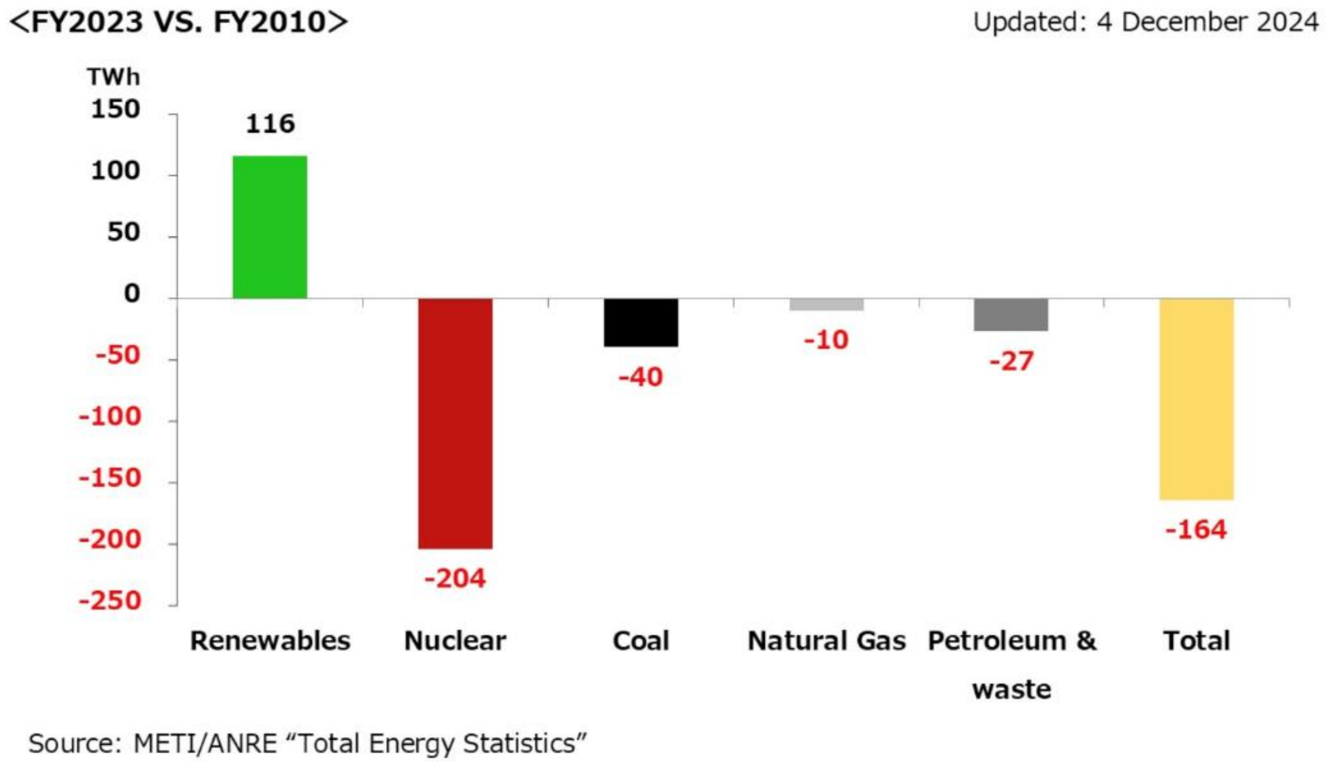
Japan renewable energy status and challenges

Japan: RES trends

Electricity generation mix in FY2023

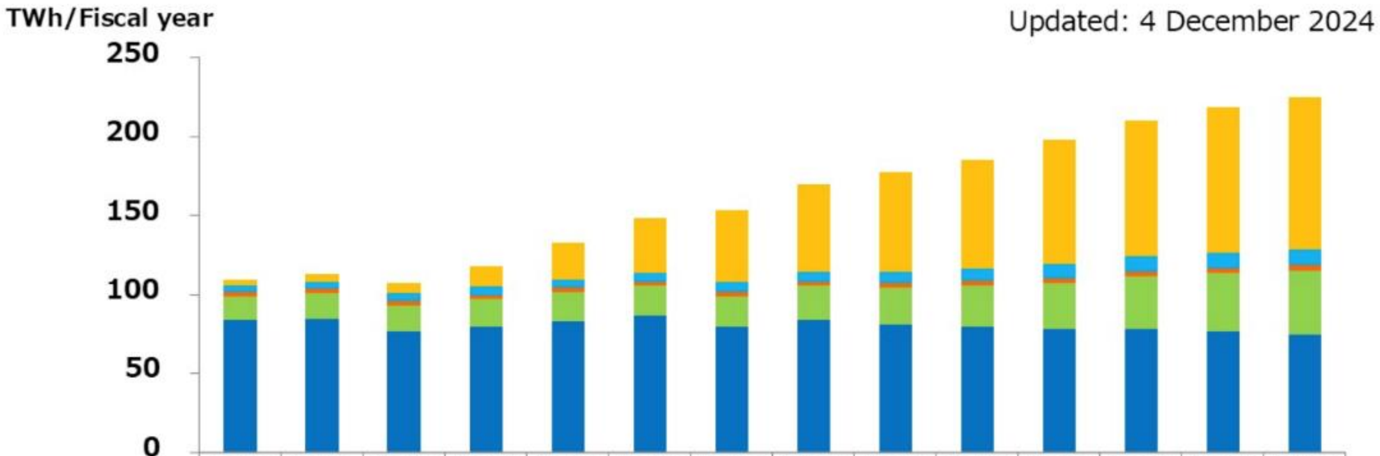


Changes in the electricity mix vs 2010



Japan: RES trends

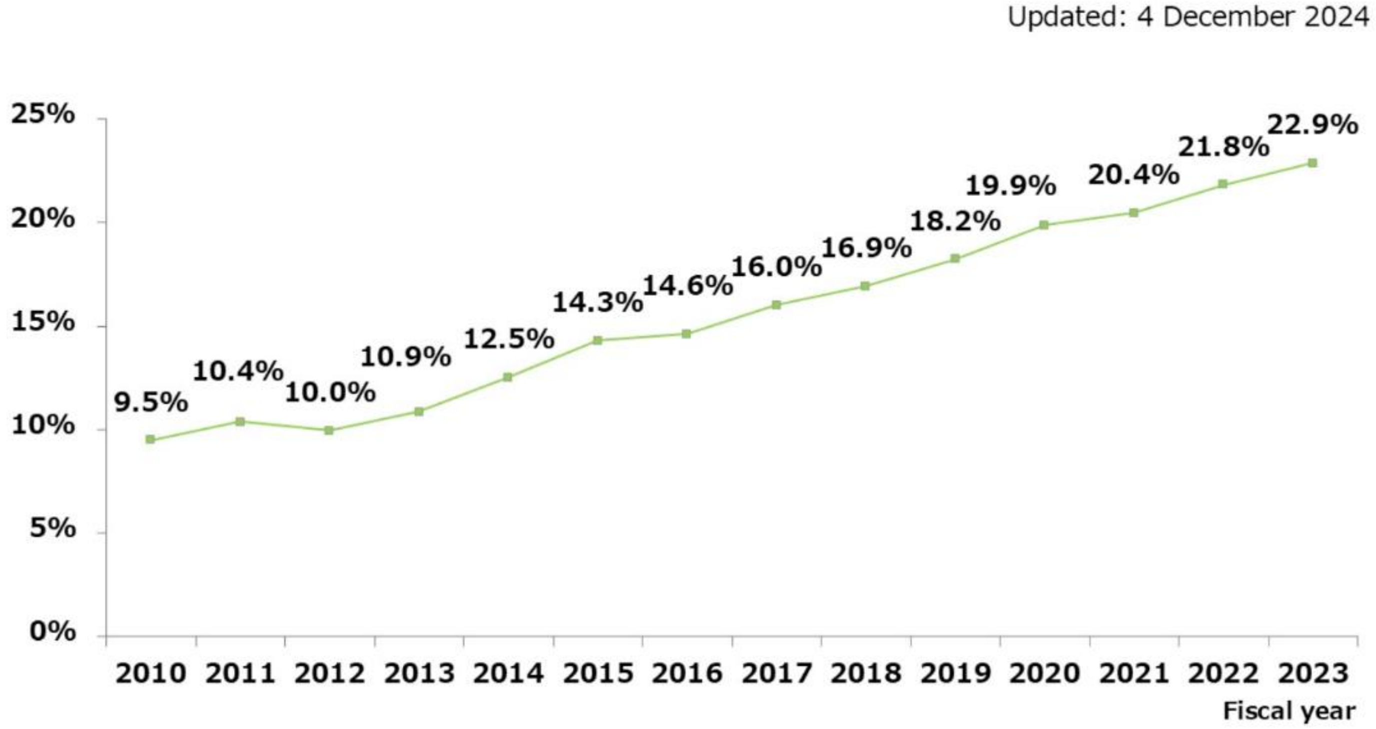
Trends of Electricity Generation from Renewable Sources



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Solar	4	5	7	13	23	35	46	55	63	69	79	86	93	96
Wind	4	5	5	5	5	6	6	6	7	8	9	9	9	10
Geothermal	3	3	3	3	3	3	3	2	3	3	3	3	3	3
Bioenergy	15	16	17	18	18	19	20	22	24	26	29	33	37	40
Hydropower	84	85	77	79	84	87	79	84	81	80	78	78	77	75
Total	109	113	107	118	133	149	154	170	177	186	198	210	219	225

Source: METI/ANRE "Total Energy Statistics"

Share of Renewables in Electricity Generation



Source: METI/ANRE "Total Energy Statistics"

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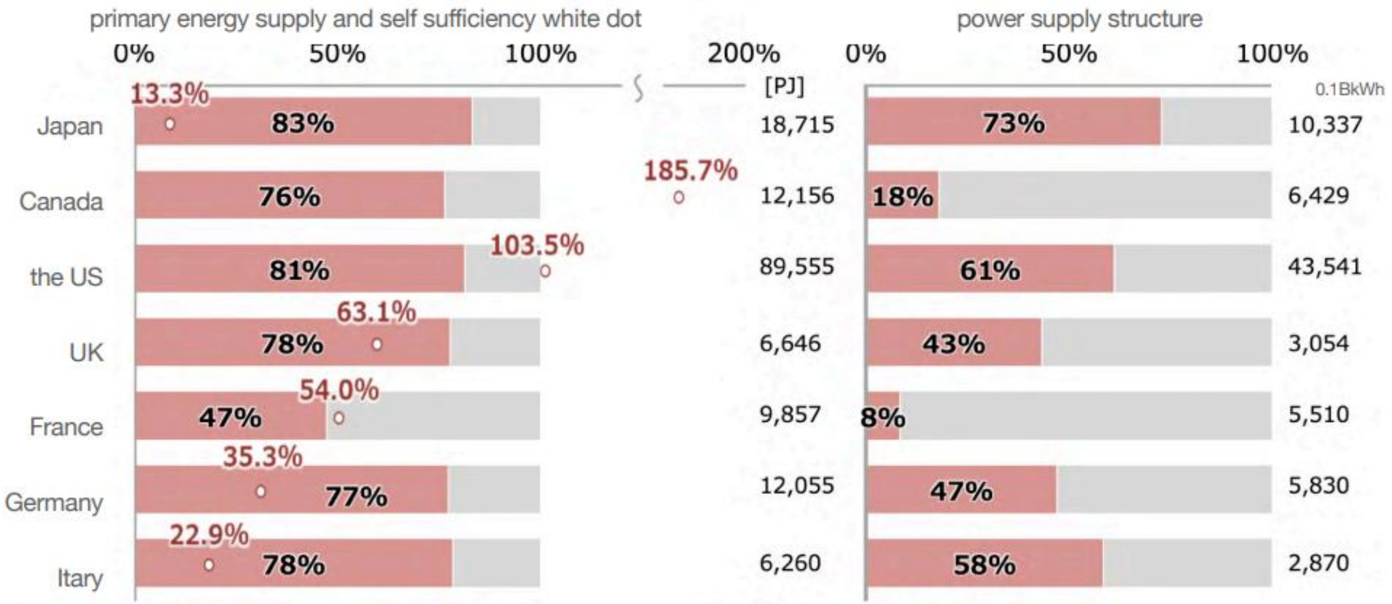
Transition to energy security and energy security of supply

Fossil energy ratio in primary energy supply and power source composition (2021)



（出所）IEA「World Energy Balances」、総合エネルギー統計をもとに作成。日本は2021年度、その他は2021年の数字。

エネルギー・産業立地

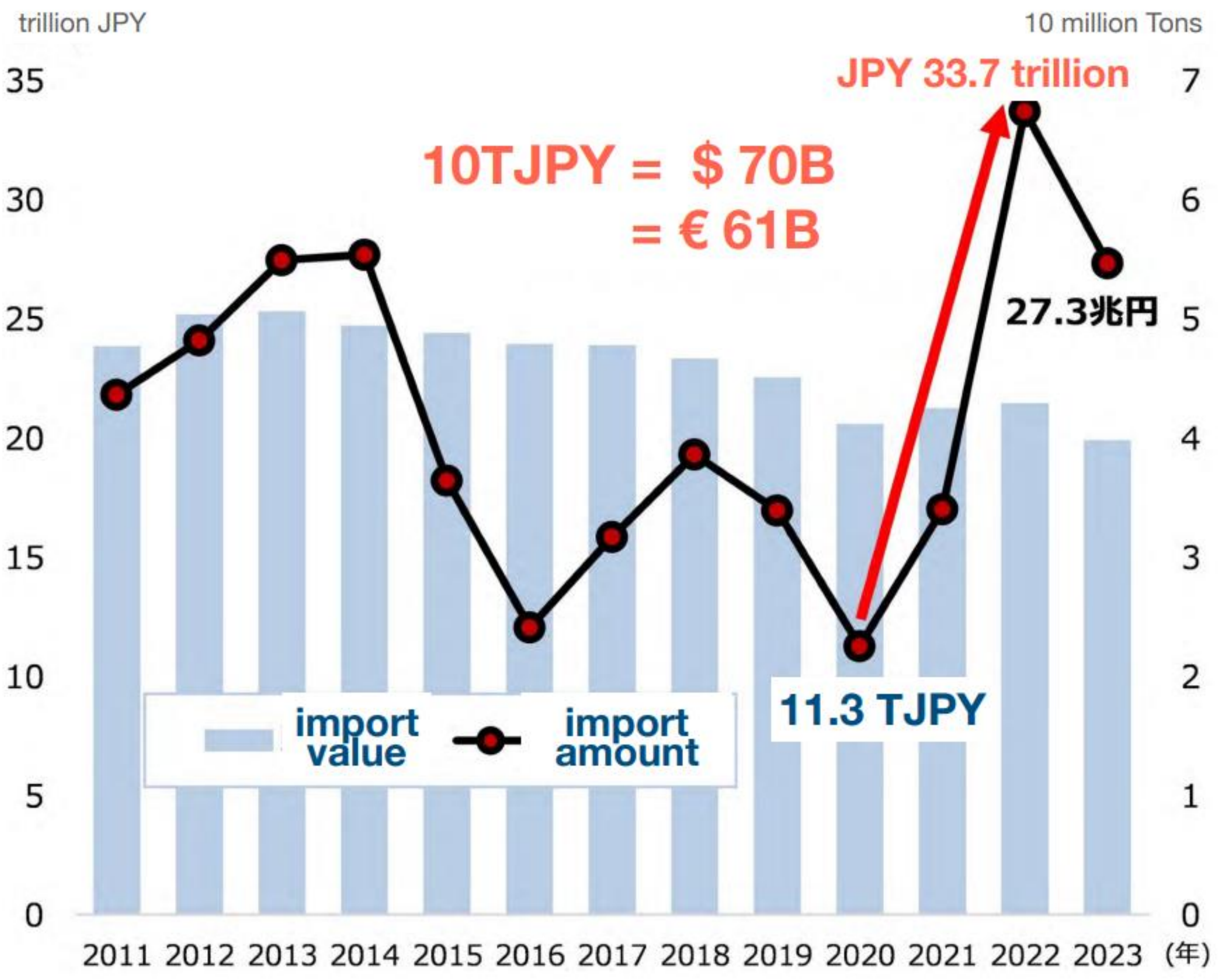
【参考】貿易収支の変遷

2024.5.13 第11回
GX実行会議 資料１

- 自国産エネルギーが乏しく輸入に頼る我が国は、高付加価値品で稼ぐ外貨を化石燃料輸入で費消。2023年には、自動車、半導体製造装置などで稼いだ分（輸送用機器約20兆円＋一般機械約9兆円）の大半を、鉱物性燃料（原油、ガスなど）の輸入（約26兆円）に充てる計算。
- 更に、世界的な脱炭素の潮流により、化石燃料の上流投資は減少傾向。海外に鉱物性燃料の大半を頼る経済構造は、需給タイト化による突然の価格上昇リスクや、特定国に供給を依存するリスクを内包。

出典：総合資源エネルギー調査会 基本政策分科会（第55回会合）「エネルギーを巡る状況について」、2024年5月より抜粋・加筆

Trends in the value of Japan's fossil fuel imports

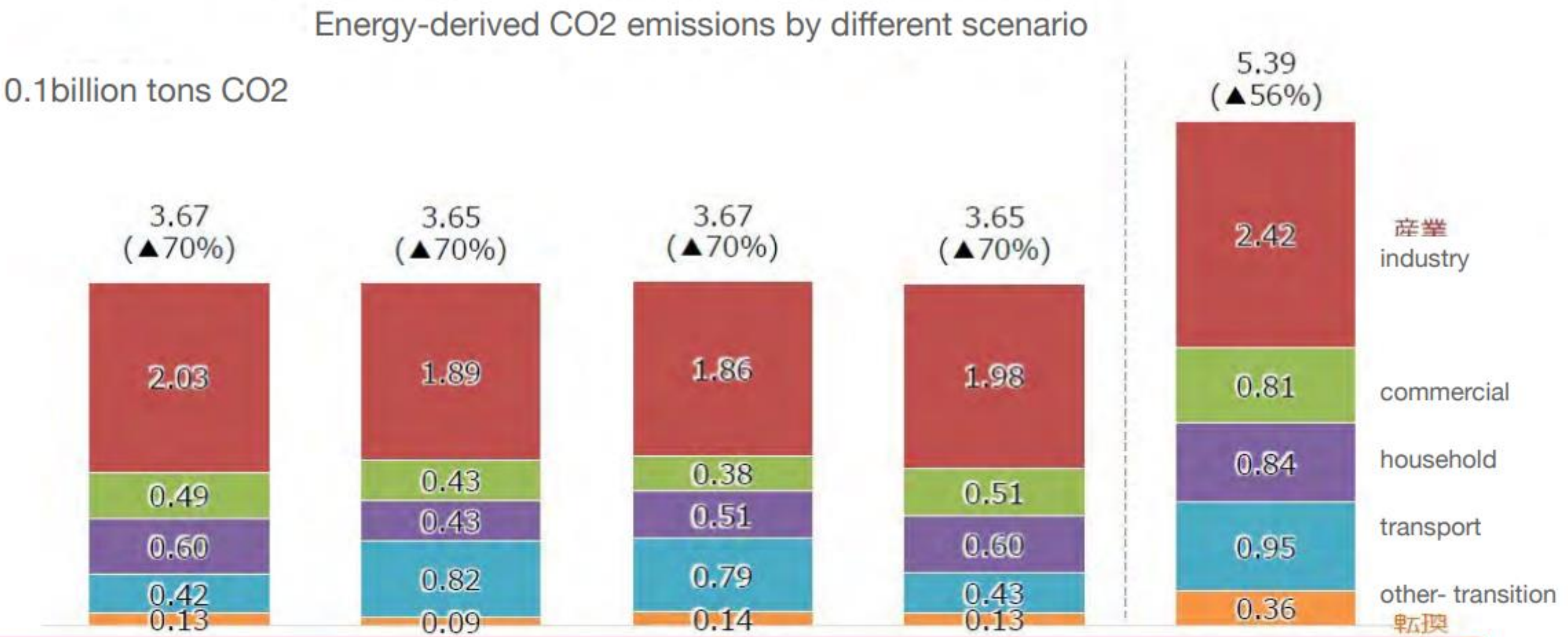


Source) ANRE, 2024 https://www.enecho.meti.go.jp/about/special/johoteikyo/energyhakusho2024.html

The Seventh Basic Energy Plan

To assume a 2040 reduction target compatible with the 1.5°C scenario, it aims at almost complete decarbonisation of the power sector in 2040. The question is which power sources will be choosen.

In a scenario with linear emission reductions towards 2050 net zero, energy-derived CO2 emissions are around 370 million tonnes (approx. 70% reduction compared to 2013)

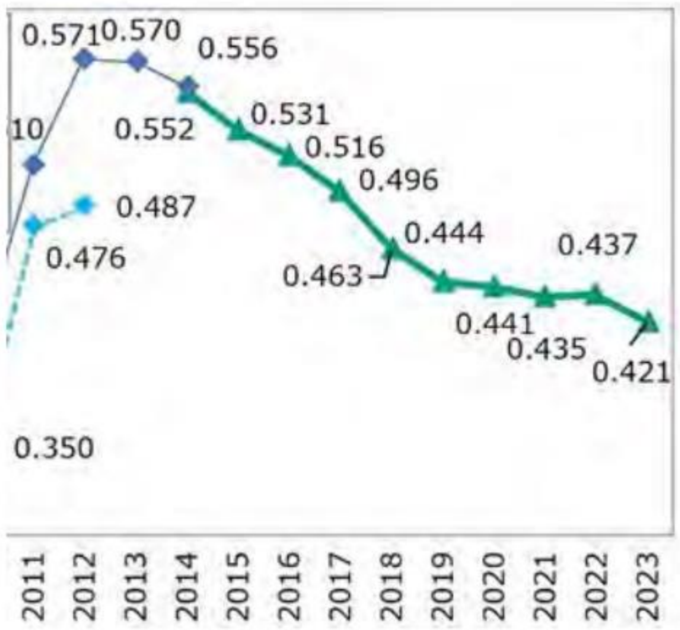


電力排出係数 ($kgCO_2/kWh$)	① renewable expansion	② hydrogen new fuels	③ CCS	④ innovative tech	⑤ tech development
全電源平均	0.04	0.03	0.00	0.04	0.13
火力平均	0.20	0.15	0.08	0.18	0.31

※ 発電に由来するCO_2排出量は、部門ごとの電力需要に応じて各部門に配分。
※ カッコ内の数字は2013年度比のエネルギー起源CO_2排出削減率。

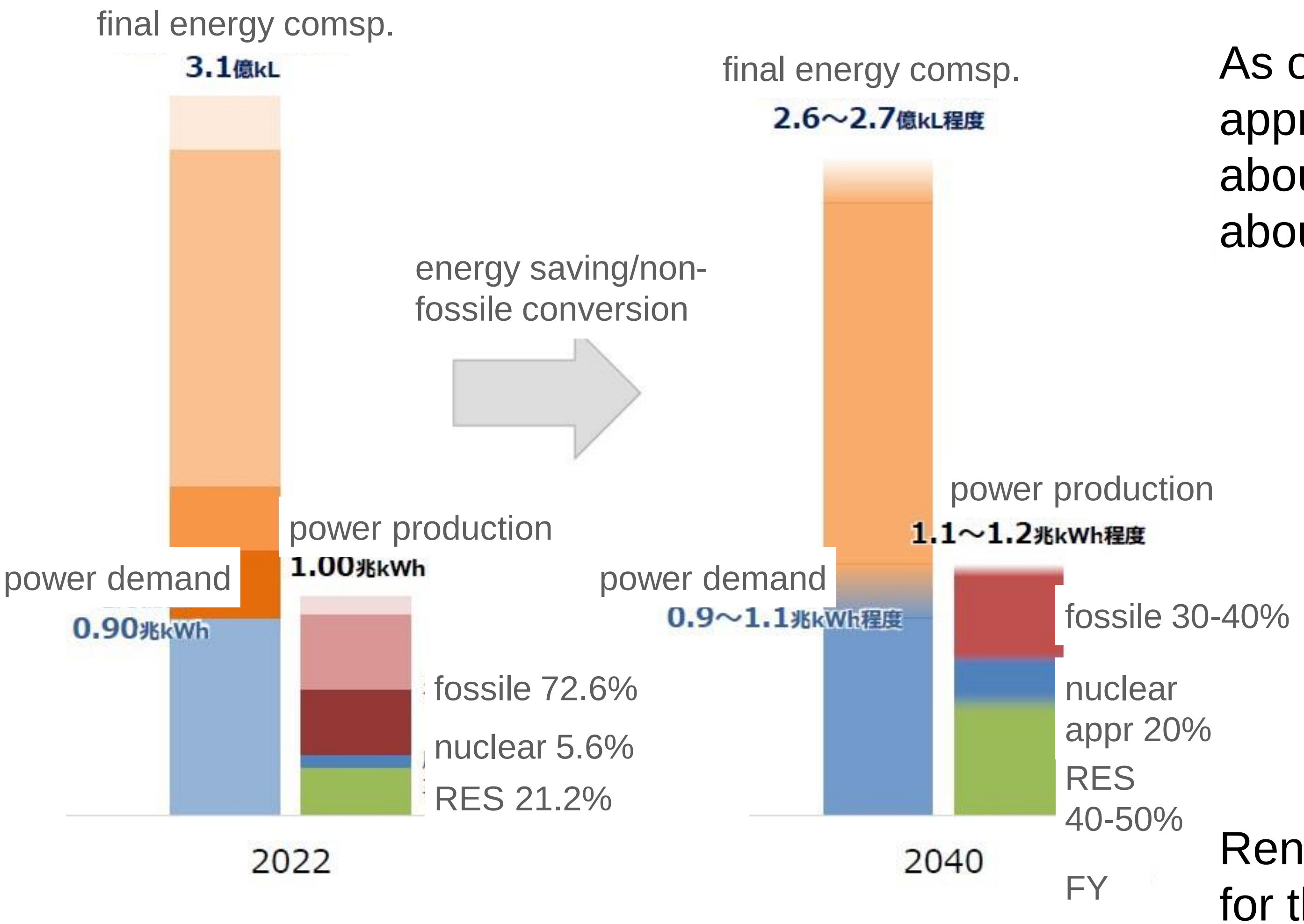
source: METI, 2025

421gCO2/kWh in 2023
→ maximum of 40gCO2/kWh



source: MoE, 2025

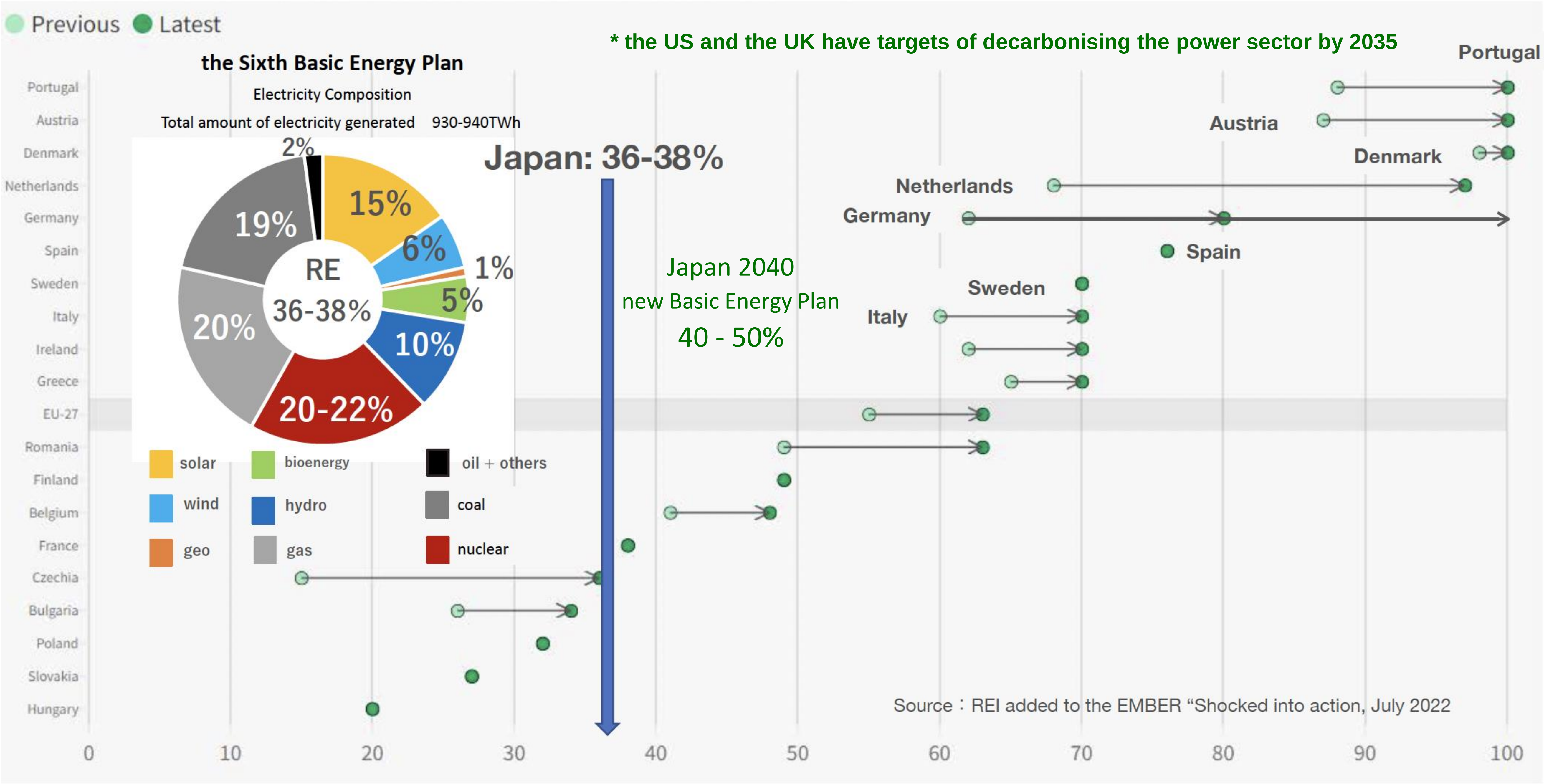
The Seventh Basic Energy Plan



As of 2040,
approx 30–40% of electricity came from thermal power,
about 20% from nuclear power,
about 40–50% from renewable energy.

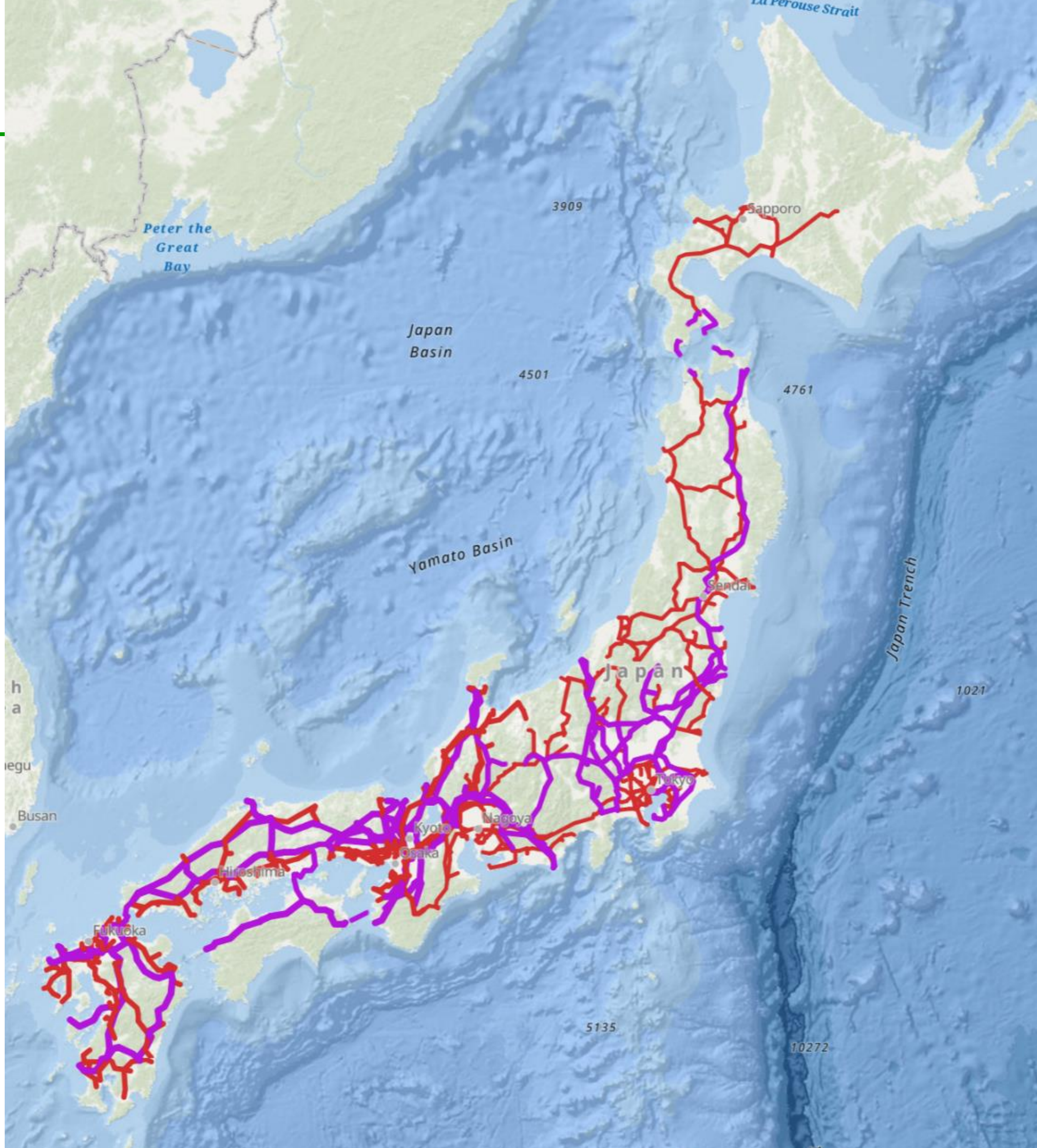
Renewable energy became the largest source of electricity for the first time.
However, the share is still low compared to the targets set by other countries.

