BEYOND SHORE POWER: HOW JENBACHER COGENERATION TRANSFORMS PORT DECARBONIZATION

Evgeny Churdalev
Sales Director CIS
Jenbacher gas engines

JENBACHER

June 08, 2026
Istanbul, Turkey

AGENDA

- The Harbor’s Challenge
- The Grid’s big problem
- The Jenbacher advantage
- A port case study
- Ready for a lower-carbon future

THE HARBOR’S CHALLENGE

Why quiet ships pollute

JENBACHER

THE MARITIME EMISSIONS CHALLENGE

Maritime transport accounts for 3% of global GHG emissions.

If considered as a country, shipping would rank among the world's top 10 emitters.

Without intervention, emissions are projected to rise by up to 130% by 2050.

Ships at berth generate substantial local emissions (CO_2, NO_x, SO_x, PM).

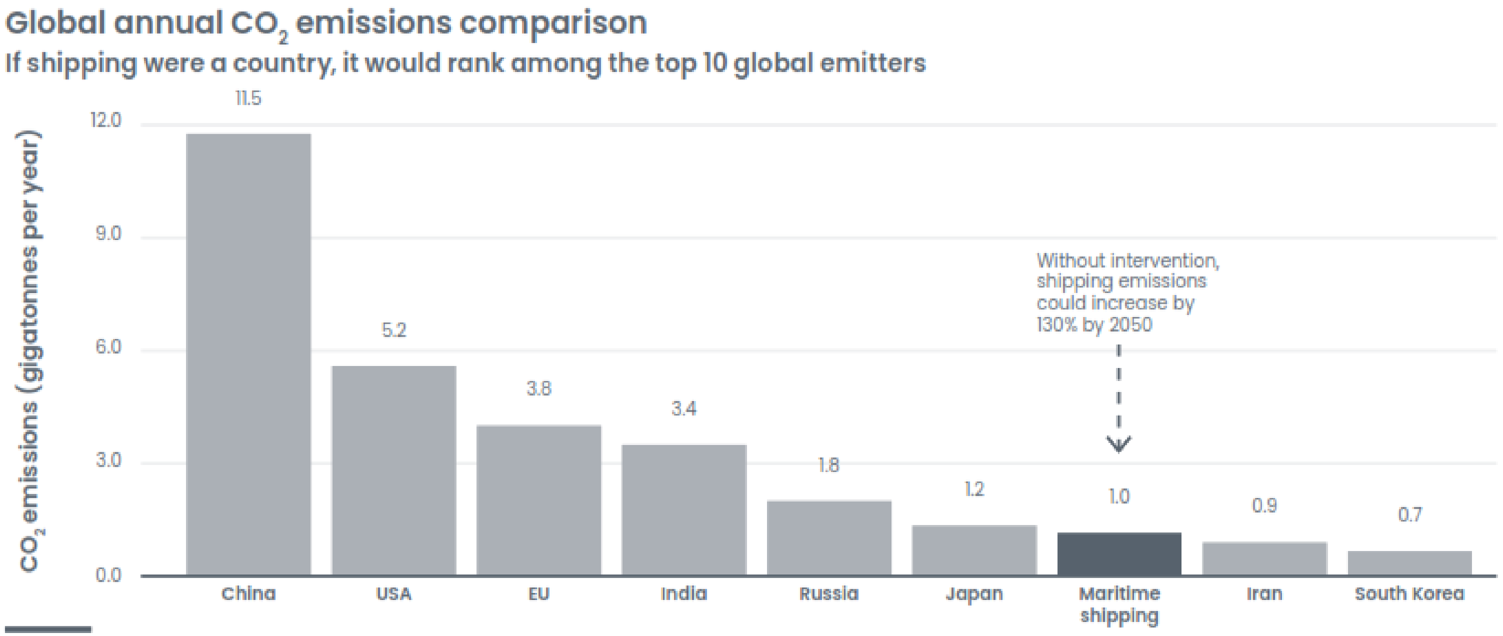


Figure 1: Global annual CO_2 emissions comparison

Source: Based on data from IRENA (2025) and International Maritime Organization (2023)

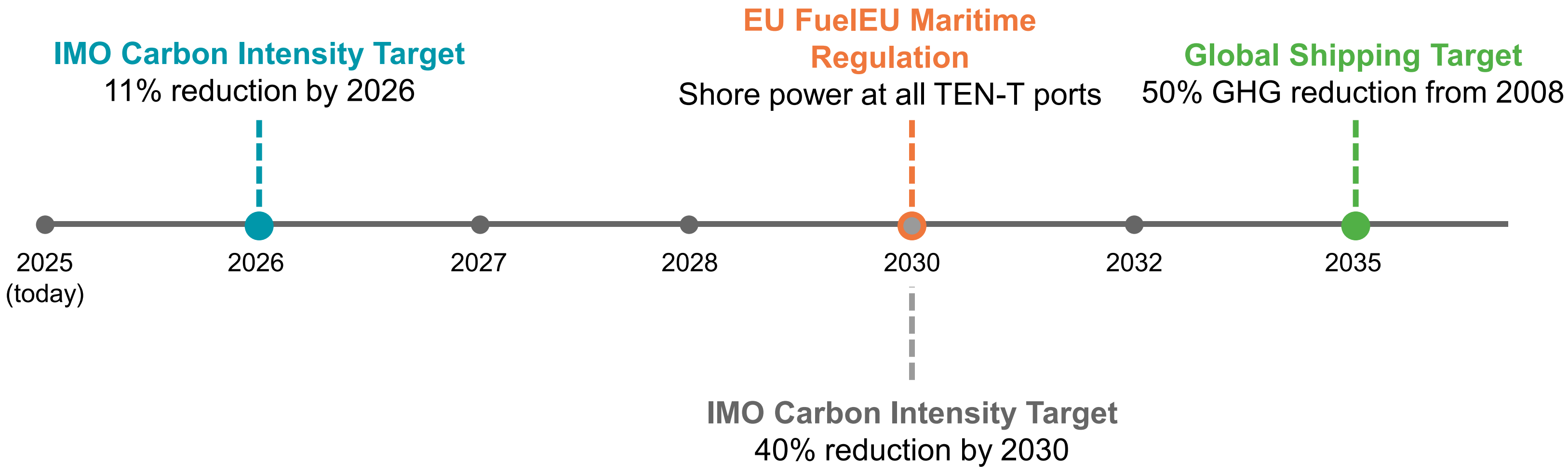
THE REGULATORY IMPERATIVE

EU FuelEU Maritime Regulation mandates shore power by 2030.

