EnergyWeek 2023

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EnergyWeek

Systems Diversifications in Energy Storage Needs and Business Models in Future Energy Systems

By: ENERGY VAASA

ExEd Vaasan yliopisto UNIVERSITY OF VAASA

24.3.2023

2023 MARCH 20–24 VAASA, FINLAND

Moderator

Cynthia Söderbacka

Project Leader in the Faculty of Technology &
Novia University of Applied Sciences

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Energy storage tech enabling reliable and green power systems

Jens Nybäck

Proposal Manager

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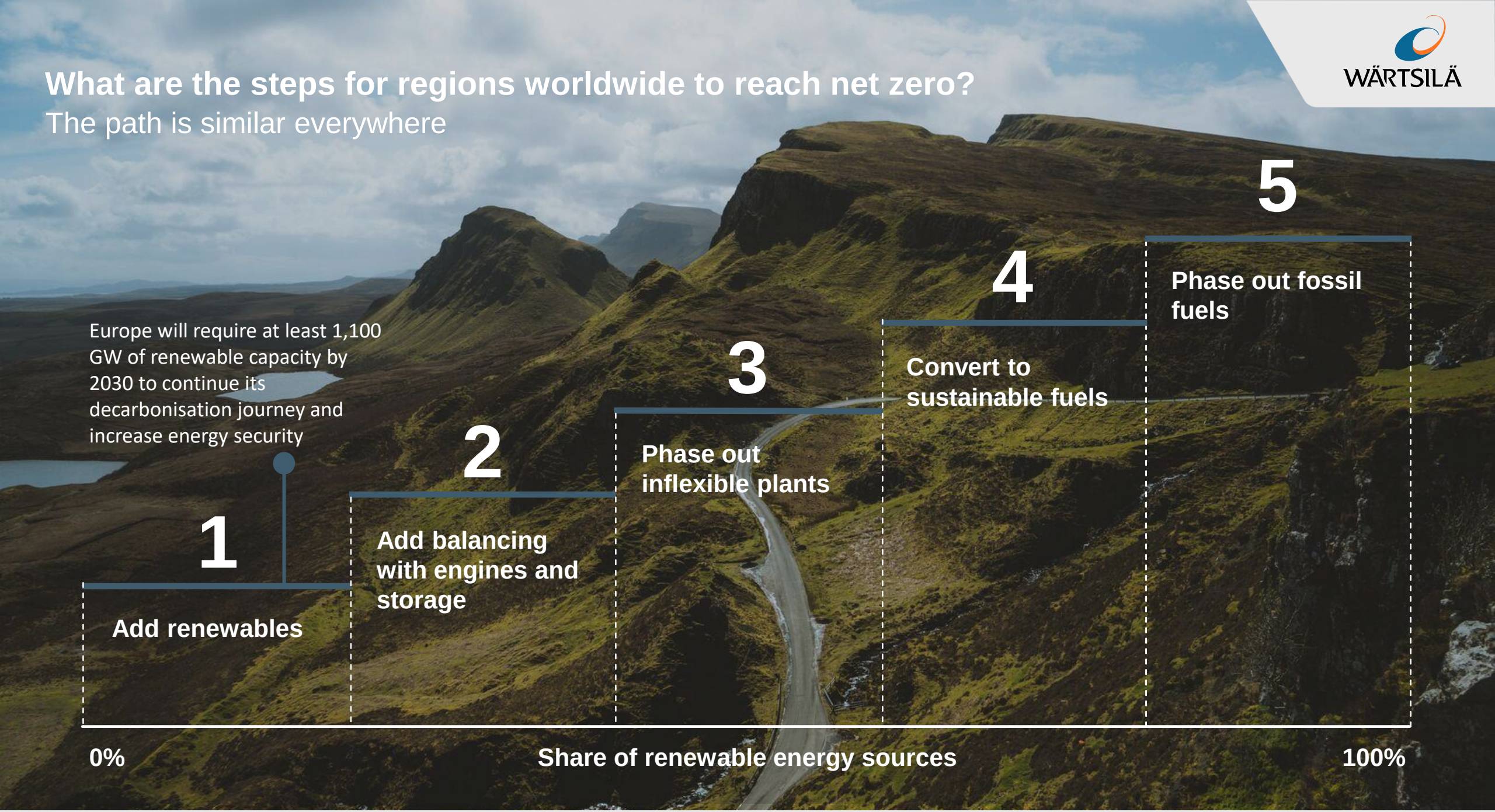
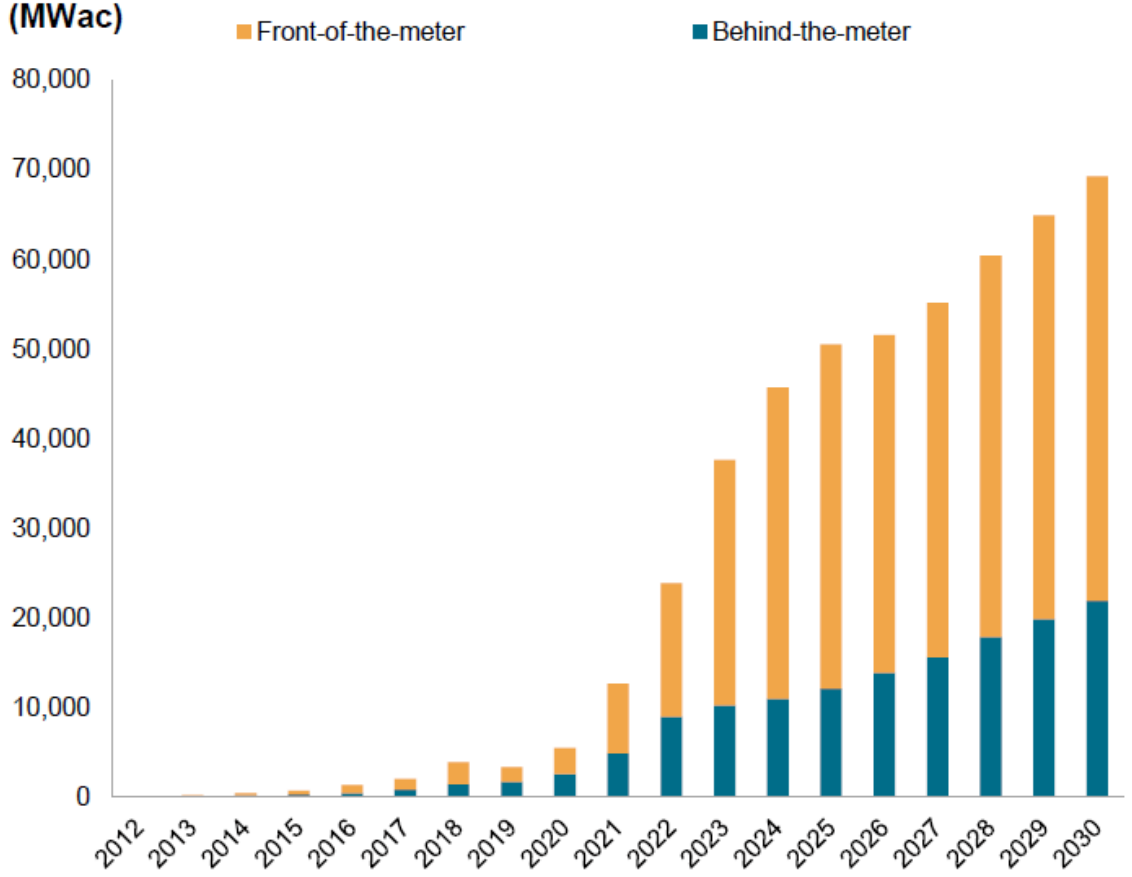
What are the steps for regions worldwide to reach net zero?

