



# L'ALTRA STRADA PER LA TRANSIZIONE

XV CONFERENZA NAZIONALE SULL'EFFICIENZA ENERGETICA

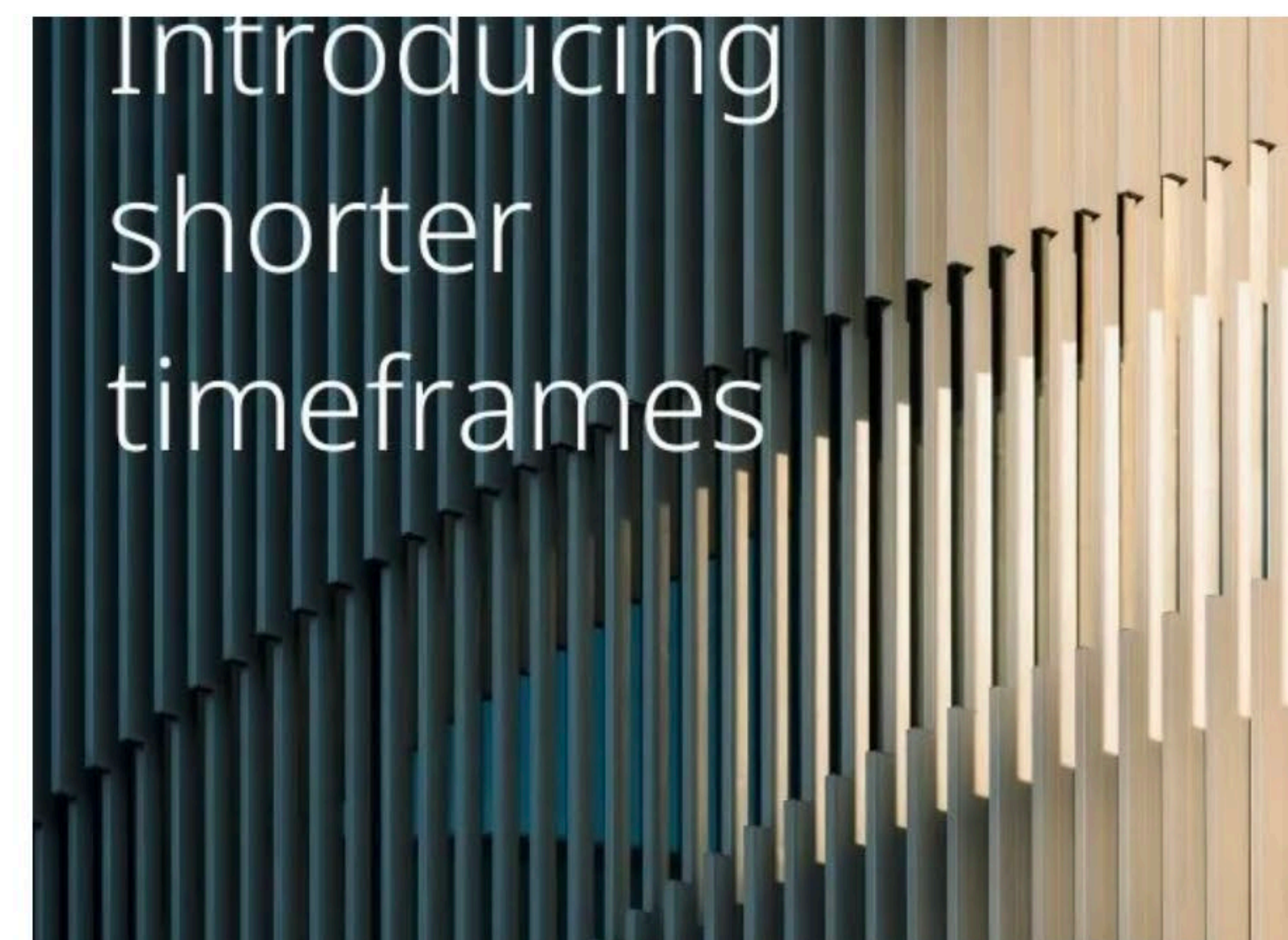
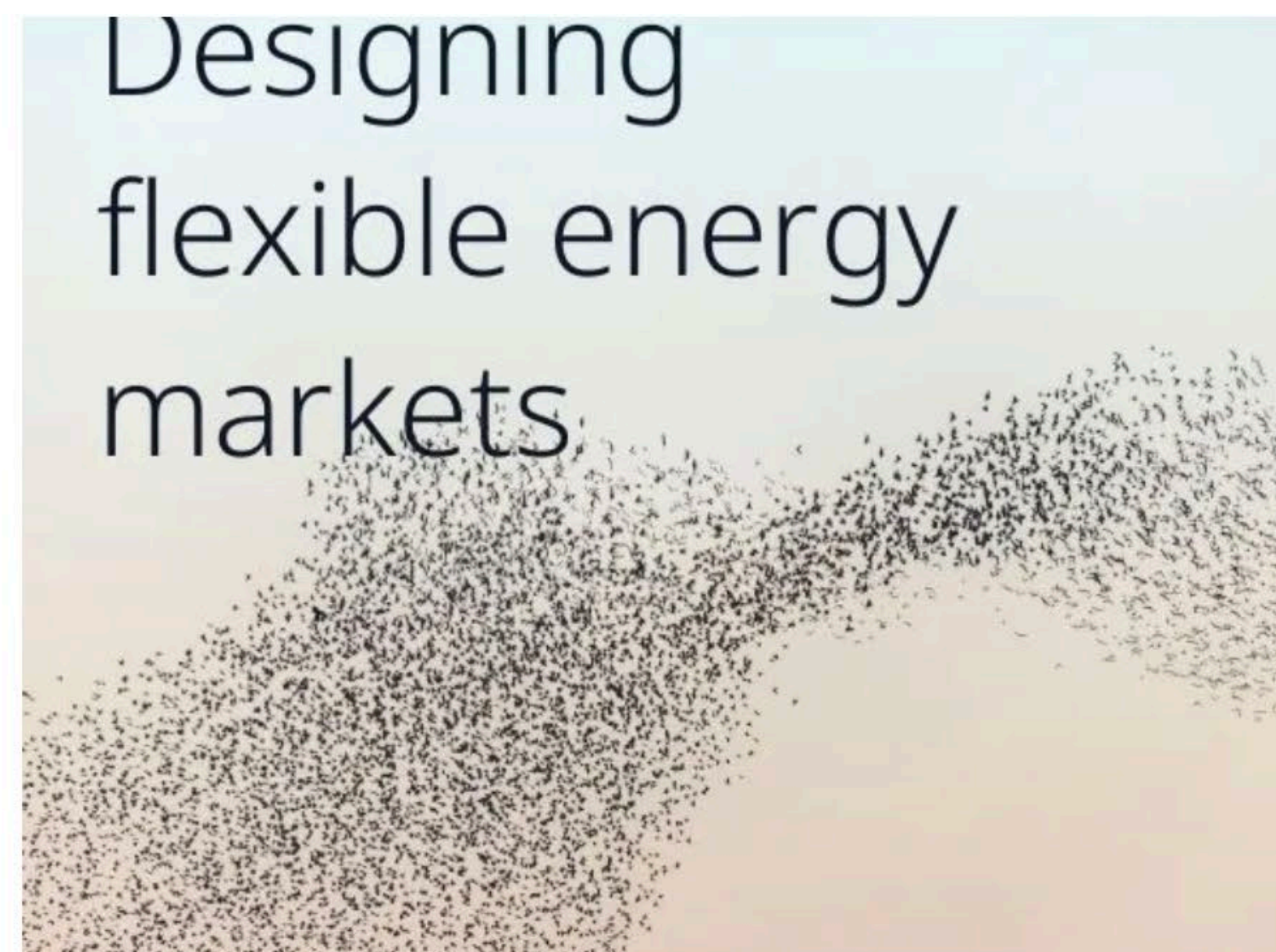
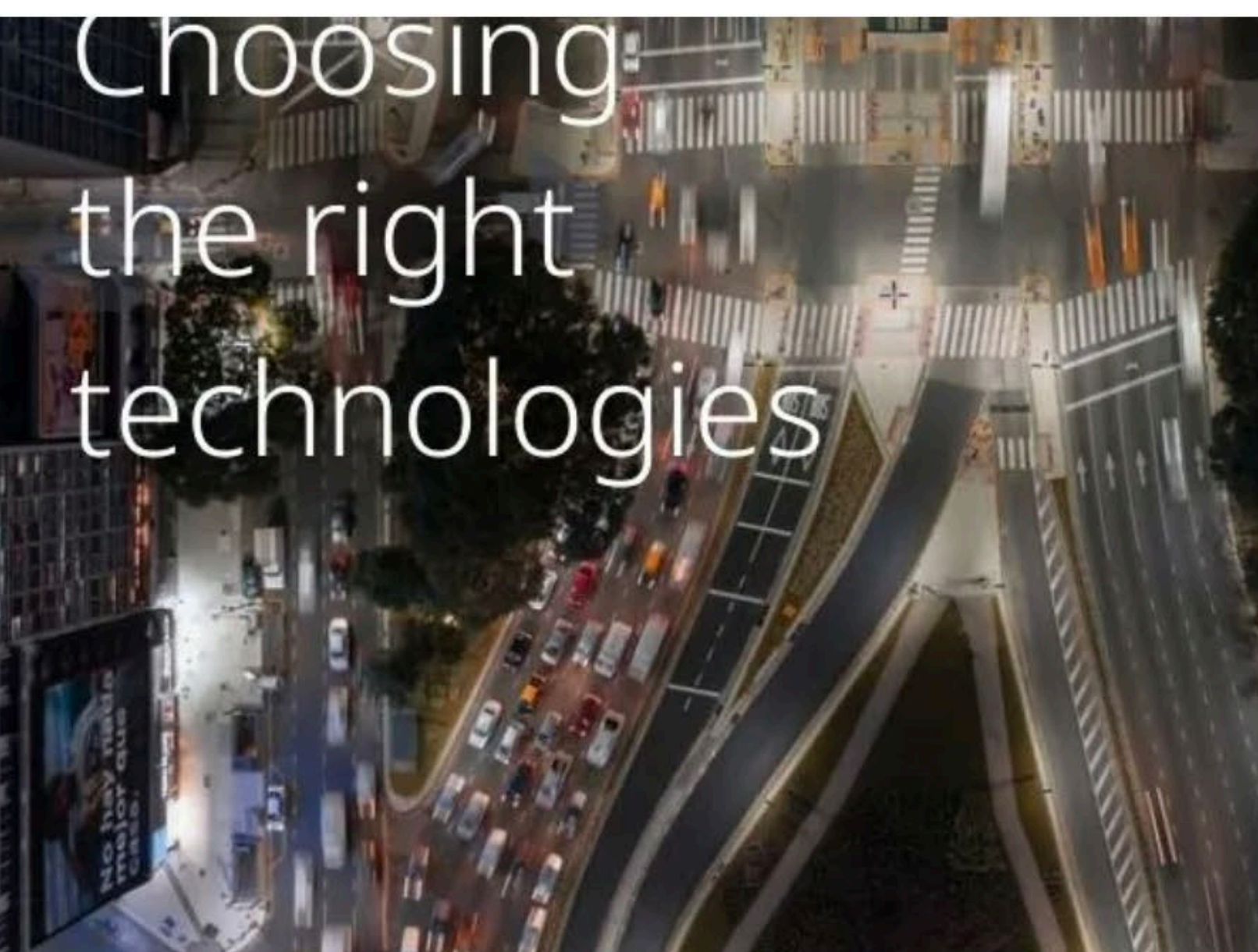
ROMA | 28-29 NOVEMBRE 2023

