

MARCH 2024

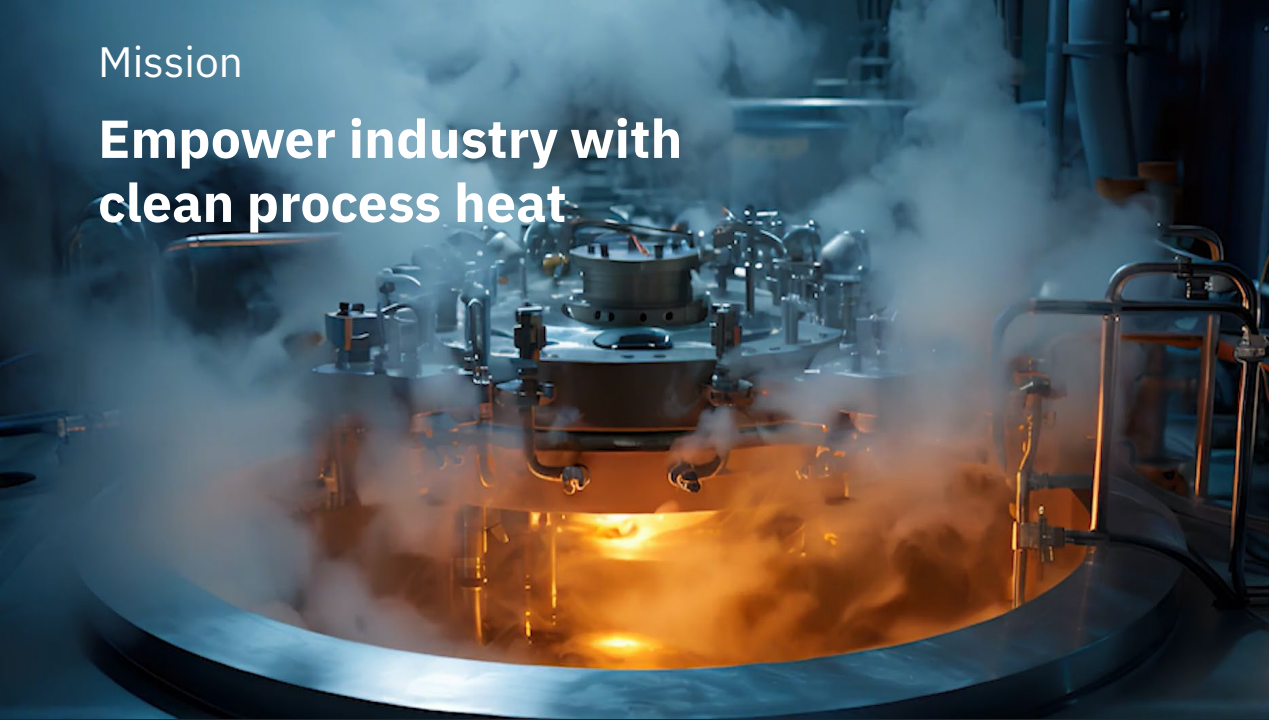
# Kyoto Group Company Presentation





Mission

Empower industry with  
clean process heat



Vision

A world powered by **Nature**



Enabled by people



Assisted by AI



# Agenda

MARCH 2024

1. What problem do we solve for the society?
2. How do we solve it?
3. How does our solution compare to other technologies?
4. What does it mean for our clients?
5. What does it mean for us?



**KYOTO**







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**Global average temperature Nov 17<sup>th</sup> 2023**

**> 2°C**

**KYOTO**





*“Humanity has opened the  
gates of hell”*

António Guterres,  
UN Secretary General

**KYOTO**



# Radical action ongoing to change CO<sub>2</sub> trajectory

Clean-tech investments need to triple. Now.  
And will be fueled by critical legislation.

## Designing a new electricity market



Renewable PPAs + storage, peak-shaving products, national objectives and support schemes for energy storage & demand response to balance the grid

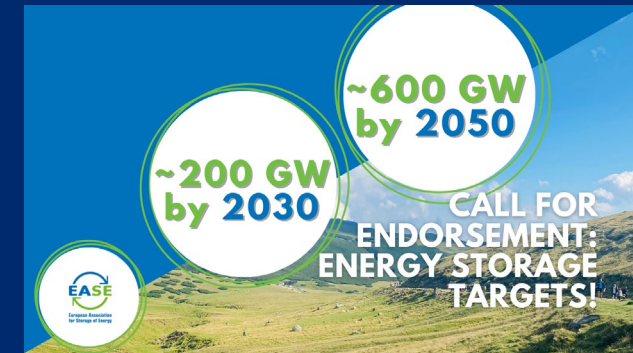
Era of “electricity only” is over

## Accelerating clean technologies



Energy storage included among selected strategic clean technologies given priority status and access to fast-track permissions, funding etc., to accelerate EU decarbonization

## Incentivizing energy storage



EU Member States obliged to set targets for energy storage & demand response and revise every second year



# New Electricity Market Design agreed

Provisional Agreement on new Electricity Market Design December 14th 2023  
Adoption in Official Journal expected during 2H 2024

NO LOOPHOLE FOR FOSSIL FLEXIBILITY!

Member states shall define national targets for non-fossil flexibility, including energy storage & demand respons

*also including capacity mechanisms, peak shaving products, support for green PPAs etc*

*EU may establish a Union strategy on non-fossil flexibility, depending on the consolidation of the Members states targets*



# Europe tightening climate policies even further

Provisional Agreement Feb 6th 2024 on a 90% reduction of GHG by 2040





# EU to strengthen European Industry

Provisional Agreement on Strategic Technologies Europe Platform (STEP) Regulation Feb 7th 2024



A sovereignty seal will be awarded to projects that contribute to the STEP objectives. It will serve as a quality label, helping projects attract public and private investments and promoting better access to EU funding



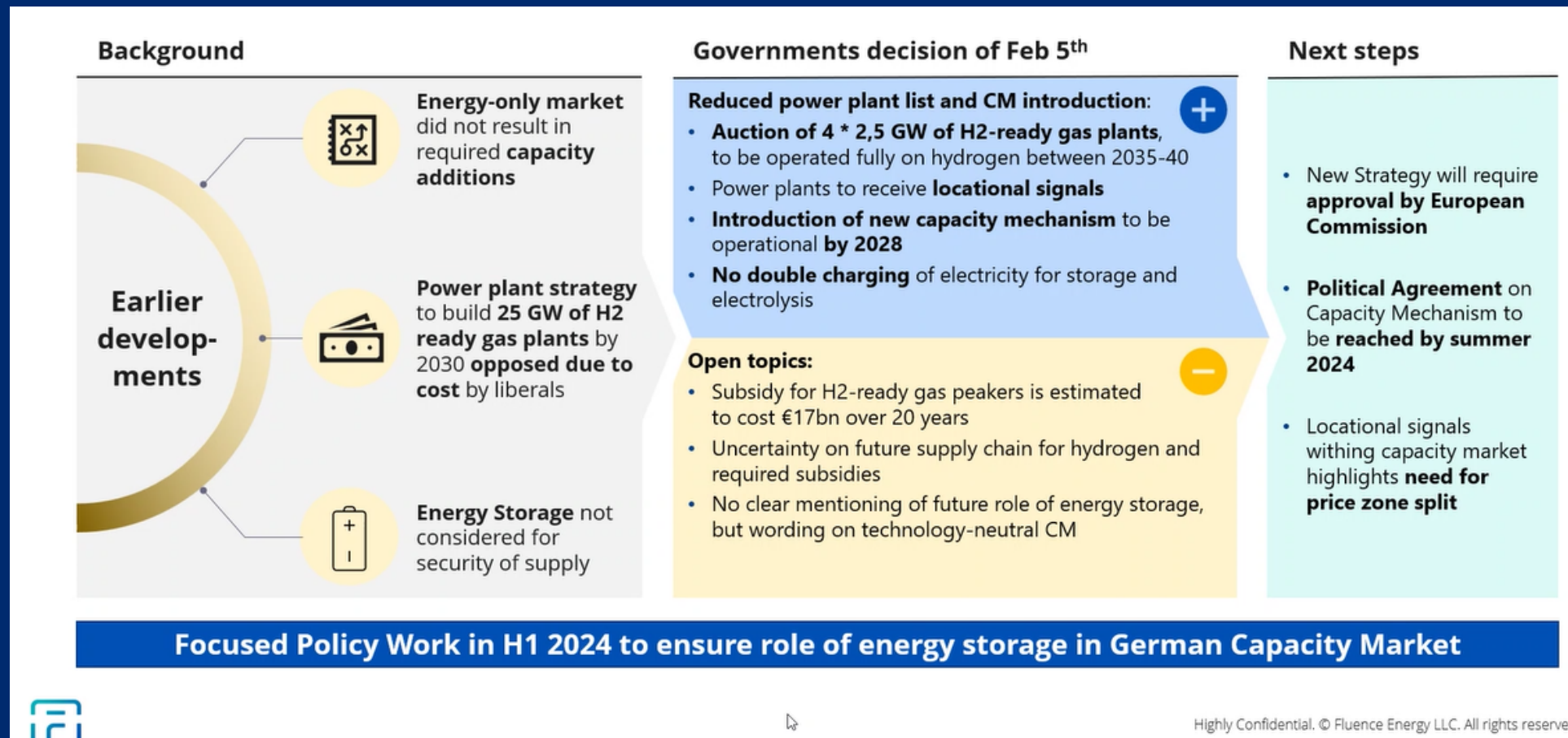
The STEP objectives are to:

Support development and manufacturing of critical emerging technologies relevant to green and digital transitions i.e. deep and digital technologies, clean technologies and biotechnologies - *the list of clean technologies includes 'electricity and heat storage'*



# Introduction of Capacity Mechanism in Germany

Example from EU Member State; fundamental shift in energy policy, Feb 5th 2024





# EU to strengthen European Industry

Addressing the competitiveness in the single market (Europe)

## EU Elections Activities – Commission Work on Competitiveness

Mario Draghi's IDEAS think tank within the EC is working on report on “The future of European competitiveness, looking at the challenges faced by industry and companies in the Single Market.”

Publication date:

- Summer 2024



# Key takeaways from Washington DC Jan 2024

Crafting The Transatlantic Green Marketplace



Recommendations delivered to the EU/US agenda

1. Prioritize electrification and TES
2. Recognize TES value for energy system flexibility
3. Focus support schemes on opex
4. Enhance long-term grid planning
5. Invest ahead of need
6. Urgently raise awareness

# THE BIG FUEL SWITCH...



## **Electricity**

1. Vehicles
2. Residential heating
3. Low/mid temp industrial heat

## **Hydrogen/Ammonia**

4. High temp industrial heat
5. Heavy long distance transportation



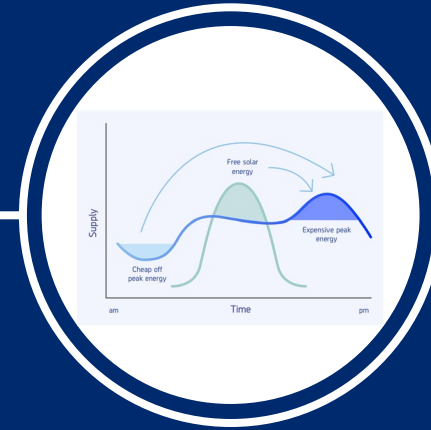
... HAS STARTED

74%

OF NEW CAPACITY INSTALLED  
IS SOLAR & WIND (2023)



# Decarbonization IMPOSSIBLE without energy storage



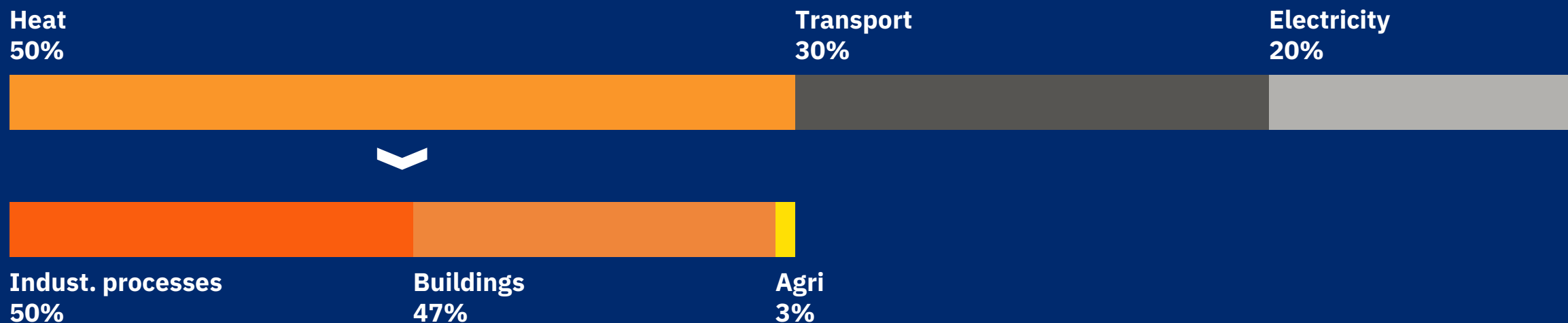
The challenge:  
Unmatched supply  
and demand

70% of new power capacity 2020-2030 is solar & wind  
70% of total electricity from solar & wind by 2050



# Heat is half!

Global energy demand



Heat generation is dirty

89 %

**non-renewable  
heat production**

40 %

**global CO<sub>2</sub>  
emissions**

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# THE BIG FUEL SWITCH...

## Electricity

1. Vehicles
2. Residential heating
3. Low/mid temp industrial heat

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## Hydrogen/Ammonia

4. High temp industrial heat
5. Heavy long distance transportation







# Industries with significant low/medium heat demand

- Paper, pulp and print
- Chemical and petrochemical
- Non-metallic minerals
- Non-ferrous metals
- Food
- Iron and steel



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PERFECT STORM - PERFECT SOLUTION

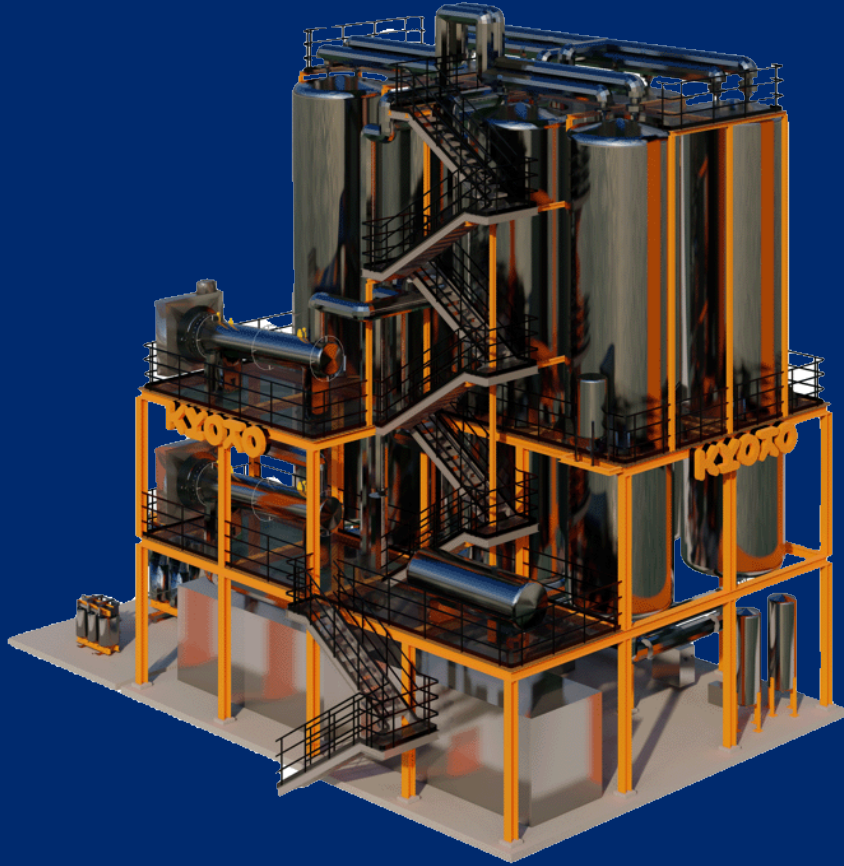
**Heatcube** electrifies process heat  
for the industry by also  
storing / balancing / load shifting

- Cost competitive
- Stable high-quality steam,  
at precise temperature
- Maximum flexibility –  
charge & discharge simultaneously  
(decoupled)
- Approved by energy authorities  
as flexible asset for grid
- Standardized modules,  
sizable to customer demands
- Strong European supply chain,  
positioned to scale