2030–2035 comparison of targets



Japan’s power system snapshot

In several regions with abundant renewable energy potential—such as Hokkaido, Kyushu, and Shikoku—the internal transmission networks are not sufficiently developed.

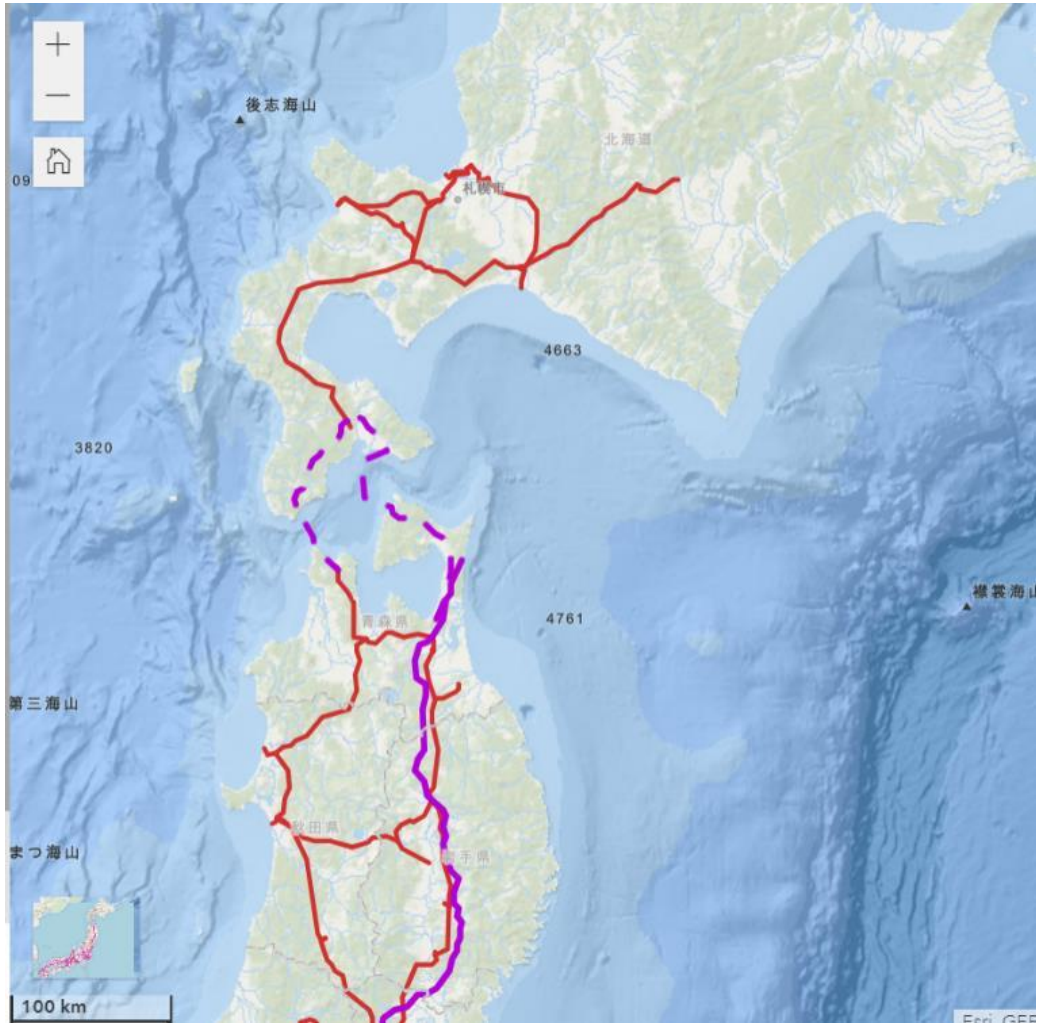


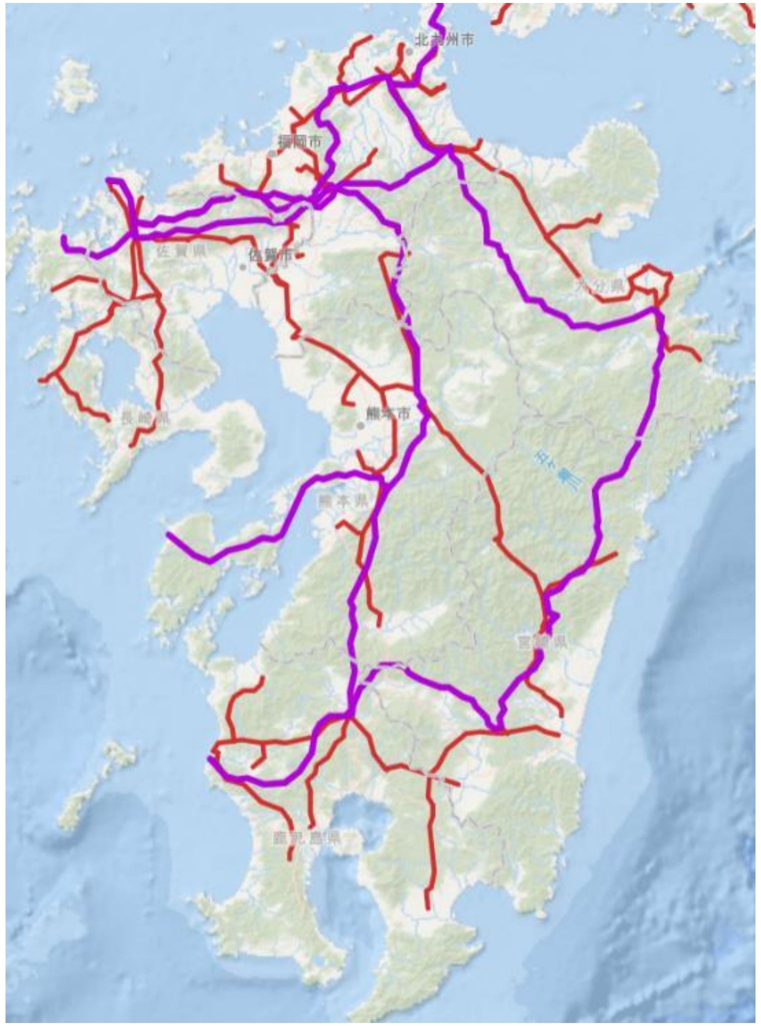
500 kV / DC
220-275 kV

https://www.renewable-ei.org/statistics/offshoremap/?page=en

Japan: energy transition needs grid system enhencement

Overwhelming lack of in situ transmission lines to accelerate the deployment of multi-GW class offshore wind in areas of great potential.
On the Pacific side of the Tohoku region, where the water depth is deep and suitable for floating wind turbines, there are no transmission lines to send several GW-class electricity to demand areas.





transmissions more than 200KV

source) Renewable Energy Institute

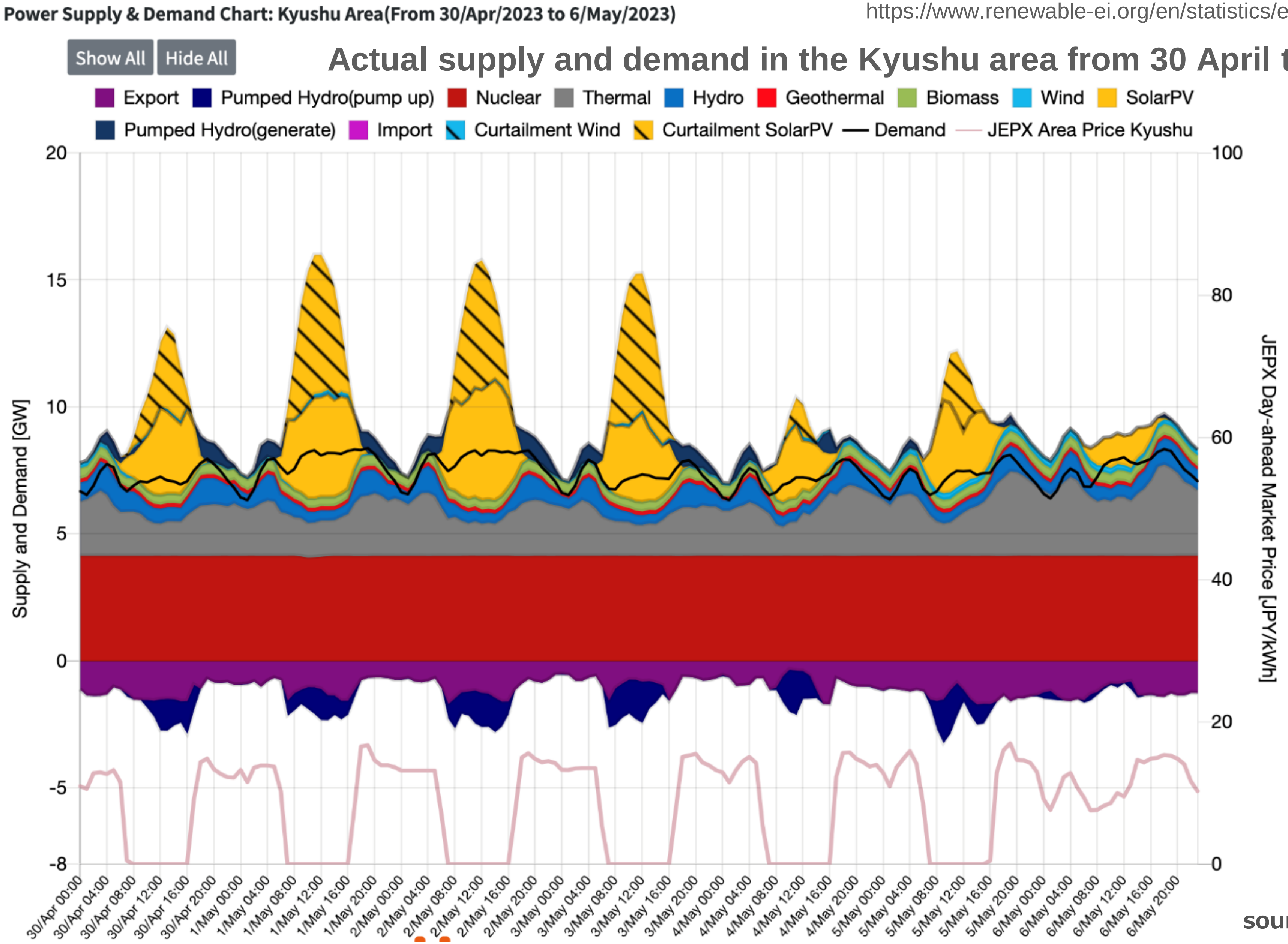
Japan: energy transition needs FLEXIBILITY

自然エネルギー財団
RENEWABLE ENERGY INSTITUTE

Generation of electricity from large long-term fixed sources is prioritised, renewables are curtailed.

https://www.renewable-ei.org/en/statistics/electricity/#demand

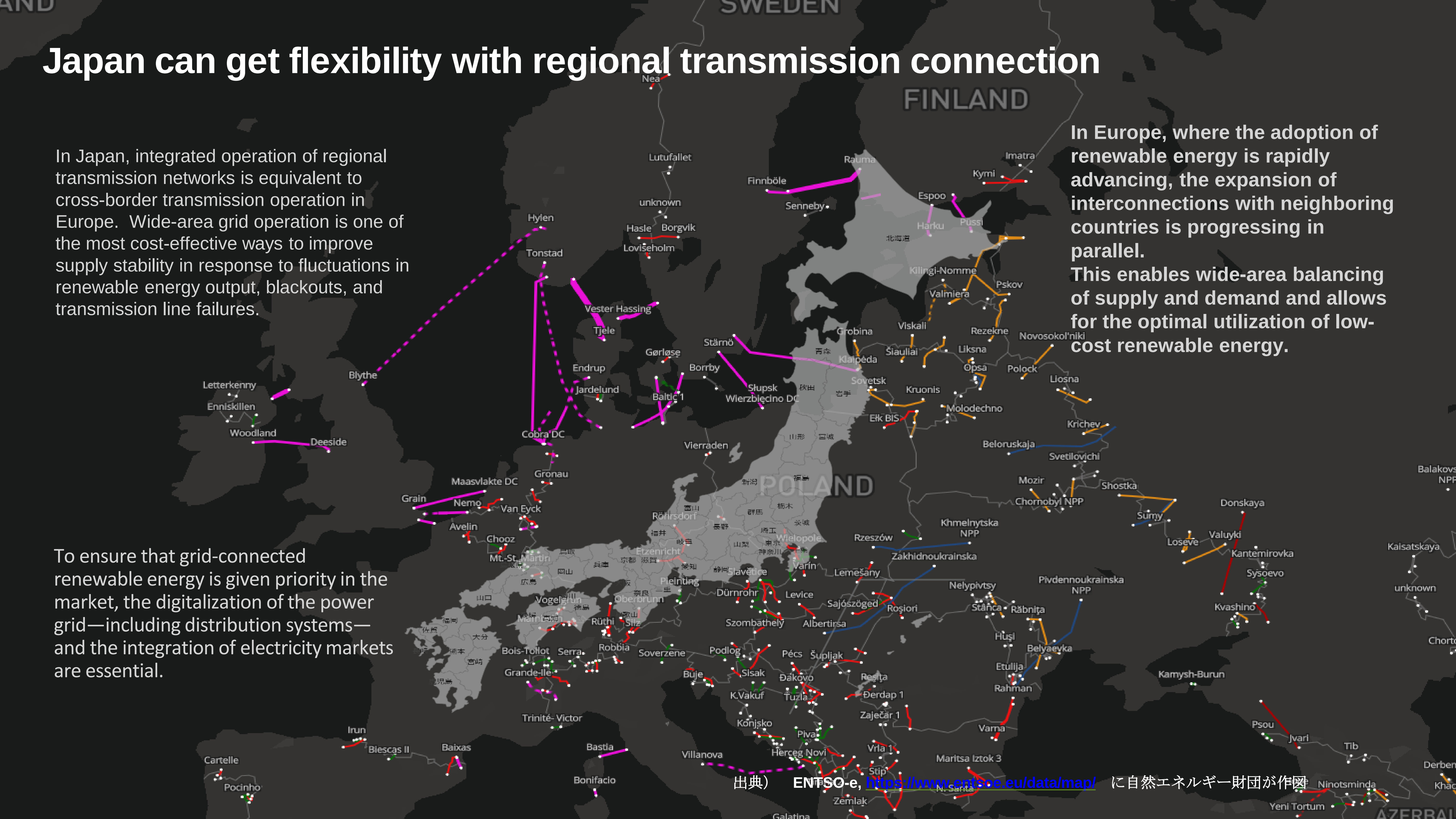
Actual supply and demand in the Kyushu area from 30 April to 3 May 2023



source) Renewable Energy Institute

Japan renewable energy status
another pathway?

Japan can get flexibility with regional transmission connection



In Japan, integrated operation of regional transmission networks is equivalent to cross-border transmission operation in Europe. Wide-area grid operation is one of the most cost-effective ways to improve supply stability in response to fluctuations in renewable energy output, blackouts, and transmission line failures.

In Europe, where the adoption of renewable energy is rapidly advancing, the expansion of interconnections with neighboring countries is progressing in parallel.
This enables wide-area balancing of supply and demand and allows for the optimal utilization of low-cost renewable energy.

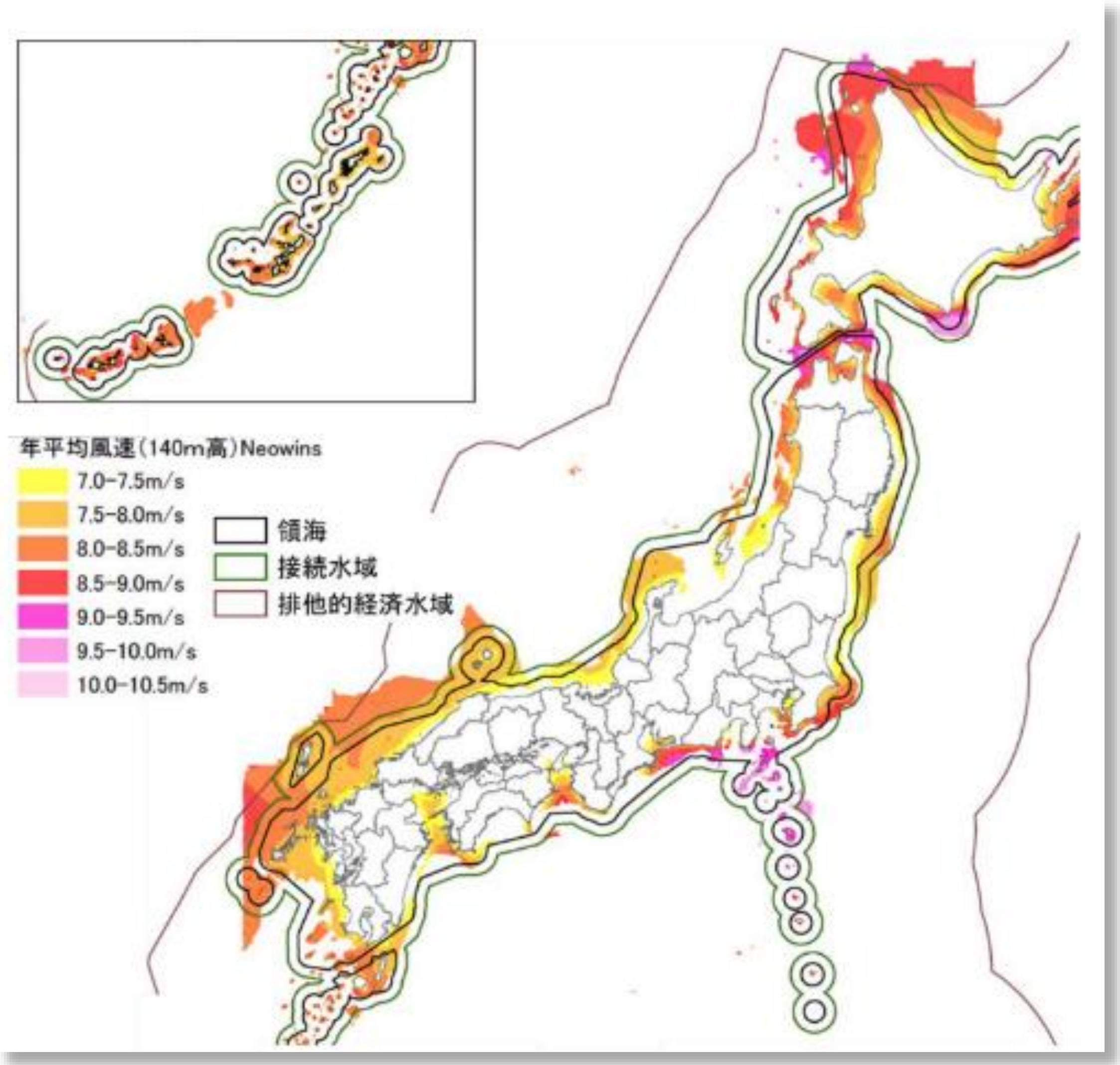
To ensure that grid-connected renewable energy is given priority in the market, the digitalization of the power grid—including distribution systems—and the integration of electricity markets are essential.

出典） **ENTSO-e,** https://www.entsoe.eu/data/map/ に自然エネルギー財団が作図

Japan: energy transition needs to accelerate

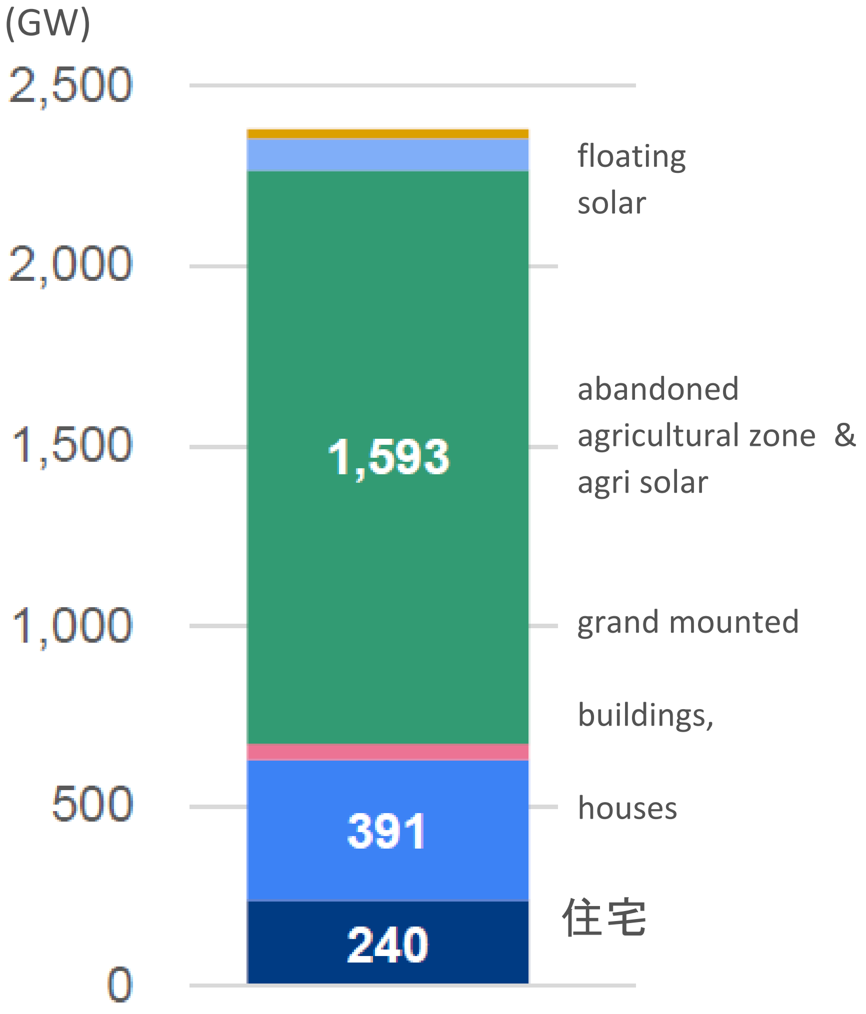
自然エネルギー財団
RENEWABLE ENERGY INSTITUTE

Offshore wind
（teritorial water＋EEZ）＝1,128GW



出典）自然エネルギー財団
「日本の洋上風力発電のポテンシャル」（2023年11月）

PV Solar - 2,380GW(DC)
*with consideration of future generation efficiency

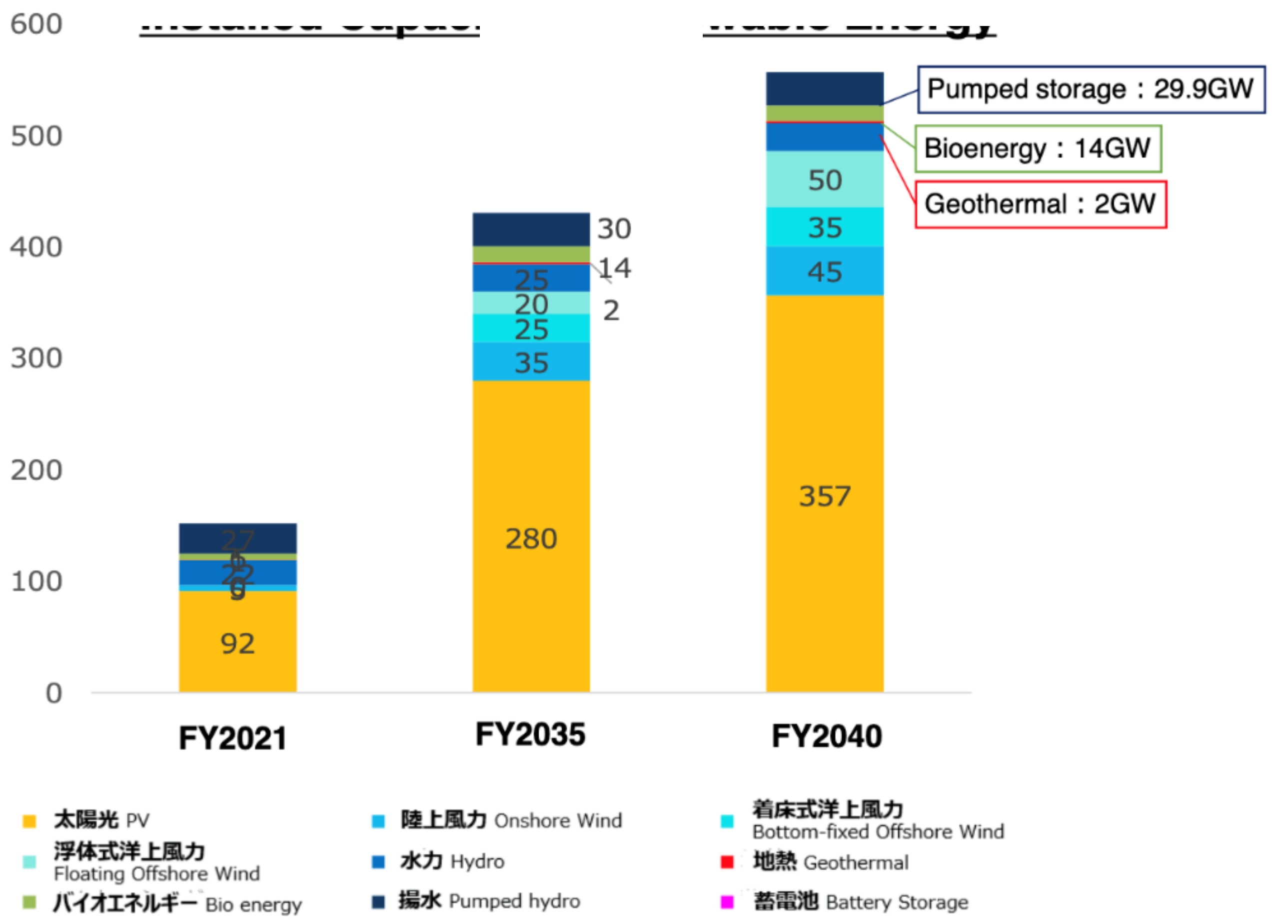


出典）太陽光発電協会「“PV OUTLOOK 2050”（2023年度暫定版）」（2023年11月）に加筆･修正

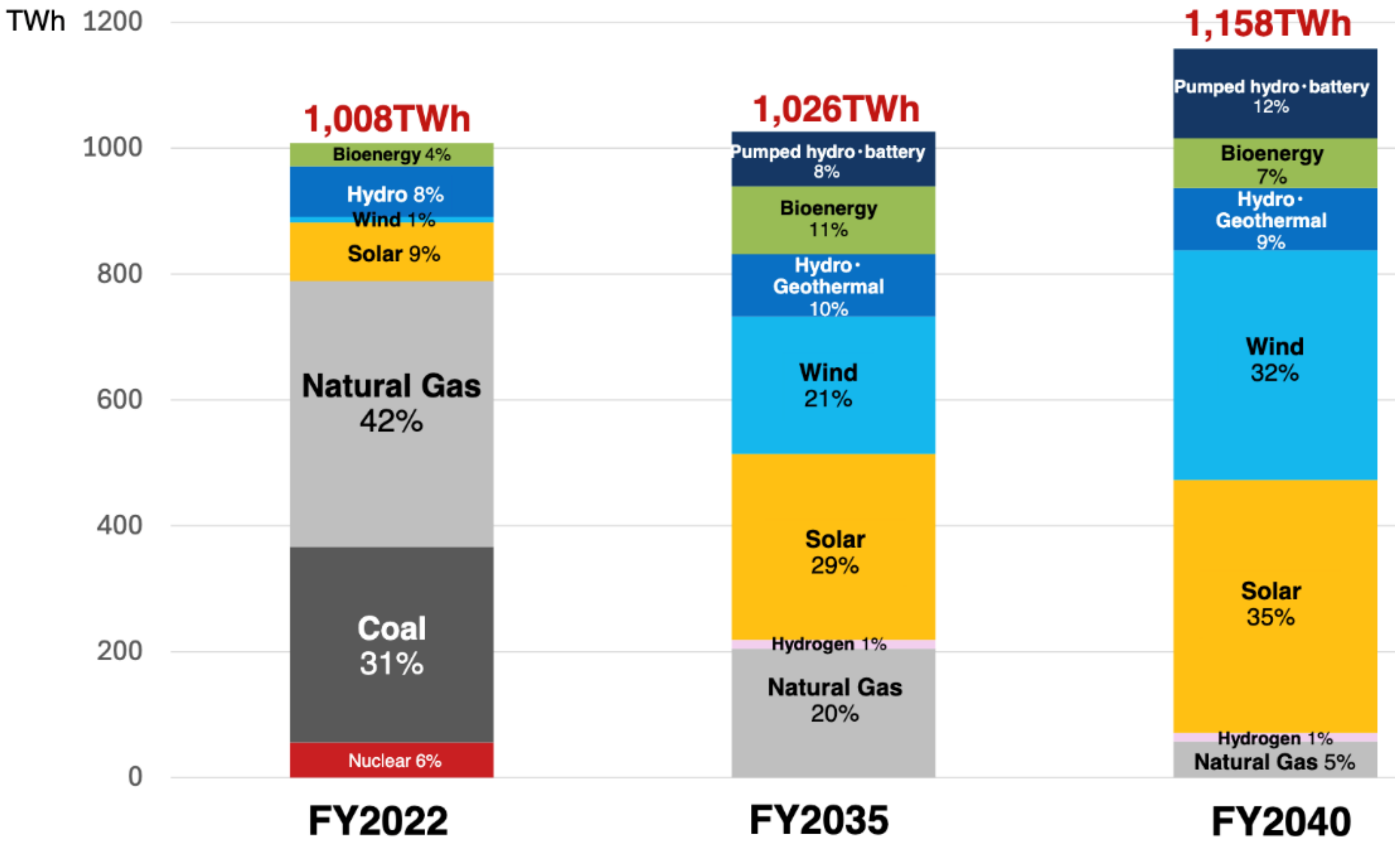
Japan: energy transition is achievable

自然エネルギー財団
RENEWABLE ENERGY INSTITUTE

Installed Capacity of RES
(GW)



Results of 2040 Scenario Supply and Demand Simulation Analysis:
Electricity Generation Mix



source: Energy Transition Scenario through Renewables Prospects Toward 2040, https://www.renewable-ei.org/pdfdownload/activities/REI_2040senario_rev-edition_en.pdf

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RENEWABLE ENERGY INSTITUTE

Paradigm Shift in Energy
www.renewable-ei.org

Panel Discussion

- Bo Normark, Industrial Strategy Executive, EIT Innoenergy
- Christian Thomsen, Cluster President NEA, Alfa Laval
- Torje Saur, Country Manager Japan, Equinor
- Christopher Halling, Managing Counsel, Gorrissen Federspiel

- Moderator: Mika Ohbayashi, Director, Renewable Energy Institute

Nordic Circle | Innovation Norway | Business Sweden | Business Finland | Royal Danish Embassy Tokyo | Business Iceland | Nordic Council of Ministers

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WORKING FOR A PLANET IN BALANCE

BASELOAD POWER JAPAN

BASELOAD POWER JAPAN

Unlocking Japan's Geothermal Potential:
Key opportunities and challenges for the geothermal industry

BASELOAD POWER
ベースロードパワージャパン

WE DREAM OF A PLANET IN BALANCE WITH RESILIENT SOCIETIES THAT RUN ON RENEWABLE ENERGY

再生可能エネルギーの普及を通してより自立した地域社会をつくり、人と地球の調和をめざします

BASELOAD GROUP

Established Jan 2018

Global HQ in Stockholm, Sweden

4 global subsidiaries

Taiwan	USA	Japan	Iceland
			

Global investors

Breakthrough Energy VENTURES | Chevron | Baker Hughes

GULLSPÅNG | BLUE | LMK Forward

equitix | Google

BASELOAD POWER JAPAN

Established Oct 2018

Japan HQ in Shinbashi, Tokyo

What is geothermal energy?