marco a.g.golinelli – Wärtsilä Italia

## Every second counts

## Wärtsilä 2023

Shaping the decarbonisation of marine and energy



Each moment that ticks by is a reminder of the potential of a single second. Within each second and decision lies an opportunity to accelerate the decarbonisation of energy.

If we want to achieve our net zero targets, decisions need to be sped up and policies need to change in many parts to accelerate the transition to renewable power systems.

# Energy is moving towards a 100% renewable energy future

## Policies and regulations

- EU: Carbon neutral by 2050
- USA: carbon free electricity production by 2035, net zero emissions by 2050
- China: Carbon neutral by 2060
- Country climate pledges to become more progressive
- RePower EU, The Inflation Reduction Act, Just Energy Transition partnerships

## Technology

- Wind and solar growing rapidly as the dominant source of energy
- Intermittent sources requiring balancing power
- Sustainable fuels for balancing power
- Digitalisation will create opportunities for optimising energy costs
- Cyber security growing in importance

## Growing energy demand

- Electricity generation would need to grow by 3X, renewables by 8X to reach Net Zero targets by 2050 (Source: IEA World Energy Outlook 2022, Net Zero Emissions Scenario)
- Gradual replacement of baseload fossil fuelled energy generation
- Renewables expected to become the largest source of global electricity by early 2025 (Source: IEA Renewables 2022 report)
- Power systems becoming increasingly complex with different types of generation assets

See our study, 2023: [Energy Market Redesign: For a Decarbonised Europe](#)

1100  
GW

Required renewable capacity to reach decarbonisation goals

19  
GW

Flexible gas capacity needed for a reliable renewable-based system

50  
GW

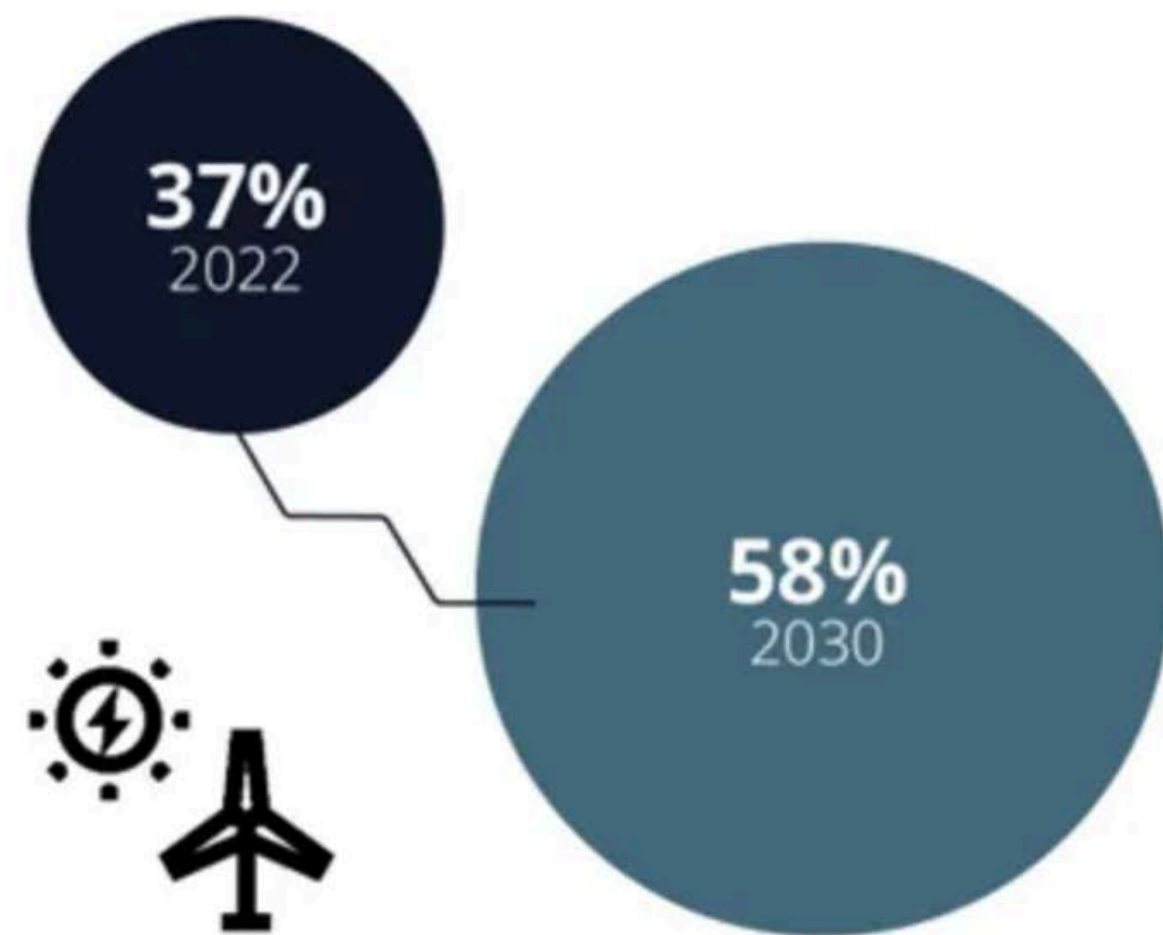
Energy storage for power during low generation periods

Europe will require at least 1,100 GW of renewable capacity by 2030 to continue its decarbonisation journey and increase energy security. However, for a renewable-based system of this scale to run reliably, it must be supported by 19 GW of new flexible gas capacity and 50 GW of energy storage to deliver power at times of low generation, according to Wärtsilä modelling. To enable 100% renewable energy systems, the grid balancing gas engines can be converted to run on sustainable fuels such as hydrogen, when these become readily available.