IMO aims for an 11% carbon-intensity reduction by 2026 and 40% by 2030.

Global momentum is accelerating, with new regulations across the EU, North America, and Asia-Pacific.

Regulatory milestones driving port decarbonization



Regulatory impact on ports:

- Just 3 major EU/UK ports have planned sufficient connection points.
- Implementation is time-critical: Most ports require solutions within 12–18 months to comply with regulations.

Source: IMO 2023 GHG Strategy + short-term CII measures (MARPOL Annex VI); Regulation (EU) 2023/1805 (FuelEU Maritime) + AFIR Regulation (EU) 2023/1804; 2023 IMO GHG Strategy (indicative checkpoints)

Even when docked, ships rely on their auxiliary engines for power, producing significant local emissions.

THE GRID'S PROBLEM

Why plugging in isn't enough

JENBACHER

Cold Ironing

Providing shore-side electrical power to a docked vessel so it can shut down its engines

Why not just plug every ship into the local power grid?

PLUGGING IN ISN'T ENOUGH

Grid power challenges

Grid capacity constraints: Port grids are too weak to meet ship demands (5-30 MW per berth).

Implementation timelines: Grid upgrades can take up to 48 months or longer.

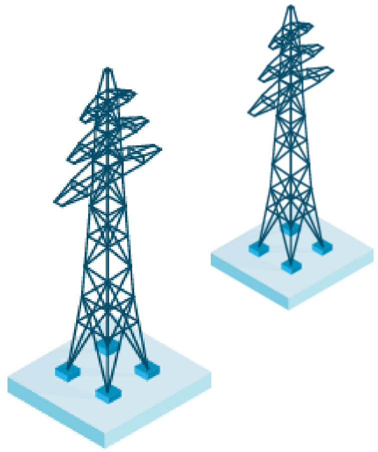
High costs: Grid upgrades average €1-2 million per megawatt.

Power quality issues: Ports must meet strict vessel requirements (frequency and voltage deviation limits).

Reliability concerns: Port grids experience 25% more power outages than average.

Variable environmental benefits: Carbon intensity of grid electricity varies across regions.

Economic barriers: Shore power is often more expensive than marine fuel.



Source: INNIO Group, Whitepaper INNIO Group

THE JENBACHER ADVANTAGE

Cogeneration and trigeneration

JENBACHER

A port microgrid generates reliable, high-quality power on site, independent of the main grid's constraints.

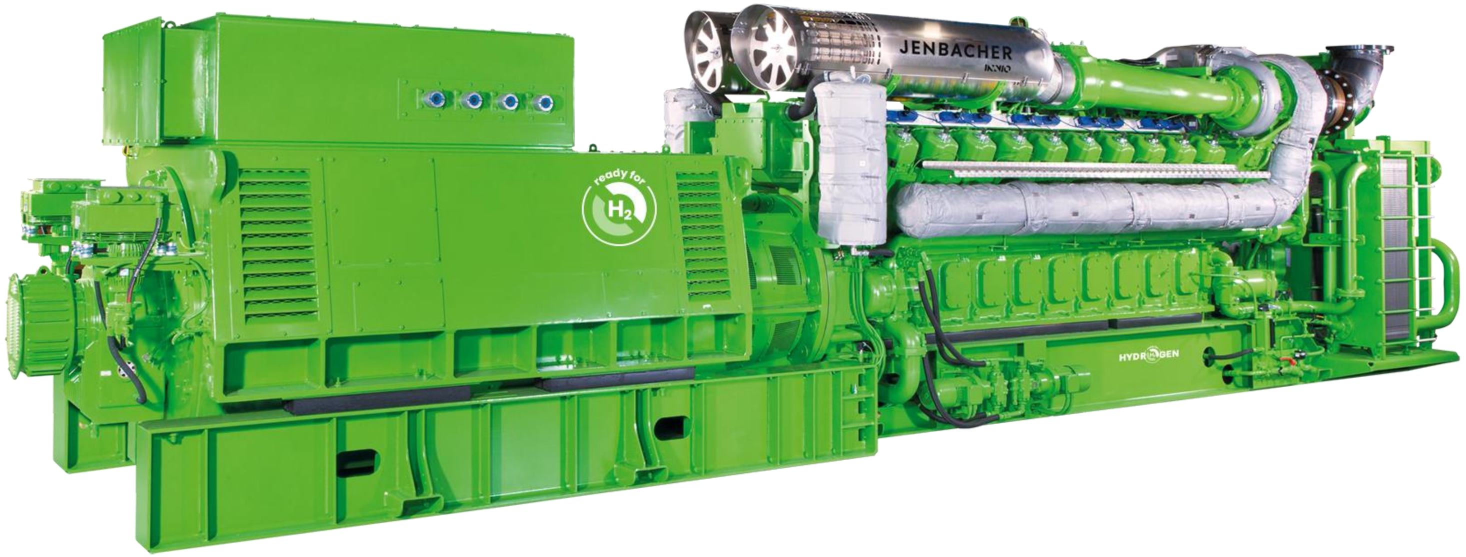
JENBACHER

Cogeneration/combined heat and power (CHP)

Simultaneously producing electricity and useful heat from one fuel source, with up to 90% total efficiency.

WHAT IS A SPARK-IGNITED RECIPROCATING ENGINE POWER PLANT?

What is cogeneration?



V-type internal combustion engine with turbocharging, mounted on a base frame with alternator.

J620 L01

- **3 508** kW el.
- **20** cyl
- **124.8** l volume
- **4 769** hp
- **36.9** t
- **9.5 x 2.2 x 3.0** m

GAS PRICE IS THE PRIMARY FACTOR AFFECTING PAYBACK PERIOD

Instant attractiveness assessment

Natural gas 1 nm^3

4.34 kW el.