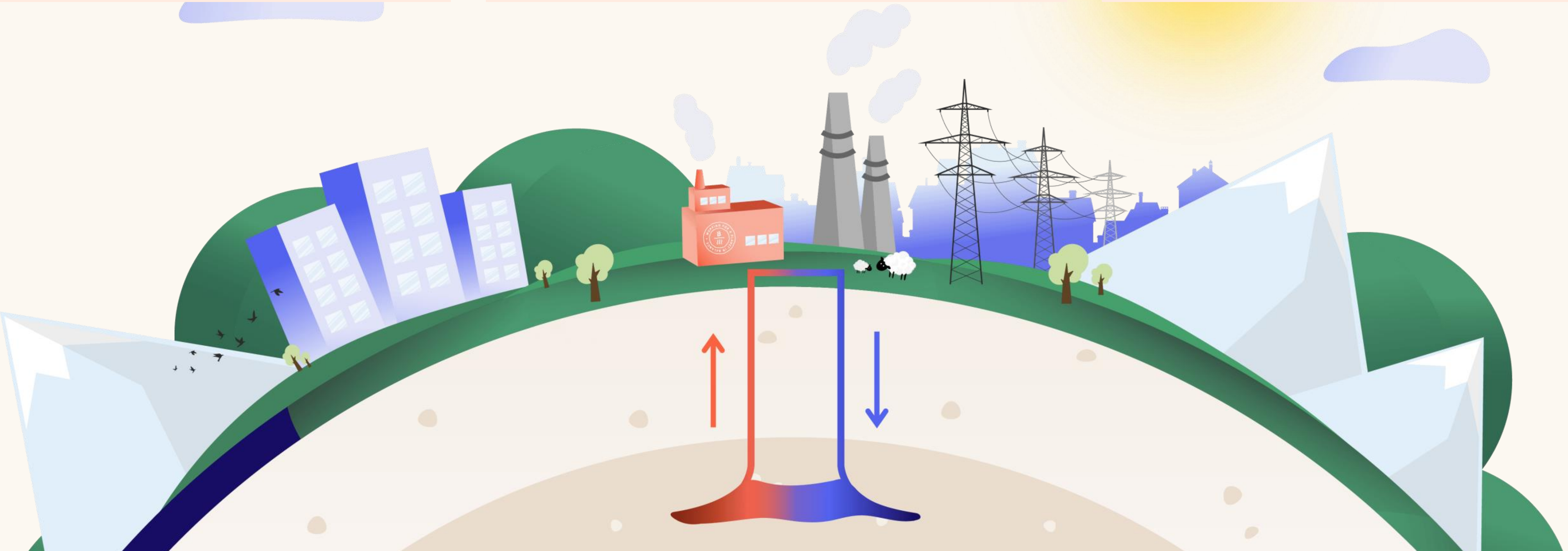
Geothermal energy is the heat naturally generated and stored in the Earth's crust.

How can we use it?

Geothermal energy can be harnessed for electricity production, direct heating, and industrial processes.

Why does it matter?

Geothermal energy is reliable and low in emissions, making it a clean, sustainable alternative to fossil fuels.



Geothermal energy has many benefits compared to other renewables

Compact design

A geothermal plant uses 88% less space than a solar farm to produce 1 GWh of electricity

Always available

Unlike solar and wind, geothermal is not impacted by day-night-cycles, weather conditions, or seasons

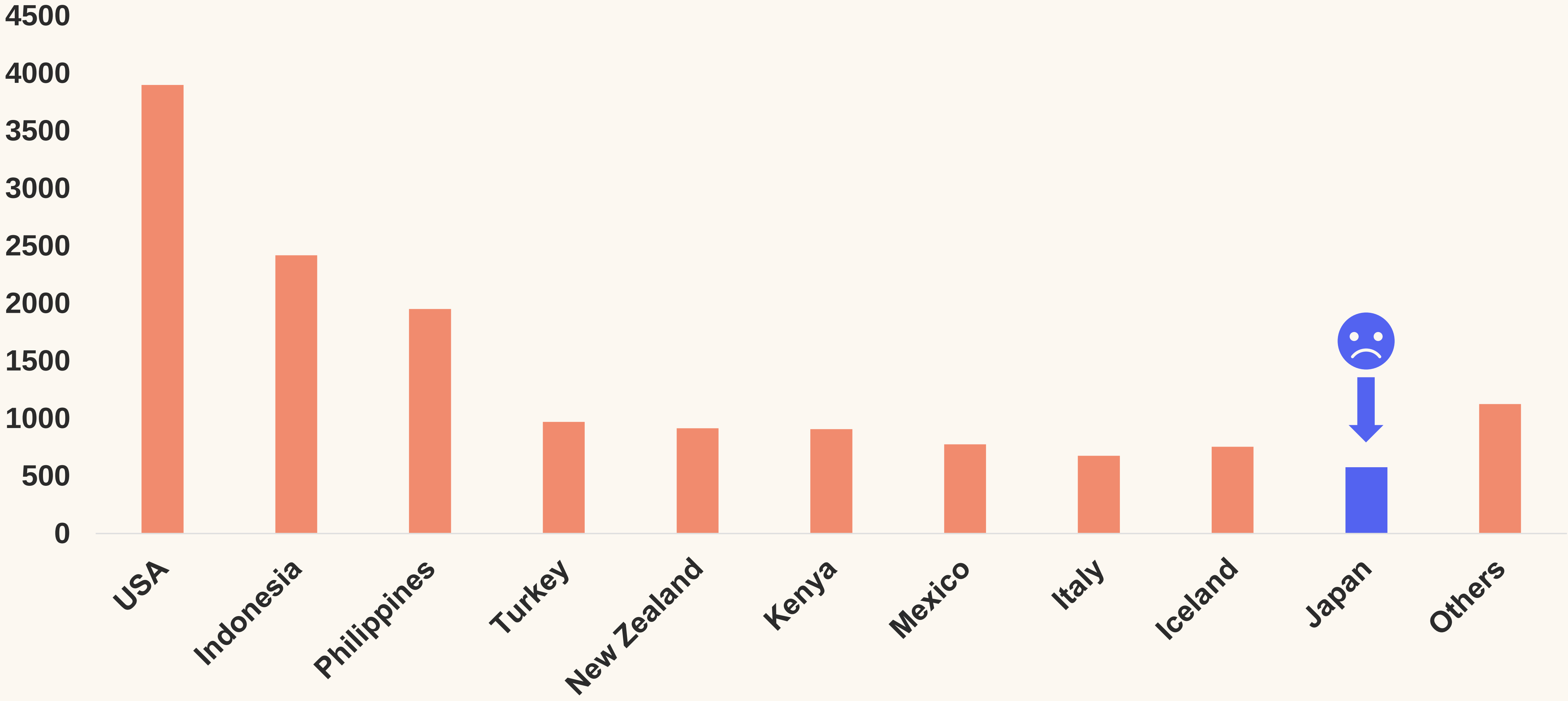
Stabilizes grid

As geothermal energy is a baseload source of power, it helps stabilize the grid

Low carbon footprint

Even compared to other renewables, geothermal energy has a very small carbon footprint

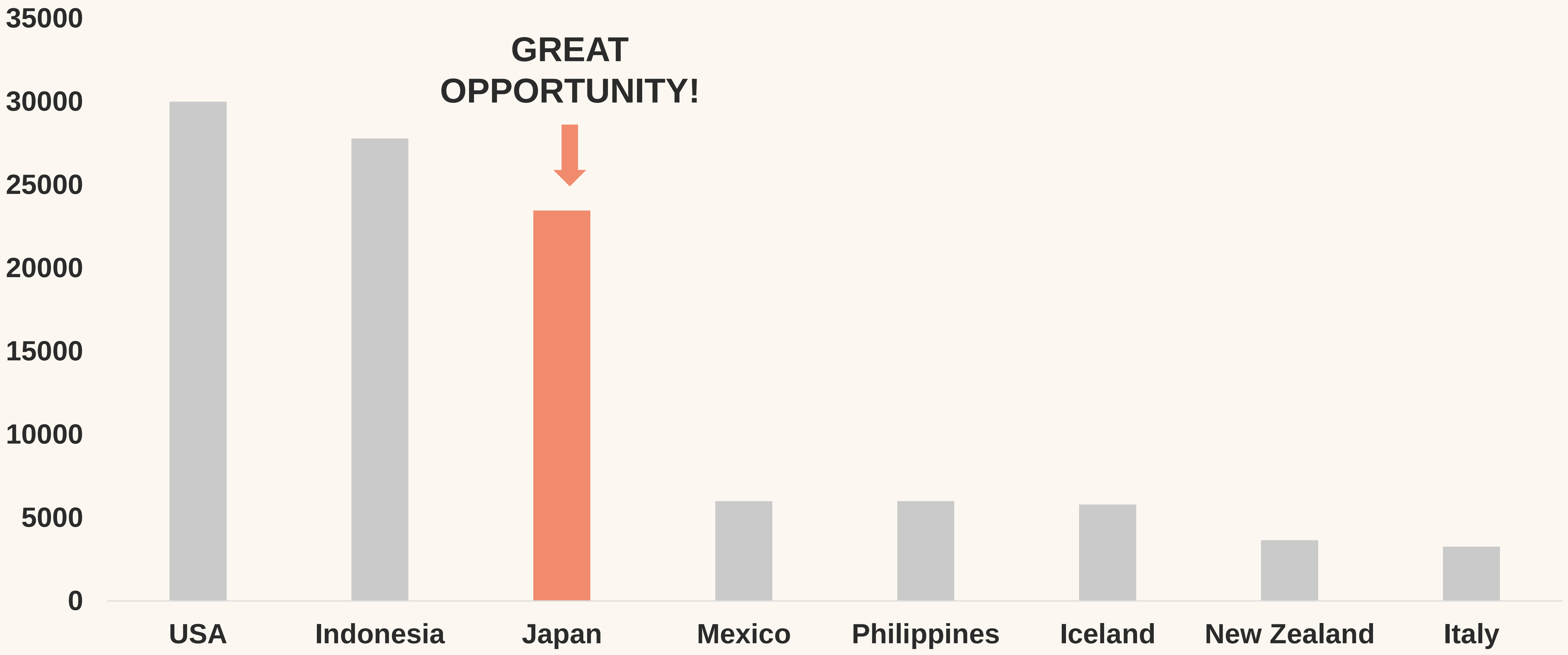
But so far only 2.5% has been tapped



Source: ThinkGeoEnergy 2023

There are many challenges to overcome to realize the potential in Japan

Japan has the world's 3rd largest geothermal potential at 23.5 GW



Source: ThinkGeoEnergy 2023

There is tremendous potential in the low/medium temperature segment

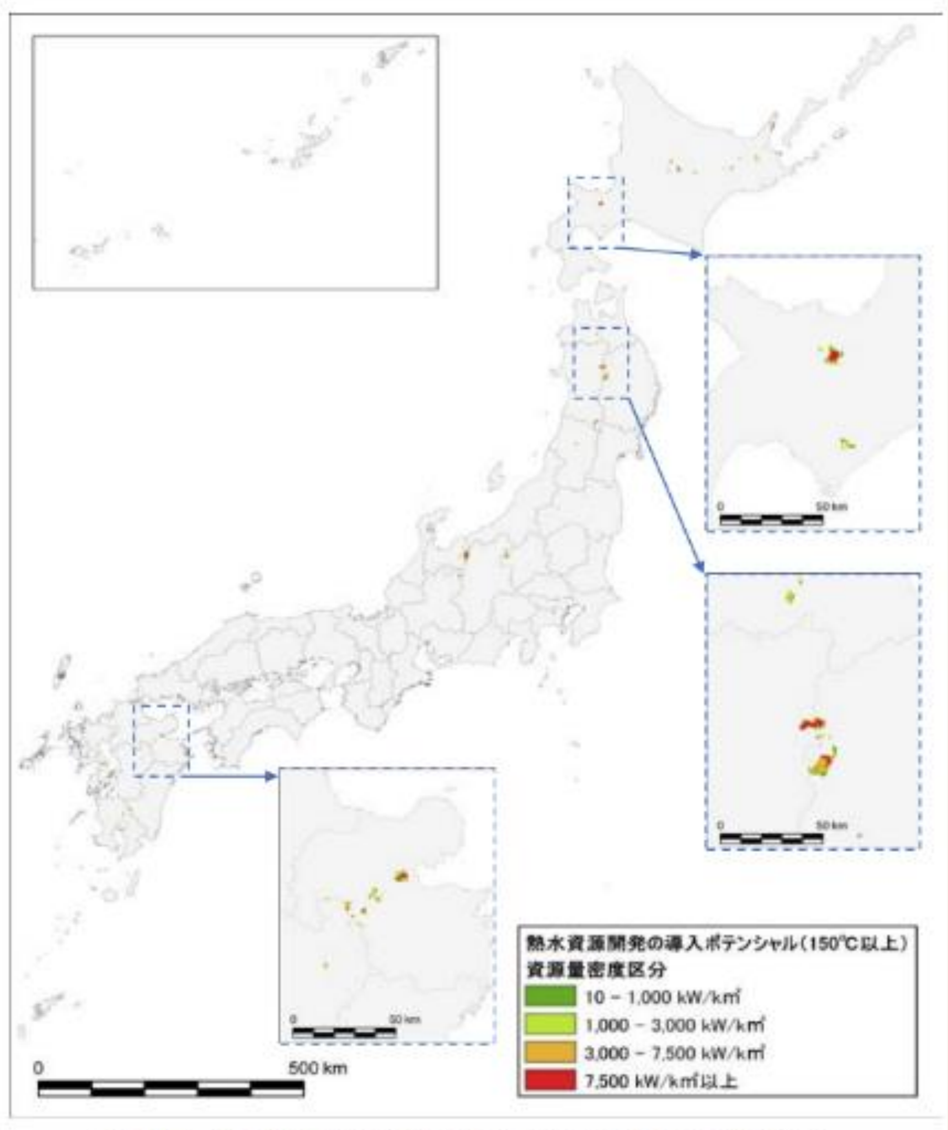


図 6-10　熱水資源開発の導入ポテンシャル分布図（150℃以上）

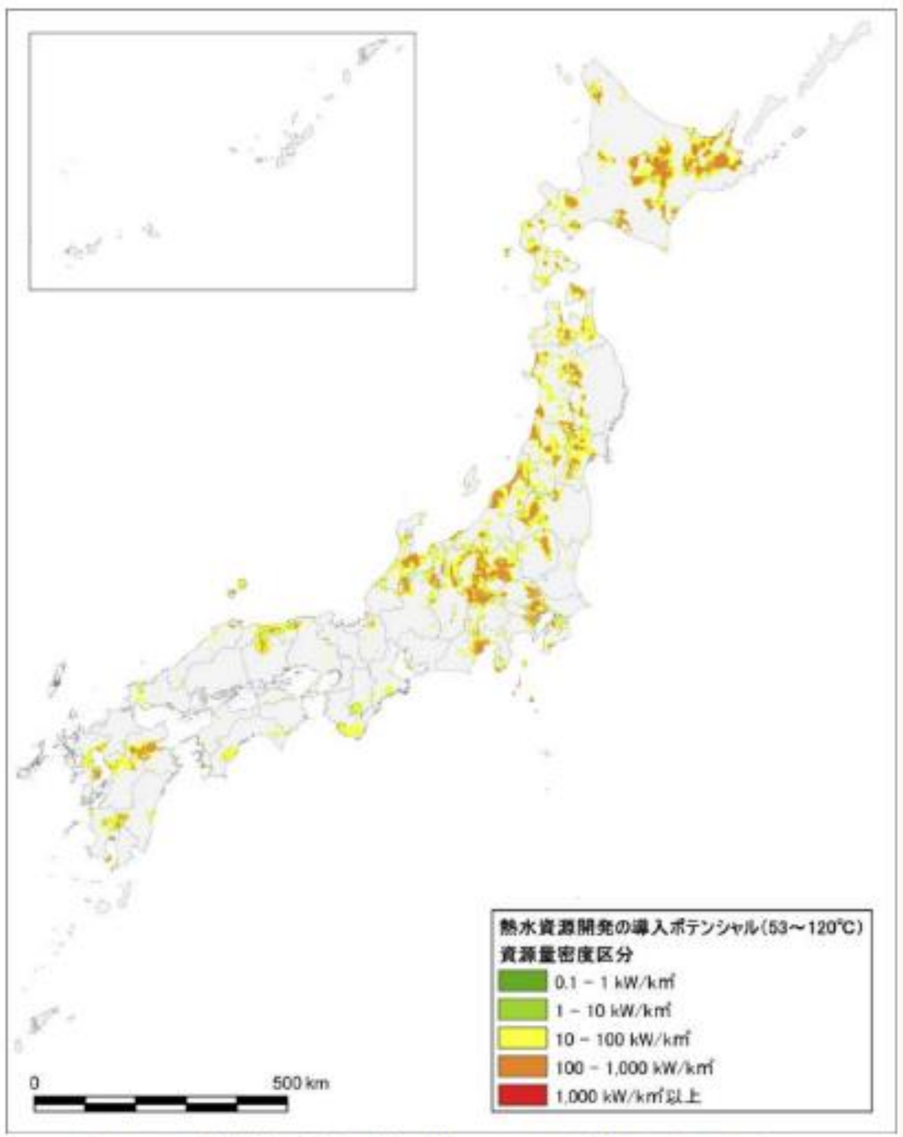


図 6-12　熱水資源開発の導入ポテンシャル分布図（53～120℃）

Various opinion leaders are speaking up for geothermal

Minister of Environment
Asao Keiichiro

“Geothermal power generation is not only a stable source of power generation, but also leads to regional revitalization through the effective use of local resource”

Prime Minister
Ishiba Shigeru

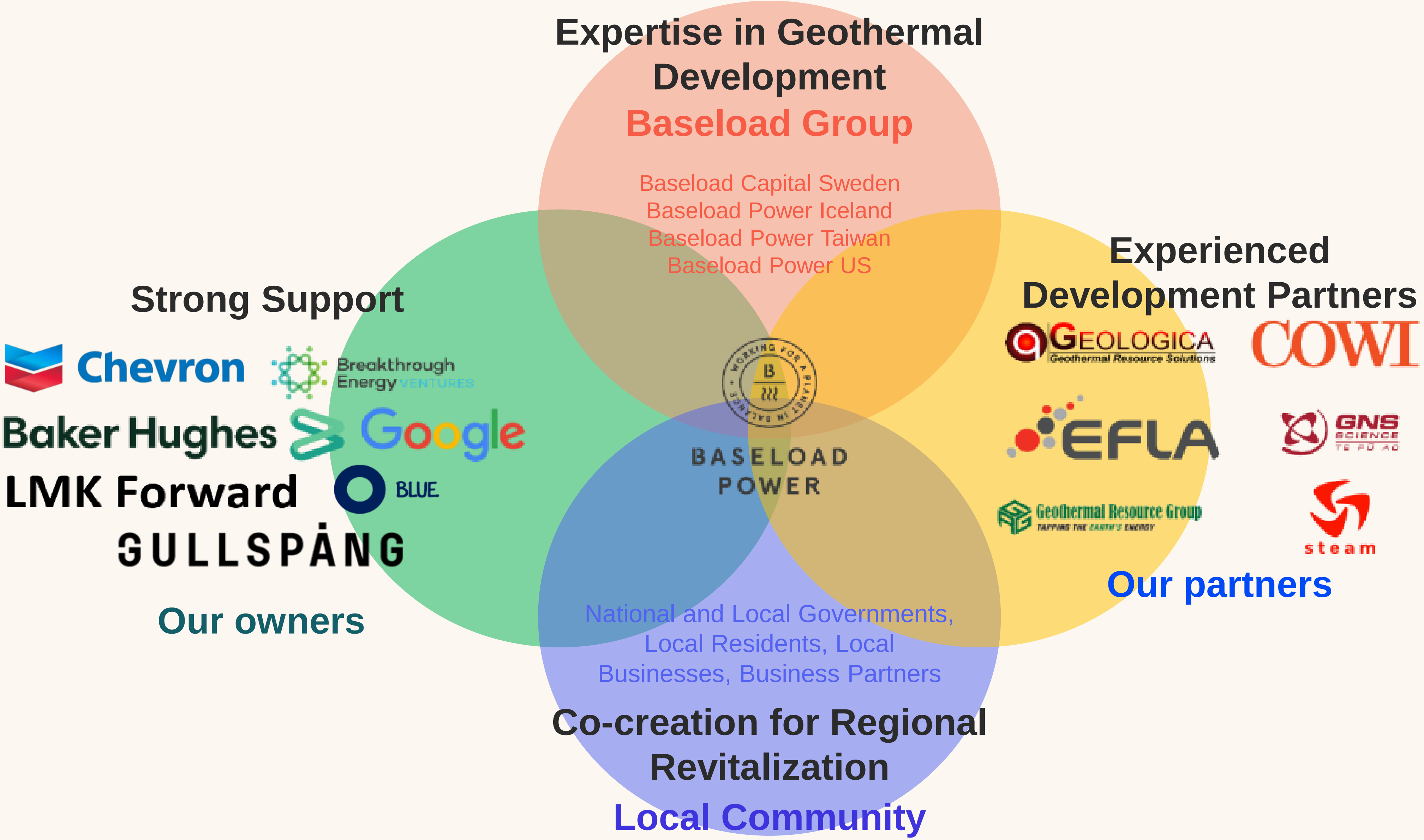
“Geothermal and small and medium hydropower development will bring GX benefits to local economies.”

Novelist
Mayama Jin

“As a volcanic powerhouse, Japan's geothermal resource potential is the third largest in the world, and theoretically there are enough resources lying beneath the feet of the Japanese archipelago to replace all nuclear power plants.”

Source: 1) https://www.youtube.com/watch?v=z2ssBCMwkbw, 2) https://www.kantei.go.jp/jp/102_ishiba/actions/202410/31gx.html, 3) https://media.mayamajin.jp/chinshi_4

Our Global Platform is a key enabler to roll out best practices globally



We believe local communities are the true enablers for geothermal energy

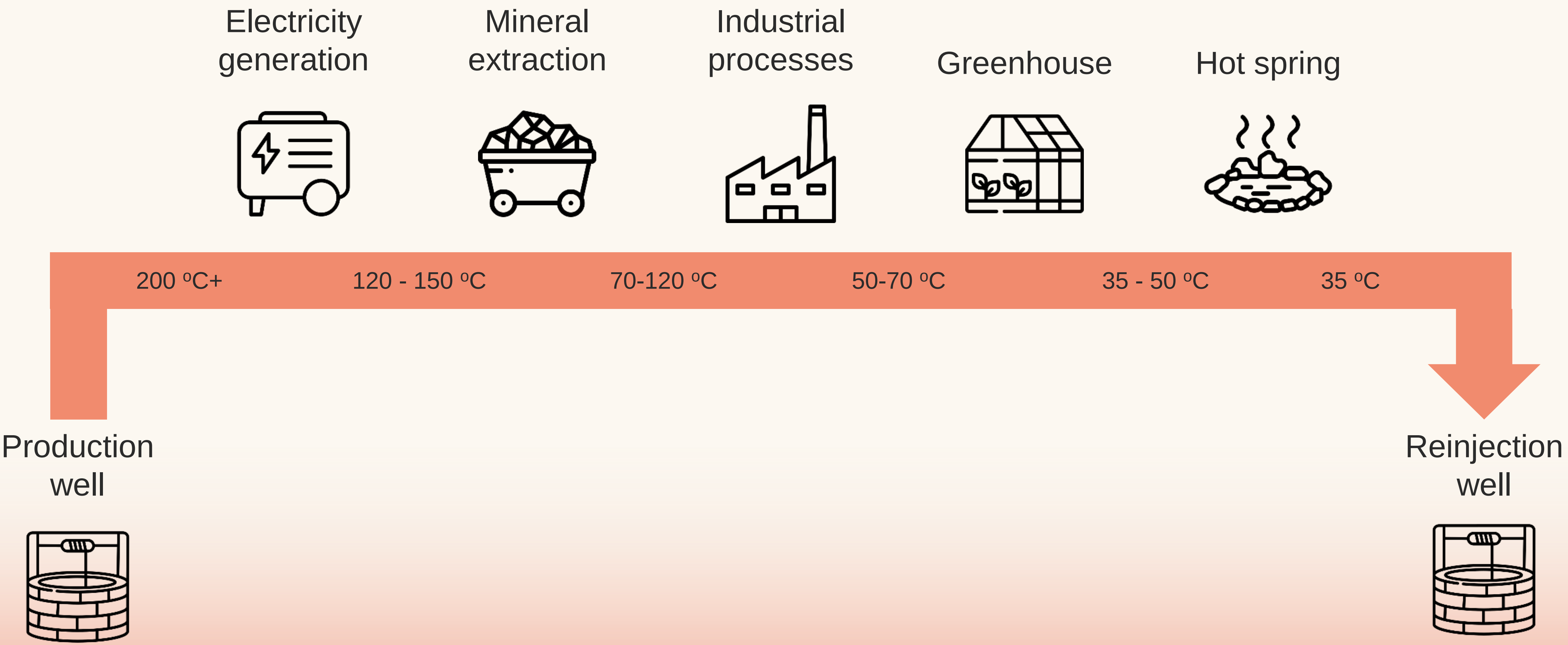
Baseload Power contributes to three key parts of Japanese society

Rural reinvigoration

Local resilience

Green Transition

There are also several fantastic use cases for geothermal waste heat and waste water



We also work with academia and NGOs to inspire the next generation

Case competition at Waseda University

Workshop for elementary school students in Miyagi Predecture

Workshop with students from Jeju Univeristy

Guest Speakers at Hokkaido University


THE EARTH HAS POWER


LET'S
SWITCH IT ON
WORKING FOR A PLANET IN BALANCE
B

WORKING FOR A PLANET IN BALANCE

THANK YOU

Petter Sund
Representative Director & Country Manager
petter.sund@baseloadpower.jp
www.baseloadpower.jp

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The world's leading ocean renewable energy technology

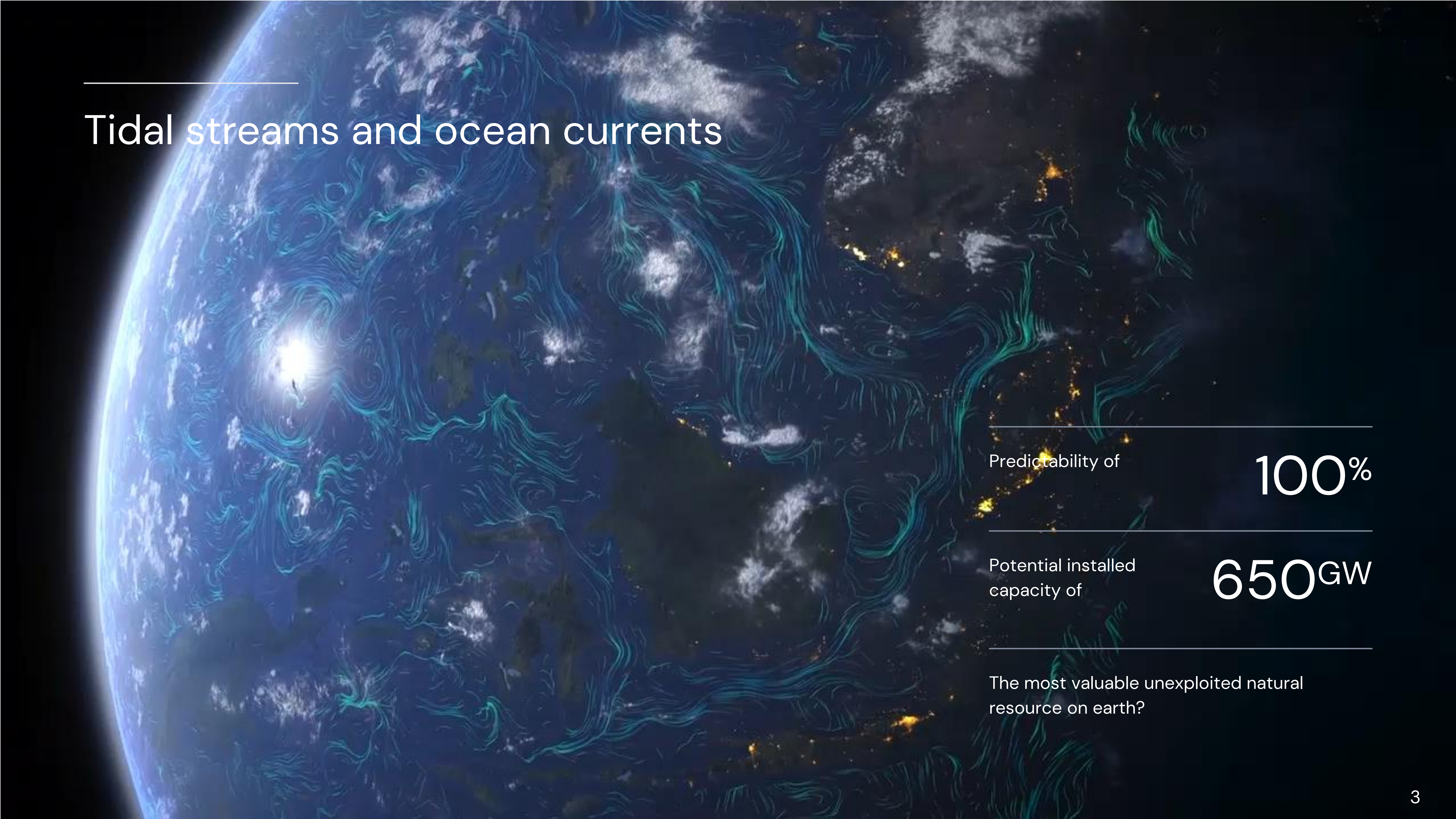
The Nordic model for fossil-free energy systems, Osaka EXPO

Dr Martin Edlund, CEO of Minesto

17 June 2025

Dragons – born in Sweden, raised in the Faroe Islands

Tidal streams and ocean currents



Predictability of **100%**

Potential installed capacity of **650GW**

The most valuable unexploited natural resource on earth?


Minesto

A verified and well-protected technology

Achievements

- Electricity 2019 (first generation)
- Electricity to grid 2020 (second generation)
- Electricity to grid with Dragon Class 2022 (third generation, first product)

Service and maintenance concept demonstrated and verified

- Transport, onshore handling, towing, installation and recovery

Installation of megawatt scale system (1.2 MW) completed in early 2024

PPA (Power Purchase Agreement) with utility customer SEV in-place

Tidal park infrastructure designed (cabling, transformation, sea-bed anchoring etc.)