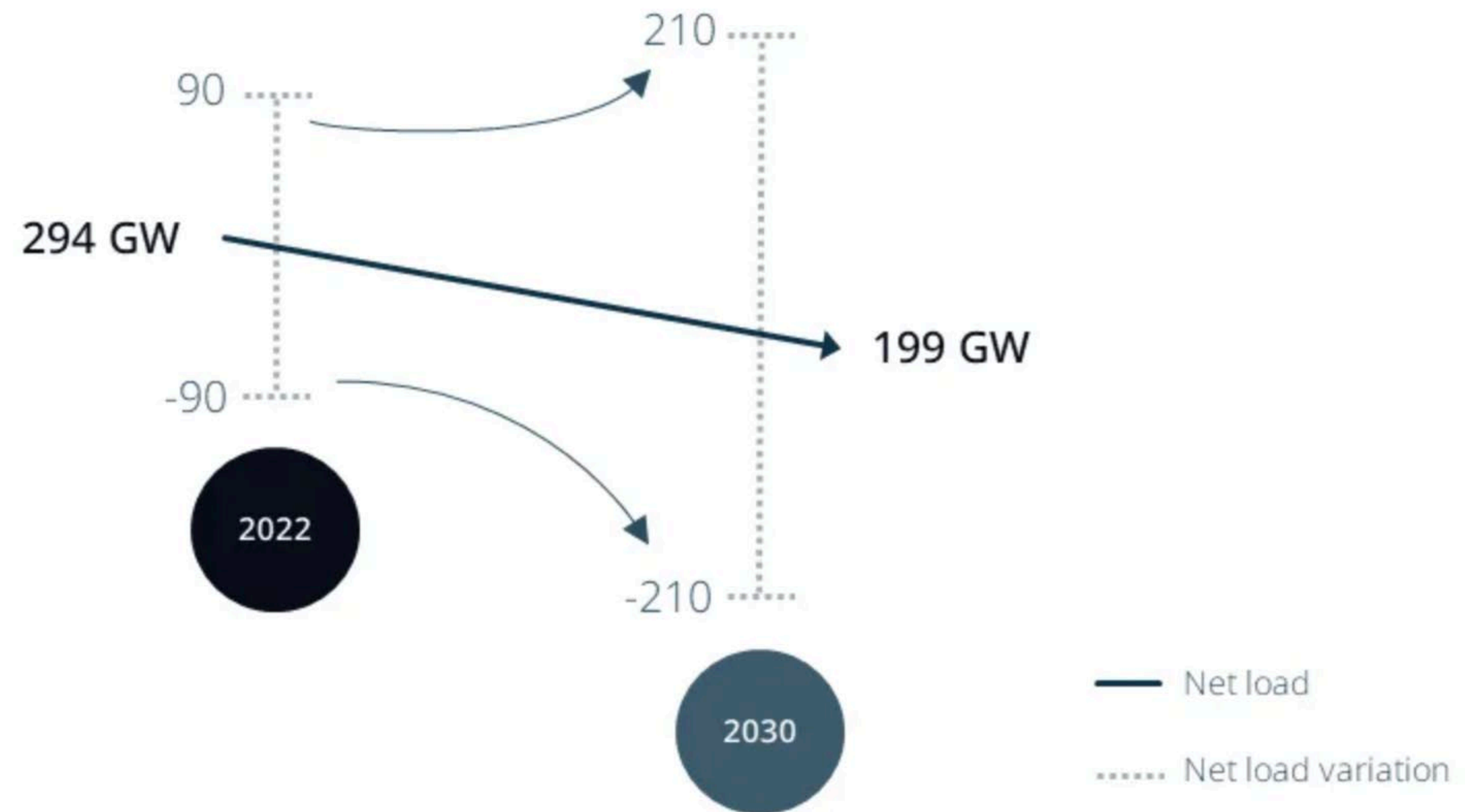
Italy in our 2024 study, stay tuned

# Energy Market Redesign: For a Decarbonised Europe

Increasing **share of renewables** in the energy mix in Europe...



...will increase dramatic energy imbalances in the system, as can be seen in **the average net load variation**.



NOTE: Renewable energy capacity is expected to grow 8x by 2050. To achieve the Net Zero Emissions Scenario\* by 2050, renewables should provide 88% of the world's energy supply.

Net load is the difference between the load and generation from variable renewable sources (solar and wind) at a given point in time. The upper and lower boundaries of the net load represent the extreme variations observed in net load during the year. Two standard deviations was used as a measure to estimate extreme variation.

# The key steps to front-load net zero

Curtailment of increased use of renewable energy sources being caused by system inflexibility.  
+  
Decrease running hours of legacy power plants.

Continue adding renewables supported by flexibility.

Utilise Power-to-X and flexible balancing engine power plants to provide carbon neutral long-term storage.

5

Phase out fossil fuels

4

Convert to sustainable fuels

3

Phase out inflexible power plants

2

Add balancing engines and energy storage

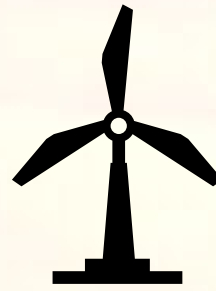
1

Add renewables

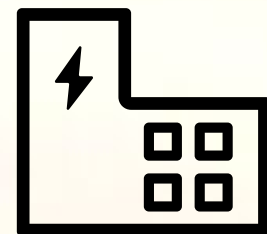


Decarbonisation is feasible with current technologies

## Technologies needed for a net zero power system



Wind and  
solar



Engine power  
plants



Energy  
storage



Sustainable  
fuels

We optimise your power system for a renewable energy future



Engine  
power plants



Energy  
storage



Lifecycle services

Energy system optimisation



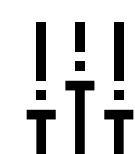


## Engine power plants for reliable energy

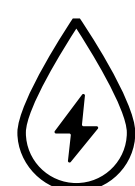
Our engine power plants offer flexible, efficient and reliable power generation in a changing energy landscape.

Our engine power plants will enable the addition of renewables in the system while ensuring reliability at all times.

To enable 100% renewable energy systems, engines can be converted to run on sustainable fuels such as hydrogen, when these become readily available.