The path is similar everywhere

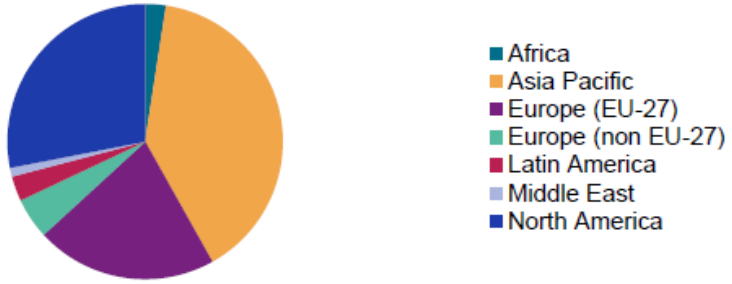


Energy storage capacity additions will again set a record in 2023

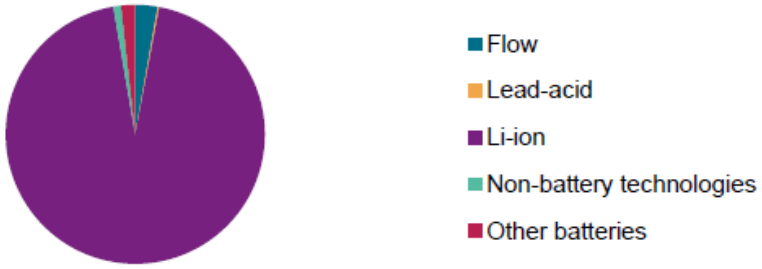
Global grid-connected energy storage gross capacity additions by siting (MWac)



Gross capacity additions by region (% of MWac, 2015–30)



Gross capacity additions by technology (% of MWh, 2015–30)