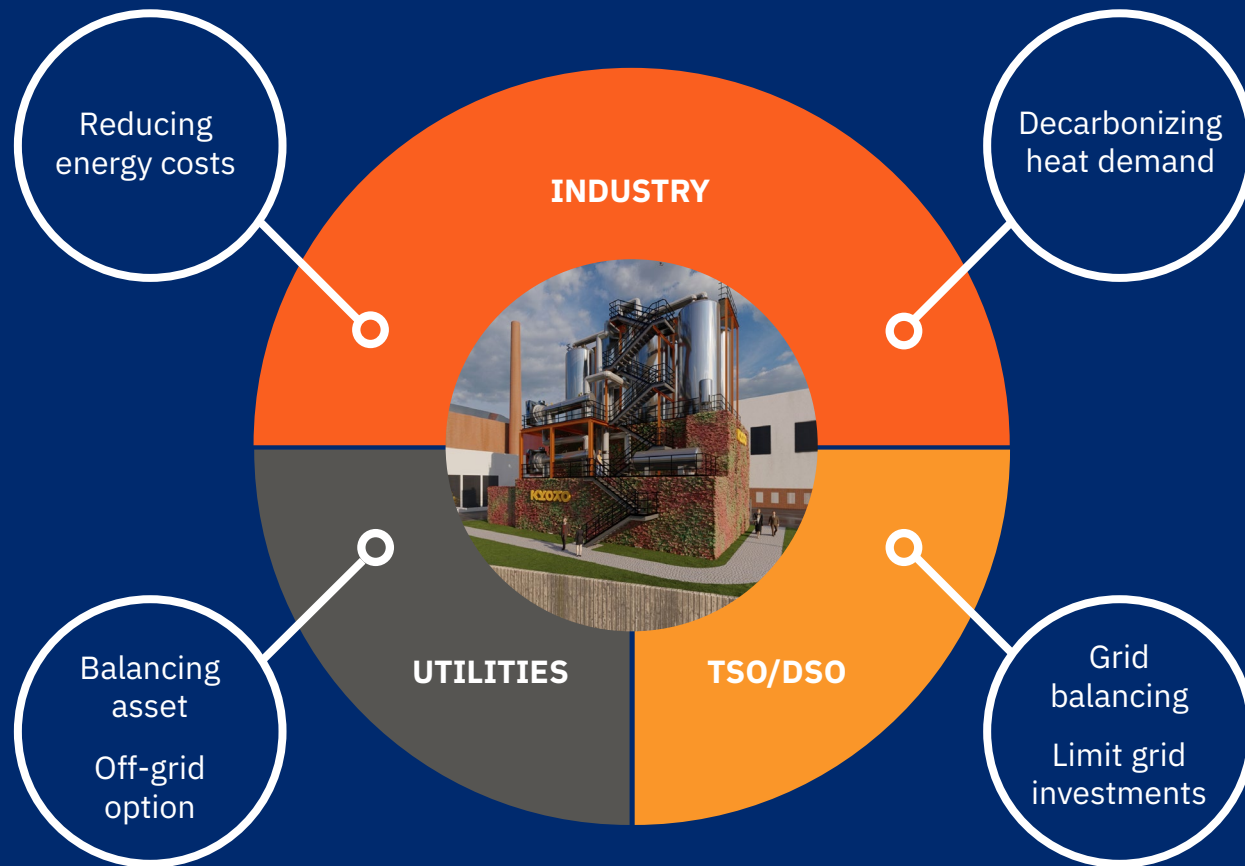
# Heatcube.



- Charging capacity: 0.5 to 30MW
- Storage capacity: 16-120 MWh
- Storage capacity per tank: 8 MWh
- Discharge capacity: 1.5 to 20 MW
- Discharge in form of: Steam, hot air or thermal oils
- Temperature range of steam: 133.5°C to 400°C
- Pressure range of steam: 3-40 bar(a)
- Temperature of salt: 190 - 415°C
- Charge response time: <90sec
- Round-trip efficiency: >93%

# Heatcube provides benefits to Industry, Utilities and DSOs

Value creation by Heatcube



## The Heatcube allows industry to:

- Avoid increasing CO2 costs
- Utilize the increasing power price volatility
- Utilize the increasing value of flexible assets



# First commercial installation

- **Location** Norbis Park in Denmark
- **Customer** Aalborg Forsyning
- **Industry** District heating
- **Purpose** Decarbonization, replacing coal
- **Start of operation** August 2023
- **Charge capacity** 5 MW
- **Storage capacity** 18 MWh
- **Discharge capacity** 4MW
- **Steam pressure and temp** 16 bar(a), 201,38° C
- **Electricity source** Onsite windmills and/or grid
- **Annual production** ≈ 275 houses powered annually
- **Annual CO2 reduction** ≈ 2000\* tonnes

*\* Based on standard efficiency and CO2e factors for coal fired CHP*





# Heatcube®

At a Glance Tech Breakdown.