(for J620 @ 9,5 kWh/nm3)

4 kW heat

MICROGRID INTEGRATION – BEYOND BASIC SHORE POWER

Component overview

Cogeneration, renewables, energy storage, control systems

Advanced functionalities

Seamless grid / island transitions

Resilience benefits

Continued operation during grid disturbances

READY FOR H_2 – JENBACHER PRODUCT PORTFOLIO
Available products today and tomorrow

Power Output (kWel)

Generator Output @ 50 Hz operating on natural gas (0, 1,000, 2,000, 3,000, 4,000, 5,000, […], 10,000)	H_2 blending to natural gas ≤ 25% (vol)[1]	Natural gas/H_2 engine >25 ≤ 60% (vol)	Pure H2-engine > 60 (vol) -100%
Type 9 – J920 FleXtra	✓		(✓)
Type 6 – J612 J616 J620 J624	✓	✓	(✓)
Type 4 – J412 J416 J420	✓	✓	✓
Type 3 – J312 J316 J320	✓	✓	
Type 2 – J208	✓	✓	

In general, "Ready for H_2" Jenbacher units can be converted to operate on up to 100% hydrogen in the future. Details on the cost and timeline for a future conversion may vary and need to be clarified individually.

(✓) = Available for customer as demonstration plants

JENBACHER

[1]Subject to required modifications for the certification of the fuel gas components — a modification of the maintenance schedule for such components may be required

DEMAND-DRIVEN CONVERSION OF JENBACHER ENGINES TO H_2 OPERATION

Built as natural gas asset

Natural gas

Natural gas with <5% (vol) of H_2 content

– Current standard

Built as a “Ready for H_2” asset

Natural gas

(with up to 20%vol H_2)

Natural gas with up to 25% (vol) of H_2 content

Pipeline gas can have up to 20% (vol) of H_2 content

Required
- NO_x sensor
- H_2 signal integrated into LeanoxPlus
- H_2 ready compensation software

Low-cost package

Switched to a hydrogen asset

Natural gas
(optional)

Hydrogen

Hydrogen fuel (natural gas optional)

When H_2 becomes available

Required
- Hydrogen conversion package
- NO_x sensor
- H_2 signal integrated into LeanoxPlus
- H_2 ready compensation software

Medium-cost package

JENBACHER

A PORT CASE STUDY

20,000 kW shore power smart microgrid

JENBACHER

A PORT CASE STUDY– OVERVIEW

Scenario: Grid-constrained port (max 3 MW available, 20 MW needed)

Key constraints: Limited grid, high reliability requirements, space limitations for PV, not practical wind power

Solution components: Jenbacher units, PV, battery storage, advanced controls

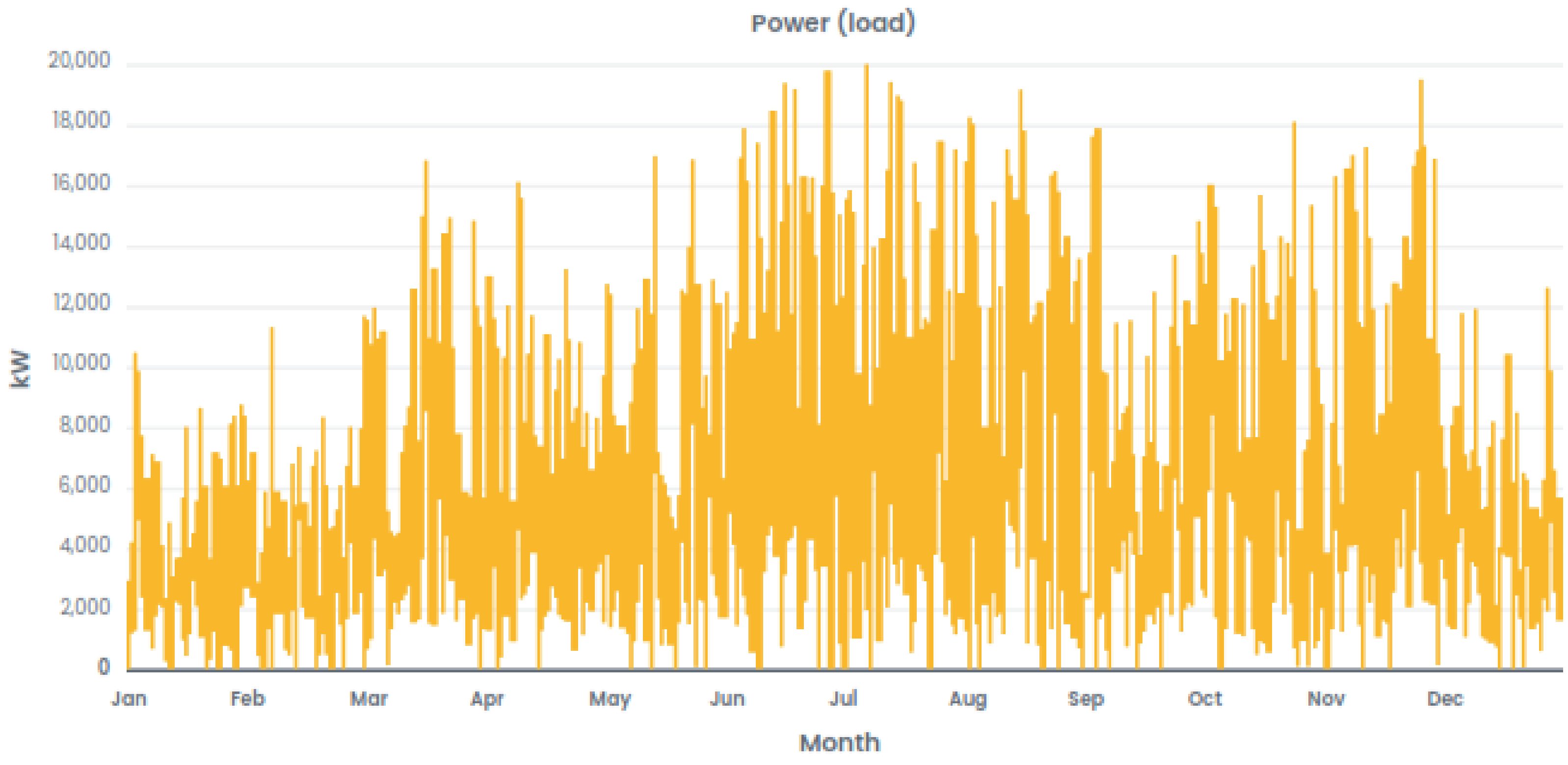
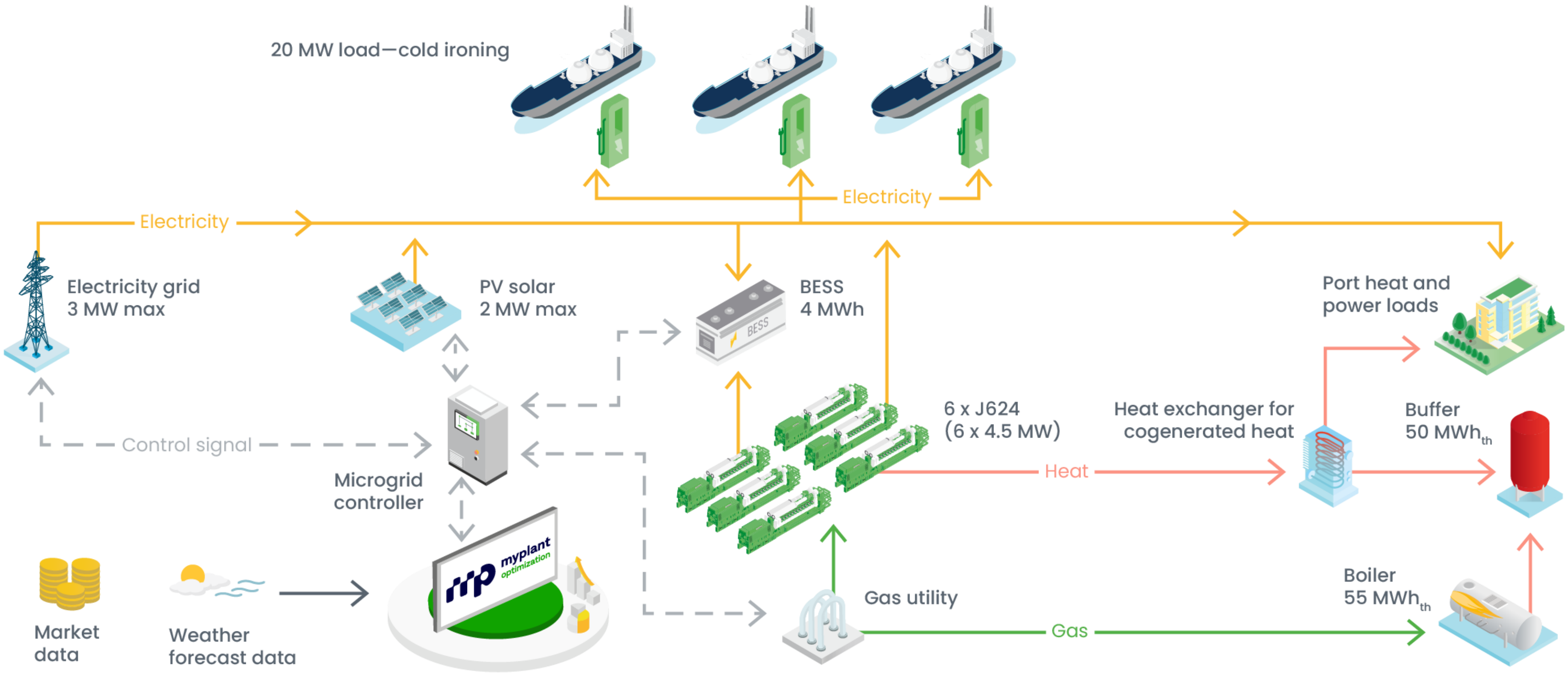