Gross capacity additions to reach 40 GW in 2023

Source: S&P Global Commodity Insights

Flexibility solutions solve multiple grid issues

Grid reliability

Meeting demand for power 24/7

Renewables integration

Ensuring seamless integration of wind, solar & other renewable energy sources

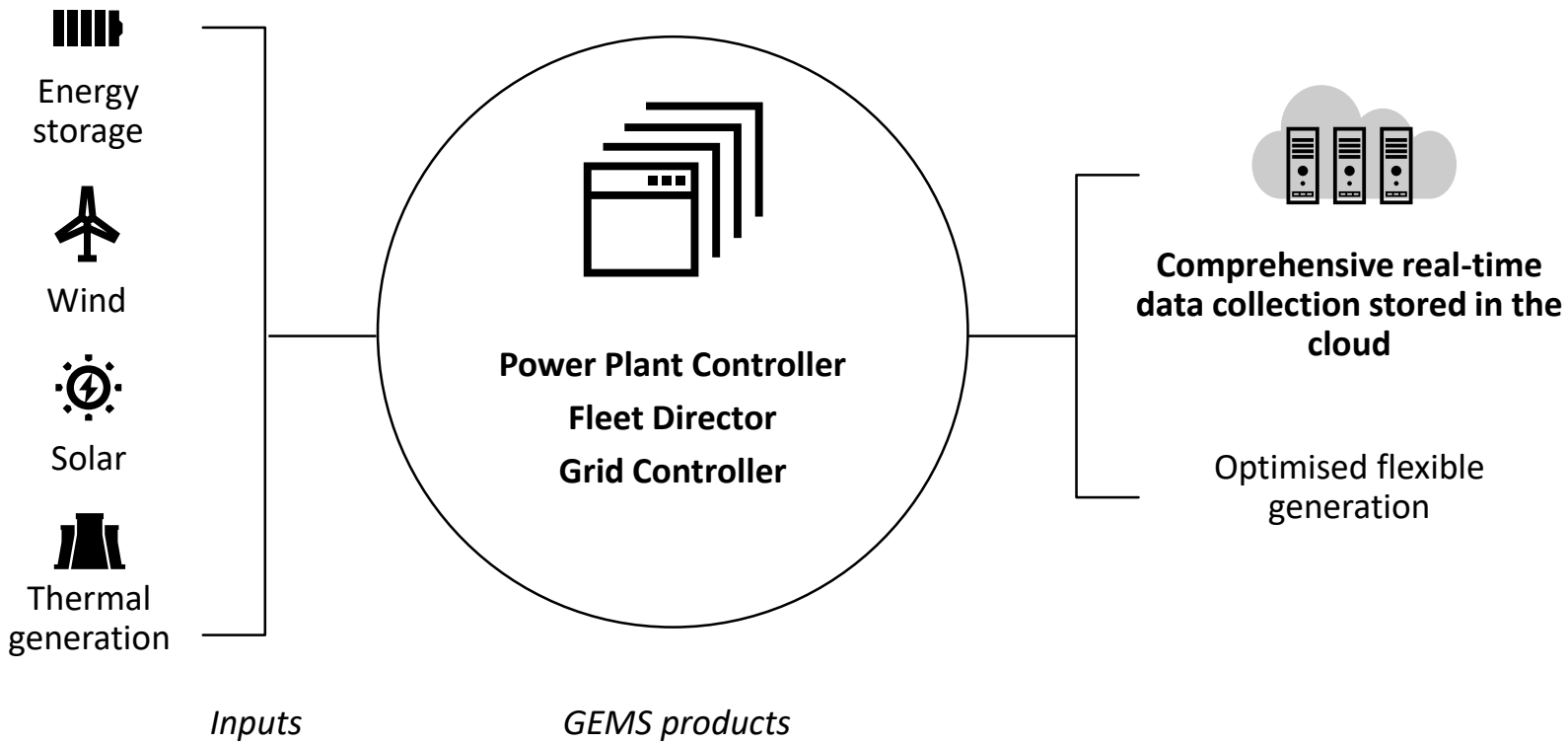
System optimisation

Creating a flexible fleet of assets working in harmony

Connecting energy assets to energy markets

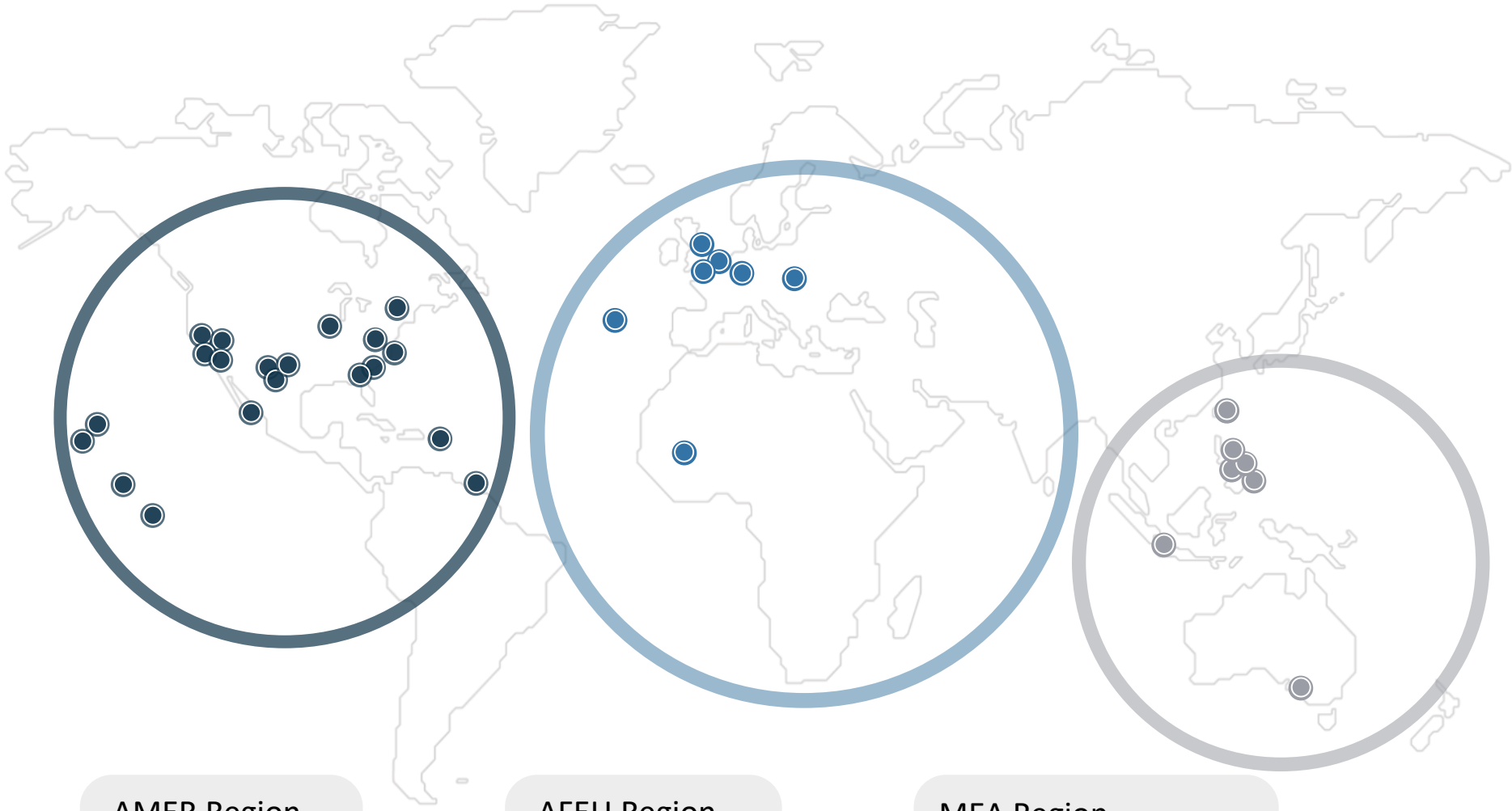
Flexibility solutions & EMS connect energy assets to energy markets in technically & economically optimised manners