02

Transformer

03

Steam generator

04

Heater

01

Storage tanks

05

Pump

06

Compressor

07

Connection to district heating

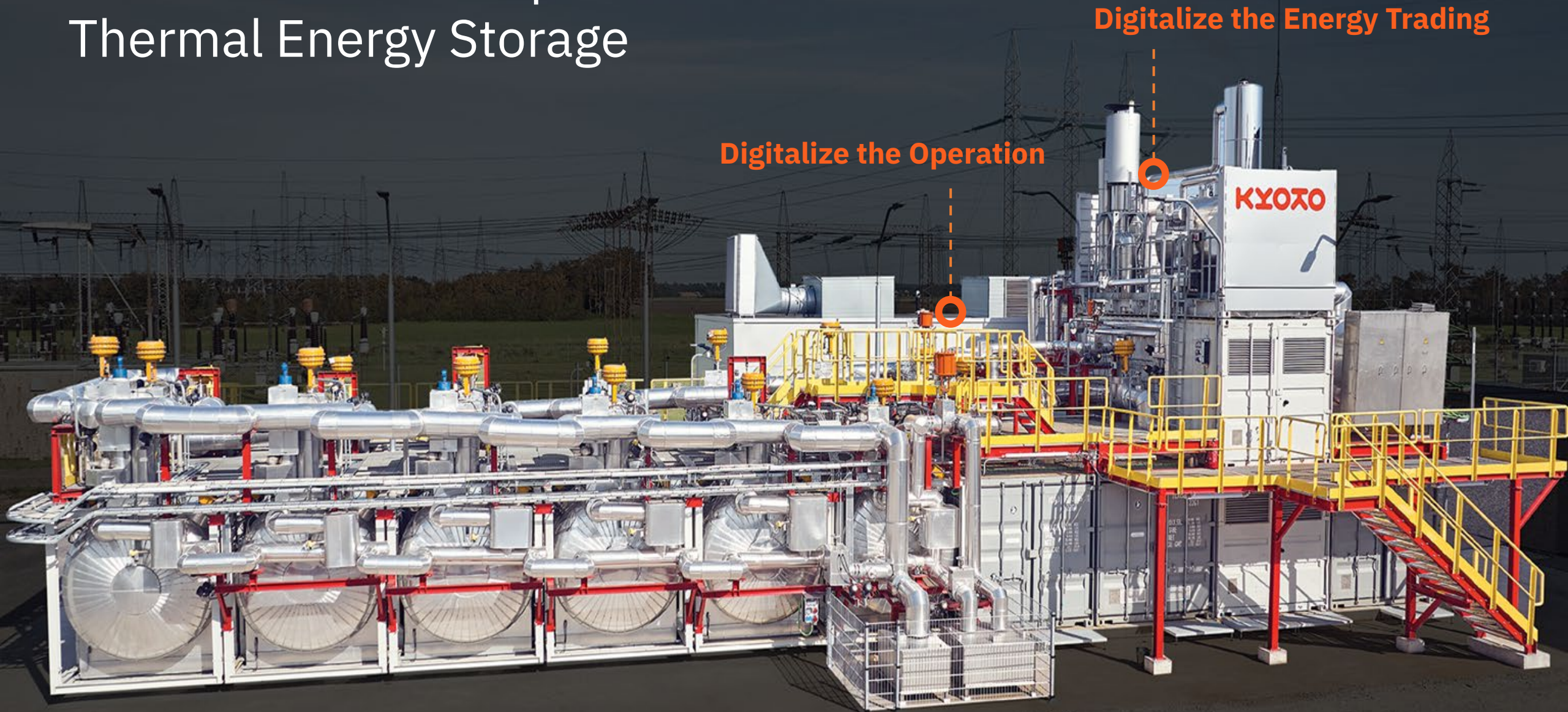
08

Battery management system



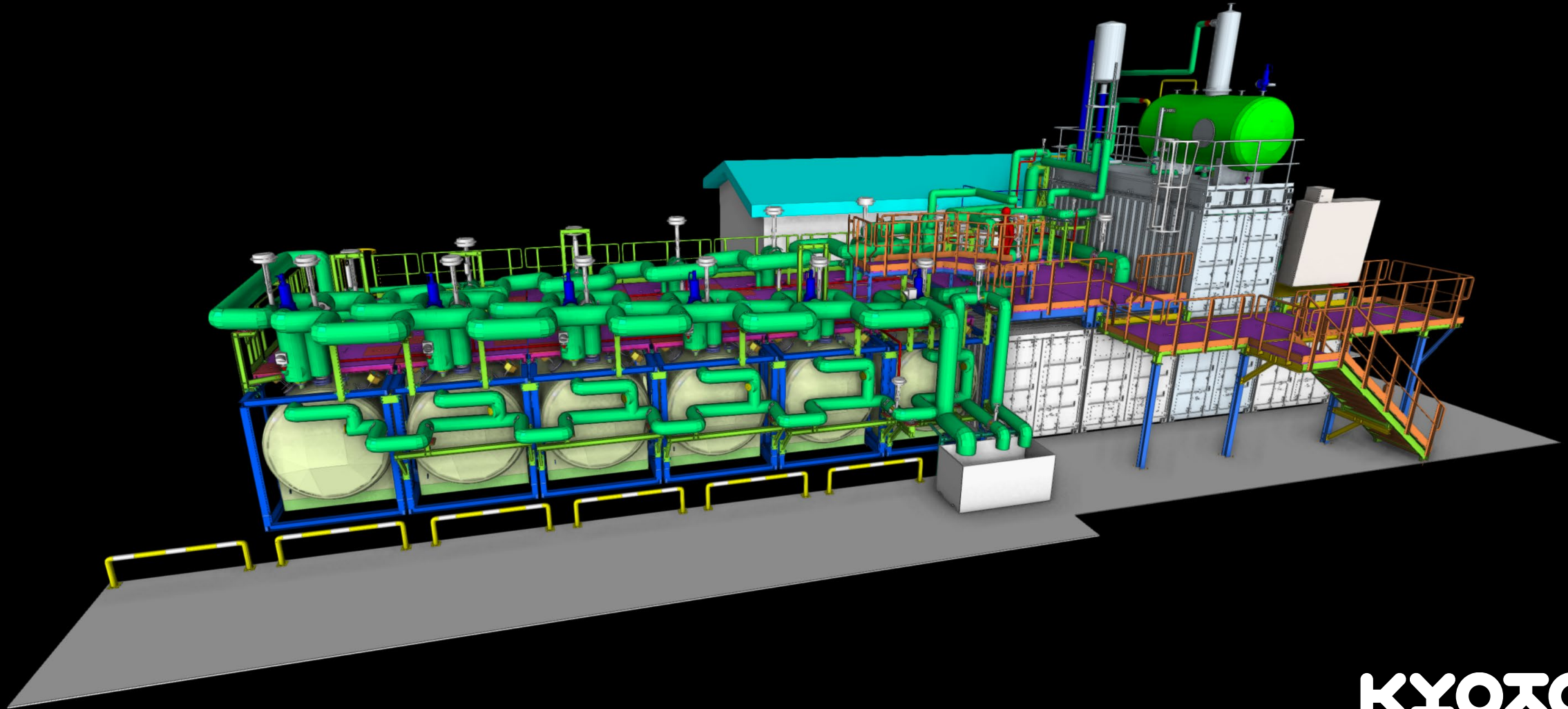


# The world's first AI-powered Thermal Energy Storage





# HEATCUBE AT NORBIS PARK DIGITAL TWIN



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# AI-powered brain of Heatcube

Enabled by digital twin

## Digitalize the operation

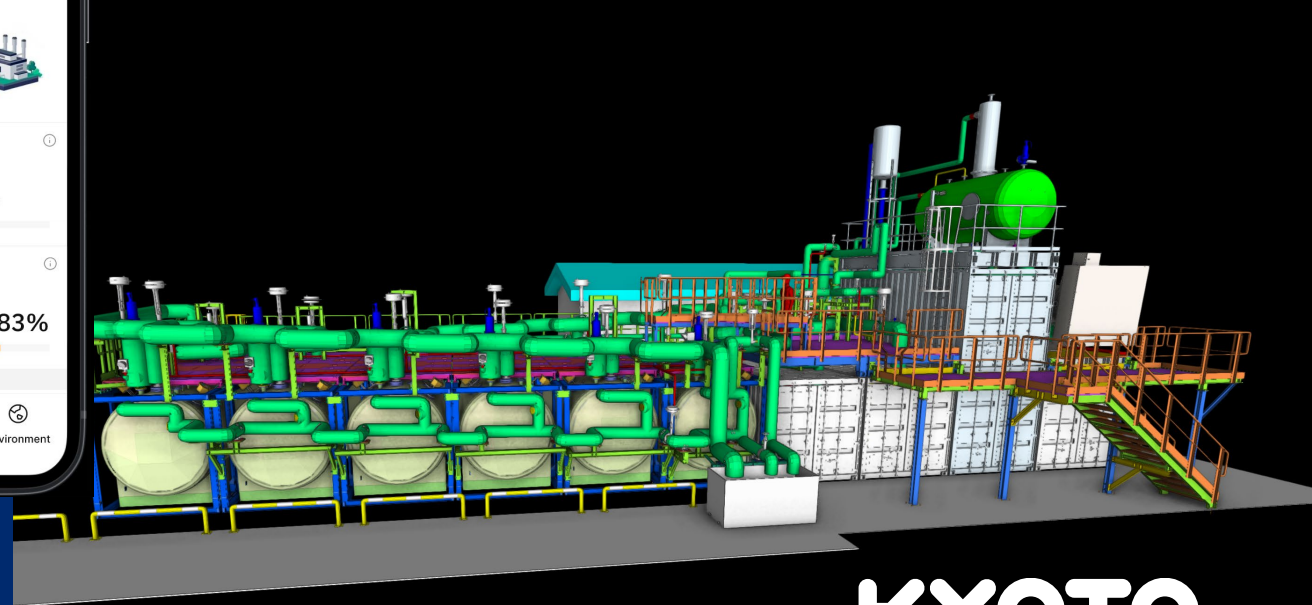
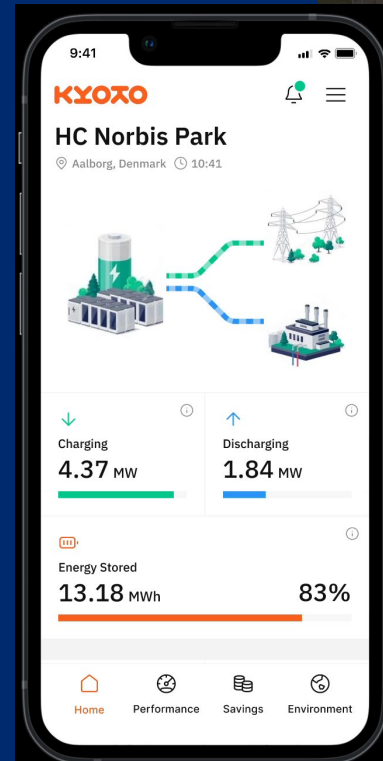
- Remote Monitoring
- Performance Analysis
- Predictive Maintenance

## Increase the performance

- Guaranteed >93% RTE
- Minimized down-time

## Reduce the operational costs

- Minimize operational maintenance
- Avoid corrective maintenance



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Approved by

**ENERGINET**

**KYOTO**



# Kyoto Group – IP strategy

Done in collaboration with



## The Purpose of Patents

- **Prevent** other actors to make use of Kyoto Group Technology
- **Delay** competitors by forcing them to spend time and resources on developing other or different technologies

## Strategy to reach the Purpose

- Patent **Key Technology** that is related to the **Modulization**, **Robustness** and **Reliability**, which leads to lower **Product-**, **Installation-** and **Operational** cost

## Actions done to reach the Purpose

- 3 patents in filed concerning the **Storage System** and the **Circulation** of molten salts
- 1 patent in preparation for filing concerning the **Melting** of ternary salts

# POSITIONED TO SCALE



steinmüller  
engineering

spirax  
sarco

Schneider  
Electric

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KYOTHERM





# 2023 DELIVERABLES

Heatcube #1 NJV operational



Iberdrola joint Go 2 market activities & second largest owner



Spirax-Sarco tech development & largest owner



Quadrupling discharge capacity in partnership with Steinmüller



Nordic Green Bank funding



Heatcube #2 KALL contract signed



# The Alliance: Enabling large scale commercial roll-out

Kyoto's technology and commercial model validated through thorough technical & commercial DD

- Together with our partners from **Iberdrola**, **Spirax-Sarco** and **Steinmüller Engineering** we are pushing for performance and excellence

One-stop-shop for industrial clients; Alliance controlling entire value-chain to decarbonize an industrial plant

- Access to **Iberdrola's** more than 2 000 industrial clients in Spain alone and competitive renewable electricity