Figure 4: Electrical load profile at the harbor with cold ironing

Source: INNIO Group

SYSTEM CONFIGURATION

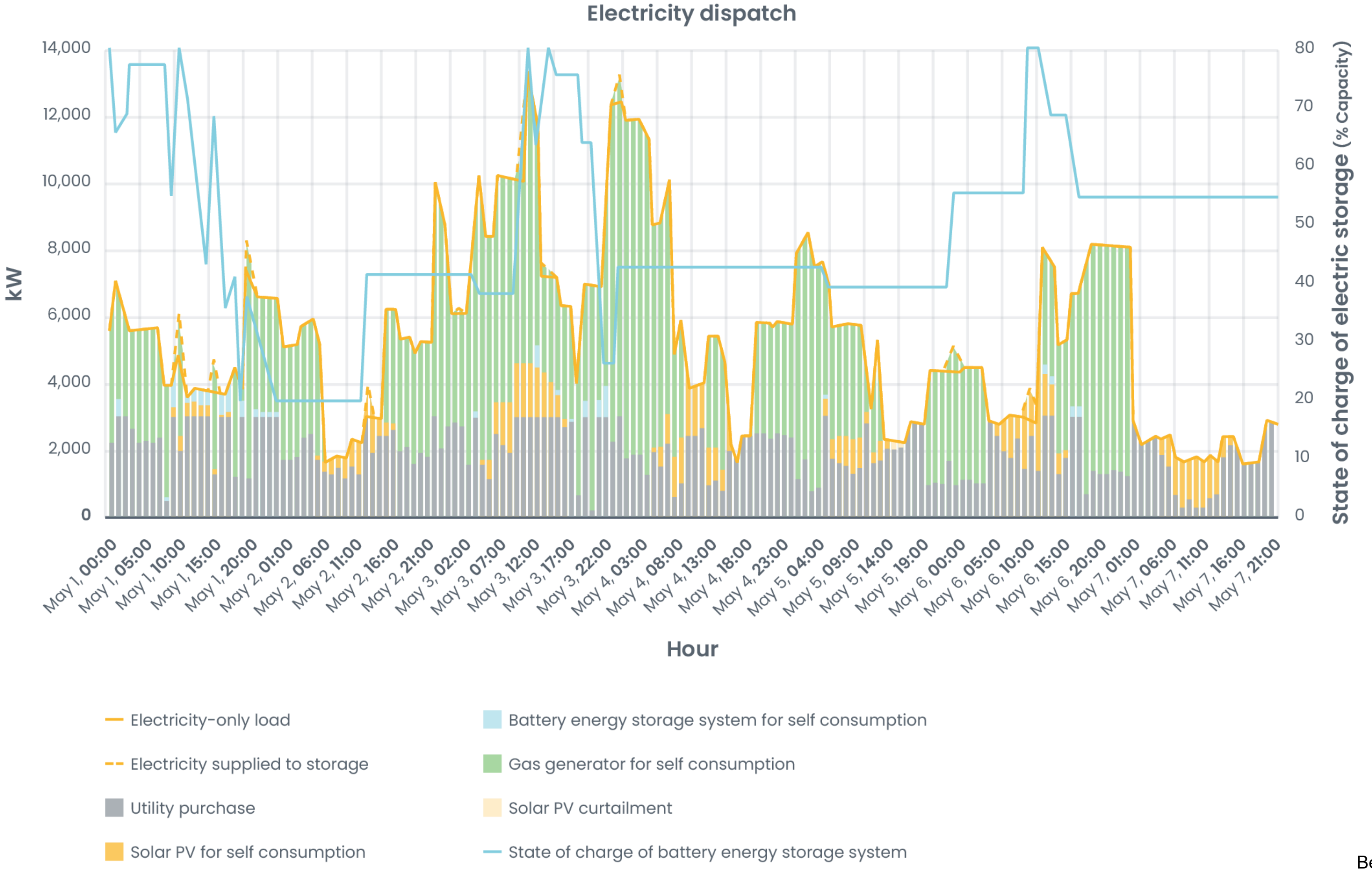


SYSTEM CONFIGURATION

Component	Capacity	Role
Grid connection	3 MW	Base and backup power
Natural gas gensets	22.5 MW	Primary power generation
Solar PV	2 MW	Renewable energy input
Battery storage	4 MWh	Power fluctuation management
Natural gas boiler	50 MW	Heat loads
Heat buffer	50 MWh_{th}	Peak management
Heat exchanger	20 MWh_{th}	Waste heat recovery

JENBACHER