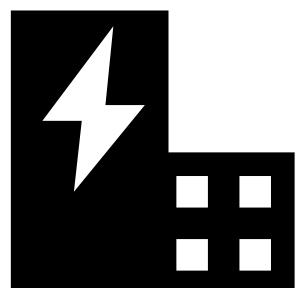
Flexible operations



Fuel adaptability



Future-proof solutions

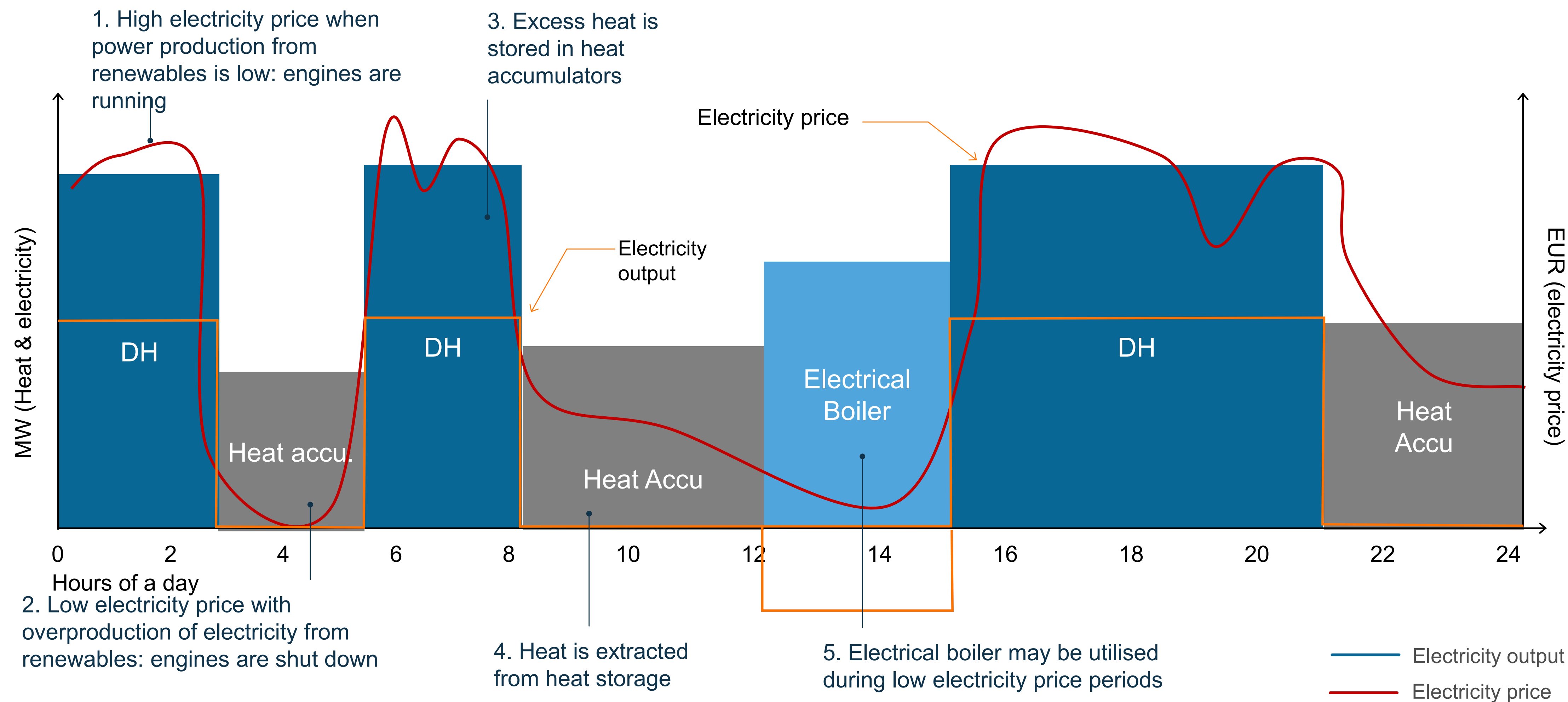
 > **50%**

## Combined heat and power plants for reliable energy (+ trigen)

- The most flexible power plant in the thermal power industry
- Proven technology
- High electrical and thermal efficiency
- Extremely high reliability and availability thanks to multi unit installations
- Best choice for cyclic operation, system balancing
- Low maintenance costs due to no EOH from starts
- Wide load range and high part load efficiency
- Low impact of ambient conditions on plant performance

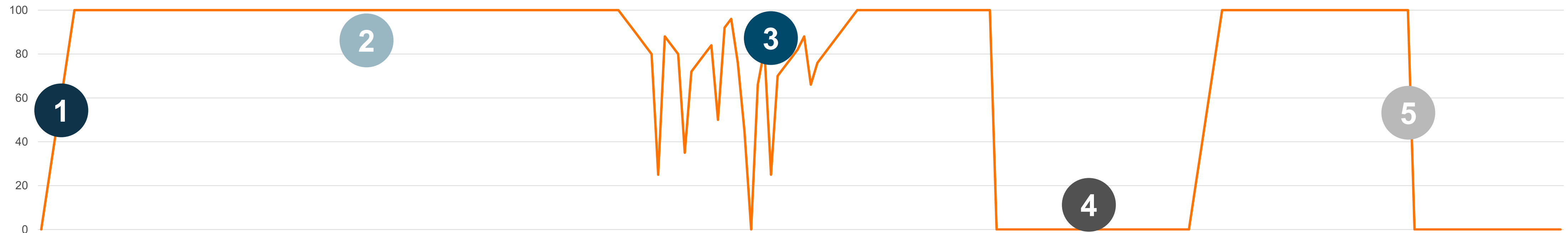


# Dinamic Distric Heating (DDH) in high renewable energy system



# Wärtsilä Balancing solutions – Benefits in practice

Output (%)

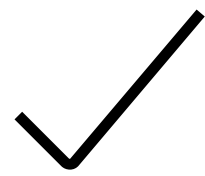


	1. FAST START	2. GRID CAPACITY BALANCING	3. LOAD FOLLOWING	4. LOW-LOAD OPERATION	5. FAST STOP
<b>BENEFIT</b>	<ul style="list-style-type: none"> <li>Grid stability support</li> <li>Ancillary Service market</li> </ul>	<ul style="list-style-type: none"> <li>Competitive life cycle generation cost</li> <li>Any output, same generation cost</li> </ul>	<ul style="list-style-type: none"> <li>Balancing renewables</li> <li>Rapid response to fluctuations</li> <li>Ancillary Service market</li> </ul>	<ul style="list-style-type: none"> <li>"Low load" = No load</li> <li>Not running when no revenue</li> </ul>	<ul style="list-style-type: none"> <li>Not running when no revenue</li> </ul>
<b>FEATURES</b>	<ul style="list-style-type: none"> <li>Power to grid in 30s</li> <li>2-5 min to full power</li> <li>Unlimited starting with no degradation</li> <li>Efficient start-up</li> </ul>	<ul style="list-style-type: none"> <li>Highest simple cycle efficiency</li> <li>(Availability)</li> <li>Firm capacity</li> <li>Multi unit - highest efficiency at any load point</li> </ul>	<ul style="list-style-type: none"> <li>Multi unit - highest efficiency at any load point</li> <li>No increase in maintenance cost when cycled</li> </ul>	<ul style="list-style-type: none"> <li>1-2 min shut-down</li> <li>No minimum down time</li> <li>Zero fuel cost</li> <li>Zero emissions</li> </ul>	<ul style="list-style-type: none"> <li>1-2 min shut-down</li> <li>No minimum up time</li> <li>No EOH calculation</li> </ul>

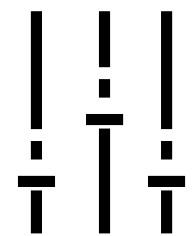
## Energy Storage & Optimisation (ES&O)



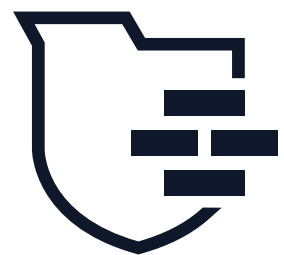
Top tier energy storage integrator globally with 15+ years of proprietary software leadership



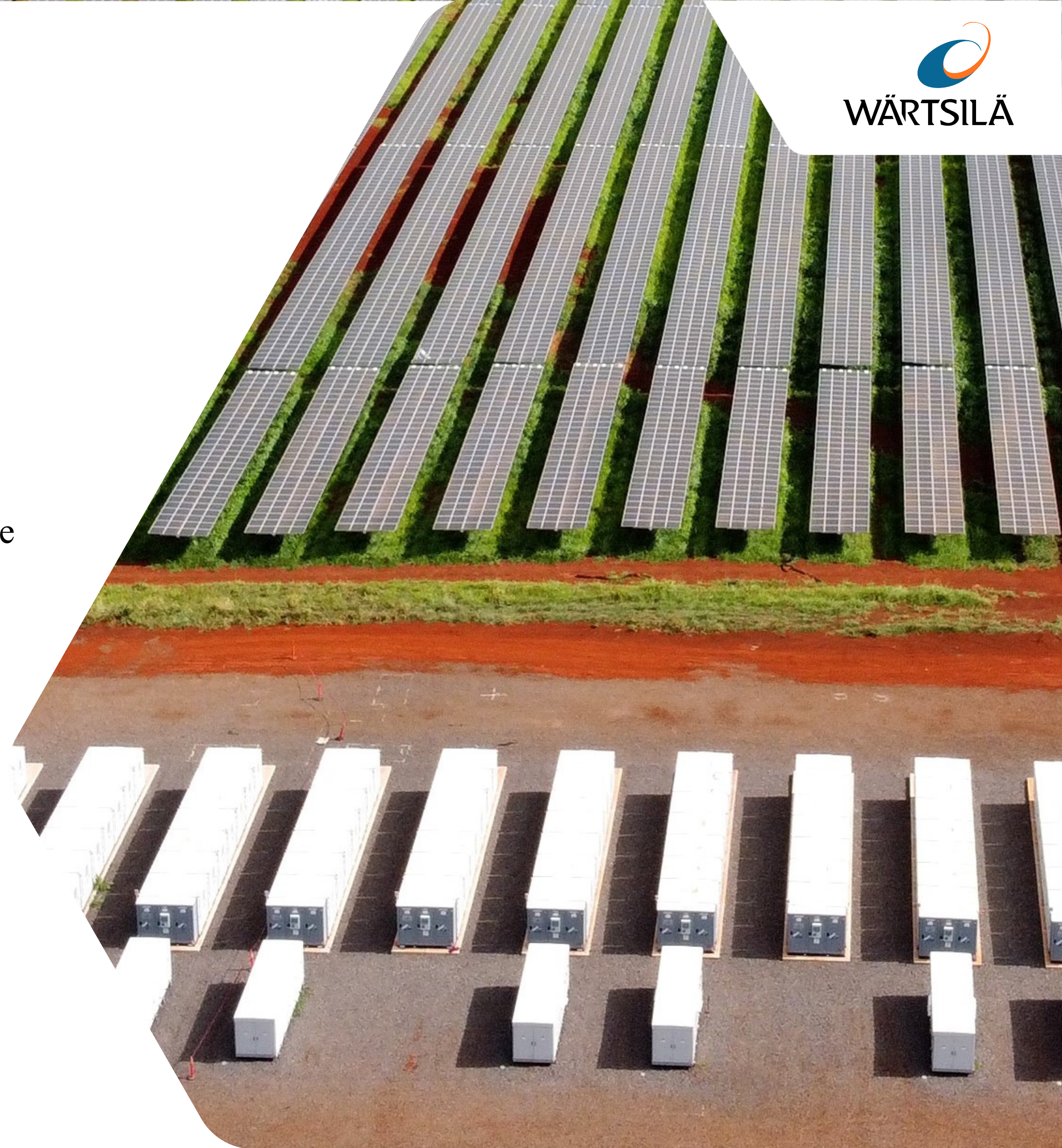
Long-proven track record of 110+ grid-scale storage system installations globally