GEMS Digital Energy Platform



A suite of proprietary software products developed for building, monitoring and intelligently operating power plants and energy resources

Wärtsilä’s global portfolio



AMER Region
Americas
1.8 GW+
4.3 GWh+

AFEU Region
Africa, Europe
637 MW+
1.1 GWh+

MEA Region
Middle East, Asia, Australia
526 MW
507 MWh

2.9 GW+
5.8 GWh+

*awarded, contracted, in deployment

GEMS Digital Energy Platform

15+ years development

110+ projects

The Netherlands

GIGA Storage

25 MW / 48 MWh

The storage system will **optimise the power system**, **regulate energy frequency** & **reliability** on the grid

The project will also make **operations more sustainable** & **integrate more renewables** onto the grid

The storage technology will store the equivalent of the annual energy consumption of more than **9,000 households** each year

Belgium

Nippon Koei Energy Europe B.V.

25 MW / 100 MWh

The system will help to **regulate fluctuations** & **supply peak power** with stored **renewable energy** in the grid

The **GEMS Digital Energy Platform** will ensure **optimal performance** for the energy supply across specified use-cases – including reserve power, frequency control response, capacity dispatch & voltage support

UK, 5 projects

EDF Renewables UK & Ireland

2 x 50 MW / 50 MWh
2 x 50 MW / 100 MWh
1 x 50 MW / 100 MWh

The projects contribute to **greater UK National Grid stability** & **flexibility**—improving route to market for clean power solutions & reducing carbon footprints

Ensuring **clean**, **affordable** & **secure electricity supply** when **more renewables** are integrated to the grid

Providing additional power capacity to **support the installation of electric vehicle (EV) charging networks** designed to accelerate the electric transport transition

UK

Zenobē

200 MW / 400 MWh

One of the first projects in the world to deliver **stability services using a transmission-connected battery** & the first to be delivered under **National Grid's NOA Stability Pathfinder programme**

Assist grid operators in the management of challenges related to **balancing supply and demand, power stability** & **constraints**

Will provide stability services to the National Grid Electricity System Operator (NGESO) including **short-circuit level** & **inertia**