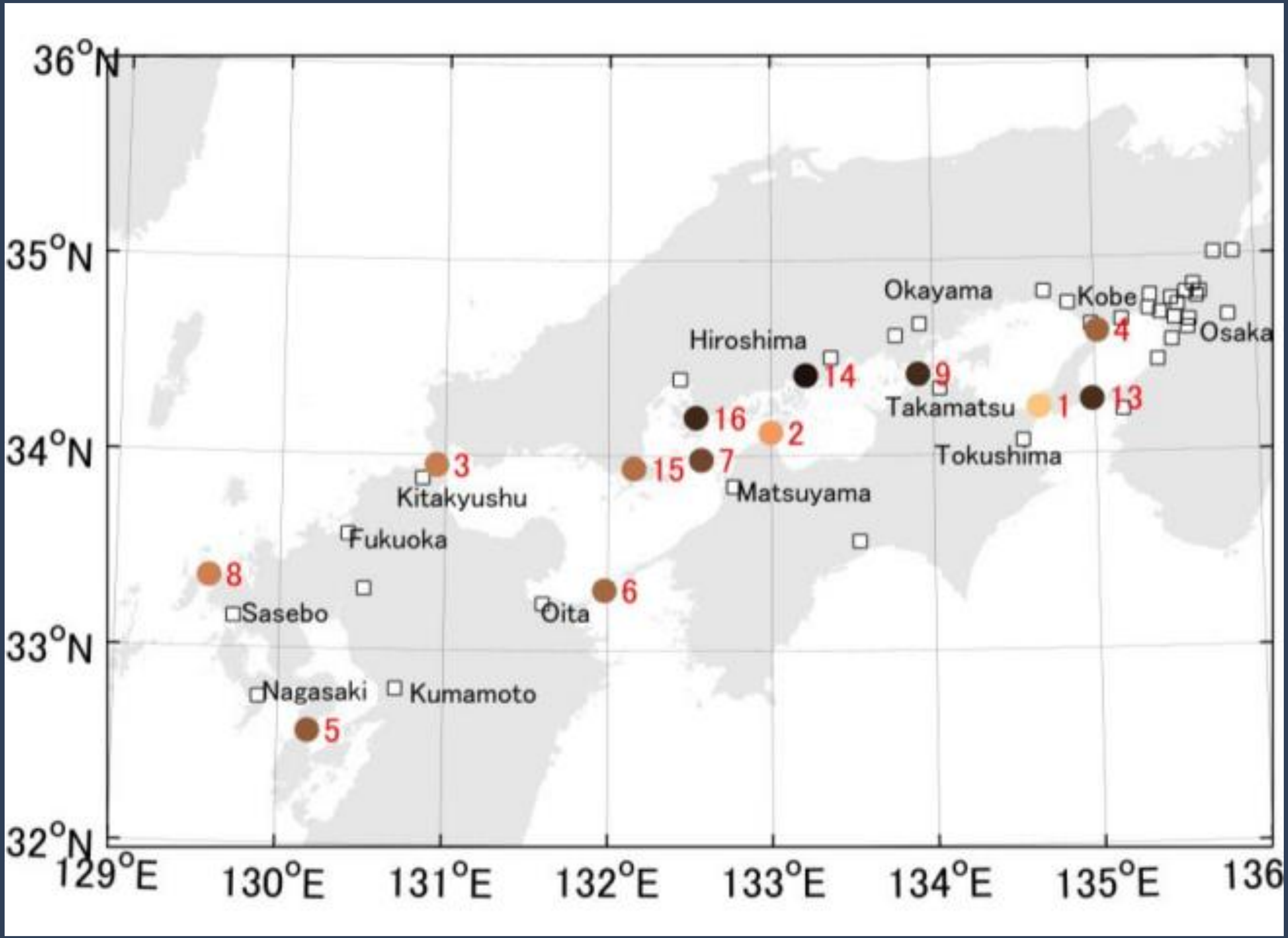
91 patents in 10 patent portfolios covering all relevant markets

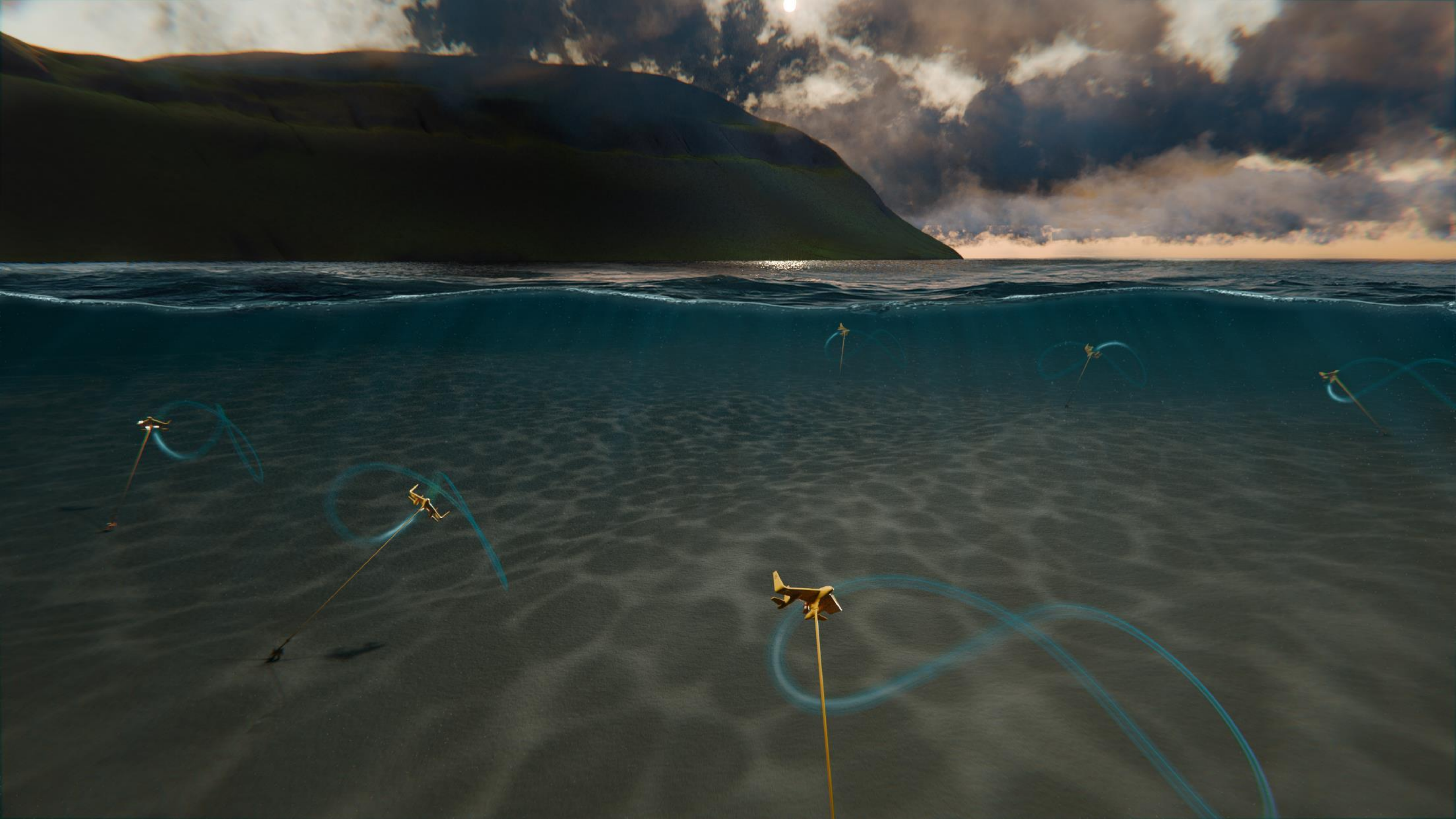
- Main principle
- Supporting functions
- Operations processes

A Set-up for Manufacturing at scale

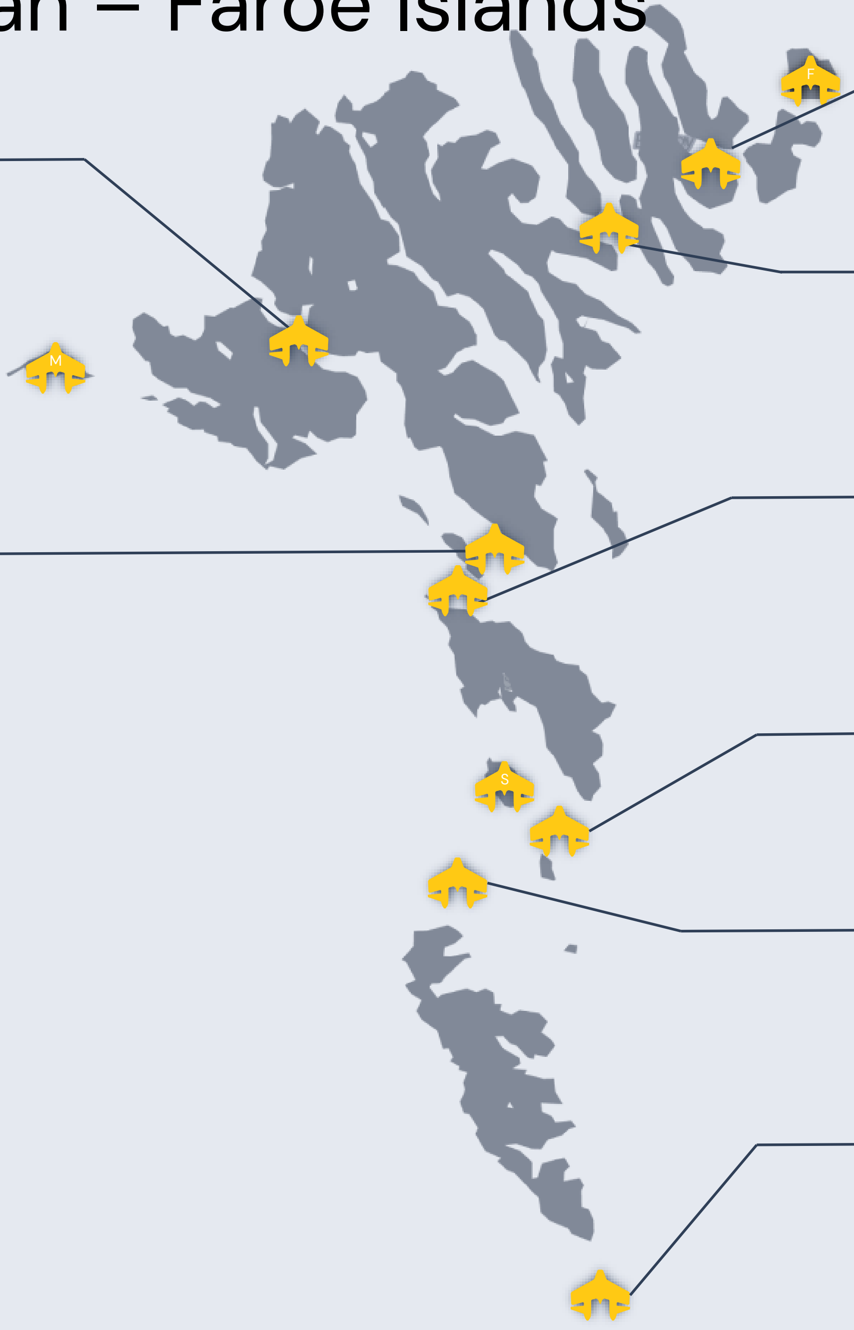
- Partners on-board
- Location selected in Sweden
- A model-factory concept

Examples of identified Minesto tidal sites in Japan





200 MW growth plan – Faroe Islands



Vestmannasund
2 x 100^{kW}
1 x 1.2^{MW}
Demo installation

Hestfjord
- Phase 1: 10MW
- Phase 2: 23MW

33^{MW}
Array installation

Non grid-connected islands
- Mykines
- Fugloy
- Skúvoy

Svinoyarfjord
18^{MW}
Array installation

Leirviksfjord
36^{MW}
Array installation

Skopunarfjord
38.5^{MW}
Array installation

Dimunarfjord
24.75^{MW}
Array installation

Suduroyarfjord
15.75^{MW}
Array installation

South of Akraberg
33.75^{MW}
Array installation


Gamlarætt
Hestfjord
Total capacity
10 MW + 22.75 MW
(Phase 1)
(Phase 2)

In harmony with nature

Environmental impact analysis in six site areas conducted

Mammal observers since 2012 (Portaferry, HHD, Vestmanna)

- Bird life studies show no risks
- Seabed analysis ok
- Seals and dolphins have a verified “avoidance behavior” to stay safe

Conclusions

0 Zero incidents since first operation in 2012

% Low risk profile assessed by marine biologists

Comparative low risks because of large clearance depth and spacing between units


Minesto

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Novel approaches to fossil-free energy

ENABLING NET-ZERO - THE HEXICON WAY

Marcus Thor, CEO Hexicon

Nordic Energy Days, June 12, 2025

hexicon

FLOATING WIND

FLOATING WIND OPENS ACCESS TO GIGAWATT-SCALE POTENTIAL

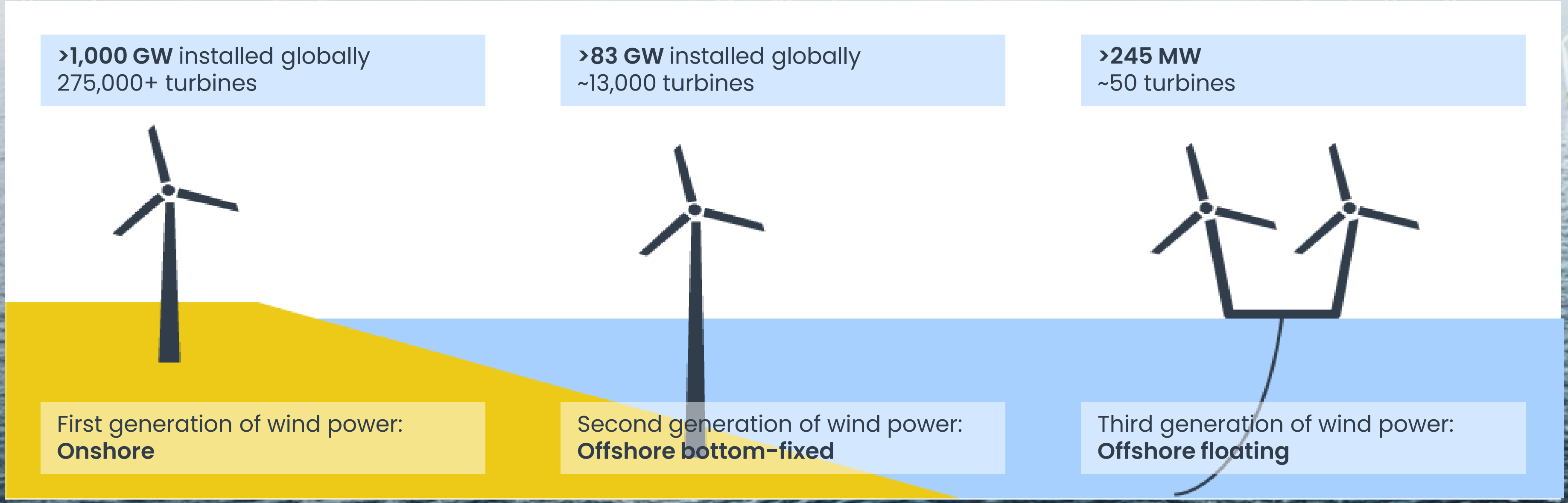
A development from onshore to offshore wind:

- Land-based wind: 100+ countries
- Offshore bottom-fixed wind: 26 countries
- Offshore floating wind: 7 countries

➔ With development and expansion comes cost reduction

BENEFITS OF FLOATING WIND

- Stronger winds = more electricity
- Flexible placement
- Further from the coast
- Less impact on animals and nature
- Scalable



Source: GWEC

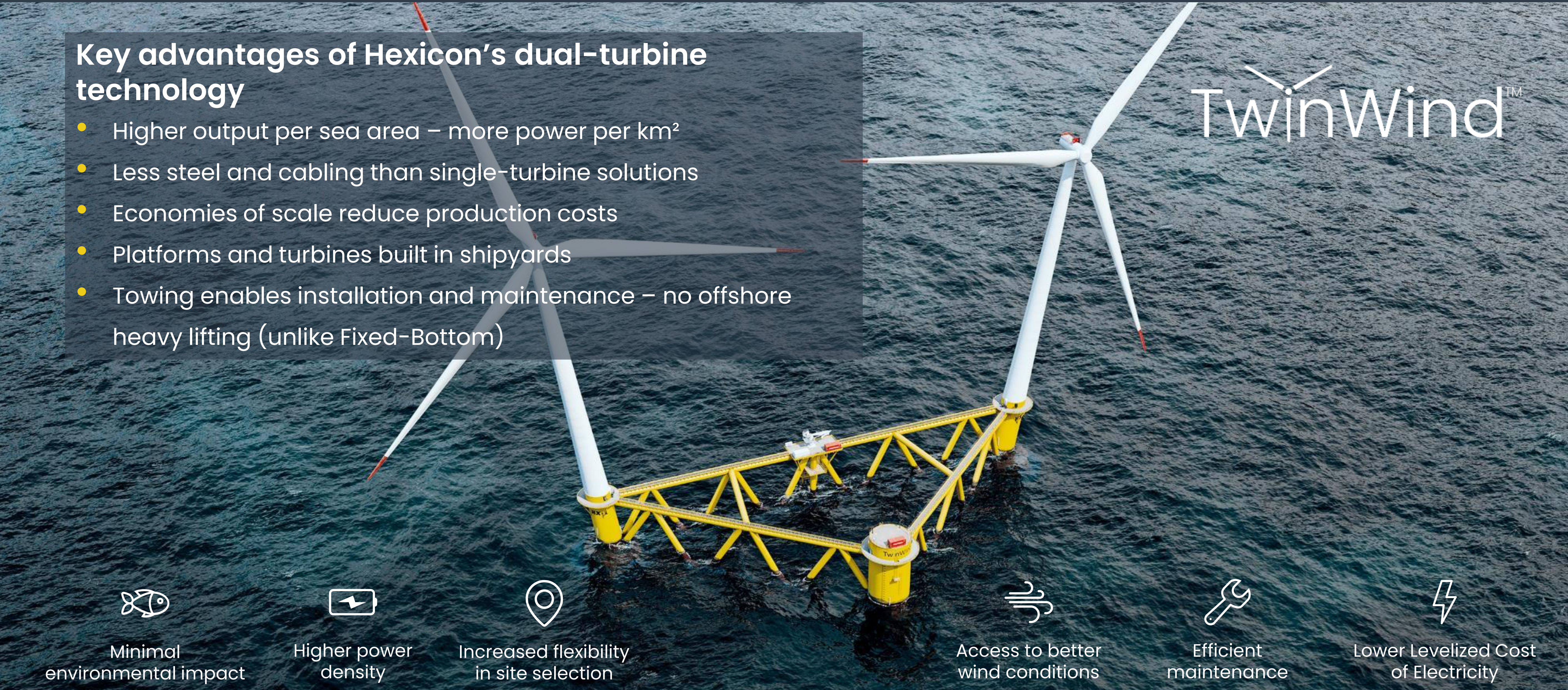
ABOUT HEXICON

- Swedish company founded in 2009
- Listed on Nasdaq First North Growth Markets since 2021
- 15+ years of experience in floating wind
- Developing markets for floating wind power – operating in Asia, Europe and Africa
- Patented technology for floating wind – TwinWind™

A CUTTING-EDGE TECHNOLOGY

Key advantages of Hexicon's dual-turbine technology

- Higher output per sea area – more power per km²
- Less steel and cabling than single-turbine solutions
- Economies of scale reduce production costs
- Platforms and turbines built in shipyards
- Towing enables installation and maintenance – no offshore heavy lifting (unlike Fixed-Bottom)



A DIVERSIFIED PORTFOLIO

KNOW-HOW FROM MUNMUBARAM READY TO BE LEVERAGED THROUGHOUT PORTFOLIO

SOUTH KOREA

MUNMUBARAM

- 750 MW project
- Electricity Business Licenses in place
- EIA2) approved in Aug 2024 by Korean Authorities
- TSA3) signed with KEPCO

ITALY

FIVE PROJECTS
JV PARTNER: AVAPA ENERGY

- 5 active projects
- 2 projects divested in Mar- 2025, to Ingka and Oxan
- Site exclusivity for gross 6,300 MW
- Site scoping completed for gross 4,200 MW

SWEDEN

MARELD
JV PARTNER: MRP

- 2,500 MW project
- Permit application submitted
- EIA2) submitted
- Recommendation received by County
- MoU signed with Preem

SOUTH AFRICA

GAGASI
JV PARTNER: GENESIS ECO-ENERGY

- 800 MW site in Richards Bay
- Entered EIA2) stage
- Ramped up project focus
- Evaluation of new sites ongoing

UNITED KINGDOM

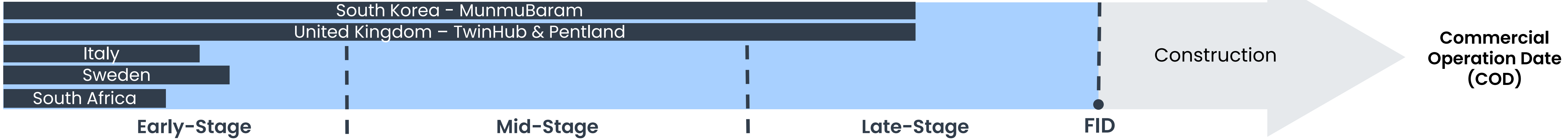
TWO ACTIVE PROJECTS

PENTLAND – JV PARTNERS CIP & EURUS

- 100 MW – next step in FOW4) deployment
- Preparing for AR7 and FID

TWINHUB - DEMONSTRATOR

- 32 MW project
- AR4 winner
- Integrated FEED with WTG1) supplier MingYang

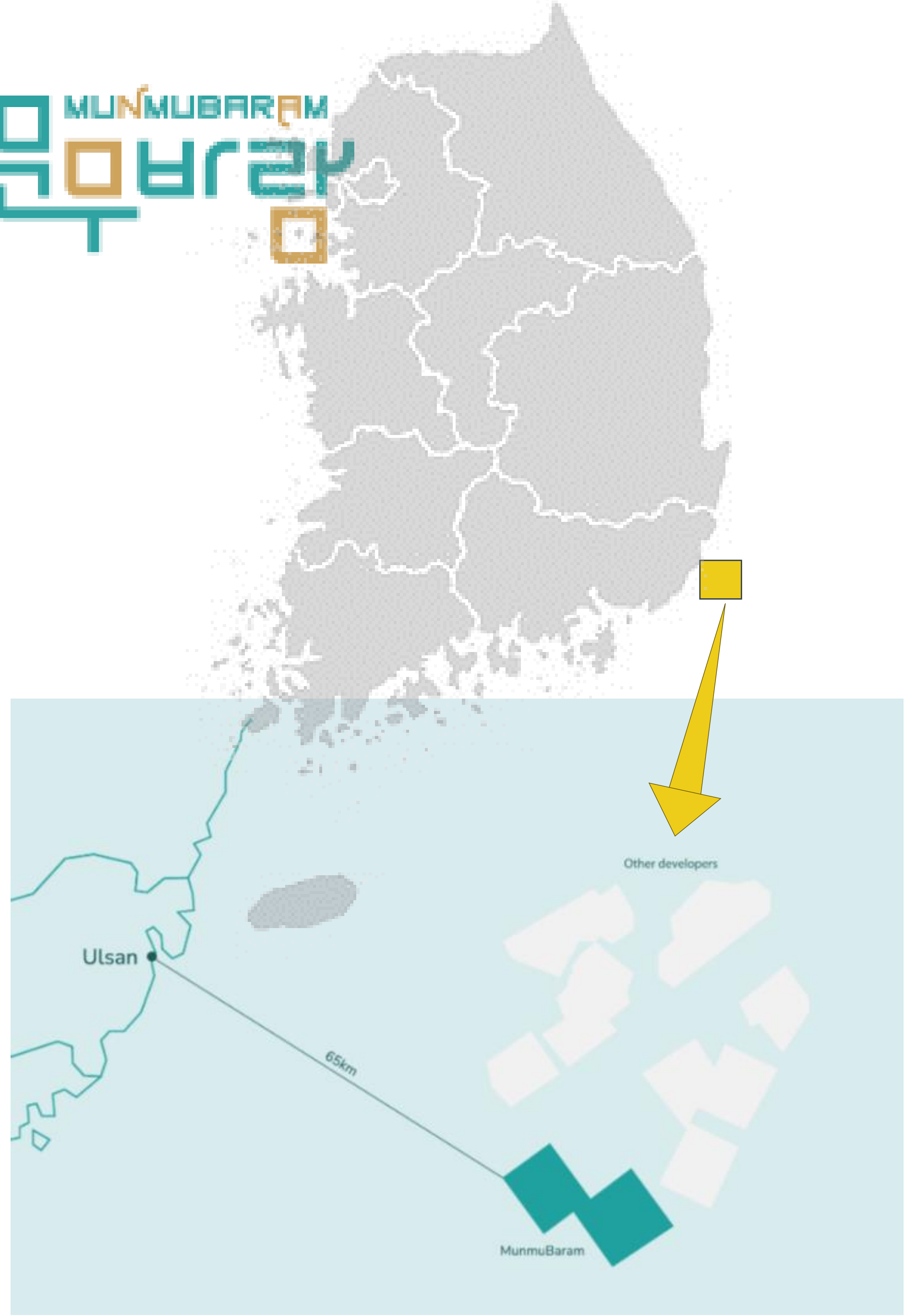


1) *Wind Turbine Generator*
2) *Environmental Impact Assessment*
3) *Transmission Service Agreement*
4) *Floating Offshore Wind*

MUNMUBARAM PROJECT

A FLAGSHIP FOR KOREA'S ENERGY FUTURE

- One of the largest and most advanced floating wind projects in the world
- Initiated by Hexicon Korea in 2018
- Located outside the coast of Ulsan, in South Korea
- MunmuBaram is now in a late project stage
  - Electricity Business Licences in place for 750 MW
  - Approved Environmental Impact Assessment
  - Transmission Service Agreement with KEPCO *(Korea Electric Power Corporation)*
- Now ➔ search for long-term partners to achieve the offtake auction and Final Investment Decision



ENABLING THE NET-ZERO TARGET

FROM MEGAWATTS TO MEANINGFUL CHANGE

ENVIRONMENT

Estimated CO_2 Reduction

- Millions of tons annually
- Reach net-zero target

ECONOMY

Jobs and Industry Development

- Thousands of new jobs
- Industry development
- International competitiveness

SECURITY

Enhance Security and Resilience

- Energy security with local generation
- Local competence, science and innovation
- Local supply chain

hexicon

Thank you for your attention!

HEAD OFFICE
Östra järnvägsgatan 27
111 20 Stockholm, Sweden
www.hexicongroup.com

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Nordic Energy Days

Join the Nordics in going fossil-free

17th June 2025

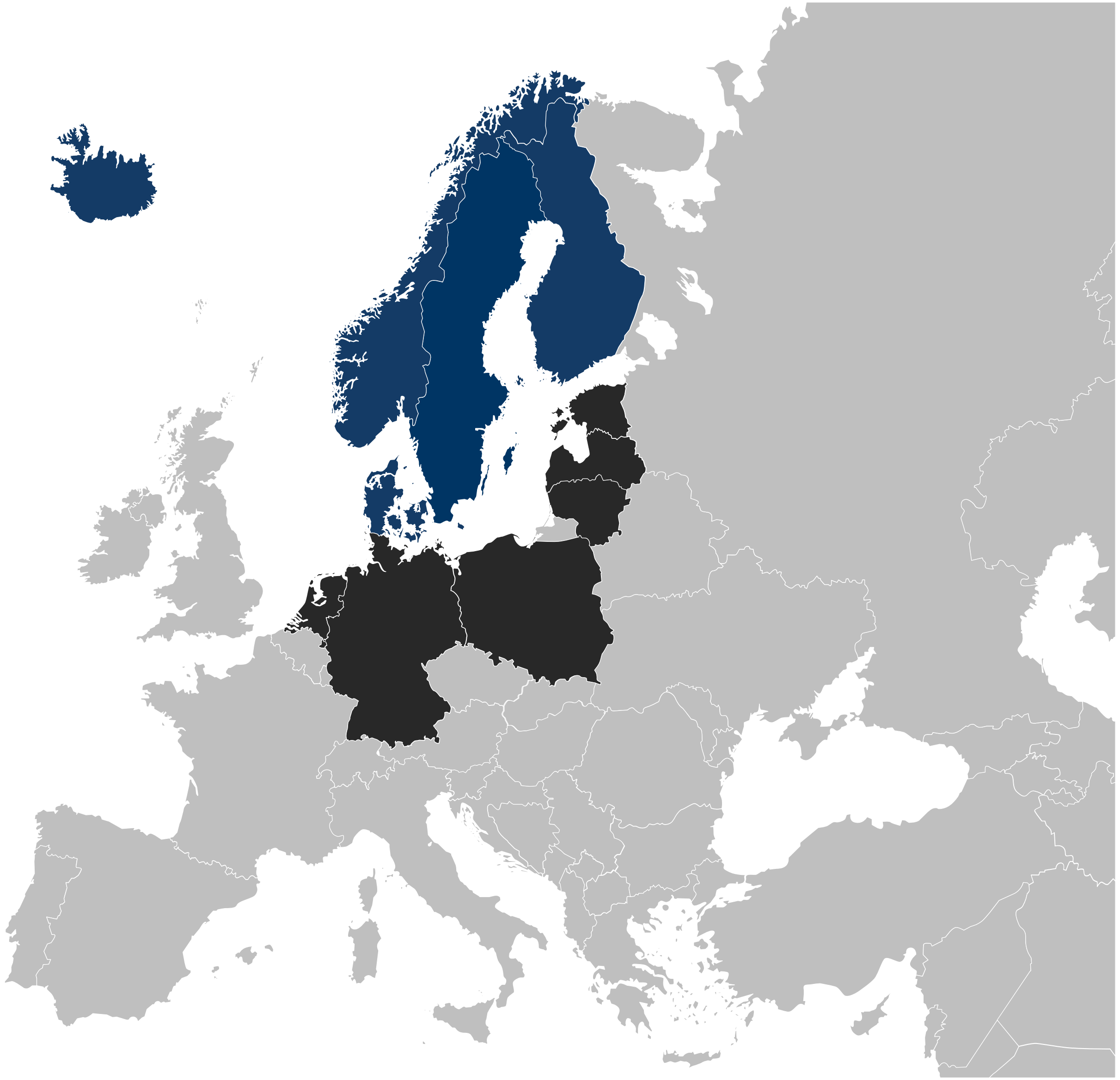
Norwegian Embassy
Tokyo

BUSINESS SWEDEN

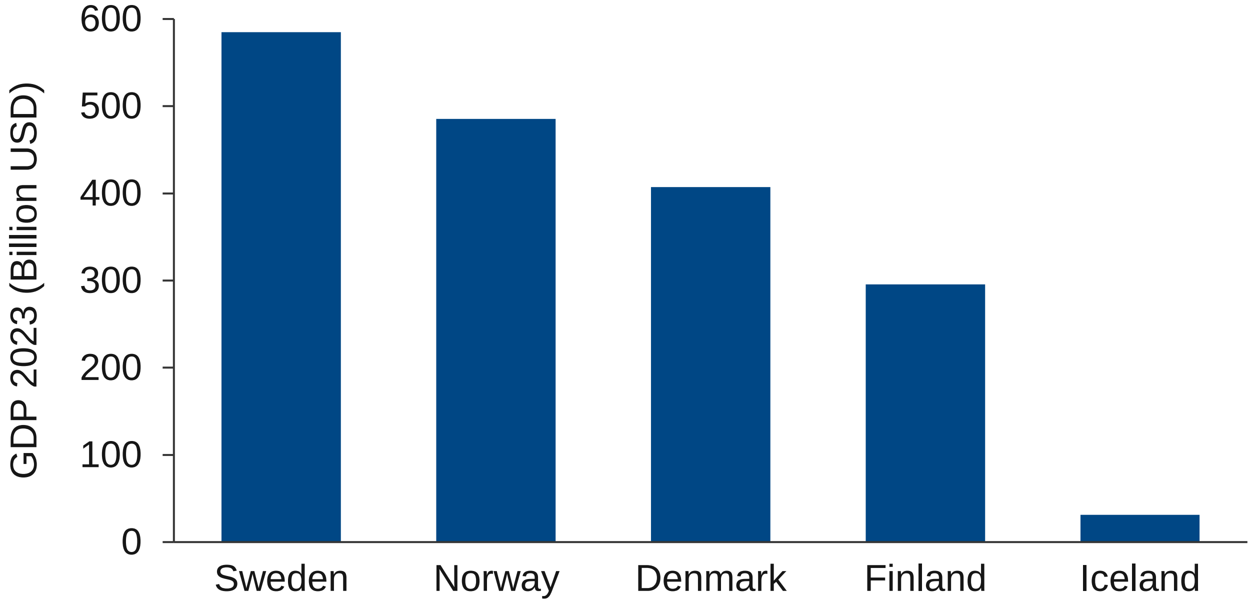
INVEST IN FINLAND

MINISTRY OF FOREIGN AFFAIRS OF DENMARK
Invest in Denmark

The Nordics constitutes a large integrated market well located to supply the EU



- The total Nordic GDP is roughly 1,89 USD trillion and the region has a total population of 27,8 million people
- Aggregated together the Nordics constitute the 10th largest economy in the world – on par with countries such as Mexico, Australia and Canda
- The Nordics are favorably located to supply the Baltic region as well as the rest of Europe