Supply chain capable of large-scale roll-out

- **Vulcanic** with large production facility in Torrelavega, Spain
- **Steinmüller Engineering** designing the steam generator made for serial-production, to be outsourced to manufactures





# Agenda

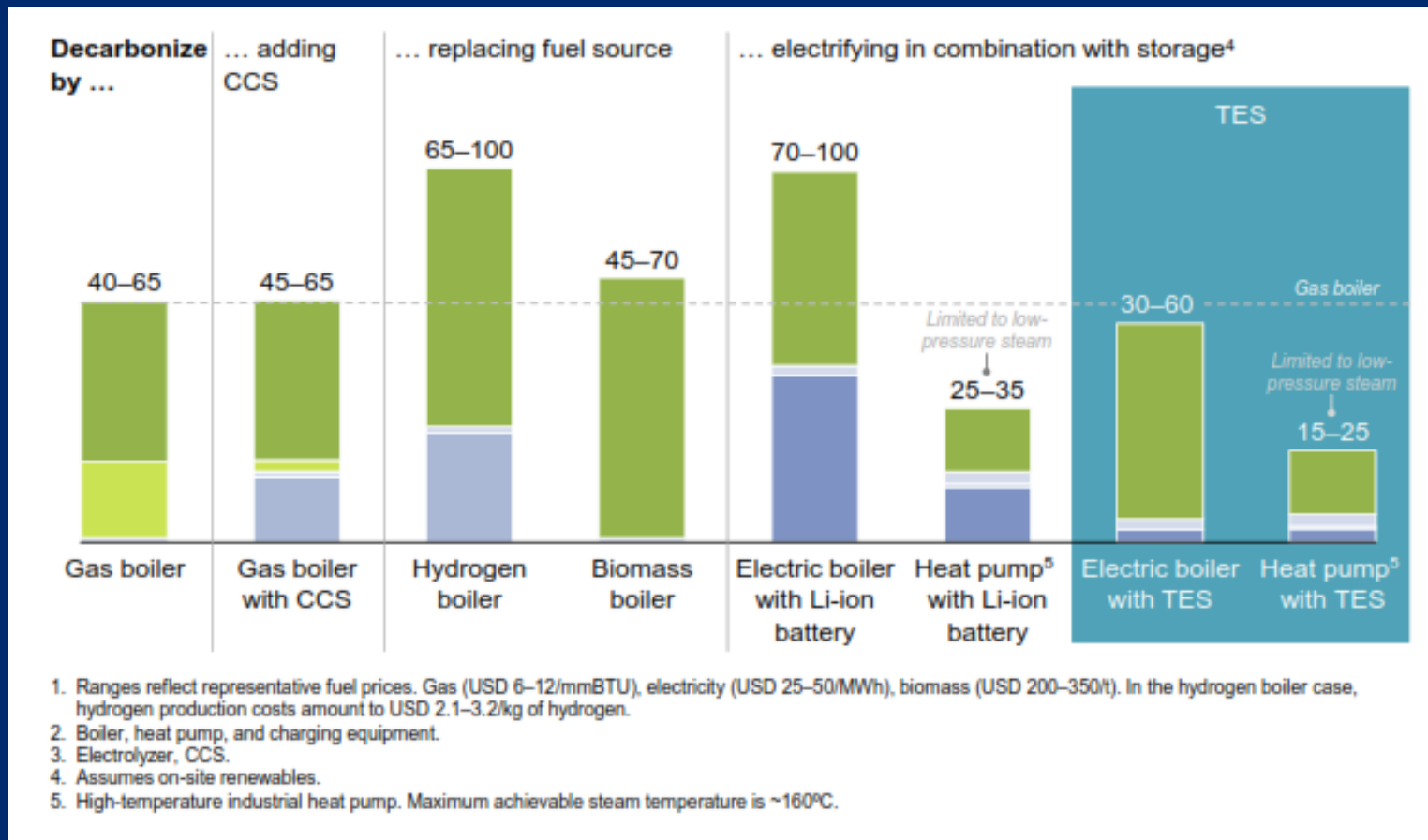
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# We are offering the most cost competitive available technology to make the decarbonization happening now

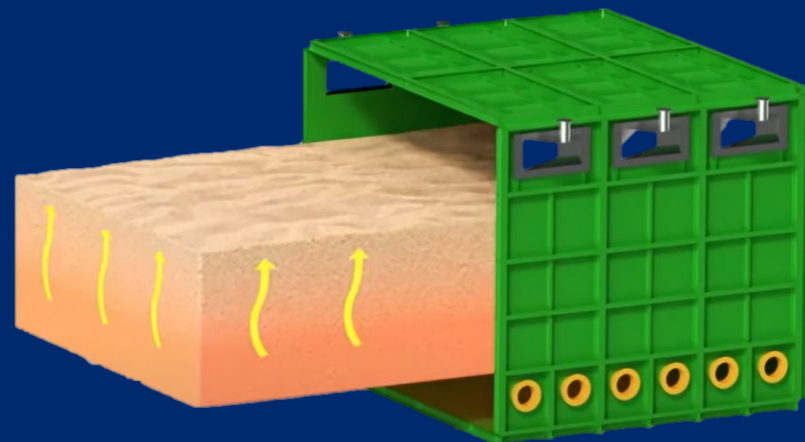


Source: "Net Zero Heat: Long Duration Energy Storage to accelerate energy system decarbonization", McKinsey & LDES, 2022



# Molten salt vs solid state storage (“rocks in a box”)

Unmatched quality, flexibility & environmental aspects



- Unmatched flexibility (= demand response)
  - Charge/discharge simultaneous, at max capacity
- Stable high-quality steam at precise temperature
  - Constant heat & pressure for any load level
- Supreme environmental & safety aspects
  - No toxic elements, no flammable gasses or liquids
- No degradation over time

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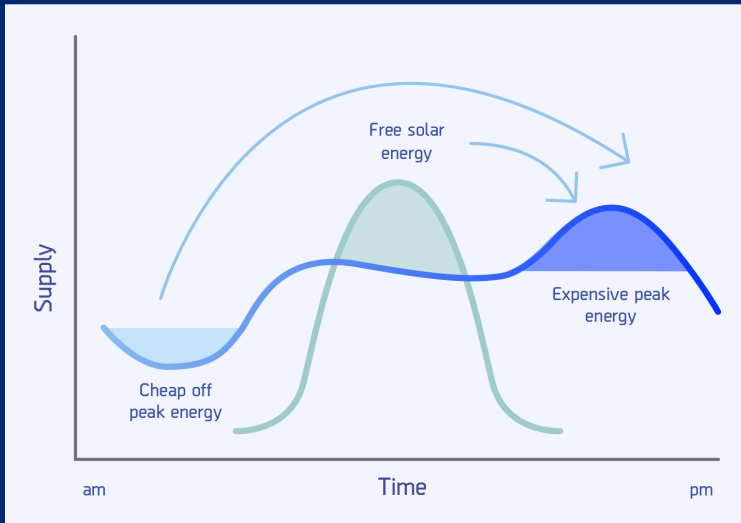


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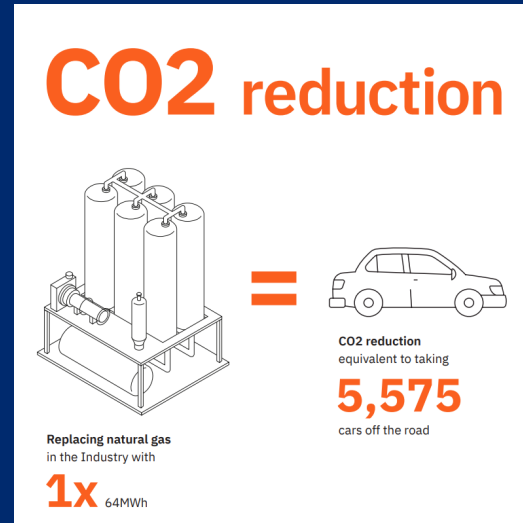


# 3x value propositions

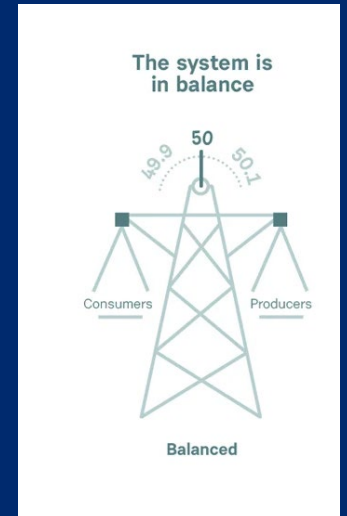
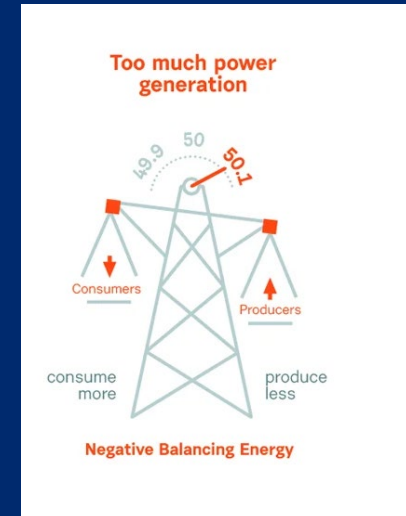
## Load shifting