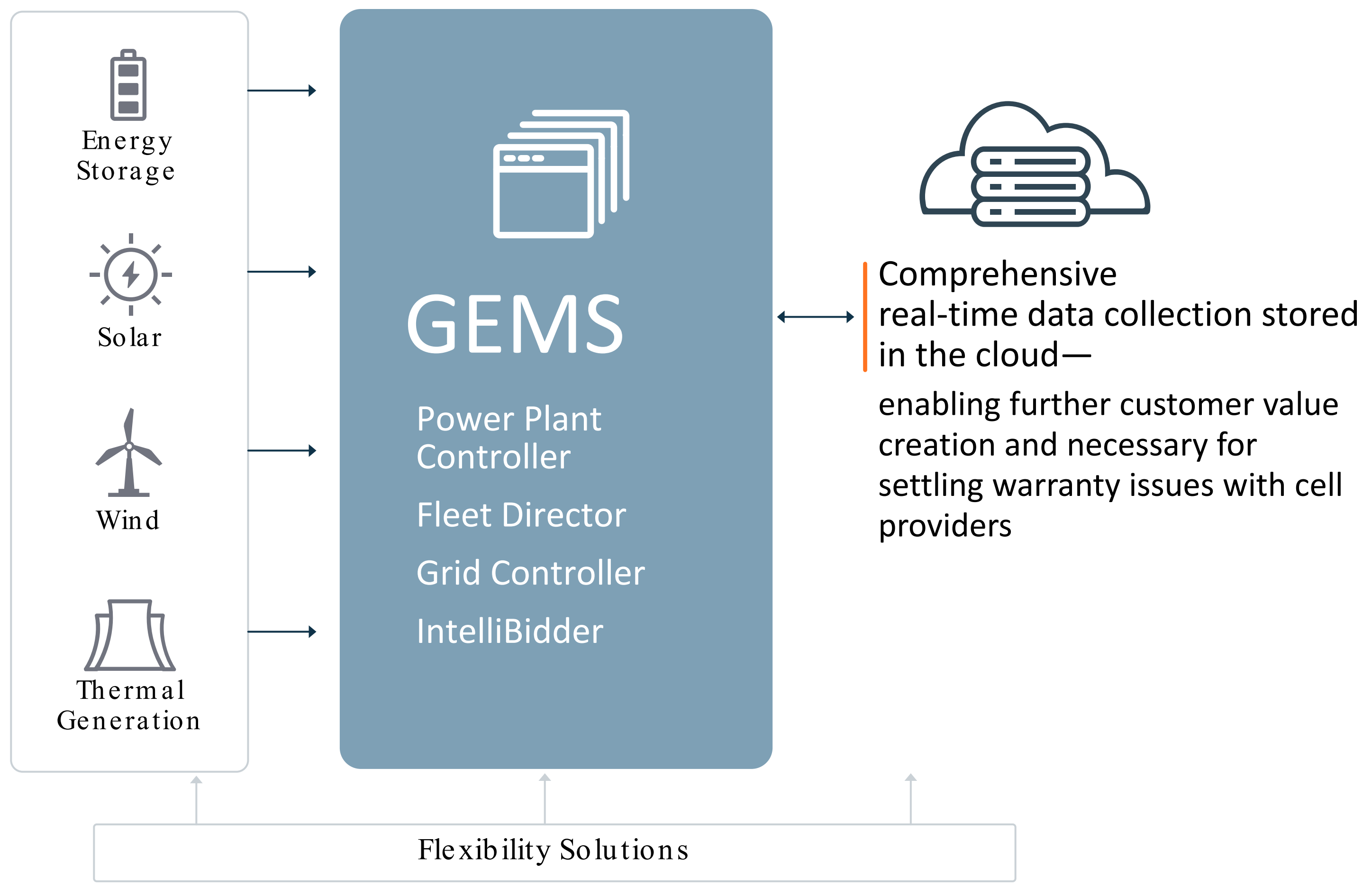
Optimisation of complex grids and multi-site portfolios with the GEMS Digital Energy Platform



Energy storage system design with safety at the forefront – UL 9540A compliant GridSolv Quantum