The future grid

- Integrated
- Safe
- Reliable
- Flexible

Enabling a 100% renewable energy future

storage.wartsila.com

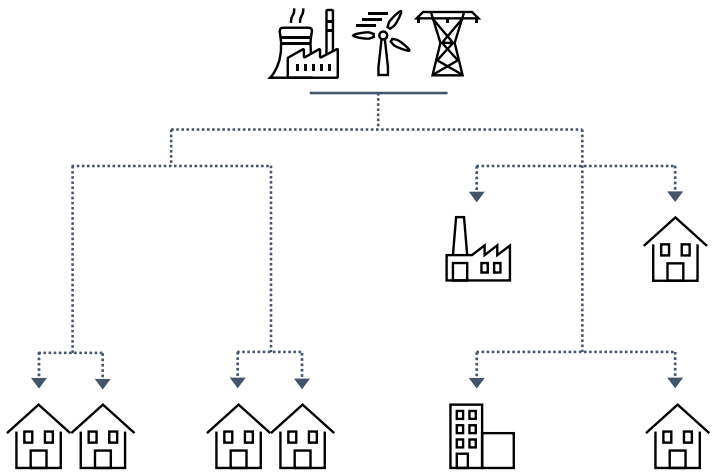

WÄRTSILÄ

Earning models and utilization of battery energy storages

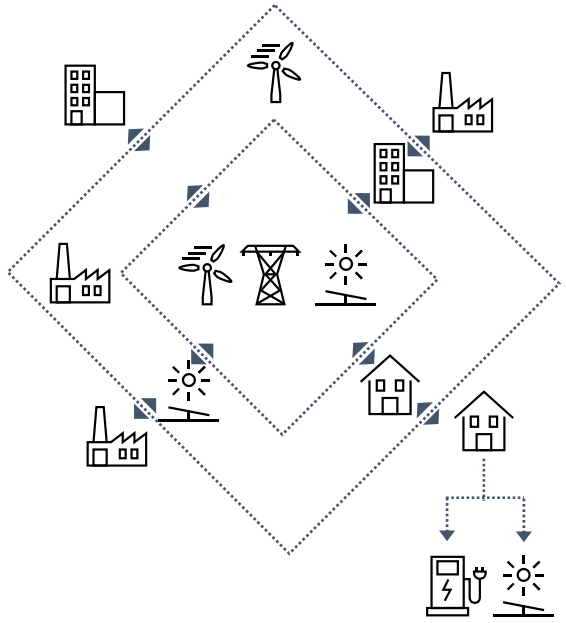
Björn Nyberg
Solution Manager
Hitachi Energy