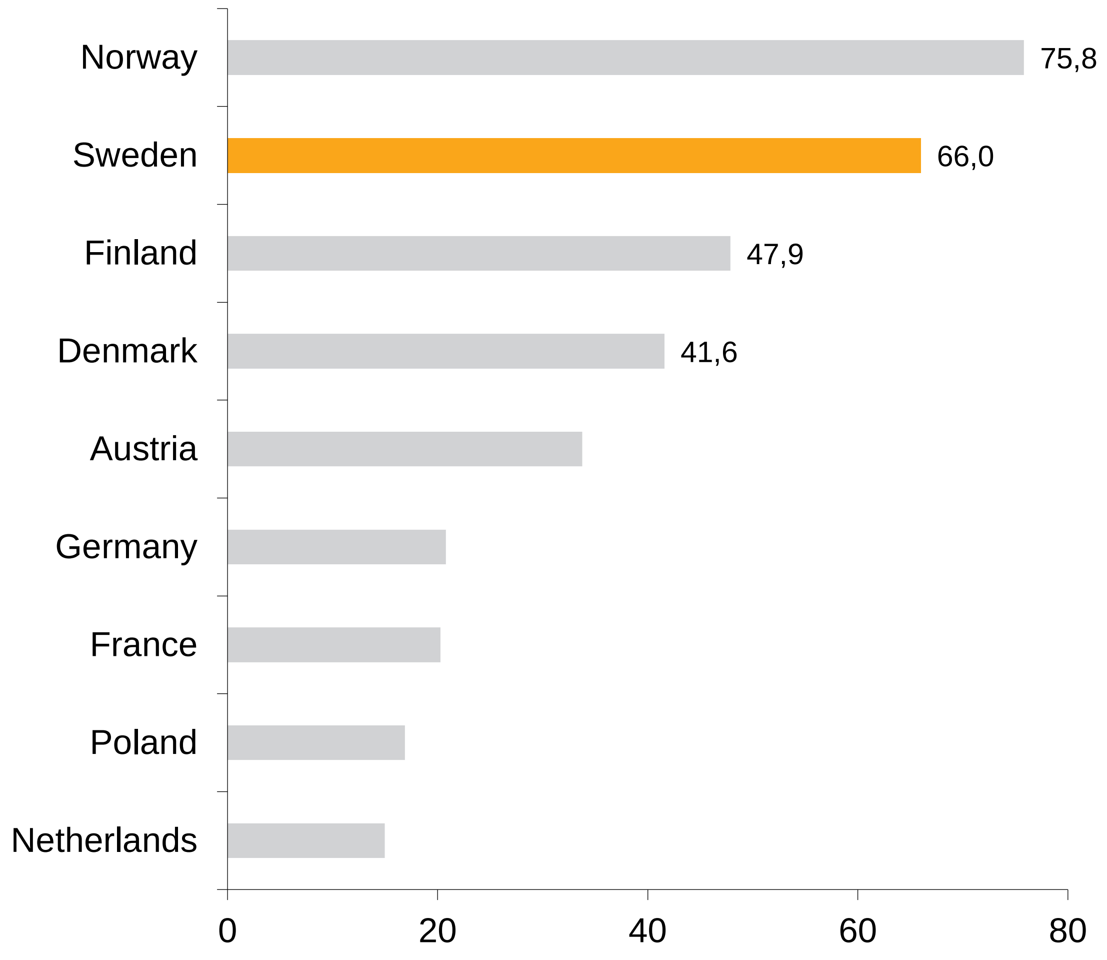
Source: World Bank 2023

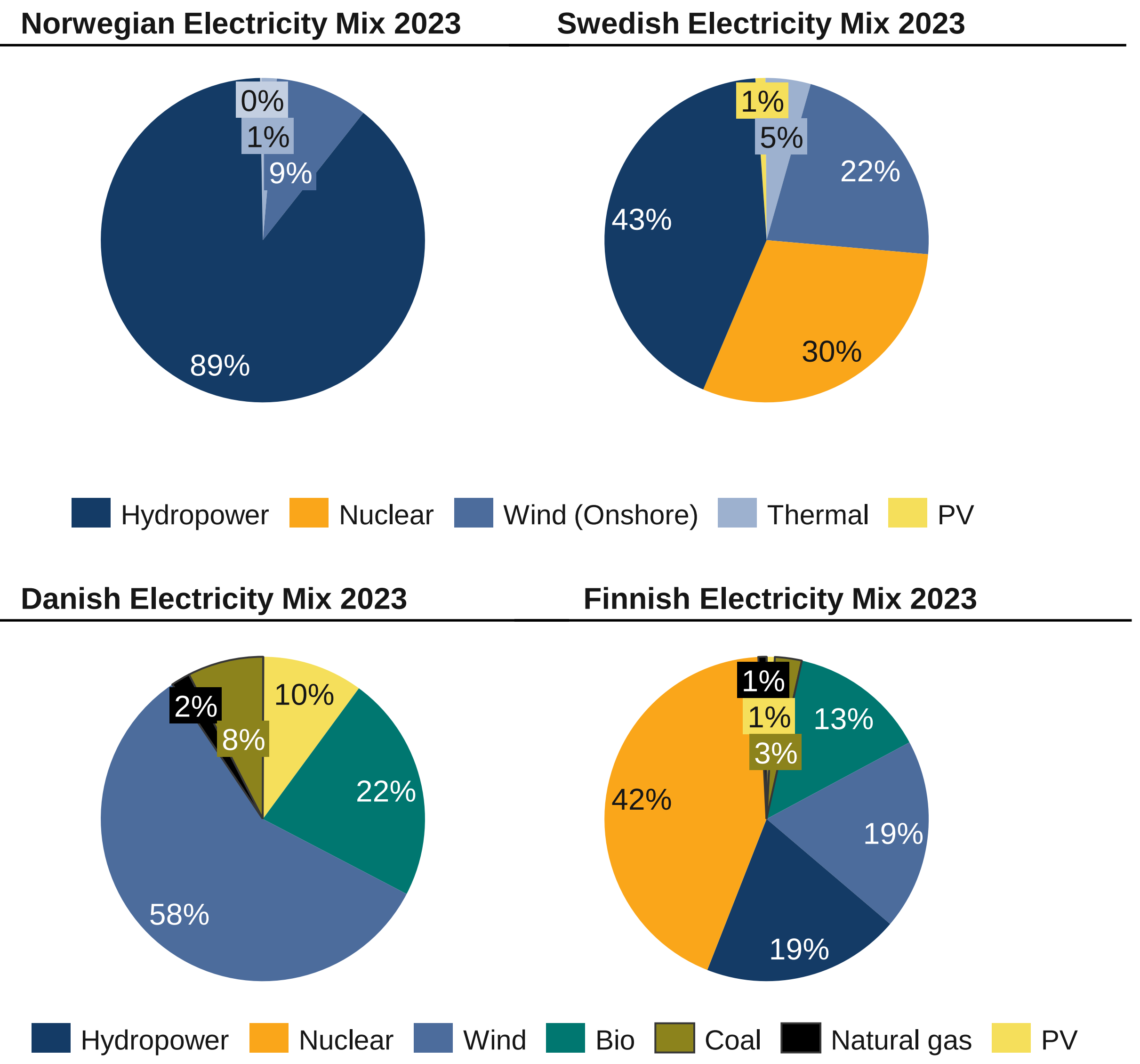
High rankings in innovation, infrastructure and sustainability makes the Nordics one of the world's most attractive regions for business in global comparisons

	Innovation			Infrastructure			Sustainability	
Global rank	**European Innovation Scoreboard**	**R&D Investment (% of GDP)**	**Global Innovation Index**	**Overall Infrastructure**	**Network Readiness Index**	**World Digital Competitiveness Index**	**Sustainable Development Goals Index**	**Most Sustainable Countries in the World**
1	Switzerland	Israel	Switzerland	Switzerland	USA	Singapore	Finland	Denmark
2	Denmark	South Korea	Sweden	Denmark	Singapore	Switzerland	Sweden	Finland
3	Sweden	USA	USA	Sweden	Finland	Denmark	Denmark	Sweden
4	Finland	Belgium	Singapore	Singapore	Sweden	USA	Germany	Norway
5	Netherlands	Sweden	UK	Norway	South Korea	Sweden	France	Switzerland
6	Belgium	Switzerland	South Korea	Finland	Netherlands	South Korea	Austria	Germany
7	Norway	Japan	Finland	USA	Switzerland	Hong Kong	Norway	Netherlands
8	Austria	Austria	Netherlands	Netherlands	UK	Netherlands	Croatia	Ireland
9	UK	Germany	Germany	Hong Kong	Germany	Taiwan	UK	Luxembourg
10	Ireland	Finland	Denmark	Taiwan	Denmark	Norway	Poland	Iceland
Source:	EIS 2024	World Data & Statistics 2025	WIPO 2024	WPR 2025	NRI 2024	IMD 2024	Sustainable Development Report 2024	Robeco 2024

Final energy consumption in the Nordics mostly comes from renewable sources – electricity mix in general is almost fossil-free

Final energy consumption from renewable sources 2022, %





Source: Energimyndigheten, Eurostat

JAPAN AND THE NORDICS

Although geographically distant and culturally distinct, Japan and the Nordic countries share several similarities:

- Low levels of corruption
- High level of political and social trust
- Emphasis on innovation
- Respect for nature
- High emphasis on education

Each Nordic country has domestic regulations and support systems – but EU regulation and funding has significant impact on market development

EU Net-Zero 2050

EU Green Deal

Excerpt of policies and support mechanisms meant to enable the EU Green Deal vision (not exhaustive!)

Policy/Support Packages	Brief Description
Fit for 55	Target of 55% GHG-emissions reduction by 2030 compared to 1990
- EU ETS (I & II)	EU-internal carbon taxation
- CBAM	Non-EU imports carbon taxation
- Renewable Energy Directive (RED) III	Binding 42,5 % renewable energy target by 2030
- Energy Efficiency Directive (EED)	Mandated yearly renovations of public buildings etc
ReFuelEU Aviation	Mandated SAF/Synthetic fuel blend
Innovation Fund	€40 billion (6700 billion ¥) of support over 2021-2030 for innovative low-carbon technologies
Offshore wind, Hydrogen strategy etc…	EU roadmaps including targets, funding etc

Sweden is continuously adding new fossil-free capacity and has dozens of green projects planned regarding steel, batteries and electrofuels

Key Green Transition Segments

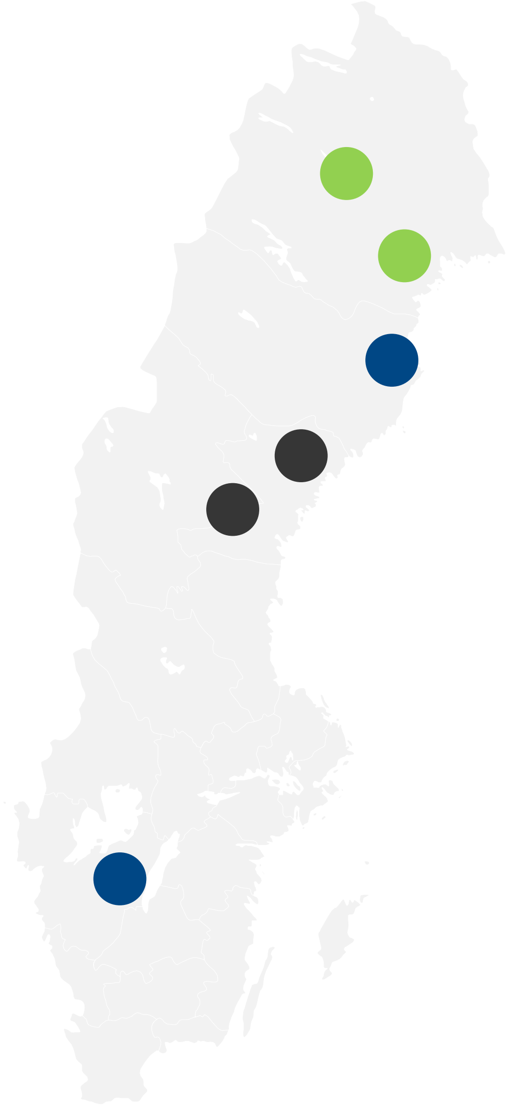
- **Green Steel**
- Mining
- **Batteries**
- **Hydrogen & Electrofuels**
- **CCUS**
- Chemicals
- Wind & Nuclear (Average 1 GW p.a Wind, 2,5 GW Nuclear 2035)

Projected Demand Development Electricity

- Net-zero target 2045 and 100 % fossil-free electricity by 2040
- Estimated increase of ~ 90 TWh by 2035 (*135 TWh load 2023)*
- Government planning target of enabling 300 TWh load by 2045
- Over 150 planned projects relating to the green transition with an estimated CAPEX totaling of over 800 BSEK

Key Projects & Companies

Mining	*Green Steel*	*Batteries*	*Electrofuels*
LKAB	Stegra	Volvo	norsk e-fuel
Boliden	Hybrit	northvolt	SkyNRG
	Ovako		Liquid Wind



Steel

E-Fuel

Battery

Source: Business Sweden

Norway – the lowest carbon footprint in the world? Leveraging renewable energy with carbon capture and storage creates exciting opportunities in the future.

Key Green Transition Segments

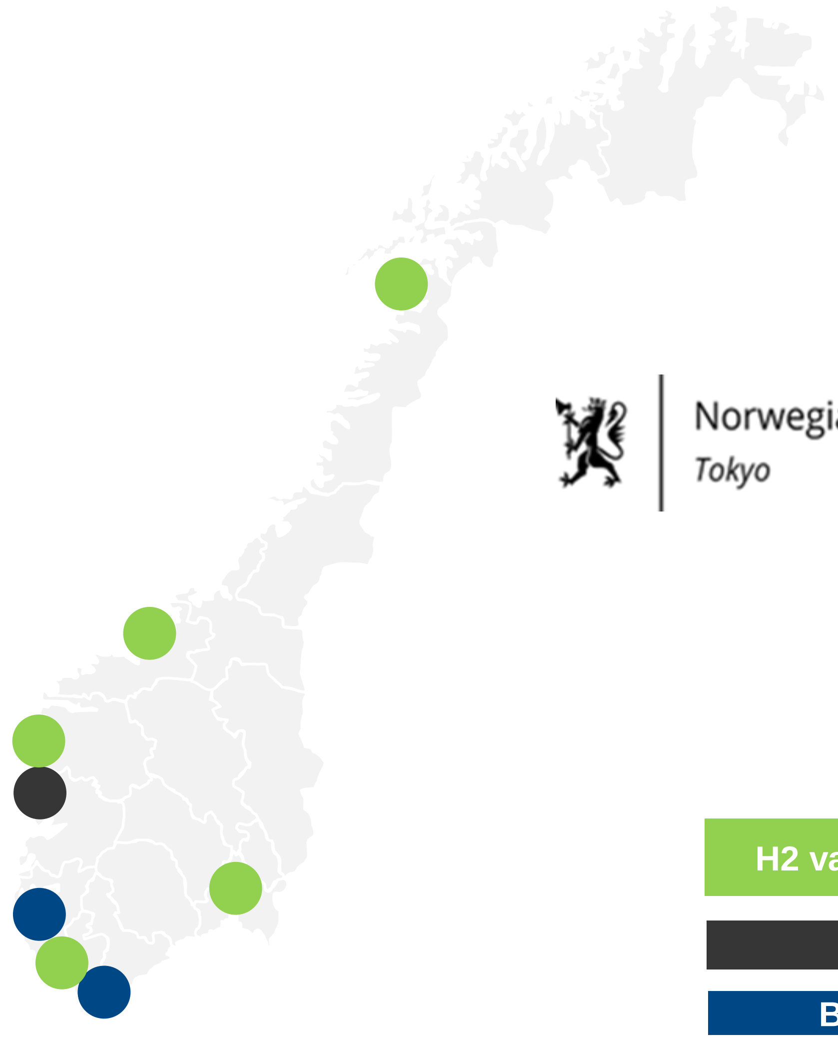
- Electrification
- Carbon Capture and Storage (CCS) and CCUS
- Offshore wind
- Hydrogen and derivatives
- Battery value chain
- Circular economy

Projected Demand Development Electricity

- Norway's electricity production is 98% renewable
- Norway's ambition to become climate neutral by 2030
- Target to allocate 30GW of offshore wind capacity by 2040
- Norway's electricity needs will double to 260 TWh by 2050
- Electricity demand drivers is electrification of transportation, processing and offshore sector, and future green industries

Key Projects & Companies - examples

Batteries	*Offshore Wind*	*Hydrogen*	*CCS*
MORROW BEYONDER nordic batteries	SOURCE GALILEO	Norwegian Hydrogen hystar	Northern Lights



Norwegian Embassy
Tokyo

H2 value chain

CCS

Battery

Source: Business Norway, Norway - IEA, DNV Energy Transition Outlook

Denmark has several projects within hydrogen, ammonia and e-fuels in the pipeline. Tender for off-shore wind projects and hydrogen pipeline on the way

Key Green Transition Segments

- Electrification
- On- and offshore wind power
- Hydrogen and electro fuels
- CCS/CCUS
- Energy Trading
- Circular Economy

Projected Demand Development Electricity

- 63% electricity consumption from wind and solar 2024
- Target: 100% green electricity by 2027
- Expected electricity consumption in 2040 – 135TWh
- Electricity demand drivers are electrification of transportation, industries, PtX and green datacenters

Japanese companies investing in DK within green energy

MITSUBISHI HC CAPITAL

OSAKA GAS

Sumitomo Corporation

ITOCHU

MITSUI & CO.

MINISTRY OF FOREIGN AFFAIRS OF DENMARK
Invest in Denmark

Finland aims to achieve carbon neutrality by 2035, leveraging its low-cost clean electricity and robust grid infrastructure, and be a leading hydrogen producer

Key Green Transition Segments

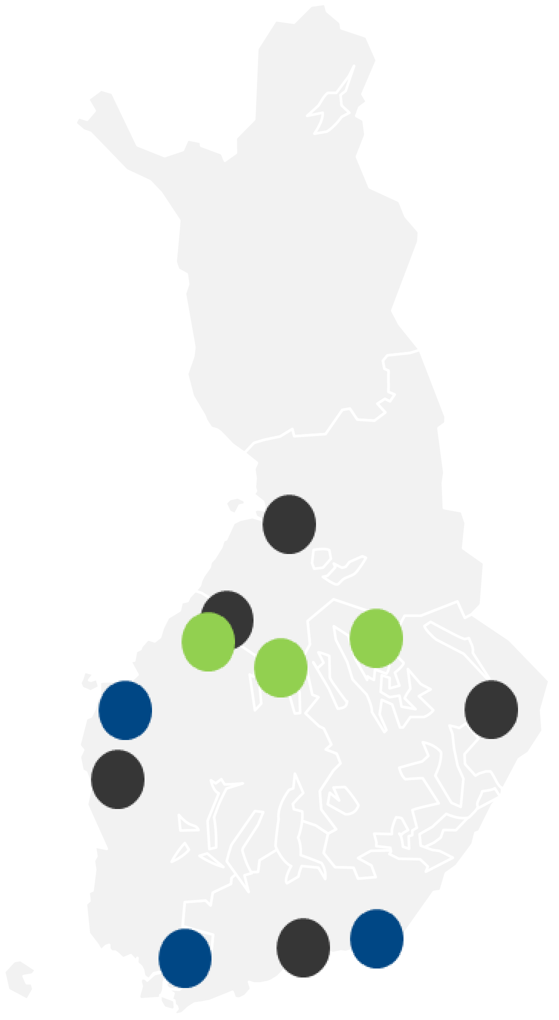
- Nuclear
- Wind power
- Mining & Batteries
- Green metal
- Hydrogen & derivatives
- Biogenic carbon

Projected Demand Development Electricity

- Carbon neutrality by 2035
- Onshore wind PJs of 62GW & Offshore 46GW published, Jan 2025
- National grid investment of 4 Billion EUR planned for 2024-2033
- Contribute to 10% of EU hydrogen capacity by 2030, and be a mojor hydrogen producer in Europe

Key Projects & Companies

Mining	*Batteries*	*Green metal*	*Hydrogen*
KELIBER	IONCOR	fortum	hycamite
Terrafame	EASPRING FINLAND	RioTinto	P2X solutions
umicore	fortum	Mitsubishi Corporation	plug



INVEST IN FINLAND

Metal

Battery

H2

Source:Business Finland

The Nordics are committed to the green transition and are open for business – Join us!

Sustainability Pioneers

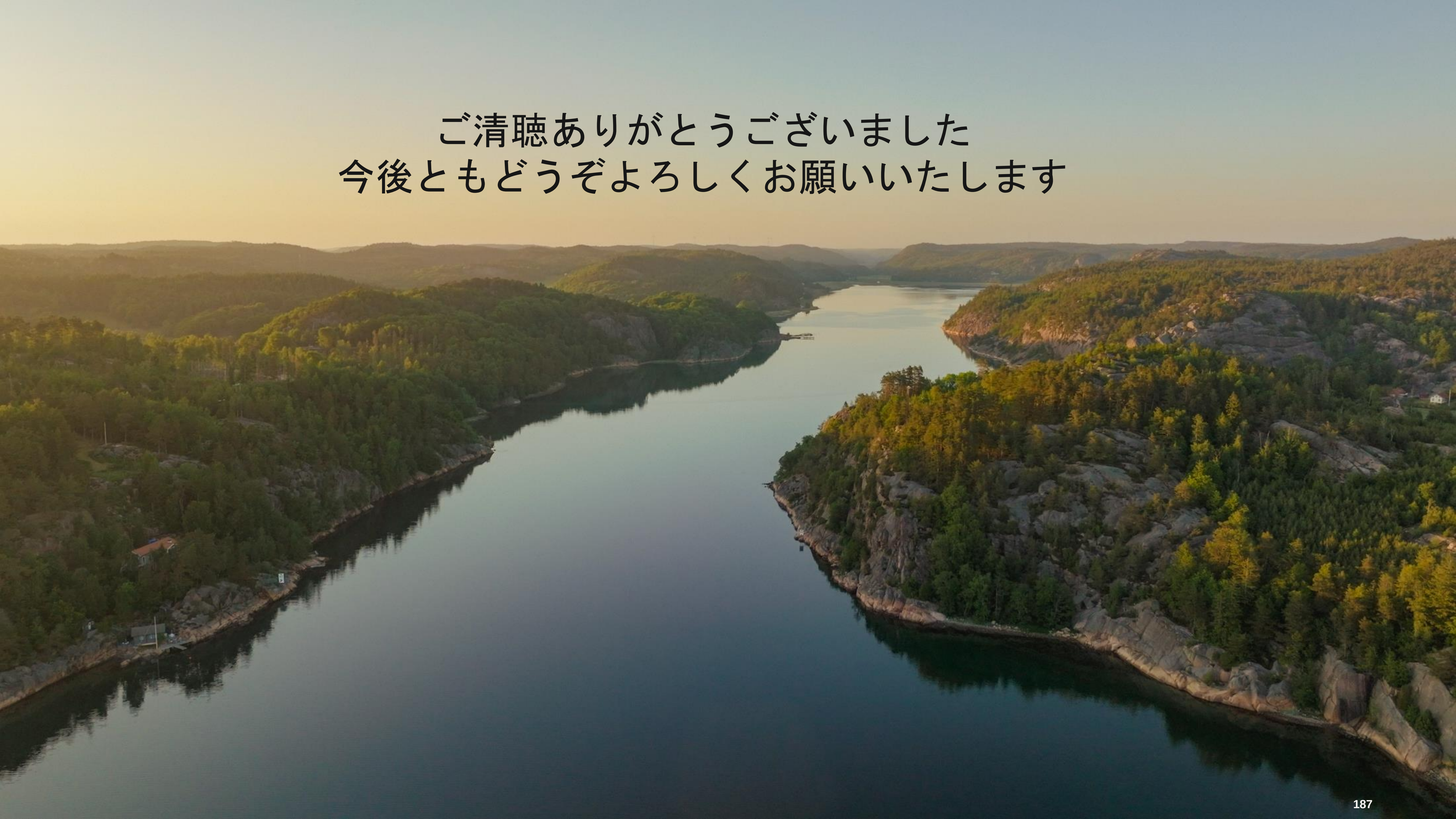
- Leading suppliers within power electronics and electricity generation
- Leading pulp and paper industry with a strong focus on circularity
- Europe’s highest share of fossil-free energy
- Europe’s lowest electricity prices

Leading Innovation

- High R&D intensity
- Strong emphasis on triple helix model
- Well developed public-private partnership frameworks
- Regional hub for all forms of climate start-ups

Efficient Operations

- High manufacturing productivity
- Highly skilled workforce
- Well developed infrastructure and logistics and easy EU access
- Competitive corporate tax rates


ご清聴ありがとうございました
今後ともどうぞよろしくお願いいたします

Session 3

14:15 – 15:45

Hydrogen and e-fuels for heavy-duty transport

Session Introduction

Helena Sarén

Head of Zero Carbon Future Mission, Business Finland

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WHEN TRUST MATTERS

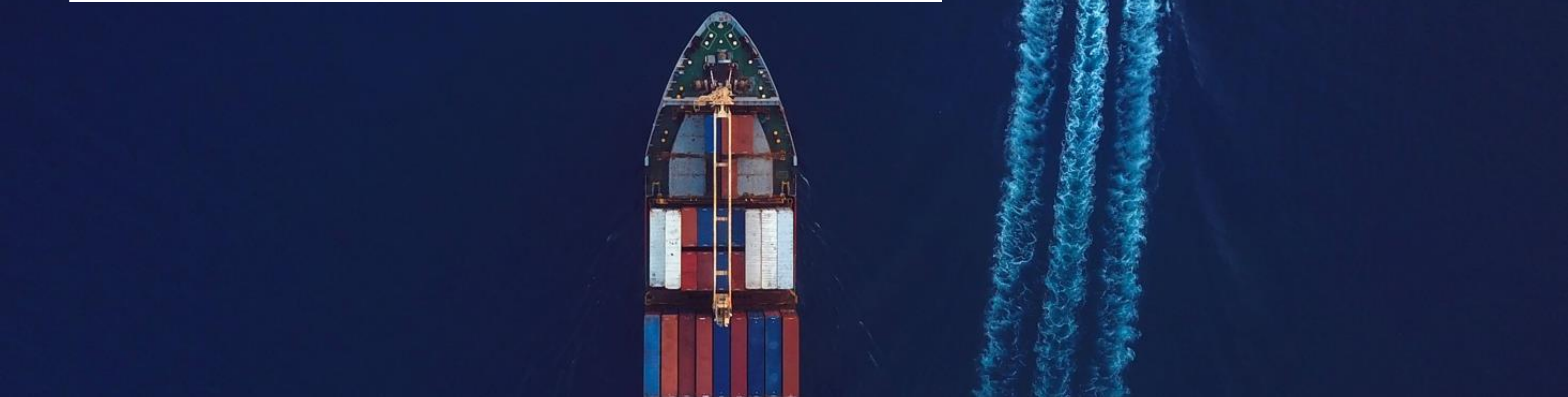
Nordic Roadmap

-Future Fuels for Shipping

June 2025

Stian Sollied – Country Manager DNV Japan

Nordic Energy Days



The Nordic Roadmap project (2022-2025)

Nordic Council of Ministers

Nordic collaboration with 70 partners coordinated by DNV and funded by the Nordic Council of Ministers

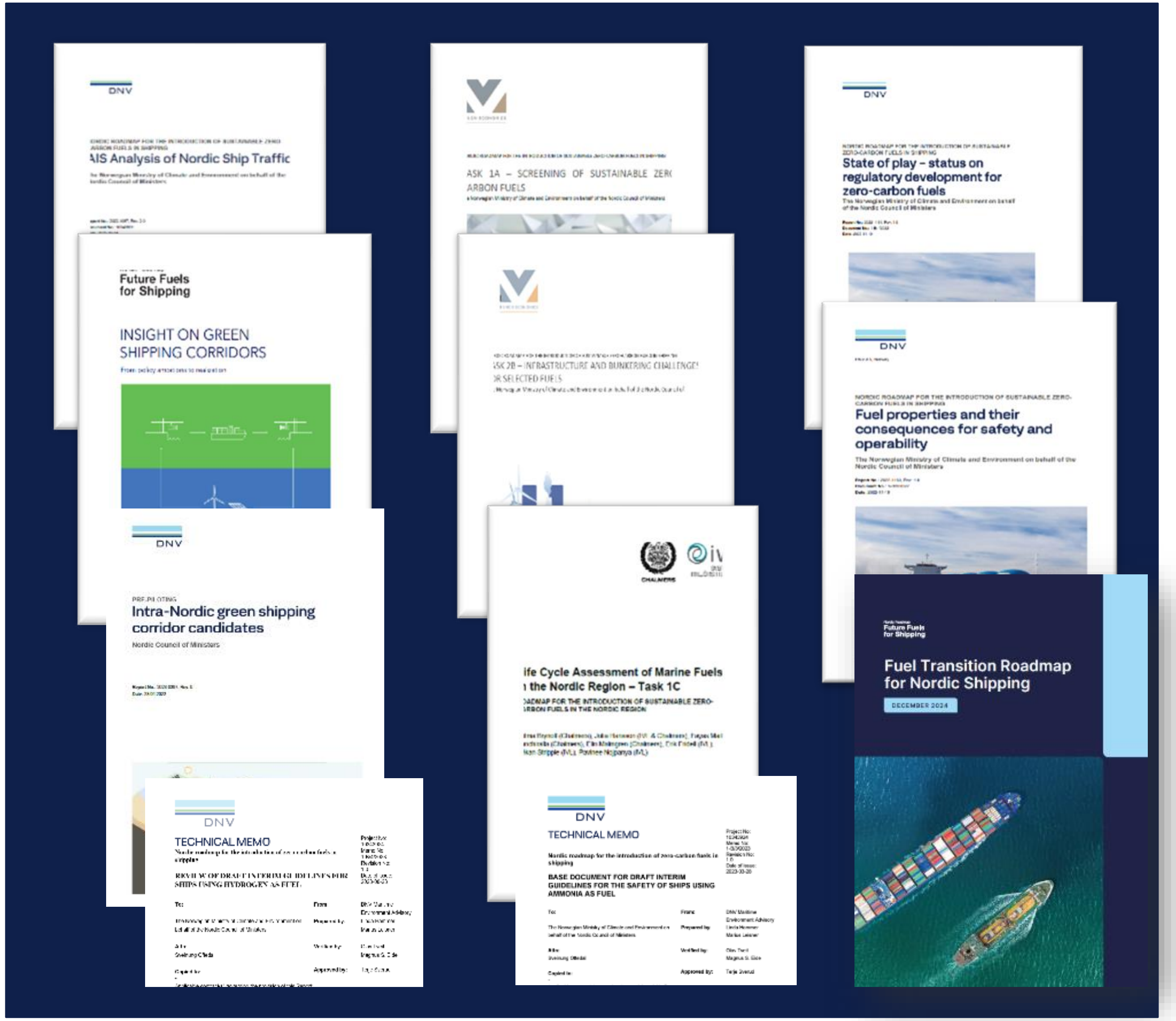
Objectives:

- Gain **technical knowledge** and regulatory development
- Establish a **Nordic collaboration platform** and **green shipping corridor pilot studies**
- Develop a **Nordic fuel transition roadmap**

➢ Fuels in focus: ammonia, hydrogen and methanol

➢ 11 technical deliverables to date, including The Fuel Transition Roadmap for Nordic Shipping

➢ 3 ongoing green shipping corridor pilot studies



https://futurefuelsnordic.com/project-deliverables/

DNV

The Nordic collaboration platform

Nordic Council of Ministers

Contributing partners:

CHALMERS UNIVERSITY OF TECHNOLOGY, ivl Swedish Environmental Research Institute, MAN Energy Solutions, DNV, MENON ECONOMICS, LITEHAUZ

Supporting partners:

AMOGY, amon MARITIME, amon OFFSHORE, AZANE Fuel Solutions, BiRR, C40 CITIES, CHNL CENTRE FOR HIGH NORTH LOGISTICS, Color Line, CIP Copenhagen Infrastructure Partners, Danish Maritime STATE OF BLUE TECH®, DanishShipping, DANISH TECHNOLOGICAL INSTITUTE, DFDS, SBB SUOMEN BIOKIERTO & BIOKAASU RY, Suomen Varustamot Rederierna i Finland Finnish Shipowners' Association, Finnish Transport Infrastructure Agency, Fjarðarorka, Flexens, FundR&I Making your ideas take off, FURSTENBERG MARITIME ADVISORY, Gasum, GREEN MARINE, GREENH, HY2GEN, INAB, Kvarken Ports, KYSTVERKET NORWEGIAN COASTAL ADMINISTRATION, MERIAURA, METHANOL INSTITUTE, NIB, NORSEPOWER, Norwegian Hydrogen, ORUST e-boats, NTNU, PBI RESEARCH INSTITUTE, PEVATECH, PORT OF GOTHENBURG, PORT OF TURKU FINLAND, PORT OF OSLO, Port of Ystad, PRECISION PRODUCTS UK the technology within, Norges Rederiforbund Norwegian Shipowners' Association, SAMORKA Icelandic Energy and Utilities, SAMSKIP, Sjøfartsdirektoratet Norwegian Maritime Authority, SMYRIL LINE, Stena, sternula, Swedbank, Transportministeriet, Umeå Hamn, Umeå kommunföretag, UNIFEEDER GROUP, UNO-MARITIME LTD, UZMAR, VASEK, VIKING LINE, VIRIDIS BULK CARRIERS, VTT, WÄRTSILÄ, wasaline, YARA, YILPORT OSLO, Aalto University School of Engineering

- Events, deliverables, and website
- Follow-up of the pilot studies
- Input to the Roadmap

Visit the project website:

https://futurefuelsnordic.com/

DNV

The Fuel Transition Roadmap for Nordic Shipping

- Roadmap handed over to **Nordic Ministers** 3rd December 2024
- **Unified** fuel transition strategy with a **strong focus on safety**
- Aims to **accelerate the fuel transition** in Nordic shipping
- Identifies **key barriers** and **specific actions** to overcome them

Download the full report here:

https://futurefuelsnordic.com/

Vision for Nordic shipping

The Nordic vision is “*to become the most sustainable and integrated shipping region in the world”,* and a global force for accelerating the green transition of the transport sector.