## CO2 reduction and cost avoidance



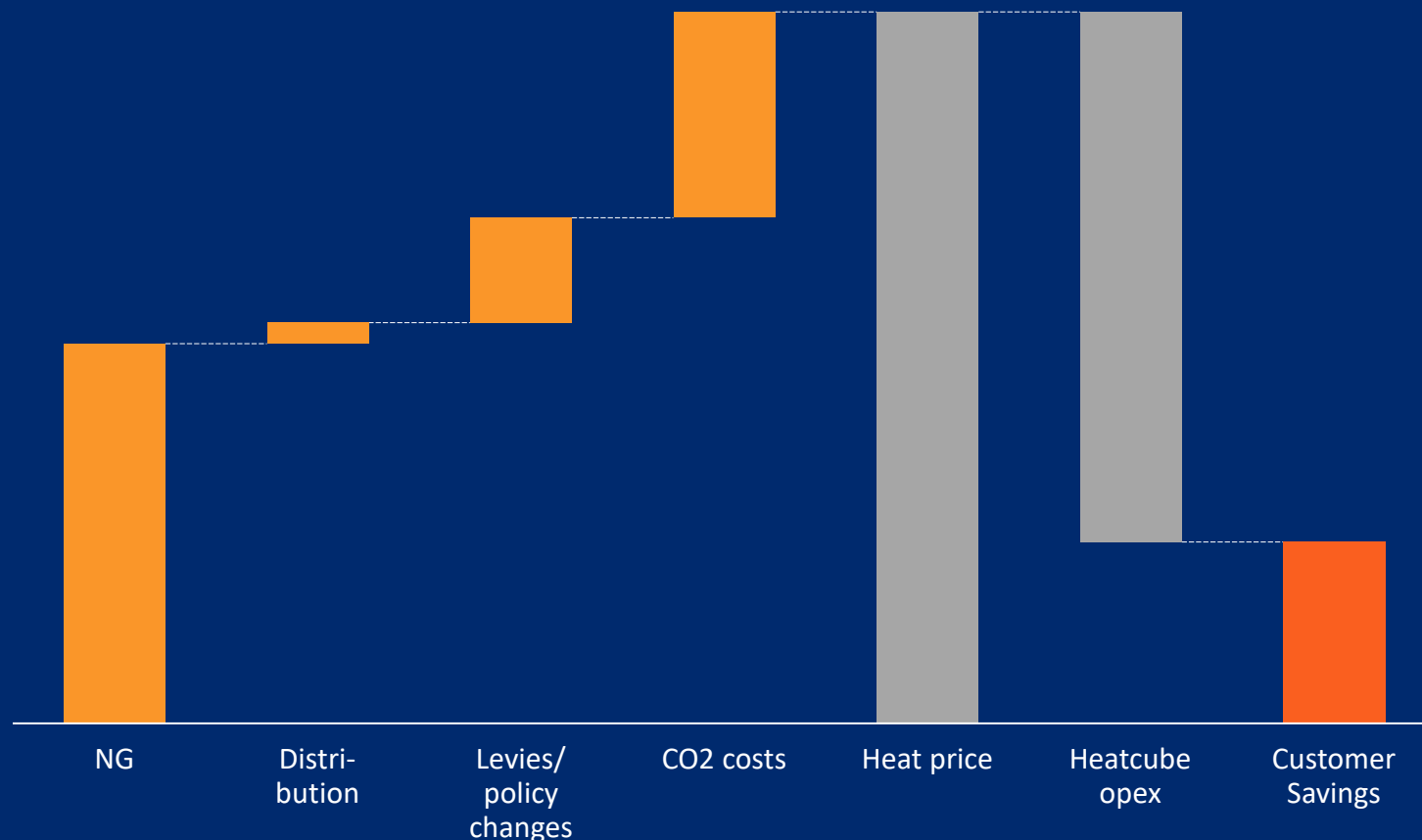
## Grid balancing



# Customer perspective on Heatcube profitability

IRR 10-20%, payback 6-10 years

Customer in Spain with heat demand of 27,500 MWh/year  
[€/MWh], real 2023 terms



- Customer's reference cost is the heat price with a Natural Gas Boiler
- Charging Heatcube with electricity from the grid and providing Ancillary Services
- Customer savings resulting in range of 10-20% IRR, nominal after tax
- Payback time typically of 6-10 years



# Heatcube unit economics

Heatcubes' come in multiple configurations, and EBITDA contributions vary across countries and client user patterns



**Medium – HC 10.64.5**  
Demand of 20,000 MWh/year  
Industry: Food & Beverages



**Large – HC 20.88.5**  
Demand of 35,000 MWh/year  
Industry: Food & Beverages

Heat price	80 EUR/MWh	80 EUR/MWh
Power, Grid tariffs* ** and flexibility reserve***	- 60 EUR/MWh	- 59 EUR/MWh
O&M*	- 2 EUR/MWh	- 1 EUR/MWh
Anticipated EBITDA contribution***	= 18 EUR/MWh 396 000 EUR/year	= 20 EUR/MWh 700 000 EUR/year

\* RTE (Round-trip Efficiency) of 90% | \*\* Comparable to a PPA price 40-50 EUR/MWh | \*\*\* 5-15% reduction in charging cost when participating in Frequency Reserve Markets

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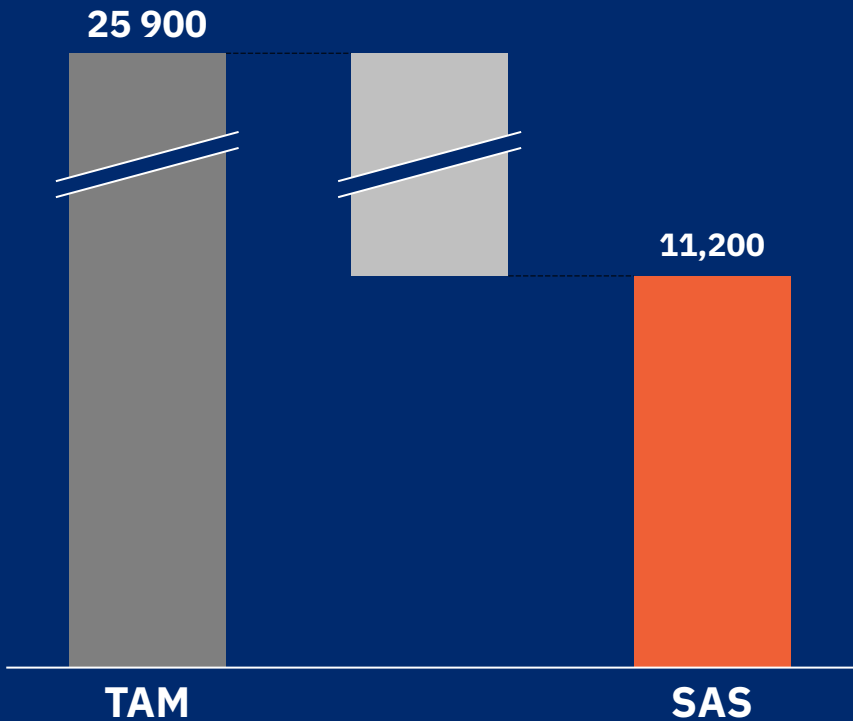
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# Close to EUR 1 000 billion\* market potential

## Global Heat demand and Serviceable market\*

[TWh/year]



- Heat is half of global energy demand
- Heatcube well suited for mid-range temperature heat demands
- Resulting Serviceable market of 11 200 TWh

\*Aurora 2021=> [click here](#)

TAM (Total Addressable Heat Market) = Global heat demand – heat demand outside the industry

SAS (Serviceable Addressable Segments) = TAM – heat demand outside relevant temperature range – existing low-carbon heat + pre-heating demand

What does a global market potential of **11,200 TWh** mean?  
**A global market of 370,000 Heatcubes**



\* Serviceable addressable segment (SAS)