# GEMS Digital Energy Platform



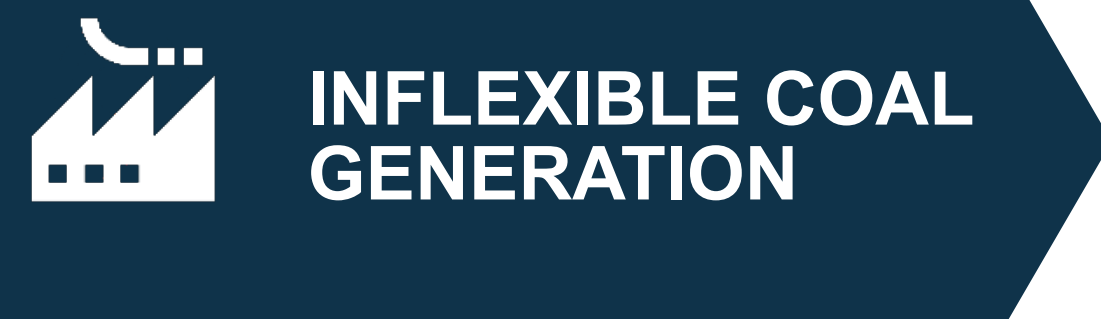
## GEMS Solutions Suite

Optimises all generation assets

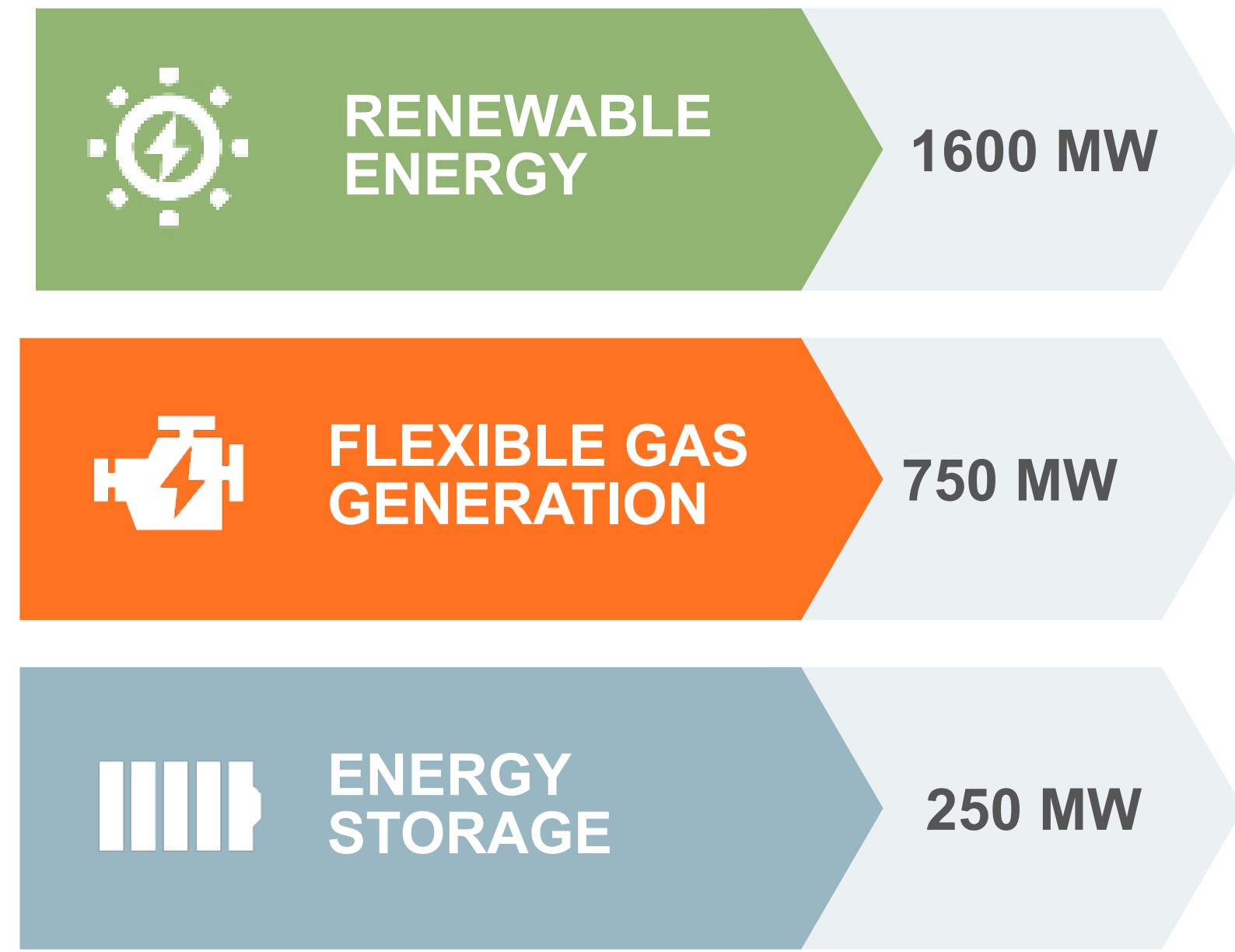
Flexible & scalable

Deployed in 110+ projects globally

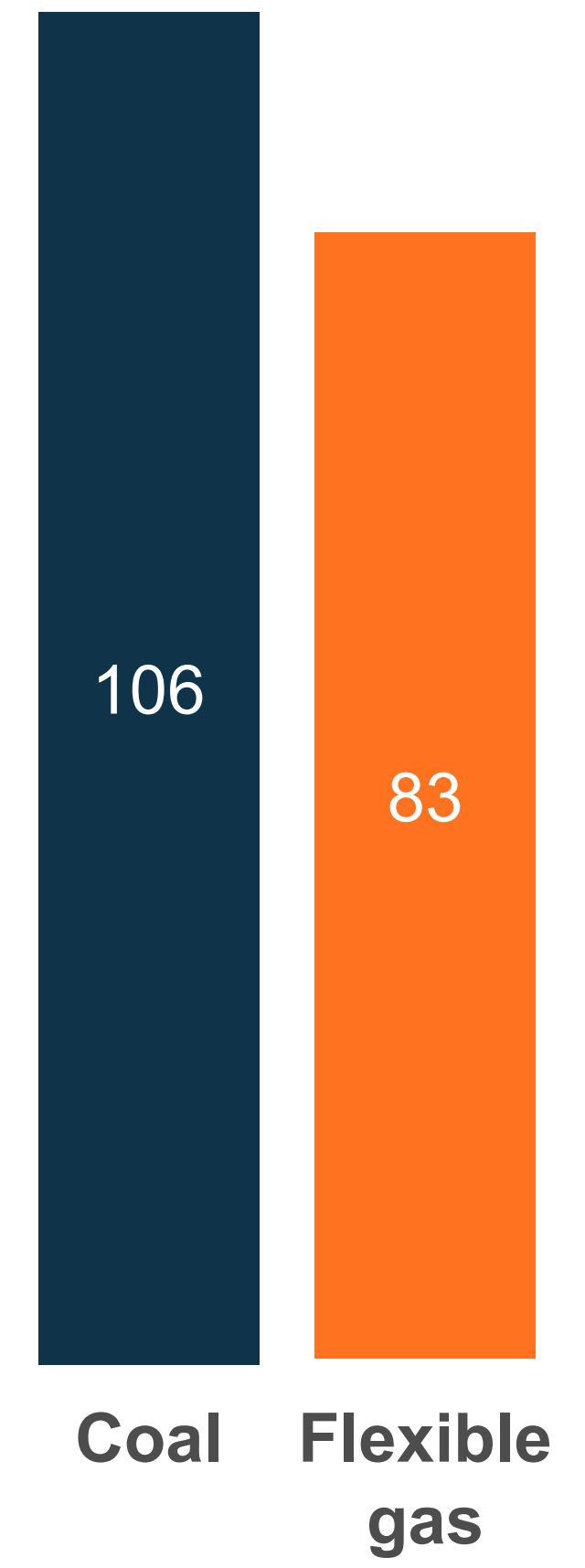
# LIDDELL Coal plant replacement in Australia by AGL Energy