ELECTRICITY DISPATCH



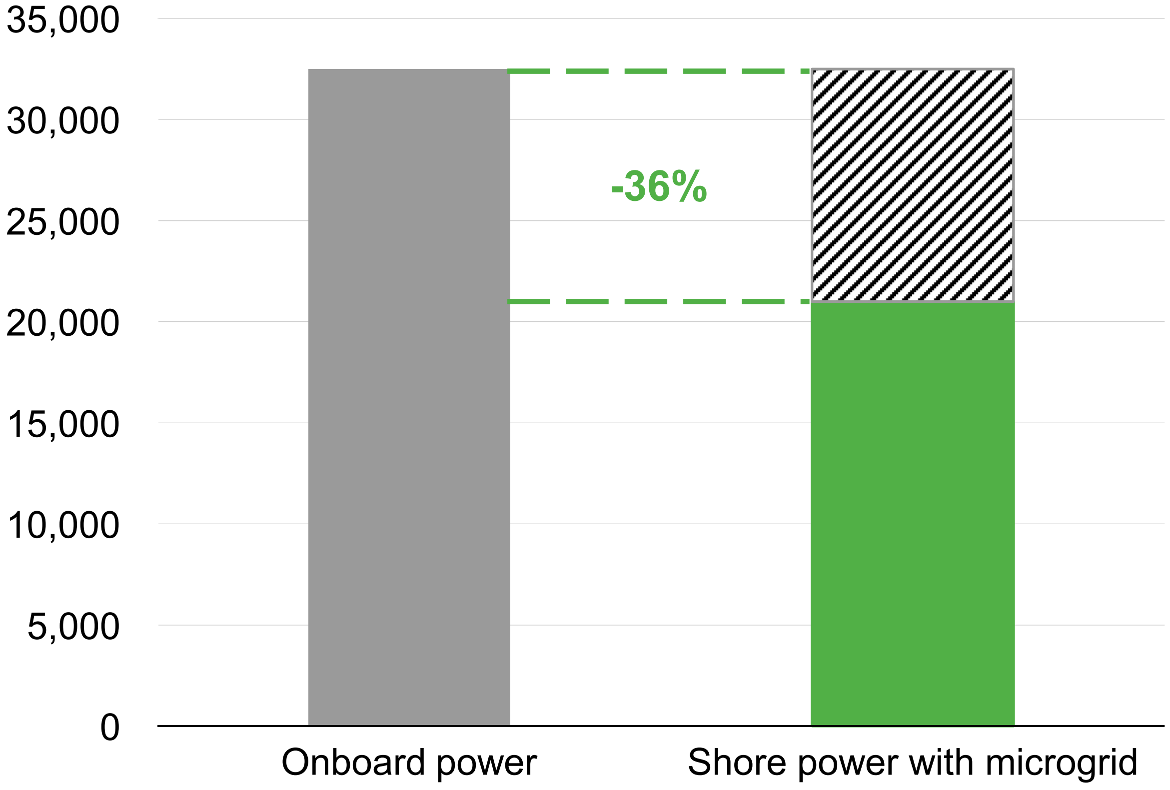
This graph shows a full week of load-profile simulation data for May, illustrating how various power sources work together to meet demand and how the battery charges/discharges throughout the week.

Source: INNIO Group

ENVIRONMENTAL PERFORMANCE

Comparing shore power microgrid CO_2 emissions with conventional onboard power generation

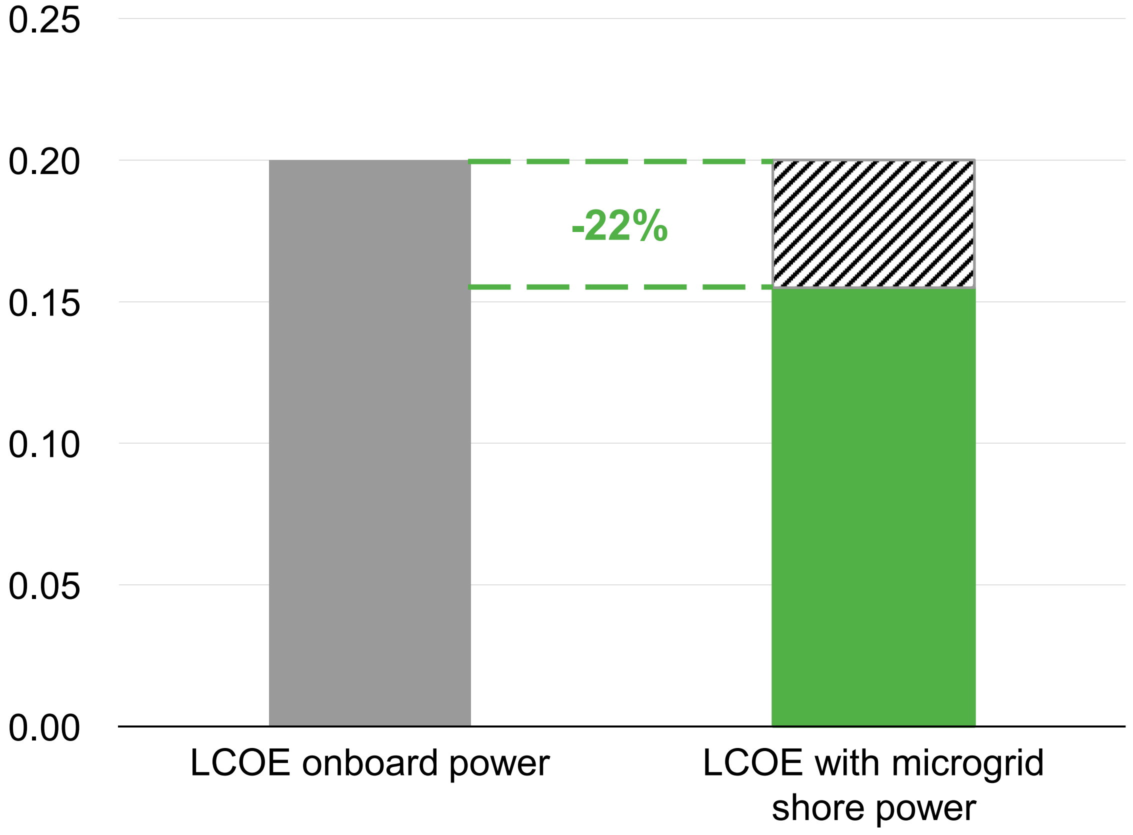
Annual CO_2 emissions for vessel power
(metric tons of CO_2)