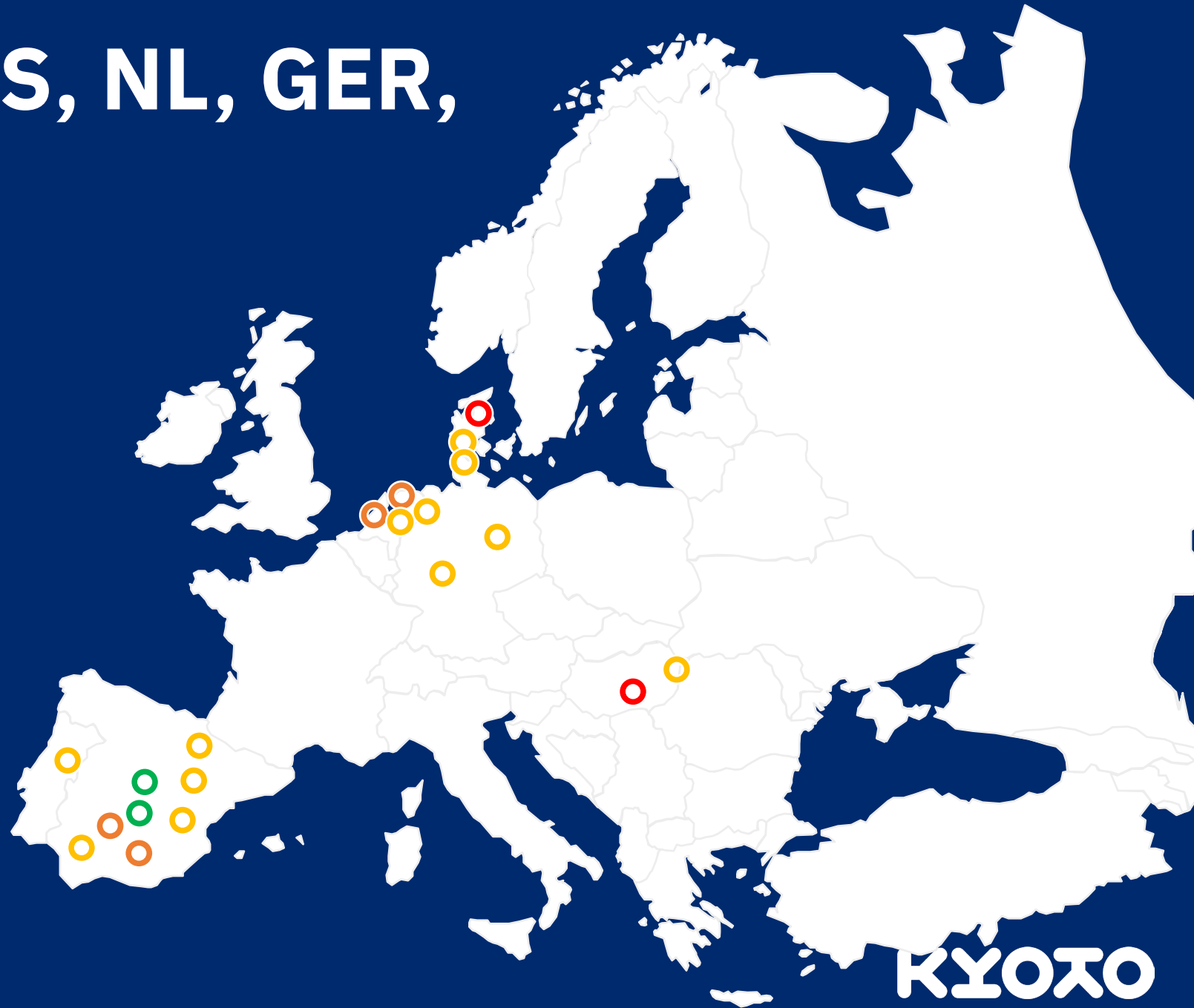
# Key Markets: ES, NL, GER, HU

 Heatcube projects with signed commercial contracts and/or installed

 Pipeline projects with funding application submitted / prepared by utility partners

 Pipeline projects with offers submitted / prepared by utility partners

 Pipeline projects with offers submitted by Kyoto

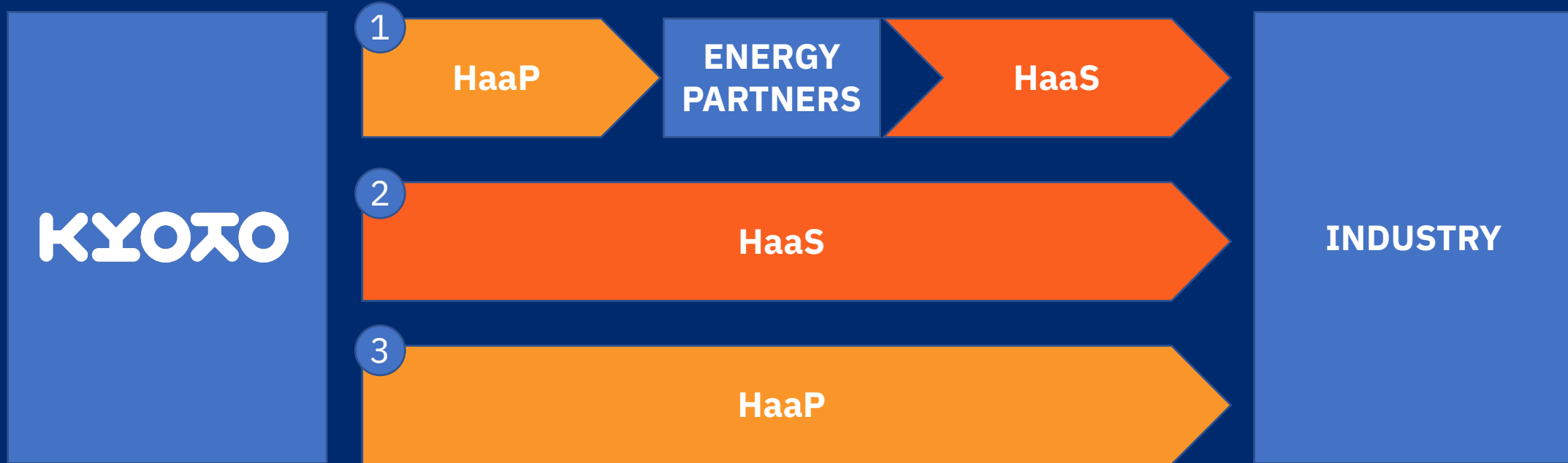


*Note: not all projects from the pipeline are represented here  
Locations are indicative*

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# Three business models for Kyoto

The established partnerships enable Kyoto offering Heatcube as a Service or as a Product to the industry