The 2023 IMO GHG strategy and other Nordic commitments on green shipping corridors, green transition, cooperation on transport, infrastructure and energy supply.

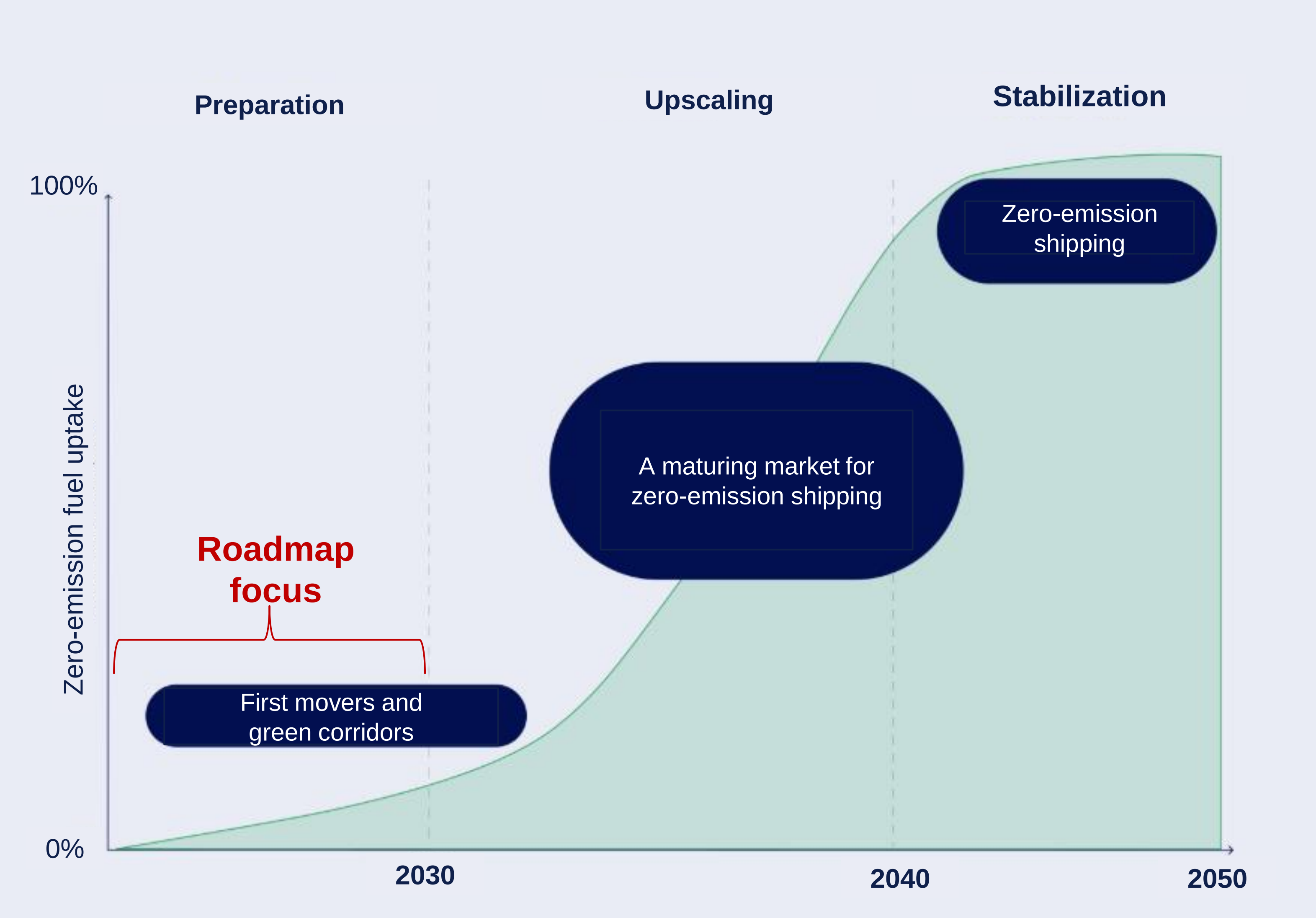
Goals for Nordic shipping

To achieve the main goal of **zero-emission shipping by 2050**, the roadmap defines the following milestones:

- By 2025, the first green shipping corridor shall be realized.
- By 2030, zero or near-zero GHG emission technologies, fuels and/or energy sources should represent **at least 10%** of the energy used by Nordic shipping.
- By 2040, zero or near-zero GHG emission technologies, fuels and/or energy sources should represent **at least 90%** of the energy used by Nordic shipping.

The Fuel Transition Roadmap for Nordic shipping

- Aims to **accelerate** the uptake of zero-emission fuels in the Nordics
- Assumes that the fuel transition follows an **S-curve**
- Critical for success to get **input** from all players in the maritime value chain



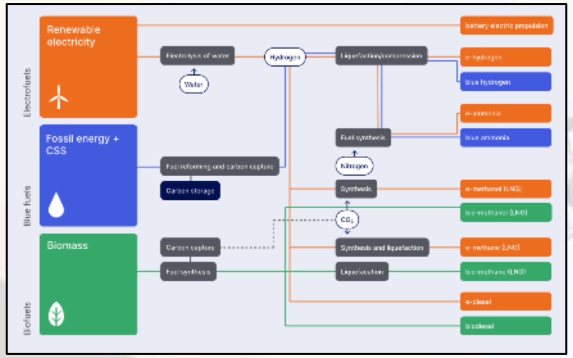
The S-curve can describe the market development of many new technologies, including uptake of LNG and battery powered ships

Roadmap content

Zero-emission by 2050

Chapter 1 **Introduction**

Chapter 2 **Goals and vision for Nordic shipping**

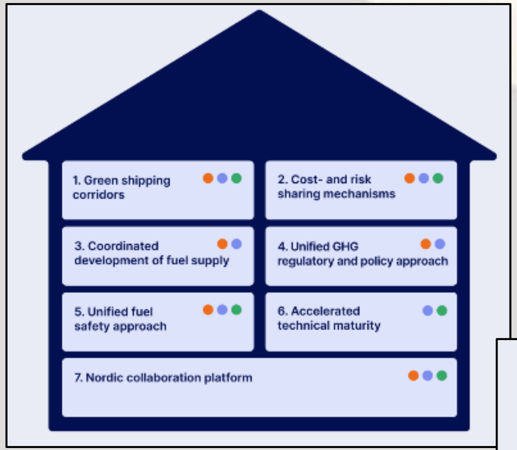


Chapter 3 **Nordic shipping today**
- Status on ship traffic, fuel consumption and emissions
- Current uptake of zero-emission fuels and technologies

Chapter 4 **Zero-emission fuel options and barriers hindering their uptake**

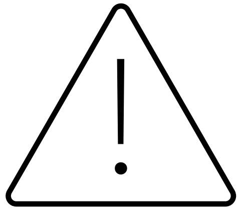
Barrier focus – what are the key challenges?

Chapter 5 **Roadmap Actions**
- Seven building blocks



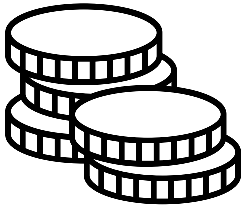
Chapter 6 **Moving further: Upscaling and stabilization phases**

3 key bottlenecks hindering the uptake of zero-emission fuels

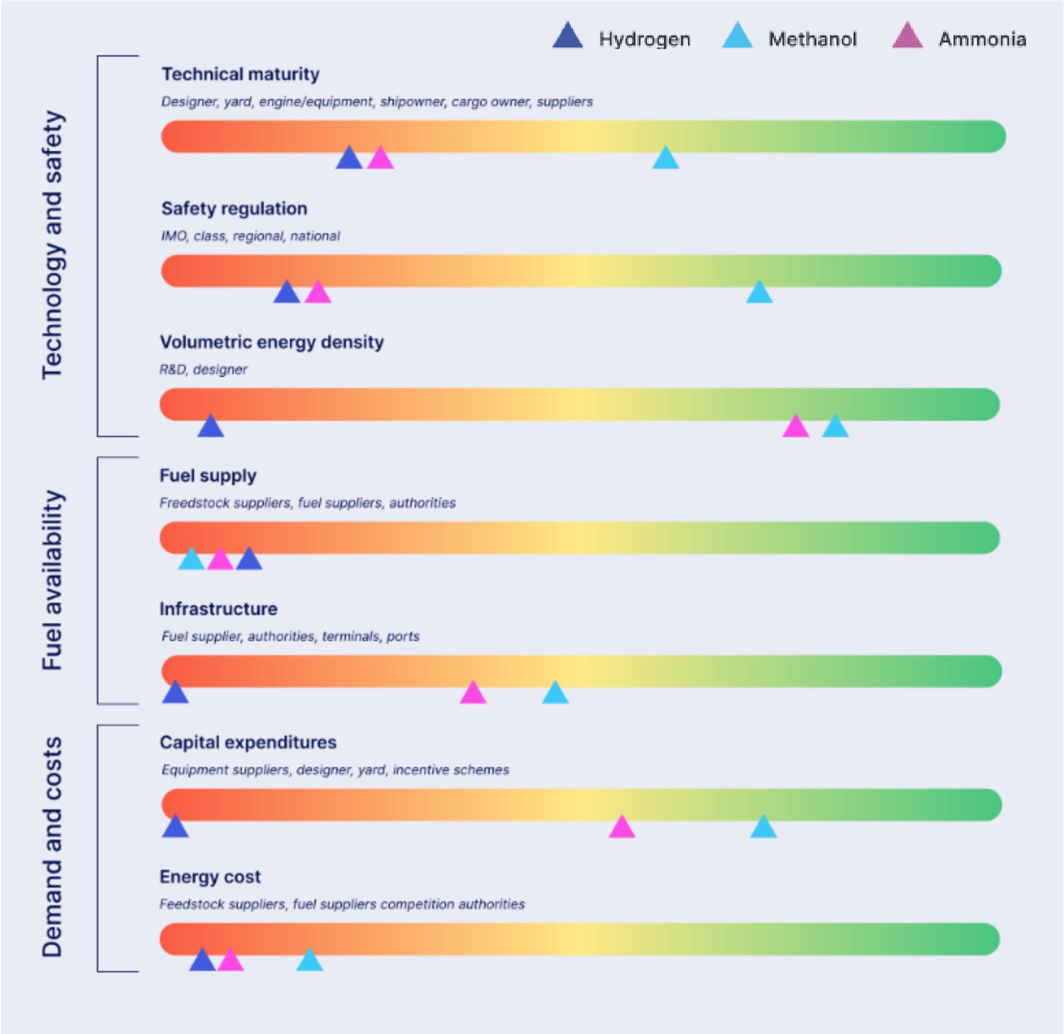


Technology and safety

Fuel availability



Demand and costs



Source: DNV – Nordic Roadmap project, https://futurefuelsnordic.com/
DNV (2022), Insight paper on green shipping corridors, https://futurefuelsnordic.com/insight-paper-on-green-shipping-corridors

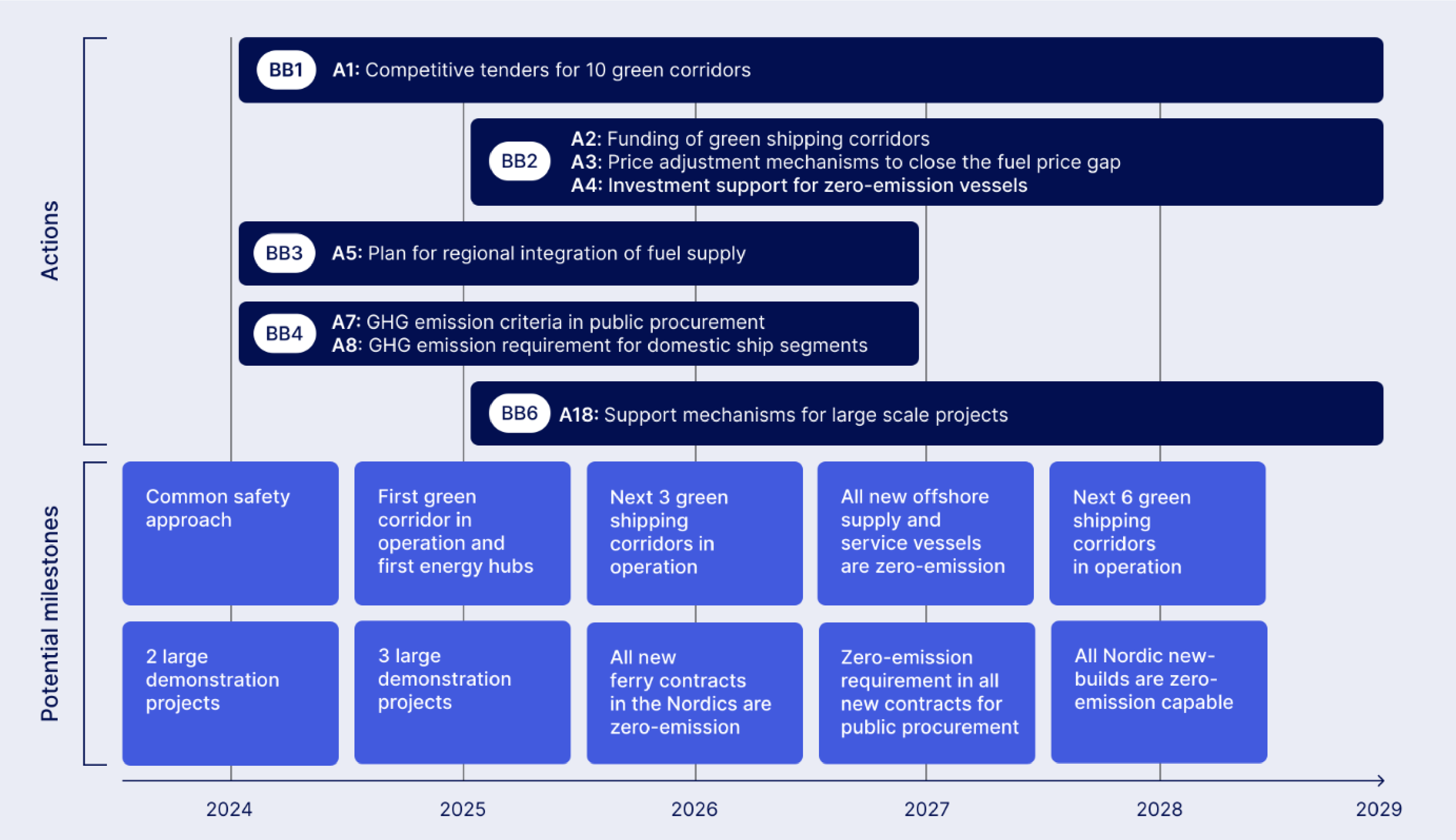
The Roadmap will lay the foundation for upscaling in the next decade

7 strategic building blocks with 20 specific actions towards 2030

- Actions to overcome **key barriers**
- Creating a **Nordic playground** – with a unified approach
- **Targeted collaboration** between stakeholders and Nordic governments
- Focus on first mover segments, operating in **green shipping corridors**

Source: DNV (2024), *The Fuel Transition Roadmap for Nordic shipping*

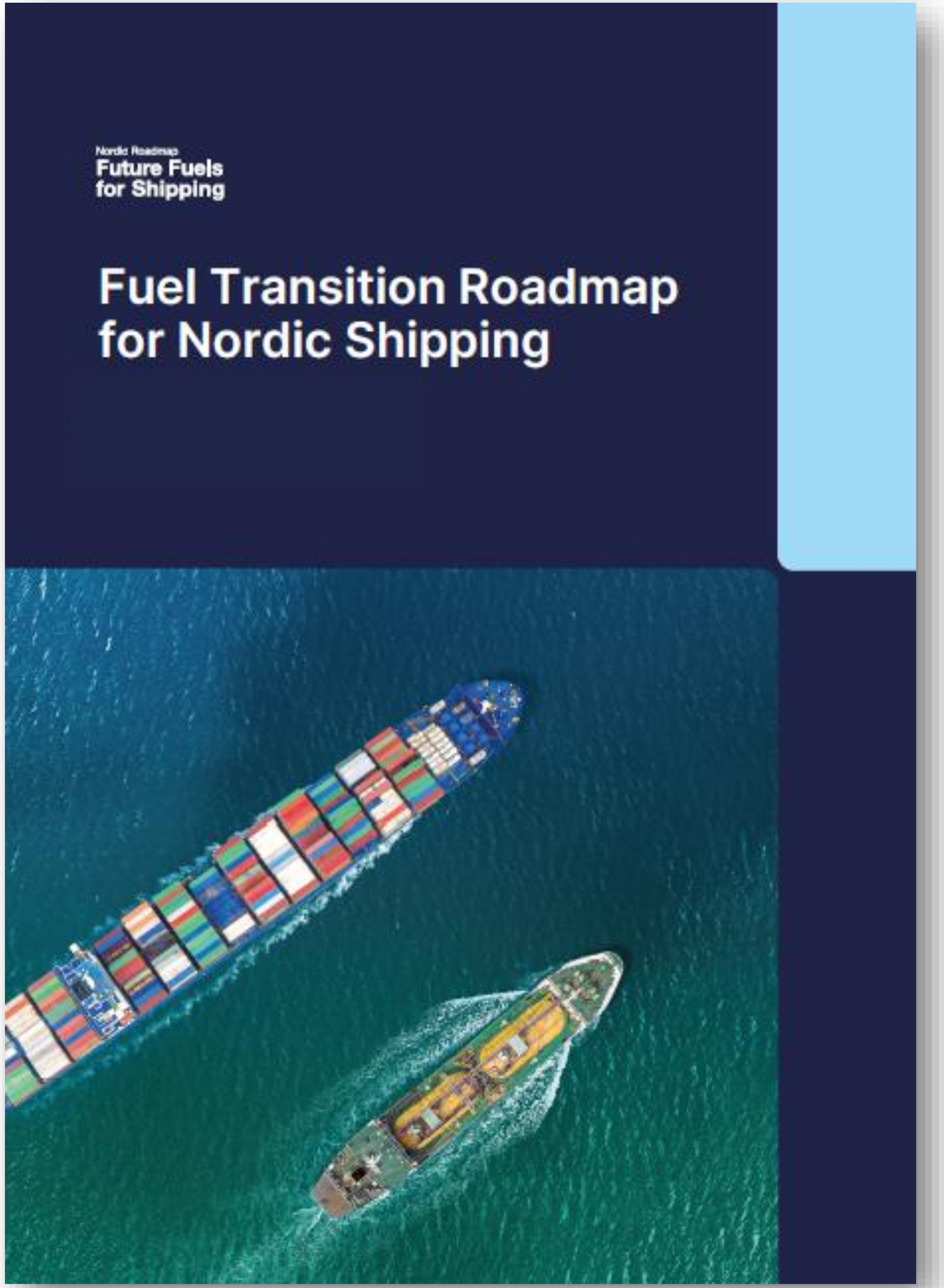
Critical actions and potential milestones towards 2030



Source: Fuel Transition Roadmap for Nordic Shipping, December 2024, https://futurefuelsnordic.com/

Next step: Implementation

- We urge Nordic governments to **implement the actions** identified, including:
  - Contribute to closing the cost gap
  - Set up competitive tenders for green corridors
- The actions will **provide confidence** for the industry to invest in zero-emission vessels, and the needed fuel infrastructure
- By leading the way, the Nordics can benefit from **value creation** and boosted exports, *and* play a **key role** in the global fuel transition



Thank you!

Stian Sollied

Stian.erik.sollied@dnv.com

www.dnv.com

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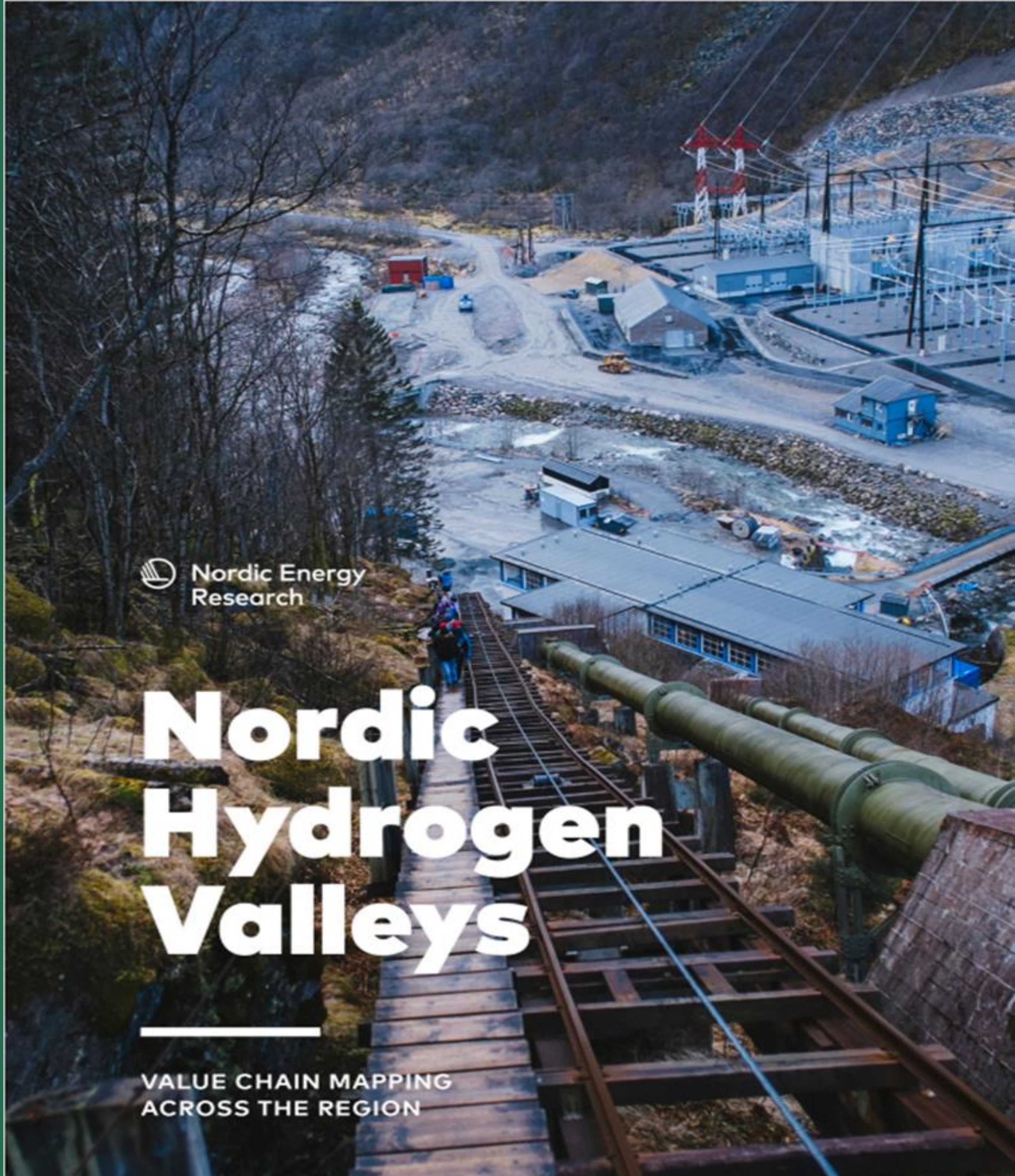
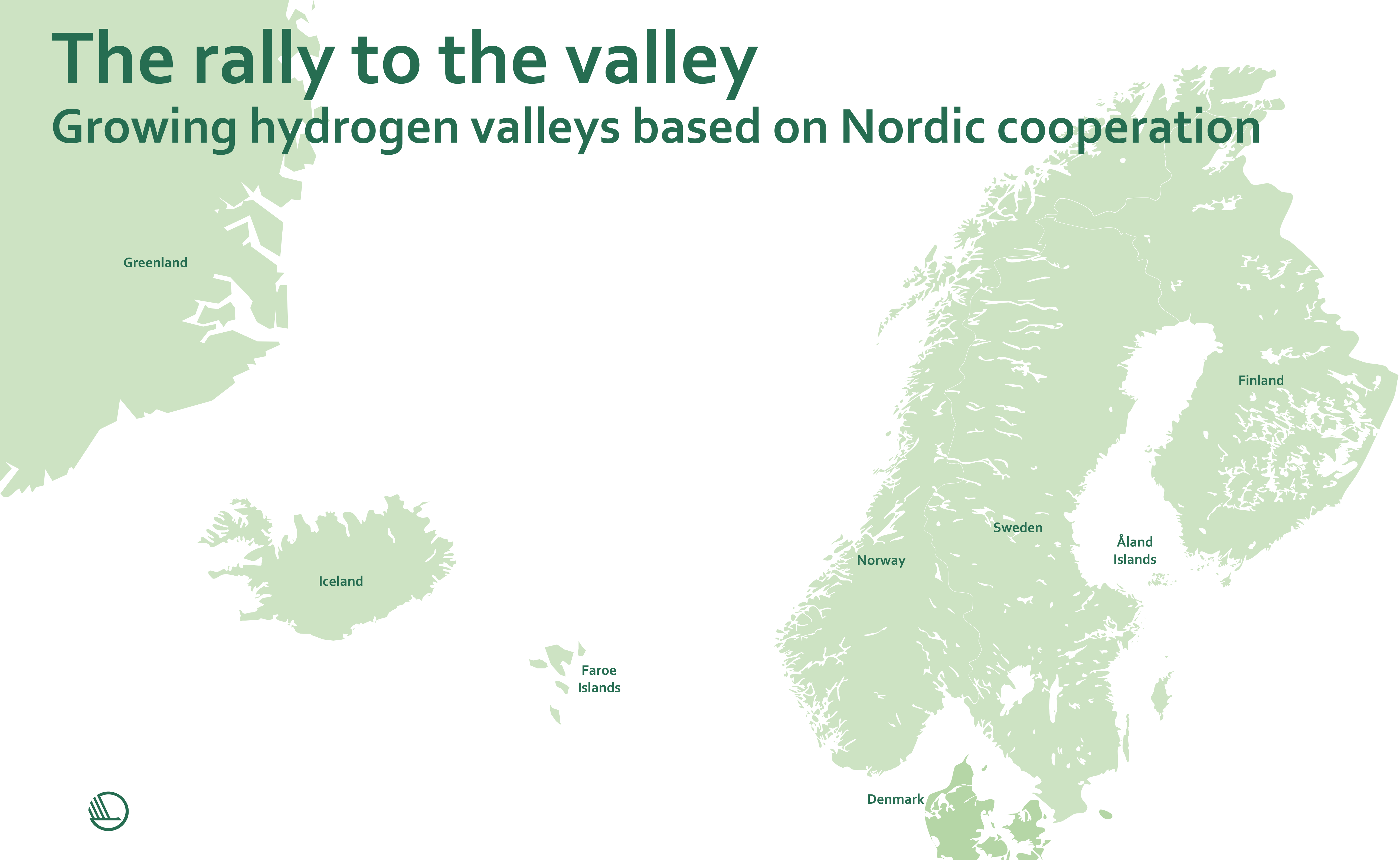
Klaus Skytte
CEO, PhD



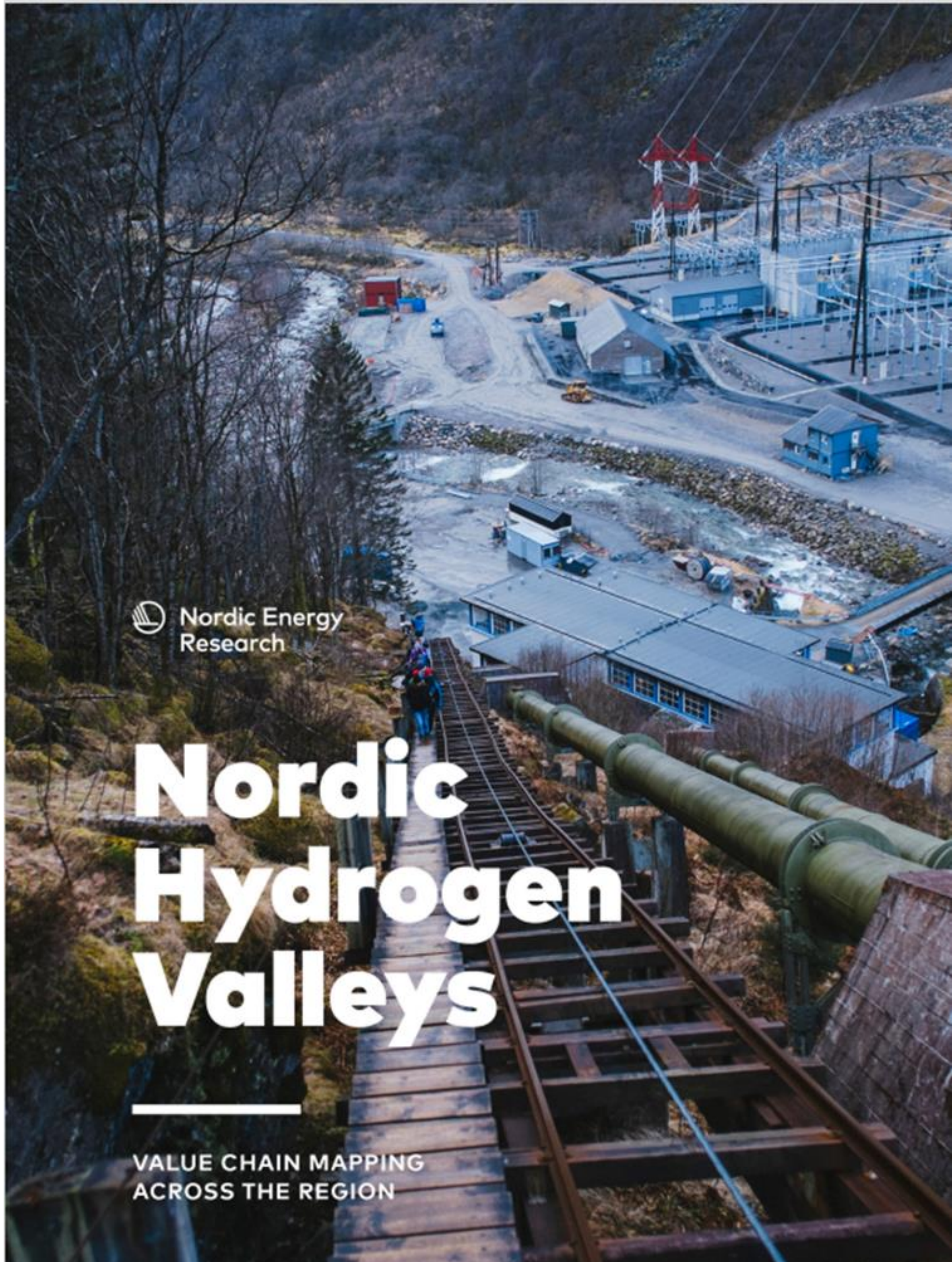
The rally to the valley

Growing hydrogen valleys based on Nordic cooperation



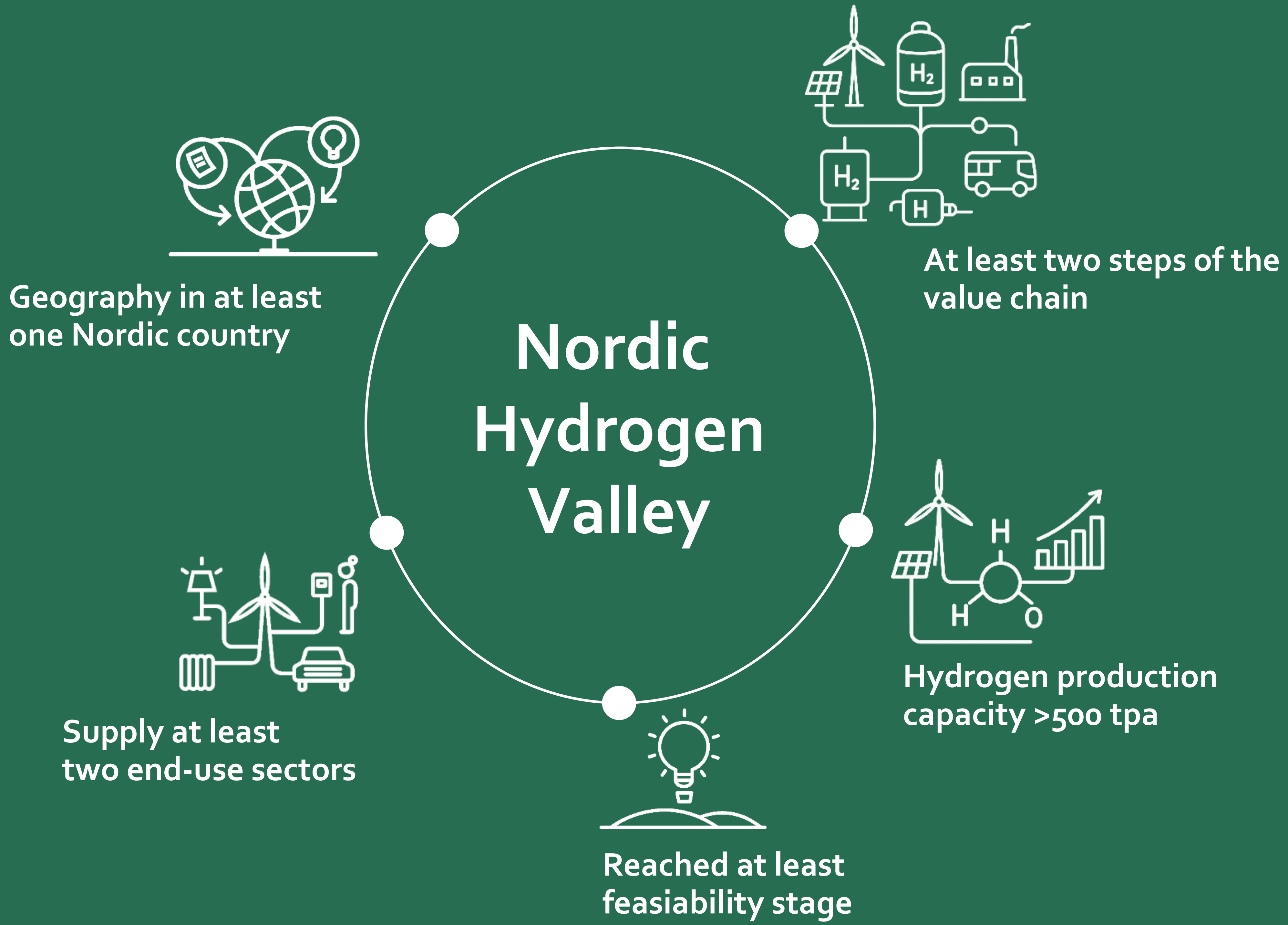
Objectives

- Create Nordic overview
- Support industries, authorities and decision-makers in development of hydrogen valleys
- Promote and enhance Nordic strengths
- Illustrate ongoing Nordic development