-36%: Annual CO_2 emissions reduction between onboard power and shore power with the designed microgrid

ECONOMIC BENEFITS

LCOE comparison
(EUR/kWh)

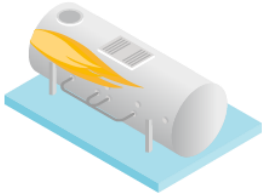


-22%: Reduction in the levelized cost of energy (LCOE) – a win-win.

Source: INNIO Group

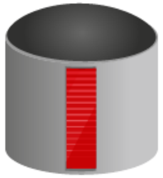
PERFORMANCE RESULTS – THERMAL INTEGRATION

Heat recovery benefits:



Can reduces boiler capacity requirements from 55 MW to 50 MW.

Can lower gas consumption for port facilities by 10%.



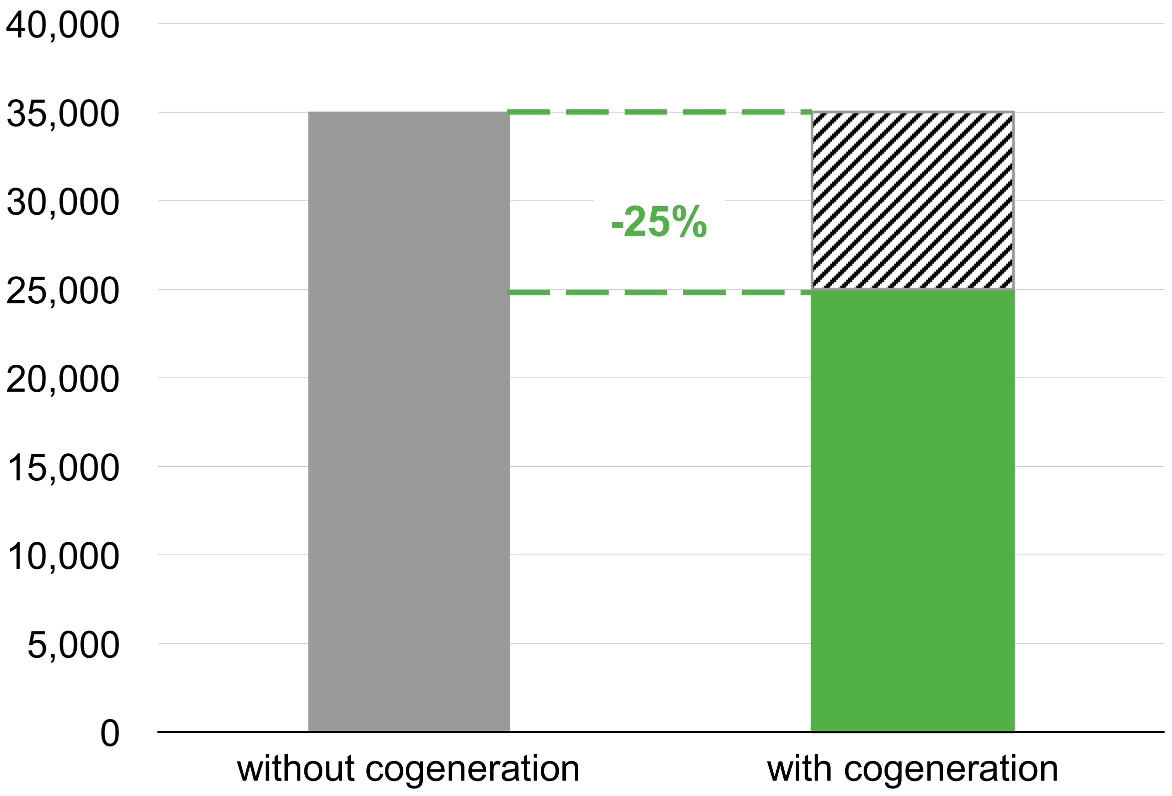
Highlights the importance of thermal storage for managing peak demand.

Source: INNIO Group

ENVIRONMENTAL PERFORMANCE

Comparing shore power microgrid CO_2 emissions with conventional heat generation at port facilities

Annual CO_2 emissions for harbor heat load



-25%: Annual CO_2 emissions reduction when comparing the boiler-only harbor heat supply (left column) with the integration of the heat from on-site generators (right column)