HaaP: Heat-as-a-Product

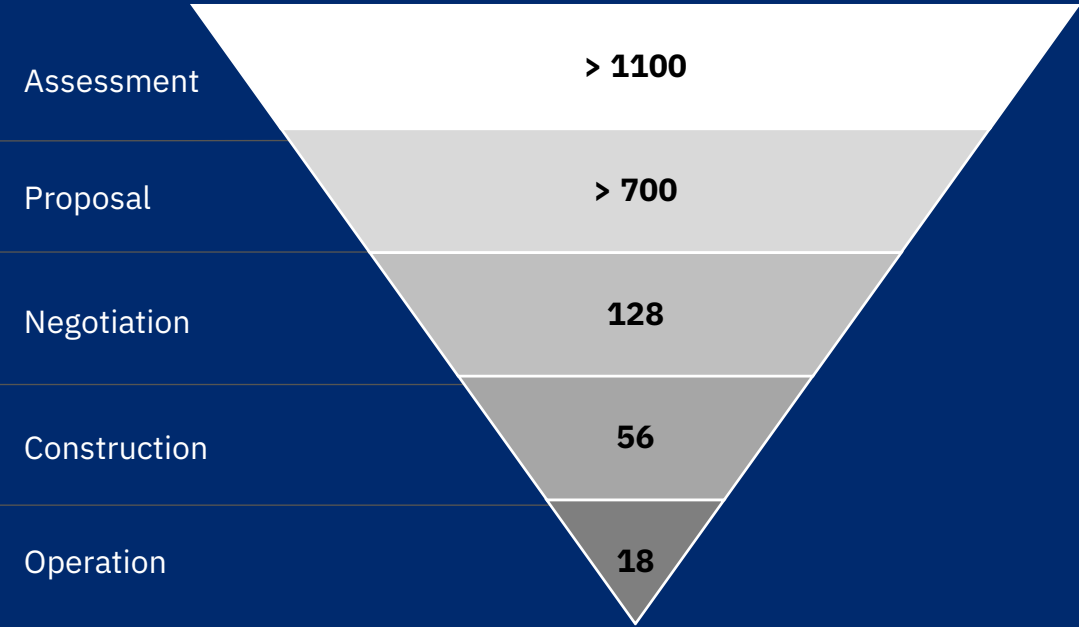
HaaS: Heat-as-a-Service



# February Heatcube pipeline status

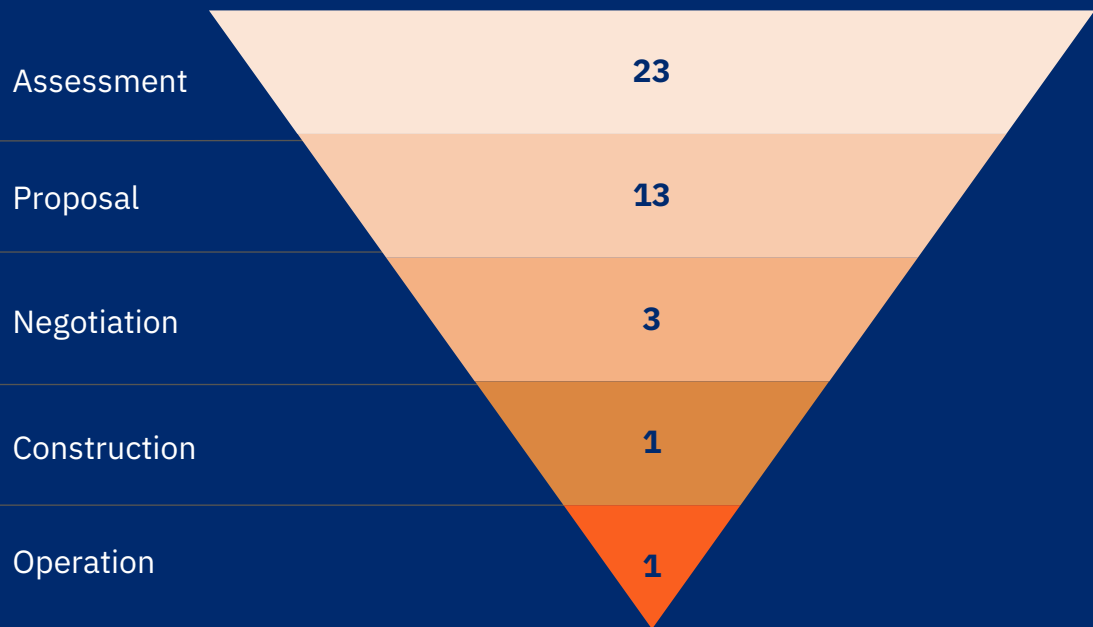
## Storage pipeline (MWh)

Total volume: > 2 100 MWh (unweighted)

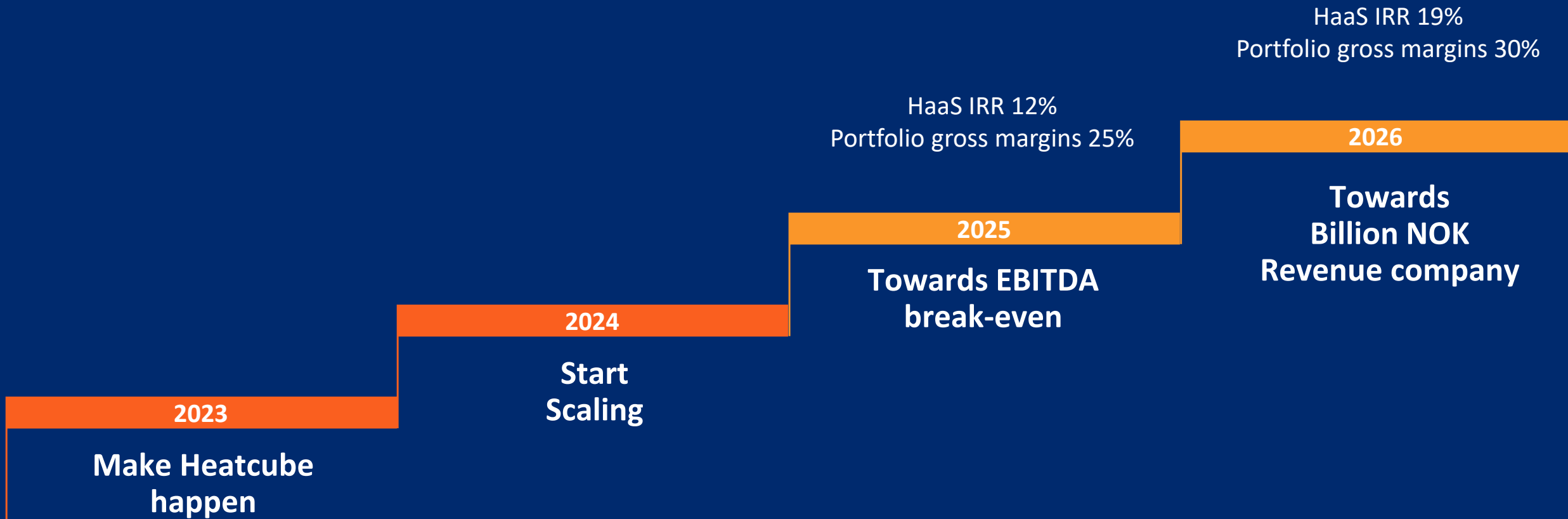


## Heatcube pipeline

Total volume: 40 (unweighted)



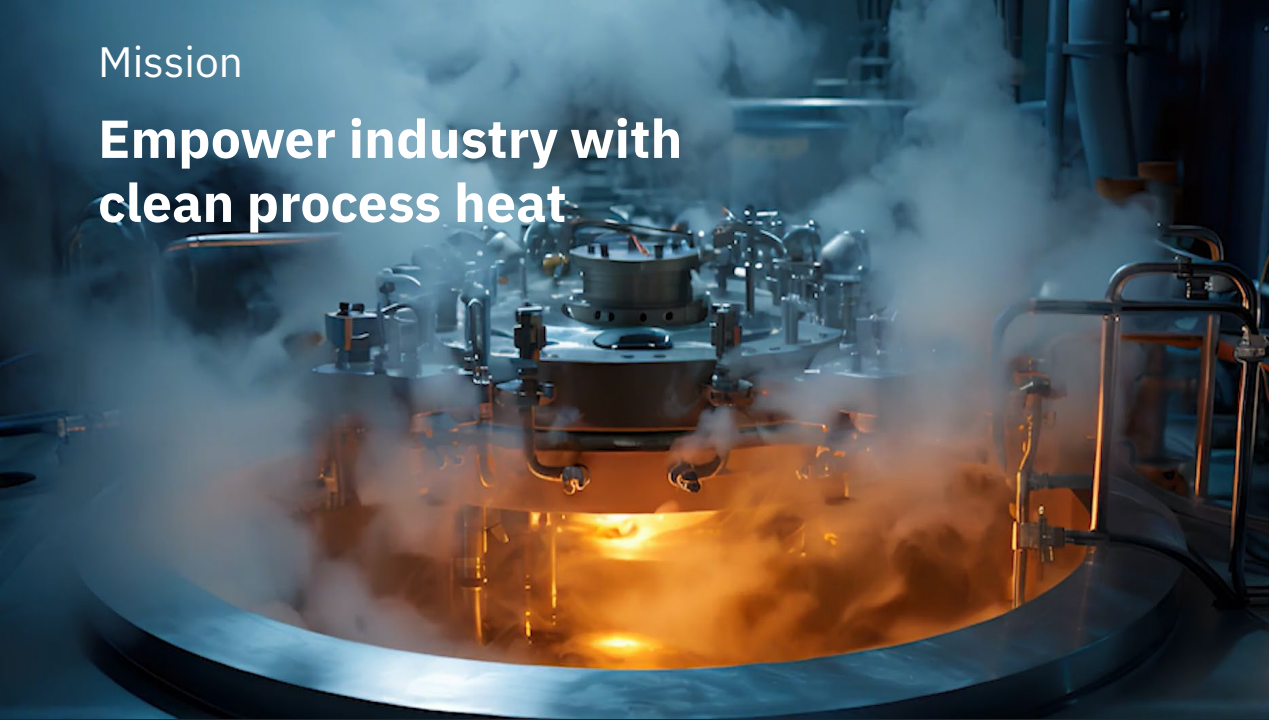
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Kyoto Group Company Presentation March 2024

# Kyoto Group

Board of Directors



Eivind Reiten  
Chairman



Thorleif Enger  
Board Member



Hans Olav Kvalvåg  
Board Member



Pål Selboe Valseth  
Board Member



Oscar Cantalejo  
Board Member



Christopher Molnar  
Board Member

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# Kyoto Group

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