TRANSITION



VALUE



LEVELIZED COST OF ENERGY, \$/MWH

2020  
**39 %**

Renewable energy

2030  
**64 %**

Renewable energy

2045  
**100 %**

Renewable energy

Solar, wind, storage, engines, hydro

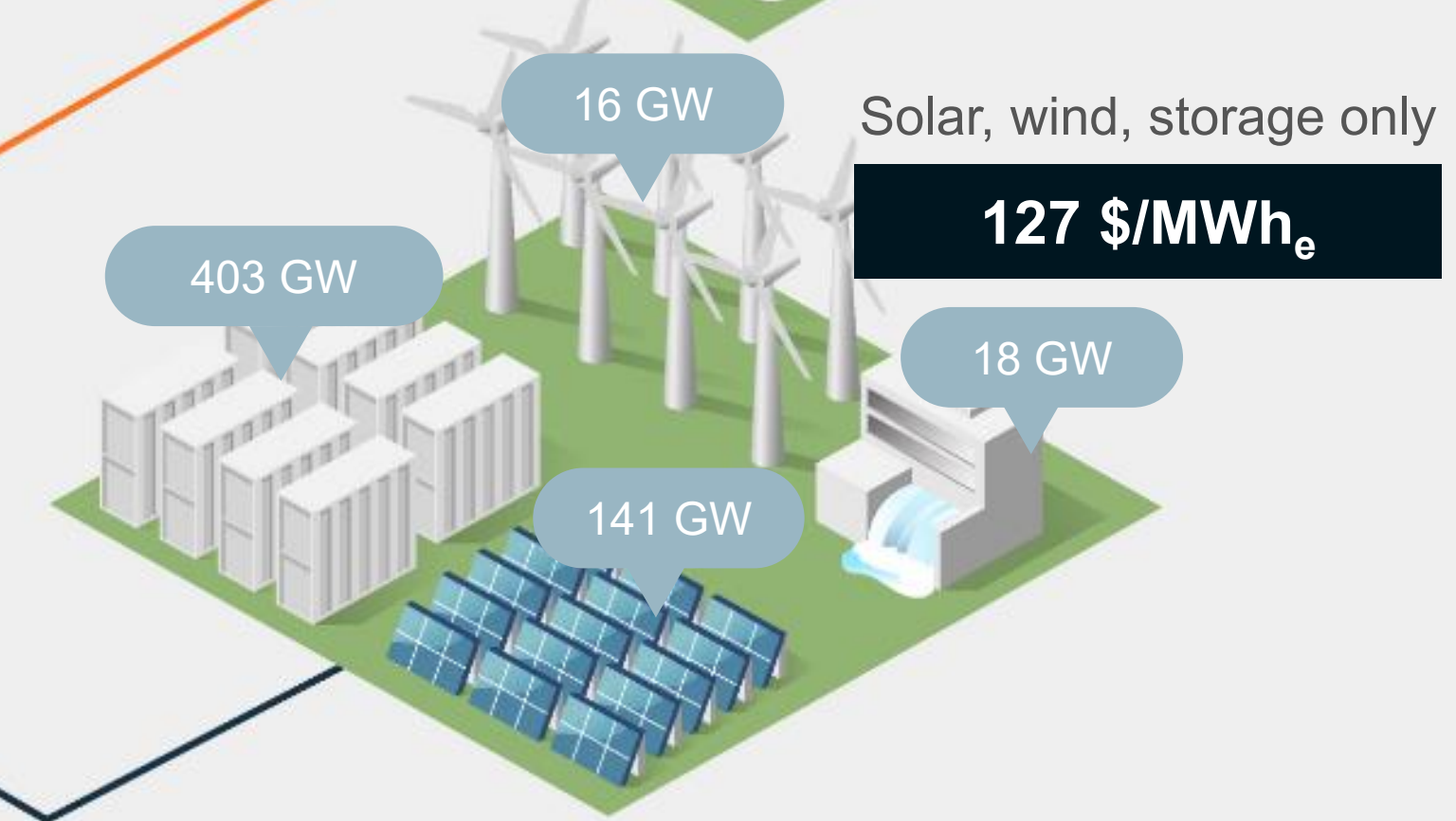
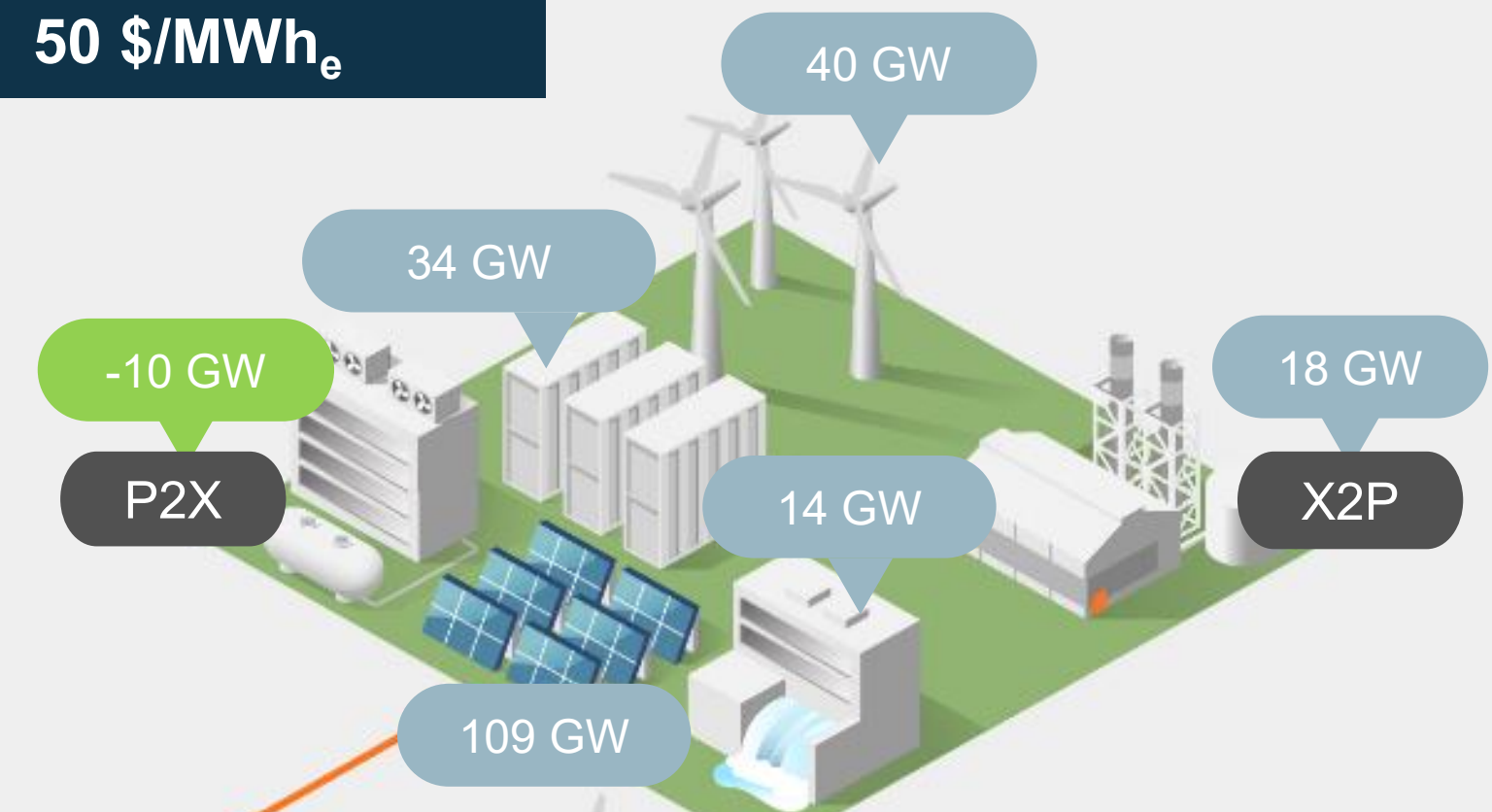
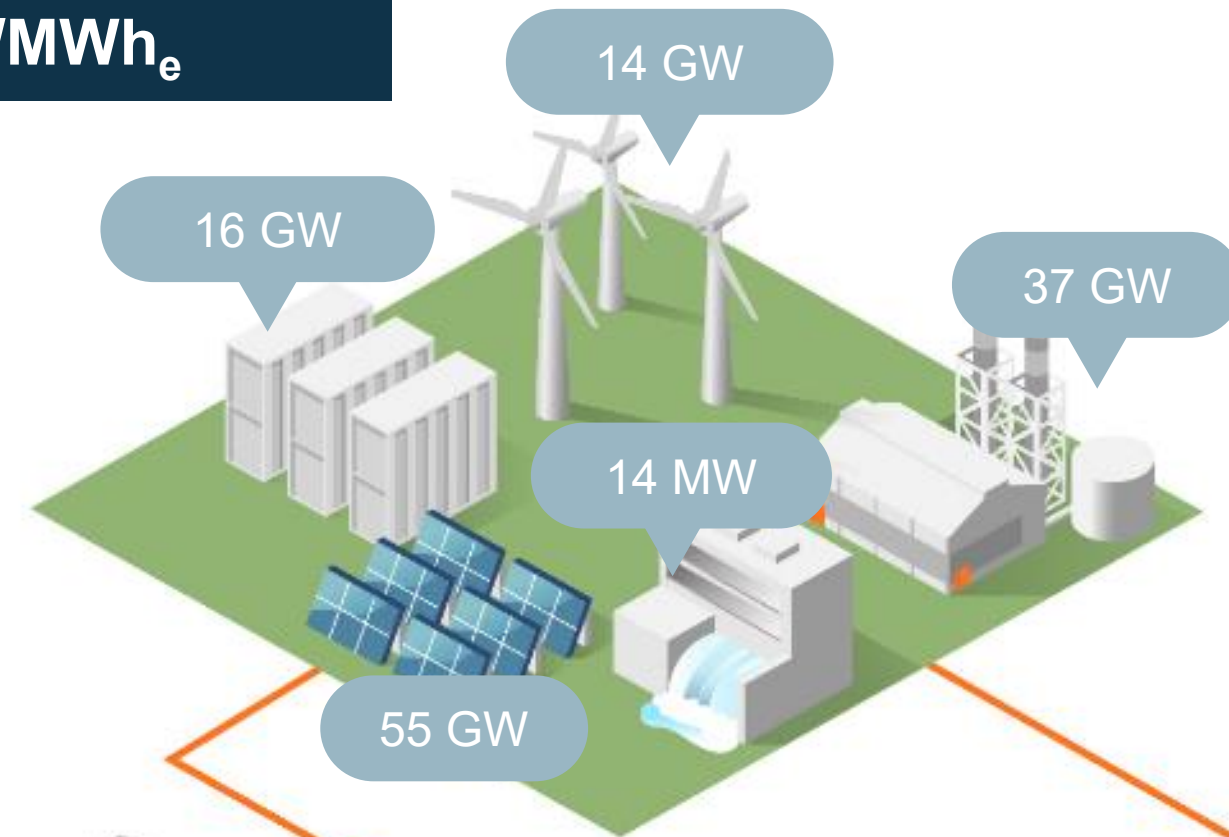
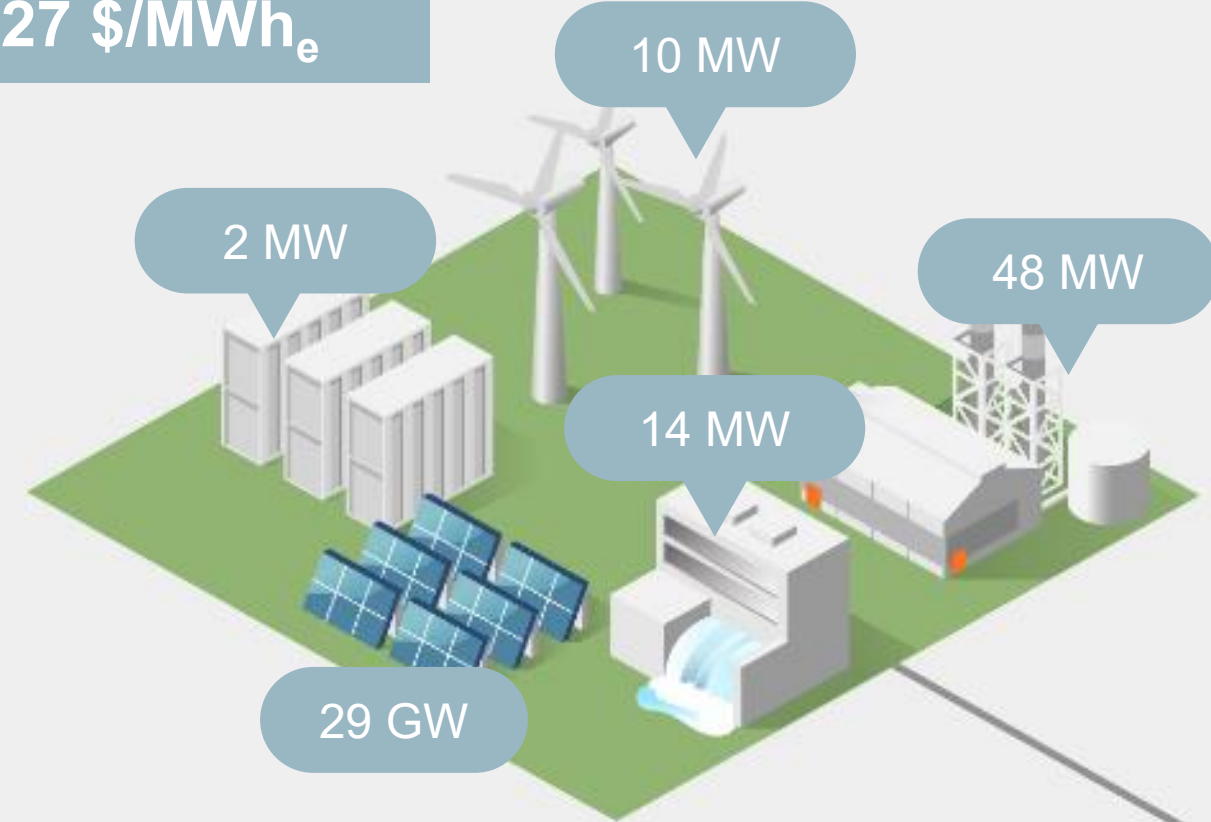
**33 \$/MWh<sub>e</sub>**