JENBACHER

Source: INNIO Group

KEY INSIGHTS & LESSONS LEARNED

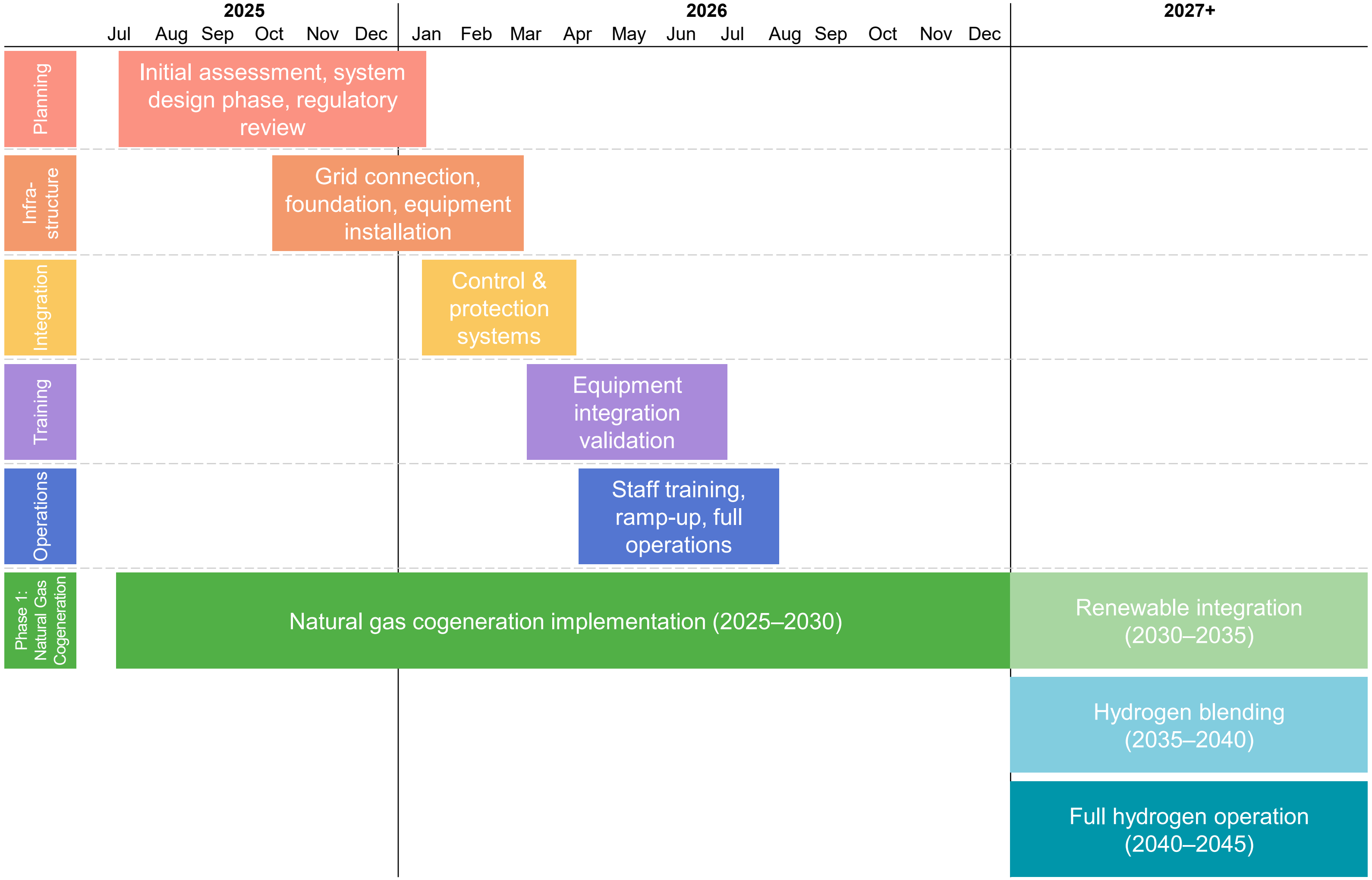
- Integrated system design is essential
- Load profile characterization drives better design
- Thermal integration provides valuable returns
- Control systems are key differentiators
- Resilience design is crucial

READY FOR A LOWER-CARBON FUTURE

JENBACHER

PATH TO A ZERO-EMISSION PORT

Implemented roadmap for port decarbonization



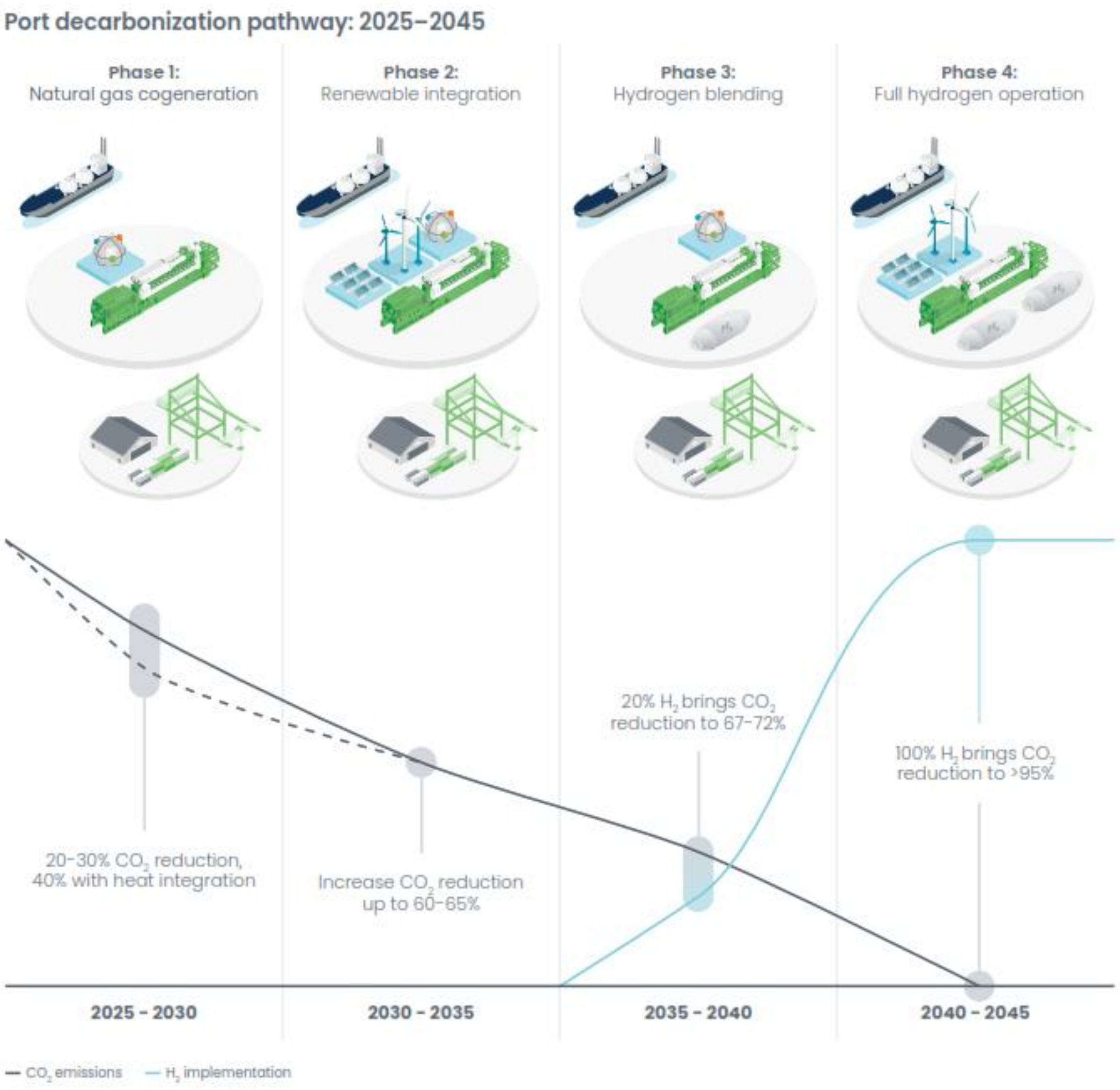
Implementation speed is a key Jenbacher advantage – the 20 MW system can be operational in 18-24 months.