Approach

- H2 — Define and map Nordic hydrogen valleys
- Create a prototype digital tool for mapping
- Analyse hydrogen potential in Arctic maritime transport
- Identify drivers and barriers for Nordic hydrogen valleys


Nordic Hydrogen Valley
Geography in at least one Nordic country
At least two steps of the value chain
Hydrogen production capacity >500 tpa
Reached at least feasiability stage
Supply at least two end-use sectors
H
H
O
H
H_2
H_2

Create a prototype digital tool for mapping

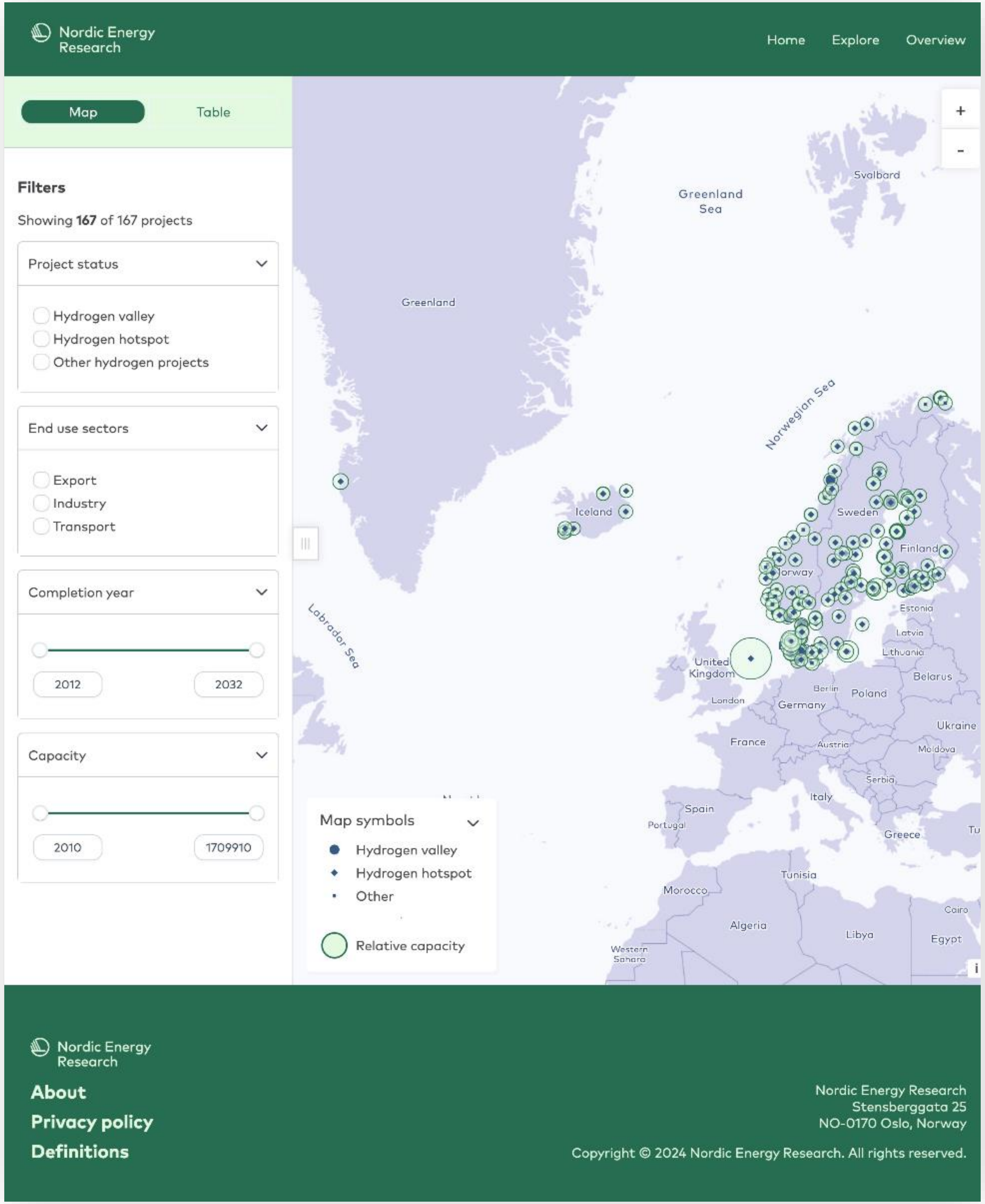
Design principles

A Nordic perspective

Let the information shine

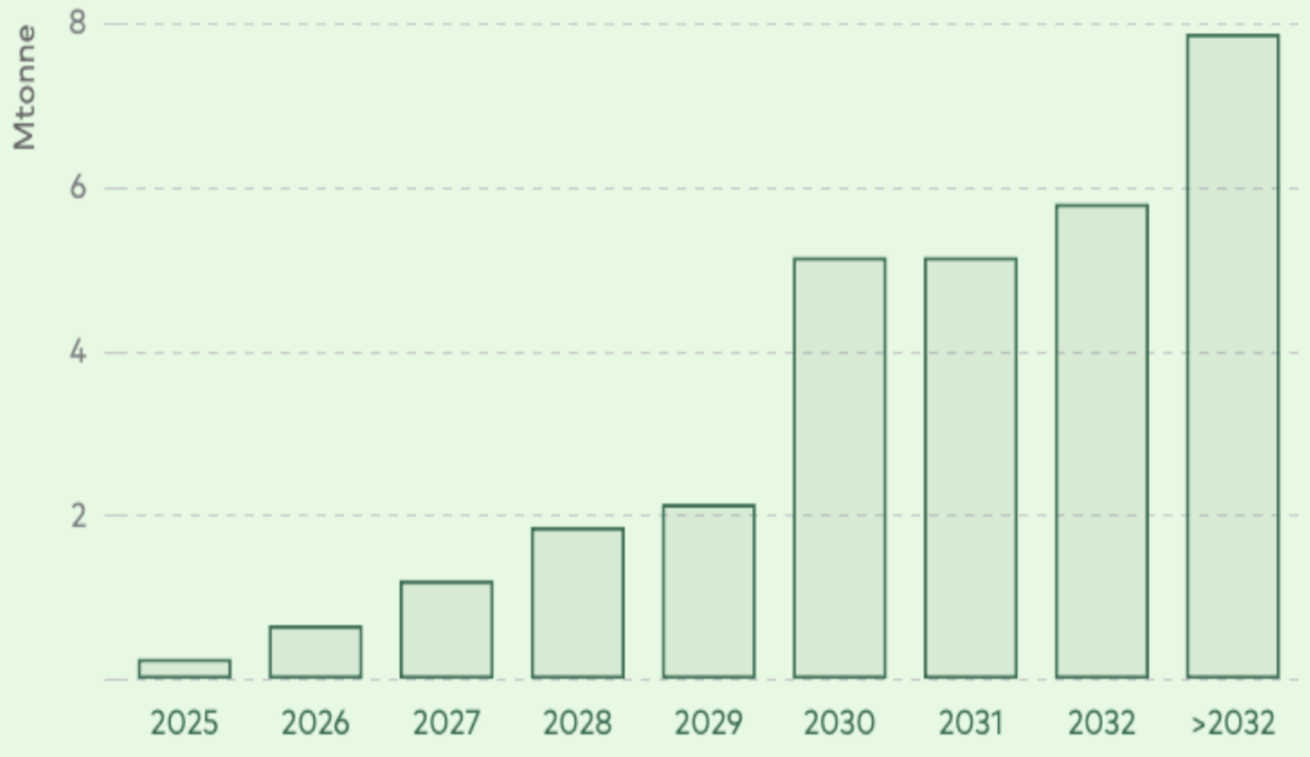
Show what we know

https://nordich2valleys.org/



Country	Potential capacity	Valleys	Hotspots	Other
Denmark	3.748.482 tonnes/year	5	18	6
Faroe Islands	0 tonnes/year	0	0	0
Finland	1.126.105 tonnes/year	1	35	0
Greenland	153.000 tonnes/year	0	1	0
Iceland	112.270 tonnes/year	0	9	0
Norway	711.162 tonnes/year	2	24	24
Sweden	1.524.052 tonnes/year	1	37	0
Åland	513.486 tonnes/year	0	4	0

Cumulative potential capacity in the Nordics



Current capacity (Mtonnes/year)

0.02

Total number of hydrogen projects

167

Nordic Hydrogen Valleys

- High level of activity/plans in all Nordic countries.
- The combined capacity = approx. 8 Mt, or 270 TWh, of hydrogen per year.
- Double the amount estimated to achieve a carbon-neutral region by 2050.
  - Could become a H2-hub for rest of EU
- Approximately 0.2% of this capacity is in operation.
- About 1% is currently under establishment.
- Large synergy gains in Nordic cooperation.

Key drivers and barriers – in the Nordics

+

Access to renewable energy production

Policy support (general level)

Industry presence and ambitions

–

Project business case (economy)

Regulatory environment (e.g. permits, safety)

Access to skills, materials and workforce

Follow us

Nordicenergy.org

Linkedin: Nordic Energy Research

Nordic Energy Research

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Nordic Energy Days

Solar Park Kasso ApS / e-Methanol + PV

from the Vision to Reality with European Energy A/S

Tatsuya “Todd” HOSHINO
Mitsui & Co., Ltd. Basic Materials Business Unit
June 17th,2025

EUROPEAN ENERGY

MITSUI&CO.

About Mitsui & Co.

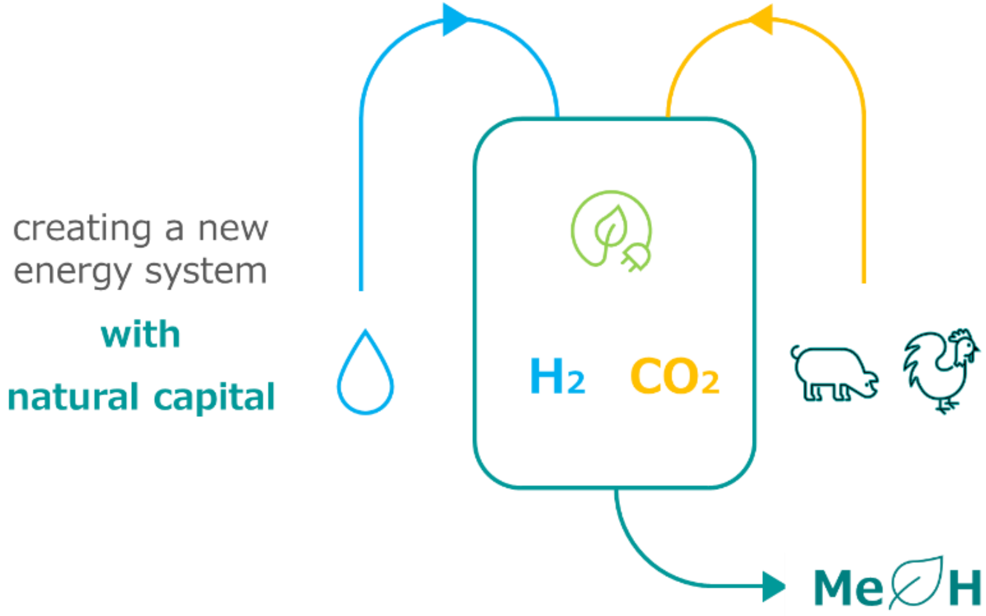
- a leading global investment and trading company operating in over 60 countries, a diverse portfolio across various industries, collaborating with leading global partners to create long-term sustainable value.
- Key Strategic Initiative, ① Industrial Biz Solution, **② Global Energy Transition**, ③ Wellness Ecosystem Creation in Medium-term management plan (2024-2026)

About myself / Todd Hoshino

- Executive Strategist, Methanol & Ammonia Div.
- Long term & broader experiences in Gas/Petrochemicals industries
- the Founding Chair of Policy Committee, Methanol Institute

Expert group member, World Economic Forum Future of Clean Fuels Initiative

Solar Park Kassø ApS from the Vision to Reality

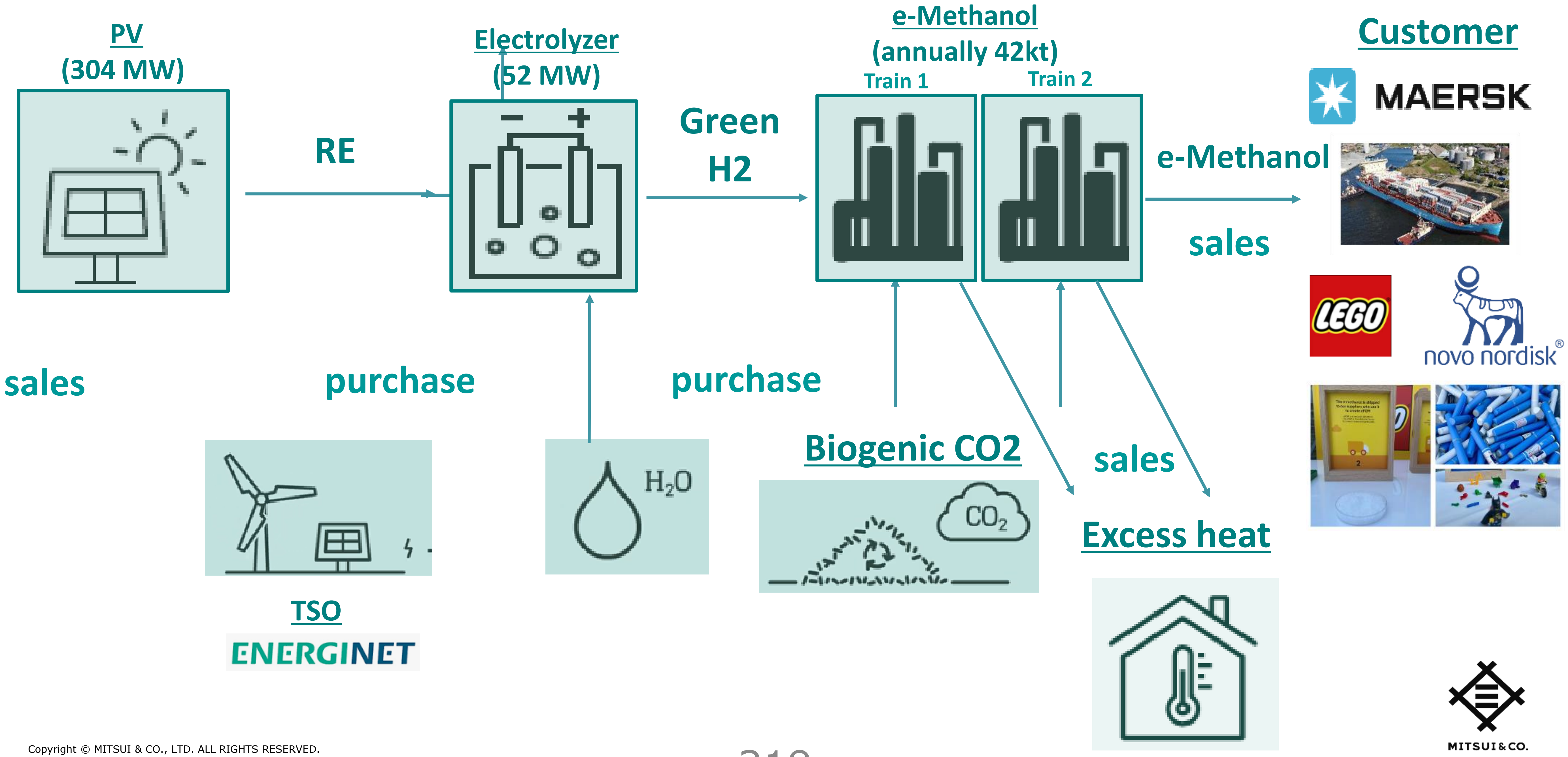


「Green H2」x「biogenic CO2」
⇒ Low carbon Methanol

⇒ new energy system with natural capital

Solar Park Kasso ApS under Kasso MidCo ApS
(European Energy A/S 51%, Mitsui & Co. 49%)

Solar Park Kassø ApS product flow



Mitsui & Co. methanol production PF

360° business innovation.

"IMC"

International Methanol Company

- Location: Al Jubail
- Annual capacity: 1.5 mil ton
- Raw material: Natural gas
  Recycled CO_2

"Fairway"

Fairway Methanol LLC

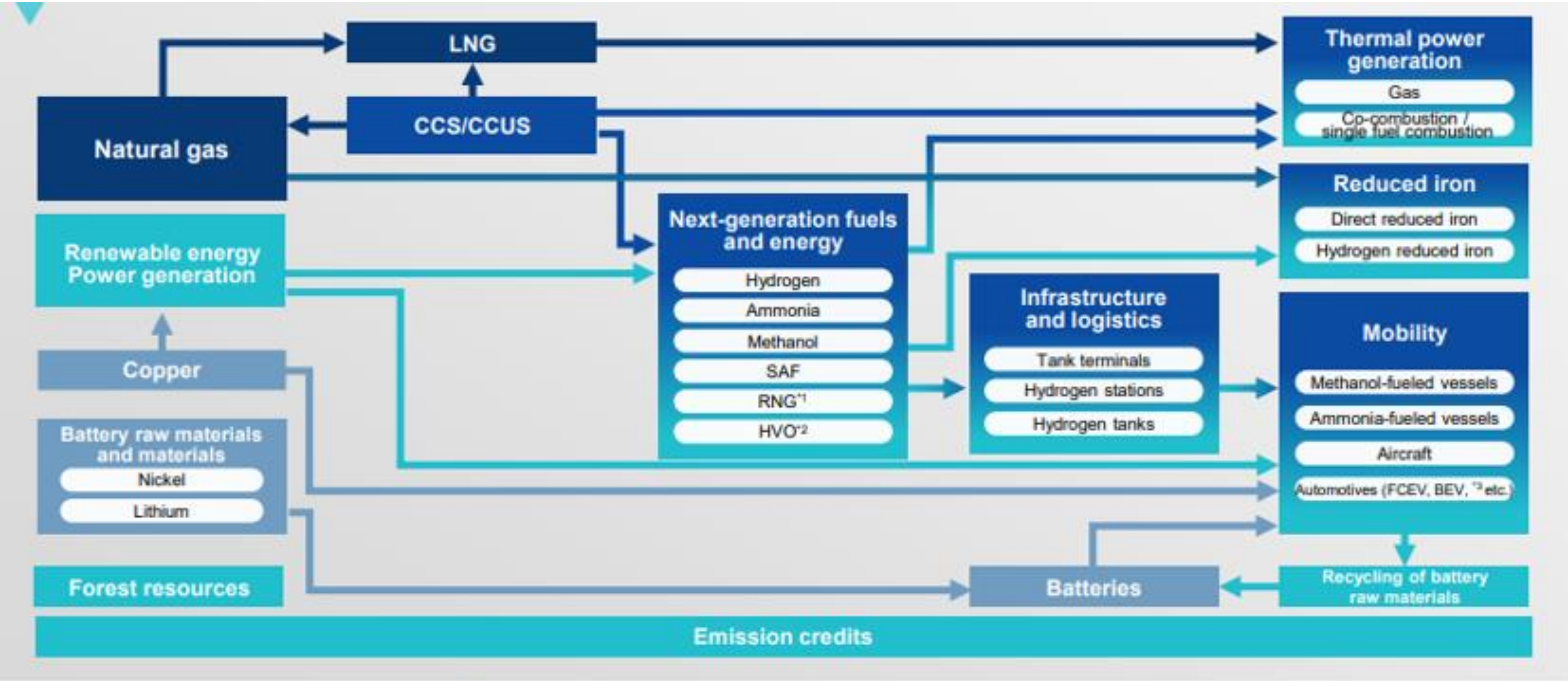
- Location: Pasadena, Texas
- Annual capacity: 1.63 mil ton
- Raw material; Natural gas
  RNG (biogas)
  Recycled CO_2
- Cert： ISCC EU／PLUS ／CFC

"SPK"

Solar Park Kassø ApS

- Location: Kassø Aabenraa
- Annual capacity: 42 kilo ton
- Rew material; RE derived H_2,
  Biogenic CO_2
- Cert: ISCC EU／PLUS

MITSUI&CO.



*1 Renewable Natural Gas *2 Hydrotreated Vegetable Oil *3 Fuel Cell Electric Vehicle, Battery Electric Vehicle

Contact Information

Tatsuya "Todd" HOSHINO

Executive Strategist
Methanol & Ammonia Div.
Basic Materials Business Unit
Mitsui & Co., Ltd.
T.Hoshino@mitsui.com

https://europeanenergy.com/kasso/

EUROPEAN ENERGY MITSUI & CO.

MITSUI & CO.

360° business innovation.

MITSUI & CO.

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WHEN TRUST MATTERS

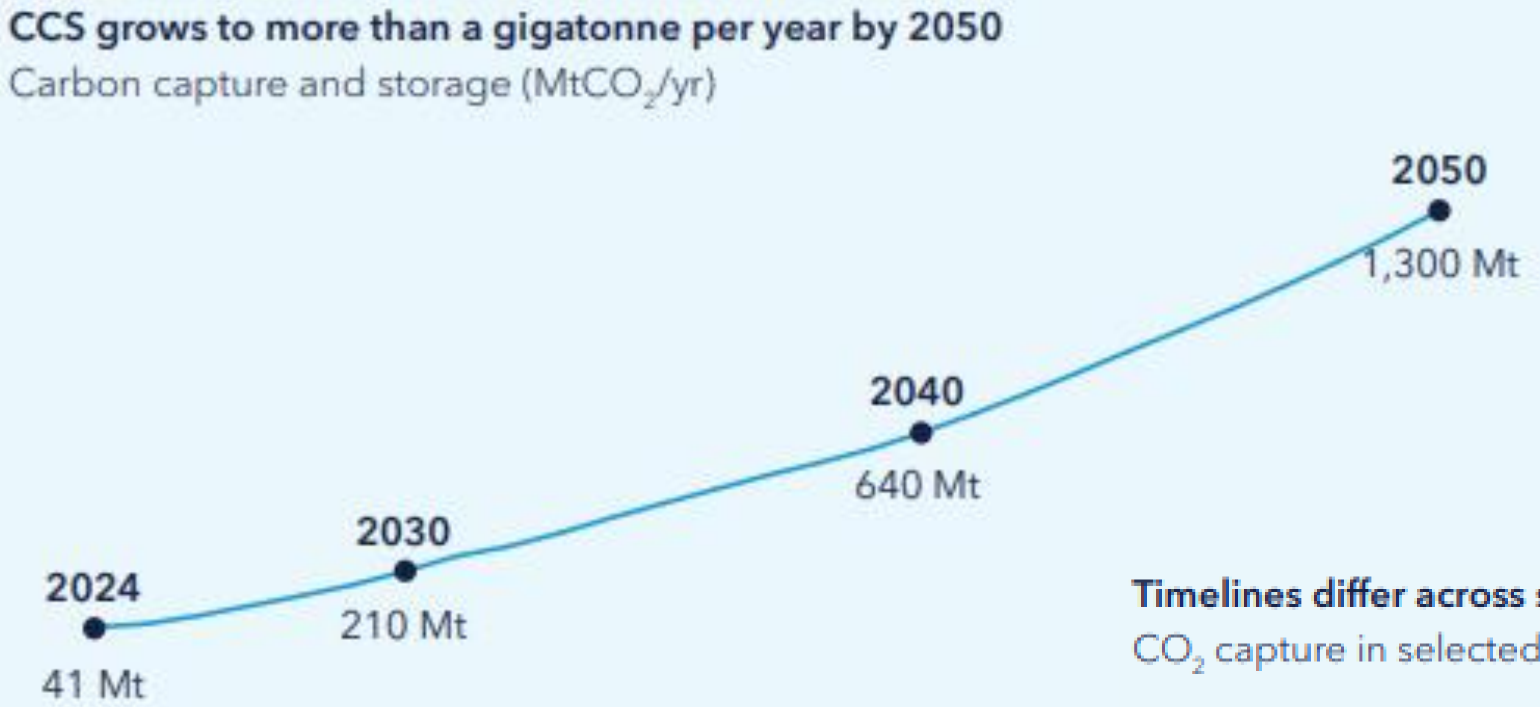
Opportunities & Challenges for CCS Value Chains

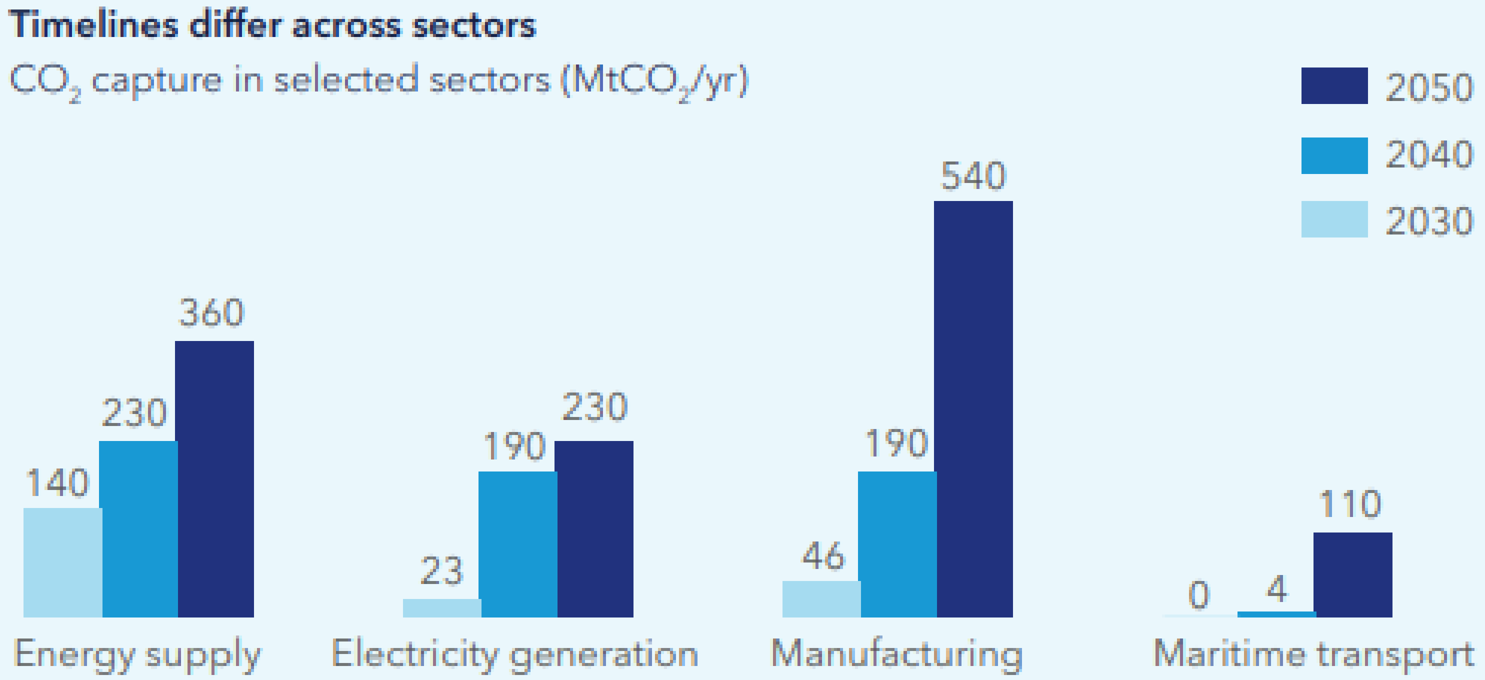
James Laybourn

17 June 2025

Download from: www.dnv.com/energy-transition-outlook

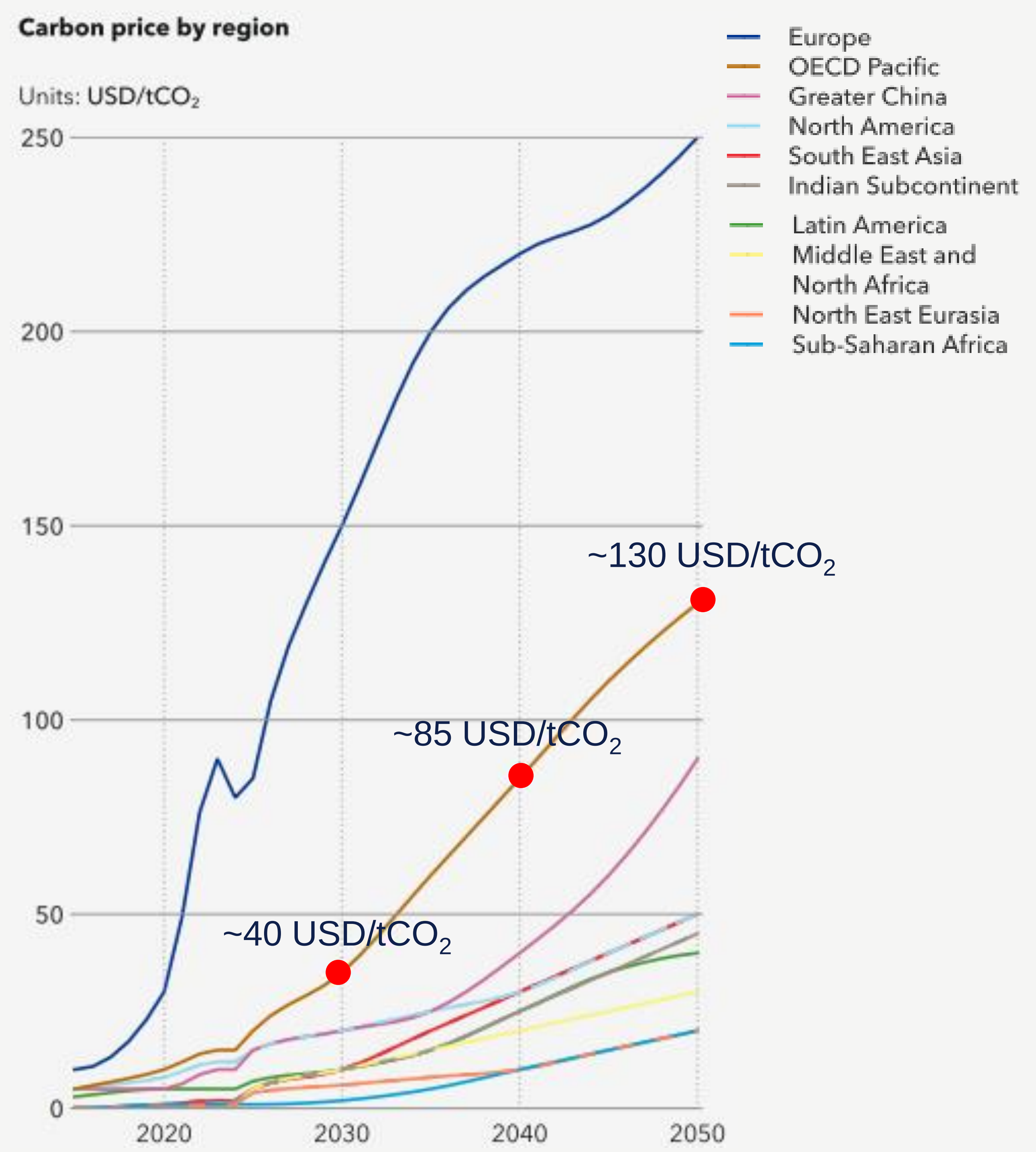
CCS Forecast out to 2050





CCUS in Japan

- Japan has announced commitments to reducing emissions by 46% by 2030 relative to 2013 peak (1395 $MtCO_2e$)
- Power Generation and Industrial Sectors together account for ~70% of emissions
- GX Promotion Act supports various carbon pricing and emissions trading schemes to provide economic support for the net zero ambitions
- JOGMEC Advanced CCS Projects aims to start 6-12 MTPA of CCS operations by 2030
- Key opportunities for CCUS :
  1. **Industrial Clustering** supported by high industrial concentration
  2. **CO_2 Utilisation** supported by maritime/aviation and chemical industries
  3. **CO_2 transport & storage** supported by high concentration CO_2 sources, increasing carbon pricing and local & Regional CCS sites



Potential for CCS Shipping Value Chains

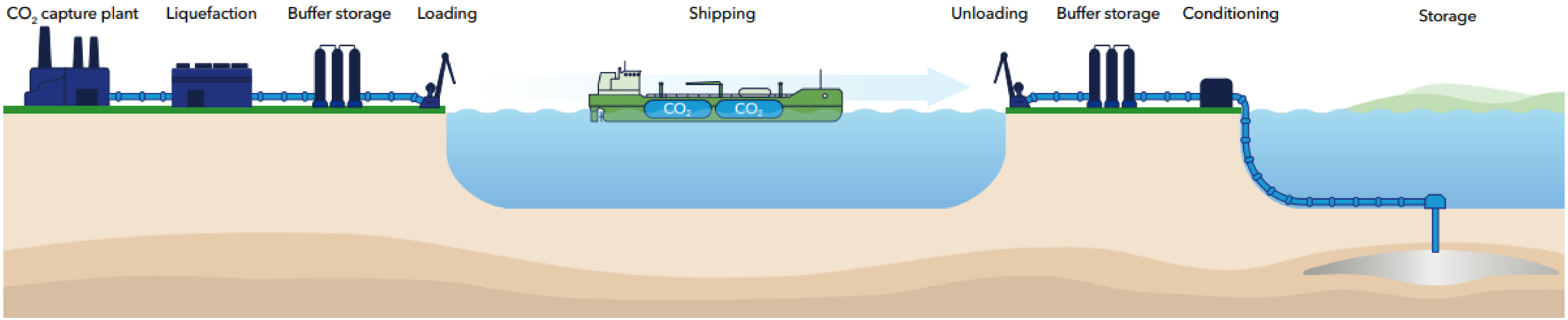
Opportunities:

- Shared costs – can support milk run model with multiple smaller CO_2 sources all accessing centralised project economics
- Flexibility – ability to change storage location removes dependence risk on single storage project
- Improved site selection – reduced geographical constraints enable selection of lower risk storage sites

Challenges:

- Technology – Large scale sequestration sites are normally located far from population and industrial clusters necessitating new transportation technologies
- Economics – Carbon price levels in Asia are unlikely to be sufficient to support full cost of sequestration
- Regulation – Regulatory regimes to support cross border CO_2 trade are slow to be established

Shipping value chain (shore-to-shore configuration)



Regional CCS Potential

- Multiple sequestration projects under development within SEA and Australia (6-10 days sailing) providing high flexibility
- Storage Viability – high potential sites with large capacity and lower risk profile (e.g. seismic)
- Lower cost – commercialisation of sequestration site and infrastructure financed by high CO_2 gas fields
- Existing Infrastructure – most of the proposed CCS sites are close to existing maritime infrastructure (LNG terminals)

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VIREON Next Wave

Next Wave – 北欧地域におけるゼロエミッショントレードラインの実現を可能にする

ノルディック・イノベーションの支援を受けた、北欧における長期的な複数関係者による連携プロジェクト

大型車両向け水素インフラのリーダー

Vireonは北欧の水素エネルギー企業であり、
水素の製造および燃料補給ステーションの
構築を行っています。

Vireon’s mission is to establish an effective network of hydrogen refueling infrastructure for heavy duty vehicles across the entire Nordic region.