Solar, wind, storage, engines, hydro, Power to X

**50 \$/MWh<sub>e</sub>**

Solar, wind, storage, engines, hydro

**27 \$/MWh<sub>e</sub>**



Solar, wind, storage only

**127 \$/MWh<sub>e</sub>**

**CHOOSE YOUR PATH**

OPTIMISED ENERGY SYSTEM

NON OPTIMISED ENERGY SYSTEM

# California, USA

## AN OPTIMISED TRANSITION WITH THE RIGHT FLEXIBILITY



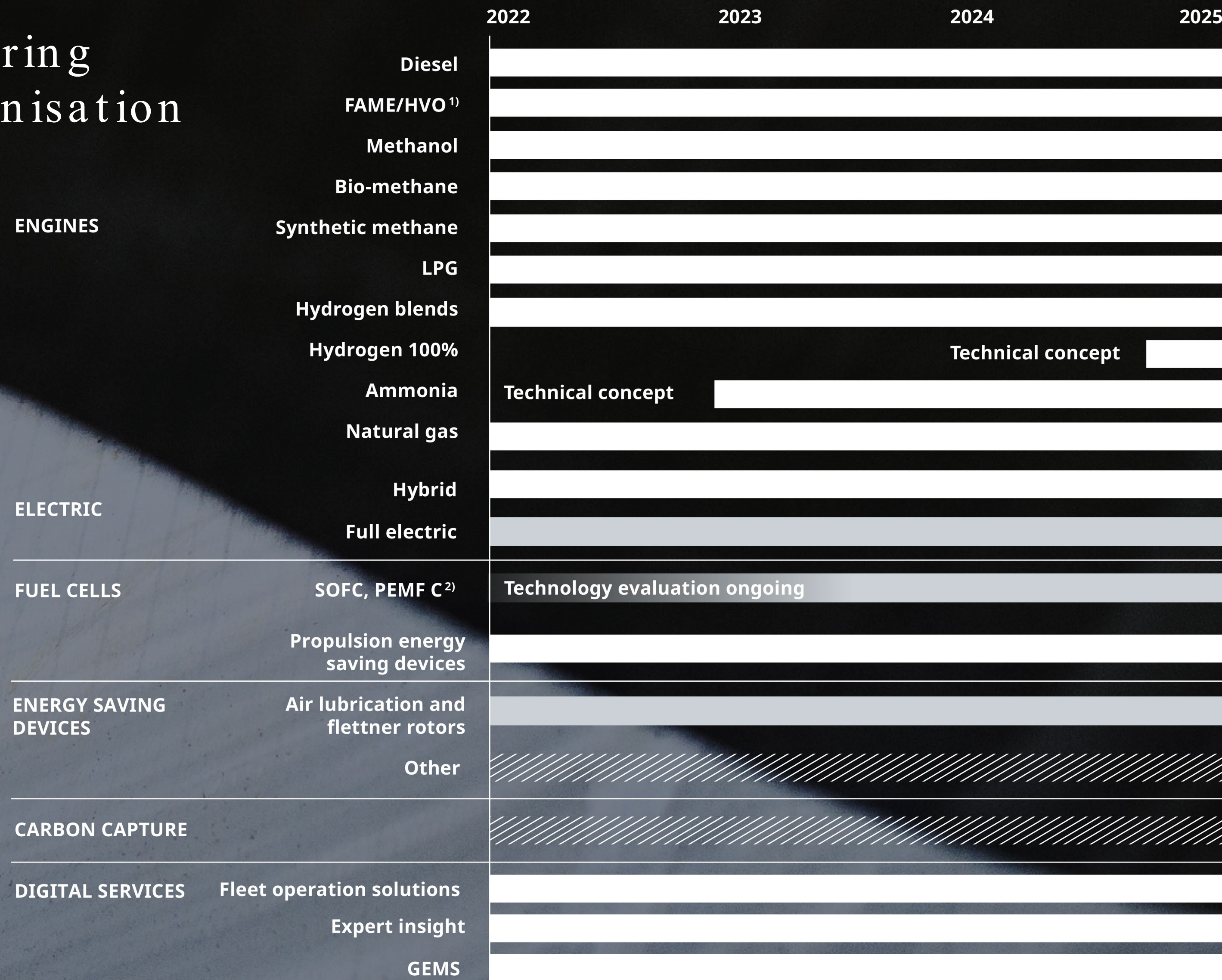


# Sustainable fuels for decarbonising power generation

The demand for green hydrogen and renewable synthetic fuels is growing significantly as industries are seeing it as a way to decrease their carbon footprint.

Technologies for replacing fossil fuels exist already today. **Power-to-X** is a process which allows the creation of carbon neutral, sustainable fuels. Fossil fuels will over time be replaced by these sustainable fuels as they lower the impact of the climate change.

# Broad solution offering to support decarbonisation



 OWN TECHNOLOGY
  Through partnering
  Both in house development and partnering

<sup>1)</sup> FAME, HVO: biodiesel <sup>2)</sup> SOFC: solid oxide fuel cell, PEMFC: proton exchange membrane fuel cell

Many years of experience  
in developing fuel flexibility



### PARTNERSHIPS IN POWER-TO-X

- Close to ten partnerships with start-ups, universities and companies
- Pilot projects
- Feasibility studies

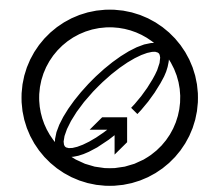


### R&D IN X-TO-POWER

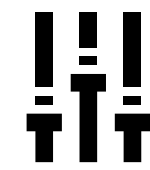
- Researching fuels, e.g. biofuel and biogas, hydrogen, ammonia, methanol
- Engine and combustion tests
- Developing technology

# CONCLUSIONS 1

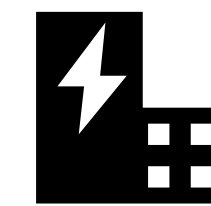
- Wärtsilä solutions are optimised for the decarbonisation's journey



Optimised for dispatchable balancing and grid firming



Highly modular and expandable with integration capabilities for energy storage



The most efficient and flexible CHP, based on proven technology, from the company with world-leading fuel flexibility pedigree

- **It can be done** : supplying world's largest solar-plus-storage project portfolio and, world's first, a Wärtsilä engine runs on 25vol% hydrogen blend in a commercially operated power plant
- Power plant **flexibility** is essential in net zero power systems
- Energy storage is needed to support flexible generation, for the short and the long term

**DAILY**

Variations in generation are handled mainly by **batteries**

**WEEKLY**

**Flexible thermal generation** ensures longer duration energy balance and system reliability

**SEASONAL**

**Power-to-X fuel** acts as energy storage to balance seasonal variation

- Energy Efficiency first
- Technology mix is the name of the game (technological neutrality)
- It can be done 2 (but rules, norms and supporting mechanisms have to be clear and stable)
- Supporting mechanism for investments and innovations



**WÄRTSILÄ**