JENBACHER

Source: INNIO Group

Jenbacher generators can operate on biogas and other renewable gases. They are designed with a clear upgrade path to run on different blends and eventually up to 100% hydrogen. All new systems are “Ready for H_2.”

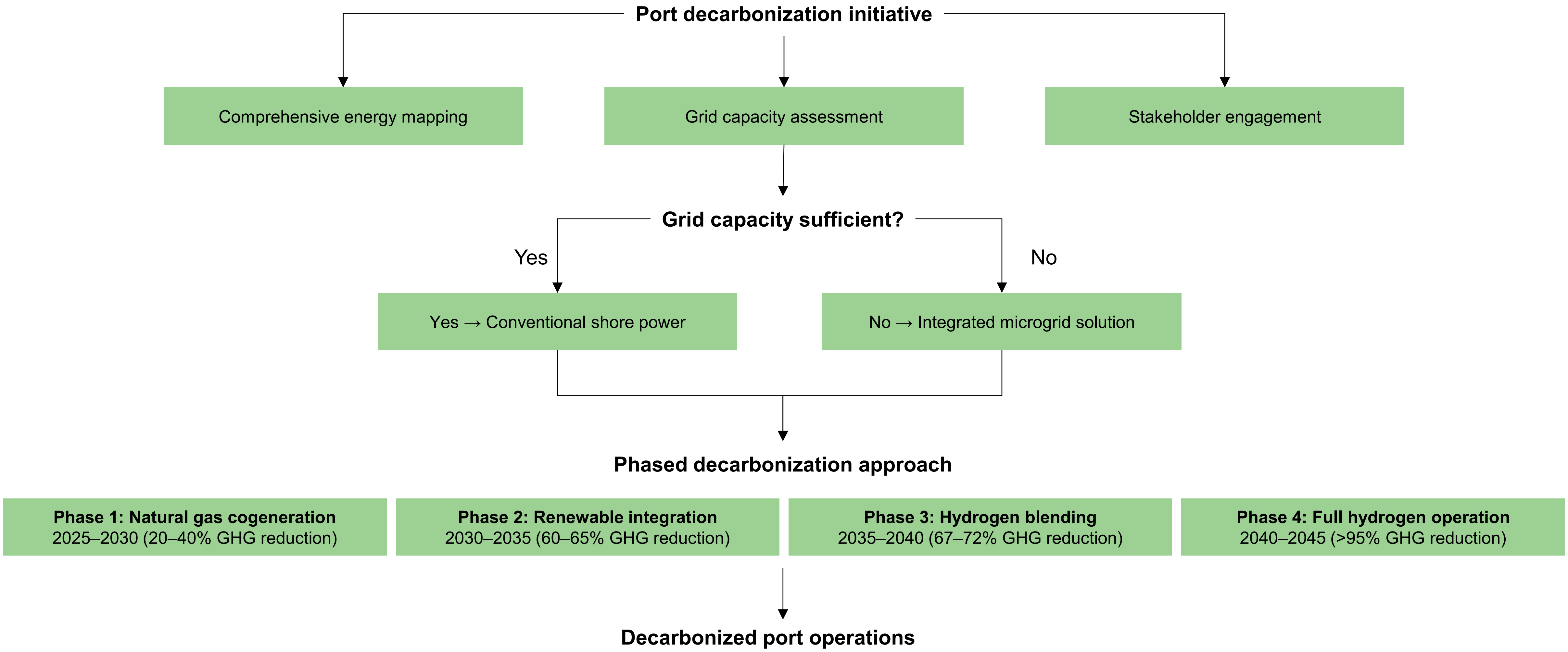
STAGED DECARBONIZATION APPROACH



A phased implementation strategy enables immediate emission reductions while establishing infrastructure for deeper decarbonization.

Source: INNIO Group

DECISION-MAKING FRAMEWORK FOR PORT AUTHORITIES



THE TAKEAWAYS

- Integrated cogeneration and microgrid systems offer a cheaper, cleaner, and more reliable way to power ports.
- Heat recovery utilization is critical for economic viability.
- This technology builds a practical bridge to a low-carbon future.
- A phased implementation approach reduces risks while enabling immediate emission reductions.

What's stopping our ports from becoming clean energy hubs?

QUESTIONS AND ANSWERS

Contact us:

Evgeny Churdalev

Achenseestrasse 1-3, 6200 Jenbach, Austria

https://www.innio.com

Eugene.Churdalev@innio.com

M.: +995 511 332 656
M.: +7771 897 1223

JENBACHER

About INNIO Group

INNIO Group is a leading energy solution and service provider that empowers industries and communities to make sustainable energy work today. With its Jenbacher and Waukesha product brands and its AI-powered myplant digital platform, INNIO Group offers innovative solutions for data center power infrastructure, distributed power generation, and compression applications. With its flexible, scalable, and resilient energy solutions and services, INNIO Group enables its customers to drive the energy transition across the energy value chain and helps ensure reliable energy supply even where the grid is not available.

For more information, visit INNIO Group's website at innio.com. Follow INNIO Group on X and LinkedIn.

In general, "Ready for H_2" Jenbacher units can be converted to operate on up to 100% hydrogen in the future. Details on the cost and timeline for a future conversion may vary and need to be clarified individually.

JENBACHER

Jenbacher is part of the INNIO Group

JENBACHER