主要株主一覧

FLAKK GROUP	18.4%
MITSUI & CO.	11.6%
HEXAGON PURUS	12.5%
HOFSETH	11.6%
Fortescue	12.3%
TAFJORD	9.2%

The first Vireon refueling station at Hellesylt Hydrogen Hub

VIREON

「トラックとバスは、道路輸送における直接的なCO_2排出量の35%以上を占めており、排出量は今も増加し続けています。」

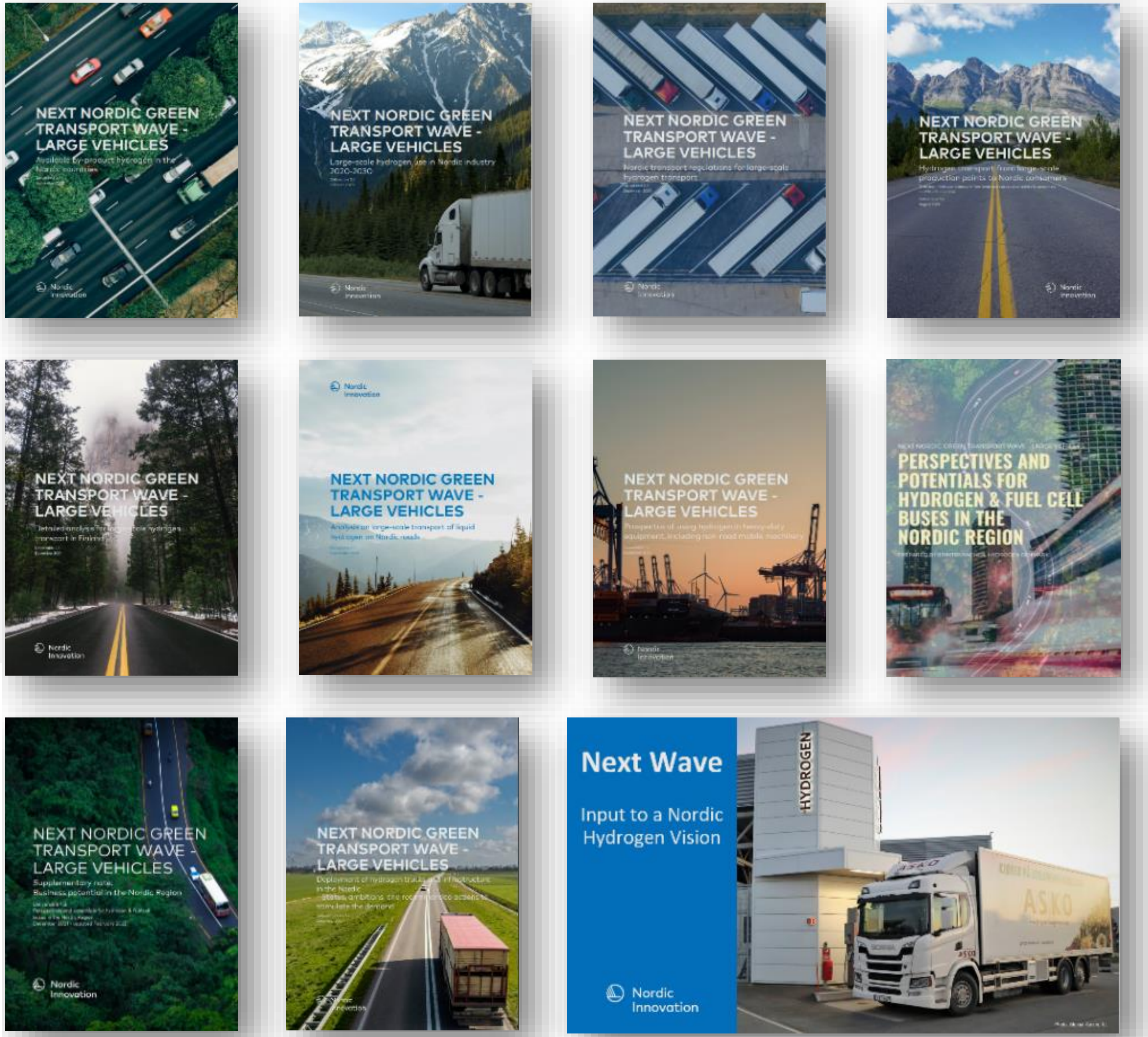
“Trucks and buses are responsible for more than 35% of direct CO2 emissions from road transport. Emissions in this sector are continuing to grow”

Source: www.iaa.org/topics/transportation

Next Wave I and II –
A Unique Nordic Overview

Next Waveプロジェクトから得られた主な知見と成果は一般に公開されています。
北欧地域における長年の連携により、独自の包括的な視点が得られました。
このプロジェクトは**2019**年に開始され、現在も継続中です。
私から皆さんへの重要なメッセージの一つは、「新たなバリューチェーンを構築するためには長期的な取り組みが不可欠である」ということです。

すべてのレポートはここからダウンロードできます



Next Wave III - 陸と海 ― 手を取り合って

港は、船舶とトラックの両方にインフラを提供する上で重要な役割を果たしています。陸上輸送と海上輸送の両方に同時に注力することで、最小限の実用的なインフラをより迅速に整備することが可能になります。

Ports play a vital role in providing infrastructure - for both ships and trucks. By focusing on land transportation and maritime transportation at the same time we can develop a minimum viable infrastructure faster.

Next Wave IV - 障壁の削減と取り組みの強化

- 北欧全域での水素トラックとステーションの導入を加速する。
- 北欧と欧州大陸間のゼロエミッショントレードライン実現に向けた障壁を取り除く。
- ゼロエミッション輸送の促進に向けて、北欧諸国間の連携強化の必要性を政治家に訴え続ける。
- Strengthen the efforts to deploy hydrogen trucks and stations throughout all Nordic countries.
- Reduce the barriers to achieve zero-emission tradelines between the Nordics and the continent.
- Continue to inform politicians about the need for a stronger cooperation between the Nordic countries to foster zero-emission transport.

VIREON®

Enabling Zero Emissions

ペアー・オイヴィン・ヴォイエ

Per Øyvind Voie

最高経営責任者（CEO）

メール: per.oyvind.voie@vireon.com

電話: +47 976 65 446

Next Wave Project

すべてのレポートはここからダウンロードできます。

Nordic Innovation

ノルディック・イノベーションは、北欧閣僚理事会の下部組織であり、「Next Waveプロジェクト」を支援しています

Vireonは北欧の水素エネルギー企業であり、

水素の製造および燃料補給ステーションの

構築を行っています。

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17.06.2026 NORDIC ENERGY DAYS (TOKYO)

MARITIME IS ELECTRIFYING

ABB Marine & Ports

ENGINEERED
TO OUTRUN

Speaker Profile
Olli Tuunainen

M.Sc. in Electrical Engineering (2007), University of Tampere, Finland

Since 2009

- Design and Commissioning Engineer
- Lead Engineer
- Engineering Manager
- Local Operations Manager
- Global Operations Development Manager
- **Local Business Line Manager** (Singapore), current position

ABB Marine & Ports

Employees
~2300

Countries
>26

50+ years
experience

ABB Marine & Ports drives the decarbonization of the maritime industry through safer, smarter and more sustainable operations for ships and ports.

Electrification is at the heart of a sustainable transition

Shift to cleaner energy

Substitute fossil fuels with alternative fuels or fuel blends, produced with low to no carbon footprint

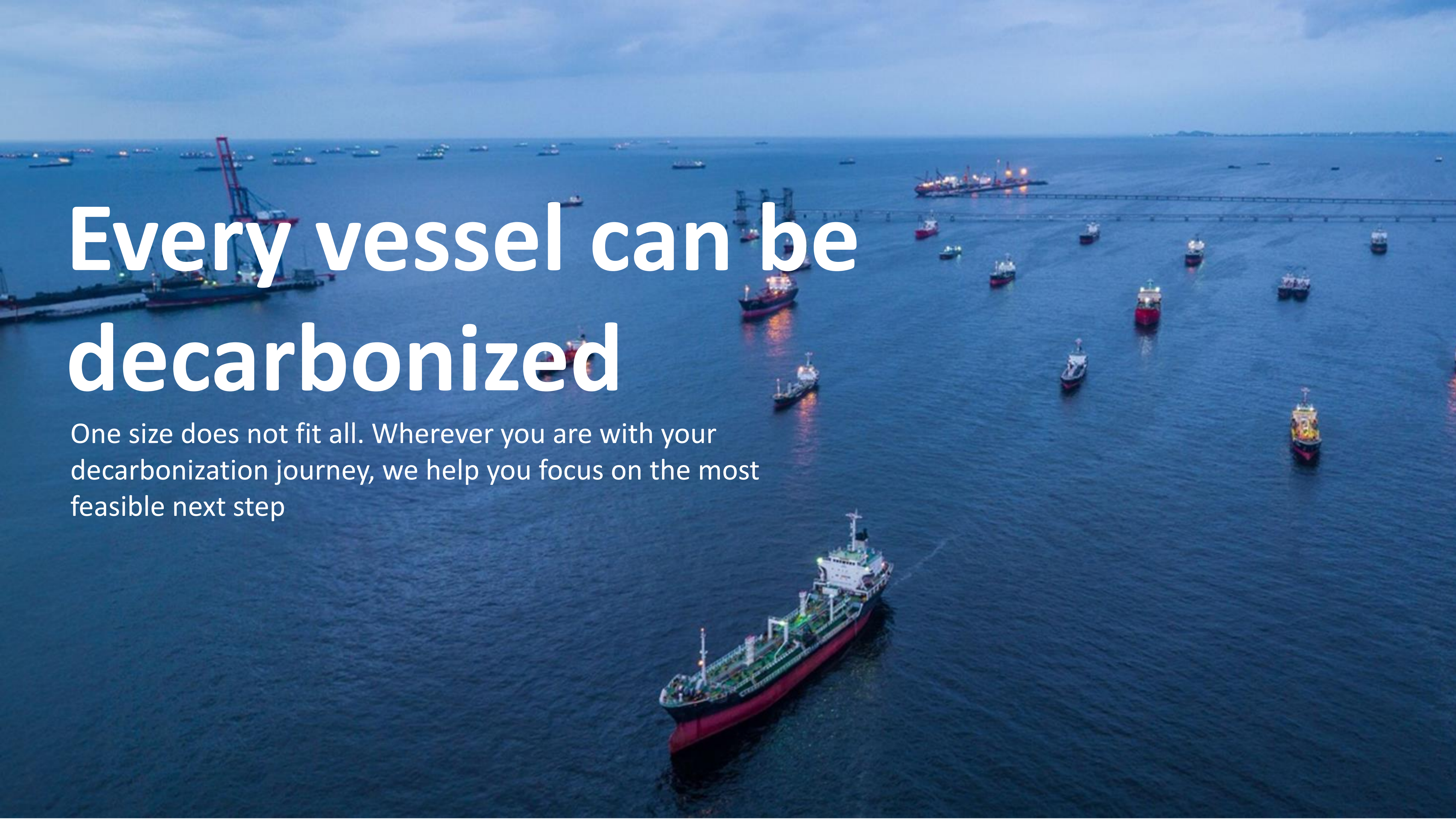
Electrify transport

Transition to electric drive trains and propulsion to enable the full scale of renewable energy modes and efficiency improvements

Increase efficiency

Transport more with less, make better decisions in every situation.

Electric propulsion enables full flexibility for utilizing all forms of energy-creation



Every vessel can be decarbonized

One size does not fit all. Wherever you are with your decarbonization journey, we help you focus on the most feasible next step

ABB

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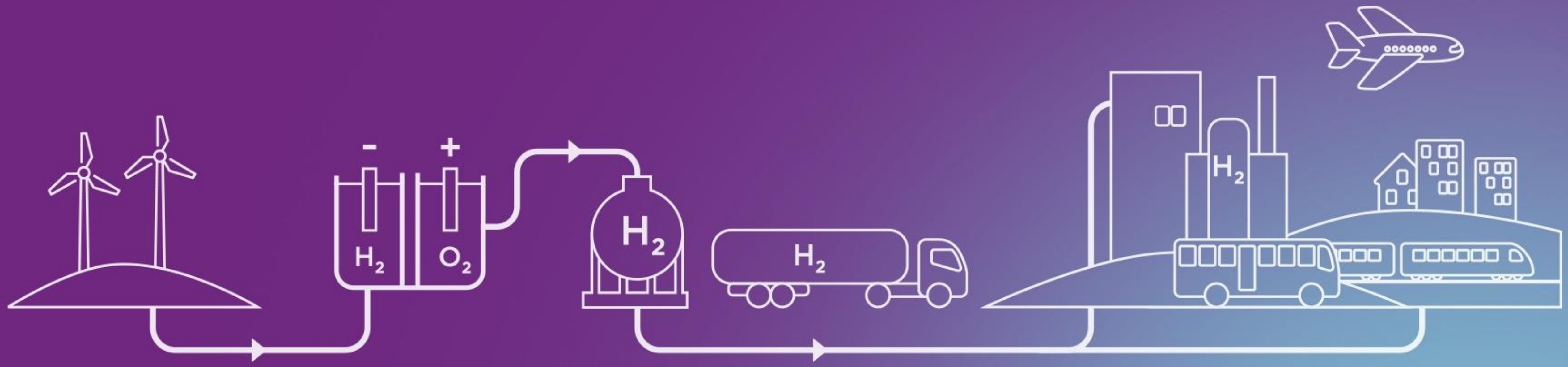
Ulf Månsson
Head of Business Development
Skellefteå Municipality

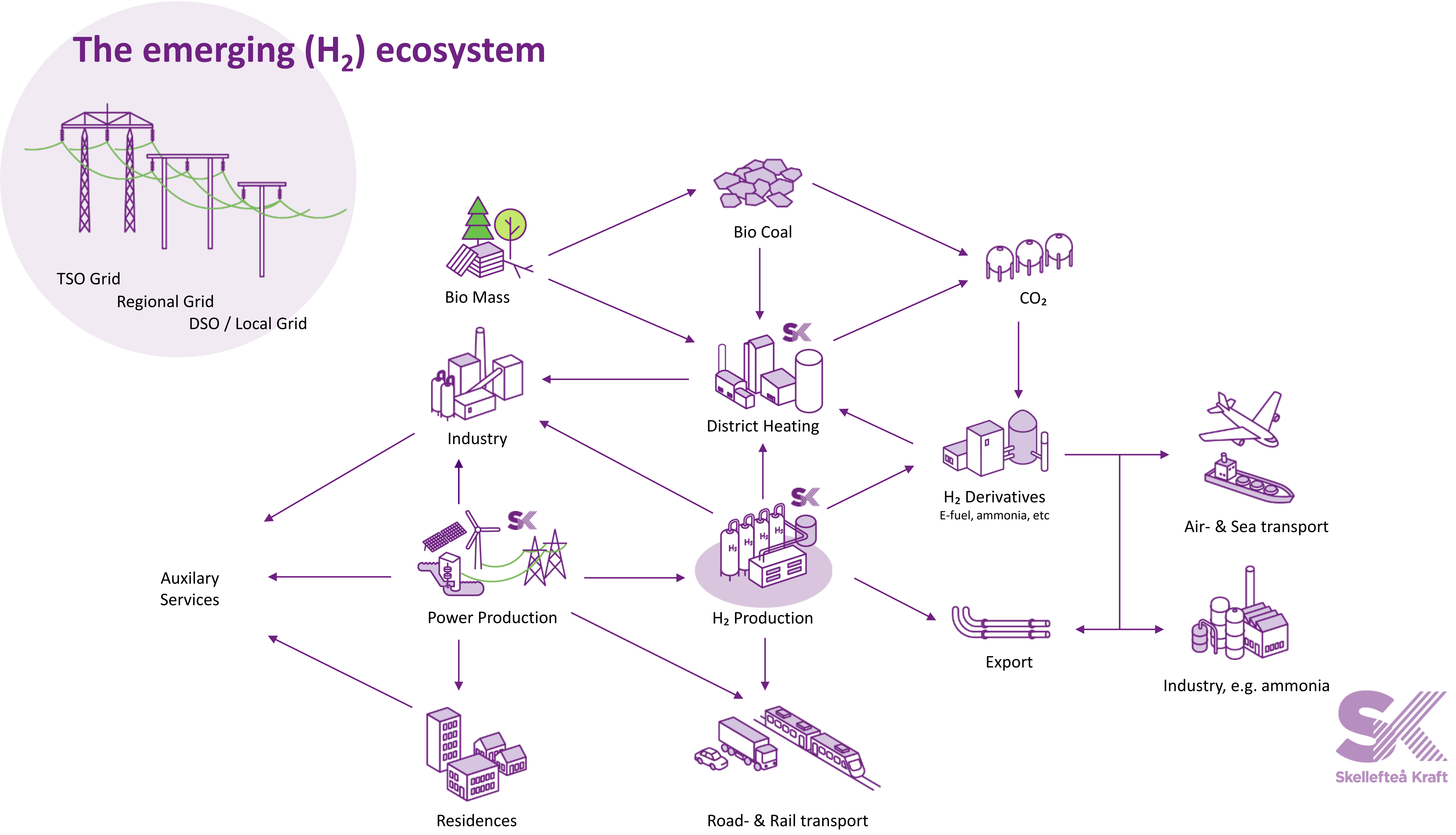
Patrik Sundberg
Head of Energy Solutions
Skellefteå Kraft

The right place at the right time with the right resources.



Fueling ideas that can take flight

The emerging (H_2) ecosystem




SKELL
EFTEA
Skellefteå Kraft

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Nordic Energy Days

Decarbonization from Ocean

17th June 2025

Toshiki Tamura / Project Lead

Next Generation Energy Development Team

MOL 商船三井

1 Who is MOL?

Establish
Year of 1884

# of MOL Group Employee
10,500
(as of Mar. 2025)

# of Countries MOL Group Bases
31
(as of Mar. 2025)

Revenues
JPY 1,775 billion
(as of Mar. 2025)

MOL Group Fleets
935 vessels
(as of Mar. 2025)

# of Group Companies
579
(as of Mar. 2025)

The year of net-zero emission
2050

Ordinary profit
JPY 419.7 billion
(as of Mar. 2025)

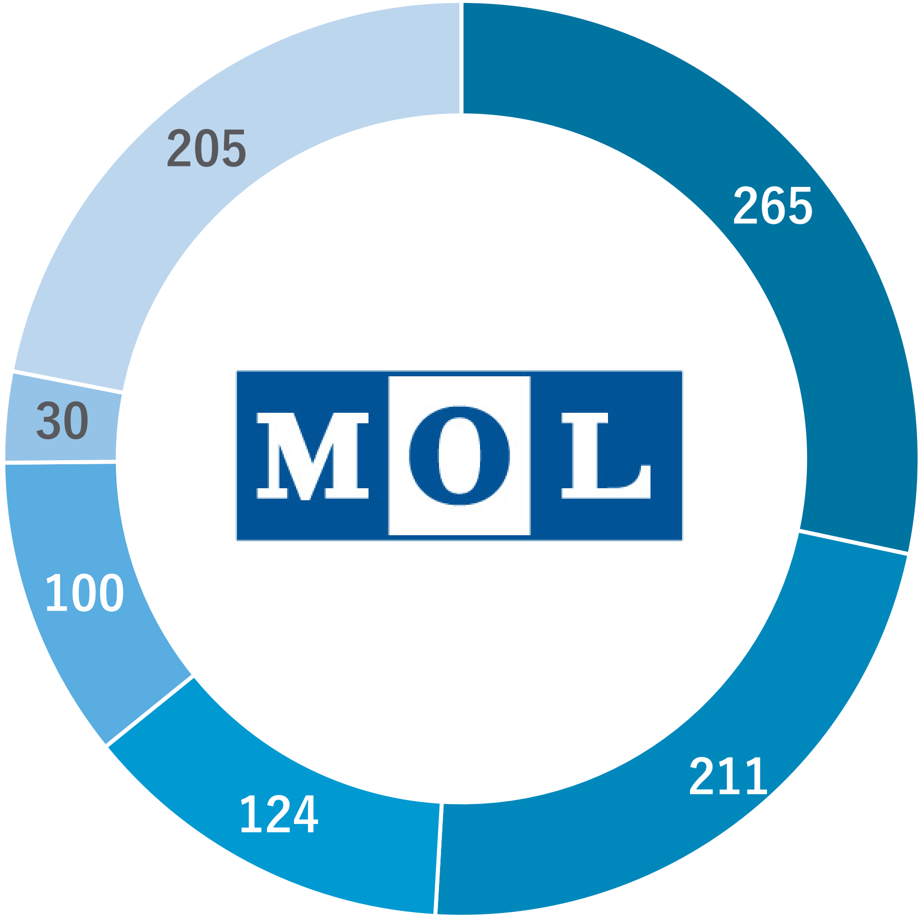
2 MOL's fleet at a glance

Others

CONTAINER SHIPS(*)

CAR CARRIERS (PCC)

Operating **over 900 vessels,** with connections to various industries around the world.



(*)Japanese three shipping companies including MOL integrated their container service under Ocean Network Express(ONE) brand in July 2017.

BULK CARRIERS

TANKERS

LNG CARRIERS/FSRU/FSU

3 MOL's Global Network

As of October 2024

Target for Net Zero Emission by 2050

BLUE ACTION MOL

ACTION 01
Adopt clean energy

KPI: Alternative fuel-powered vessels
- 2030: No. of LNG/methanol-fueled ocean-going vessels — 90 vessels
- 2035: No. of net zero emissions ocean-going vessels — 130 vessels

KPI: Ratio of zero-emission fuel used
- 2030: 5%

KPI: Ratio of power from renewable energy for Scope 2
- 2030: 100%

ACTION 02
Further adopt energy-saving technologies

KPI: Vessels equipped with Wind Challenger
- 2030: 25 vessels
- 2035: 80 vessels

ACTION 03
Efficient operations

KPI: Fuel efficiency (Energy consumption per ton-mile)
- 2025: –5% (compared to 2019)

ACTION 04
Build business models that enable net zero emissions

KPI: Amount of removal type carbon credits used
- 2030: 2.2 mil. tons (cumulative)

2030: GHG emissions –23% (compared to 2019)

2025: Environmental investment ¥650 billion (FY23-25 cumulative)

2050
Net zero emissions for the entire Group

[Legend]
- KPI
- Milestone

5 What MOL does for decarbonization?

We are developing various businesses to **create a value chain of the next-generation energy**.

Upstream	Midstream		Downstream
Energy Production	Shipping		Terminal, Bunkering, Fuel purchase/use, FSRU, etc.

Invest in Producing Project

Clean Ammonia Production Project
- Invested in a project by Clean Hydrogen Works (CHW)

e-Fuel Production Project
- Invested in a project by HIF Global

Develop Producing Project

Production MCH
- Developed "Wind Hunter"

Develop/Operate Fueled Ships

Ammonia-fueled Ships
- Obtained AiP for large-scale ammonia fuel ships.

Methanol-fueled Ships
- Implemented the world's first bio-methanol "Net Zero Voyage".

Hydrogen-fueled Ships
- Launched Japan's first passenger ship using hydrogen and biofuel.

Shipping

Ammonia Carrier
- Participated in transportation study for Japan with JERA

Methanol Carrier
- Promoted clean methanol transportation

Hydrogen Carrier
- Participated in JSE Ocean and Woodside study

Receiving Terminal

LBC Tank Terminals
- Entering the tank terminal business by acquiring 100% shares in LBC.

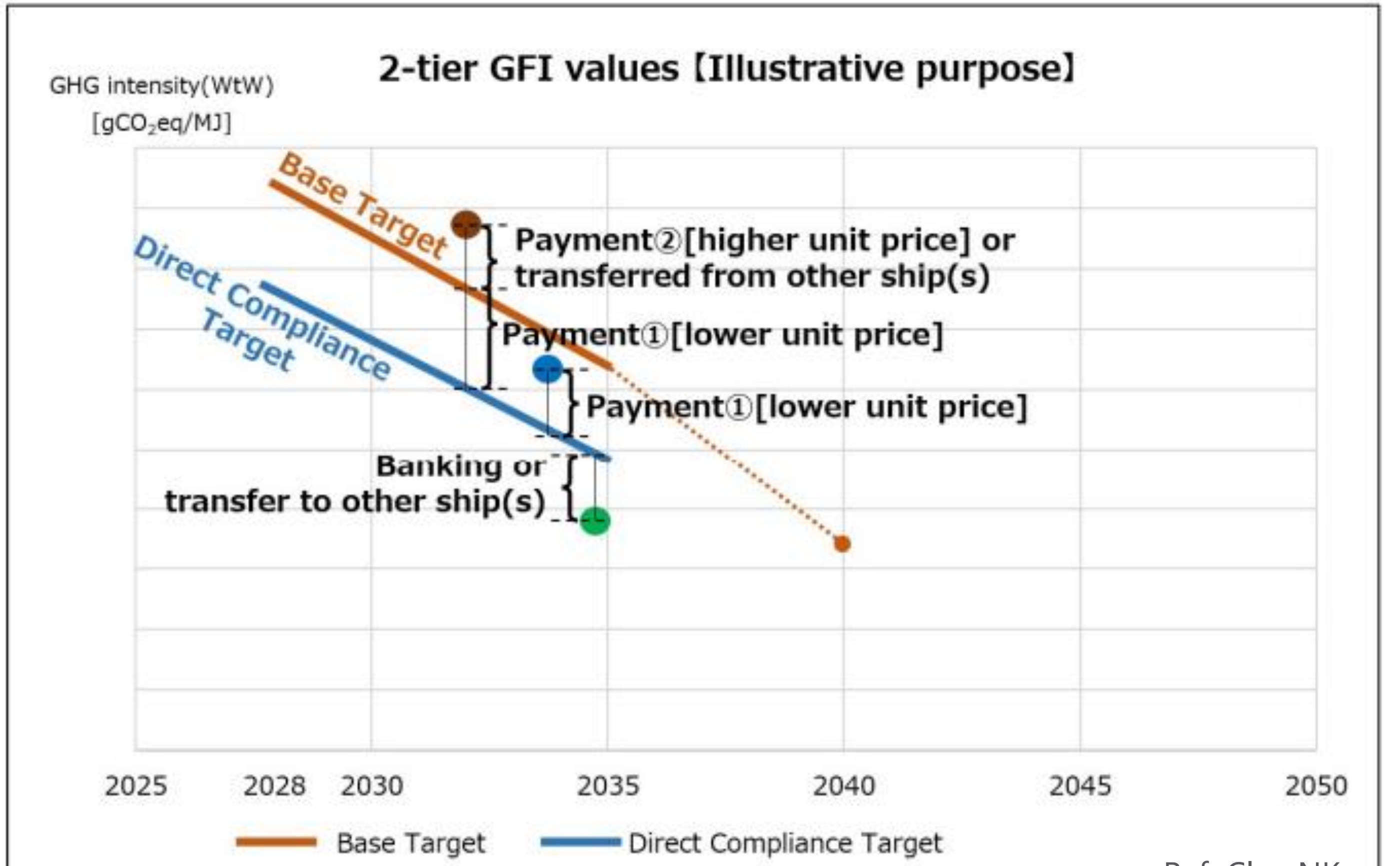
Ammonia FSRU
- Leverage our "only" operational experience among Japanese shipping companies

Bunkering

Ammonia Bunkering Ship
- Obtained AiP for an ammonia bunkering ship
- Participated in study in Singapore

6 How the shipping industry will be decarbonized?

Two baselines of the marine fuel's GFI (GHG Fuel Intensity) are likely to be imposed by IMO since 2028. A vessel would be **penalized** when consumes a fuel with higher GFI than the baselines. However, if she consumes a zero/near-zero emission fuels ("**ZNZ**"), she would **get a reward** instead.



Ref: ClassNK

	Short-mid term	Long term
VLSFO	Mid~High	Low
Fossil-LNG	High	Low~Mid
Biofuel (Diesel, LNG, MeOH)	Very High	High~ Very High
e-Ammonia, methanol, LNG	Mid	High~ Very High

Disclaimer

*This document has been independently researched, analyzed, considered and made by Mitsui O.S.K. Lines, Ltd. (the "**Company**") based on publicly available information and interviews with relevant parties.*

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MOL
商船三井

Final Remarks

Helena Sarén

Head of Zero Carbon Future Mission, Business Finland