New energy ecosystem

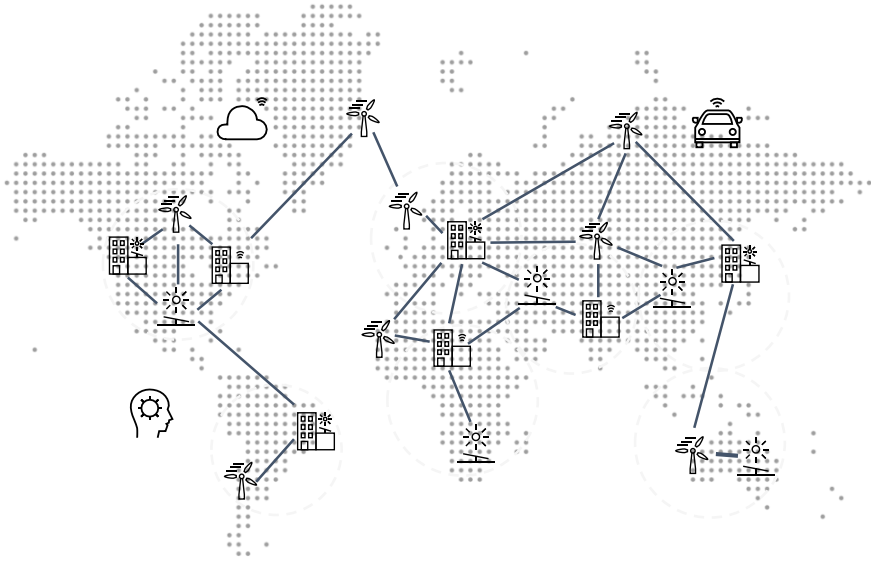
Yesterday



Today

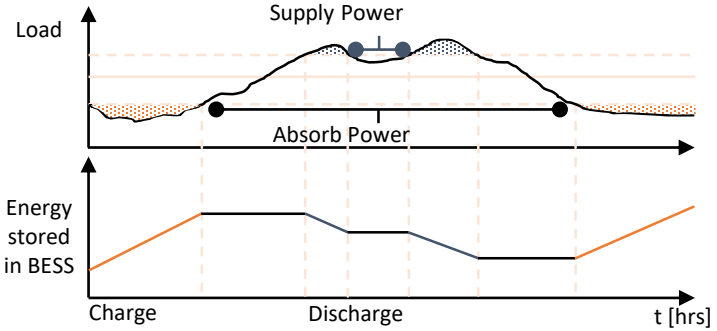


Tomorrow

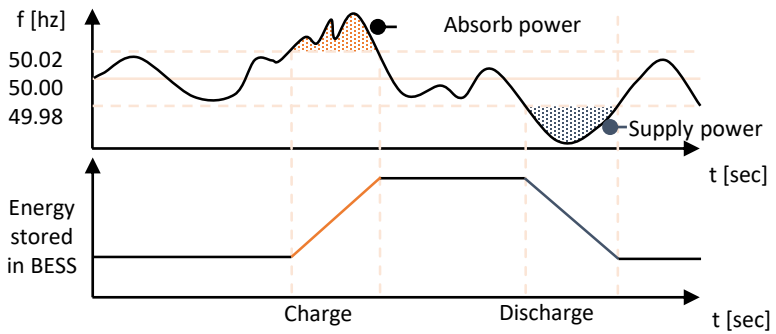


Renewables, grid edge technologies and digitalization drive the evolution of future power systems

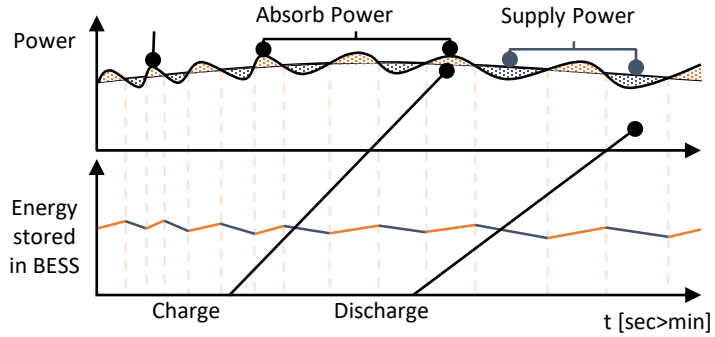
BESS applications



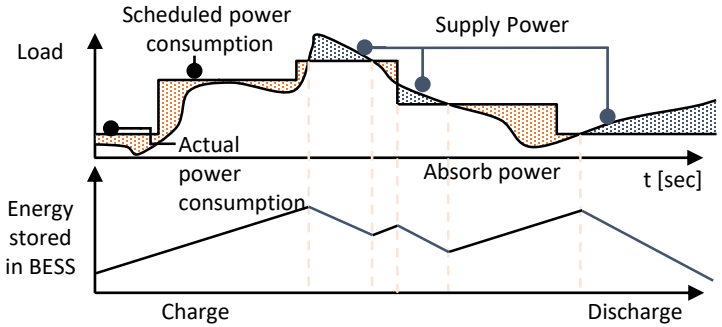
Load leveling



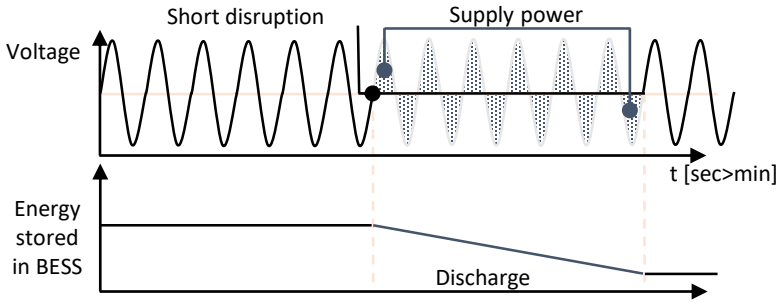
Ancillary services



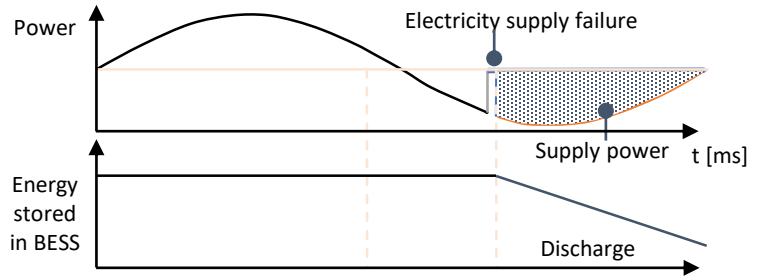
Integration of renewable resources



Peak shaving



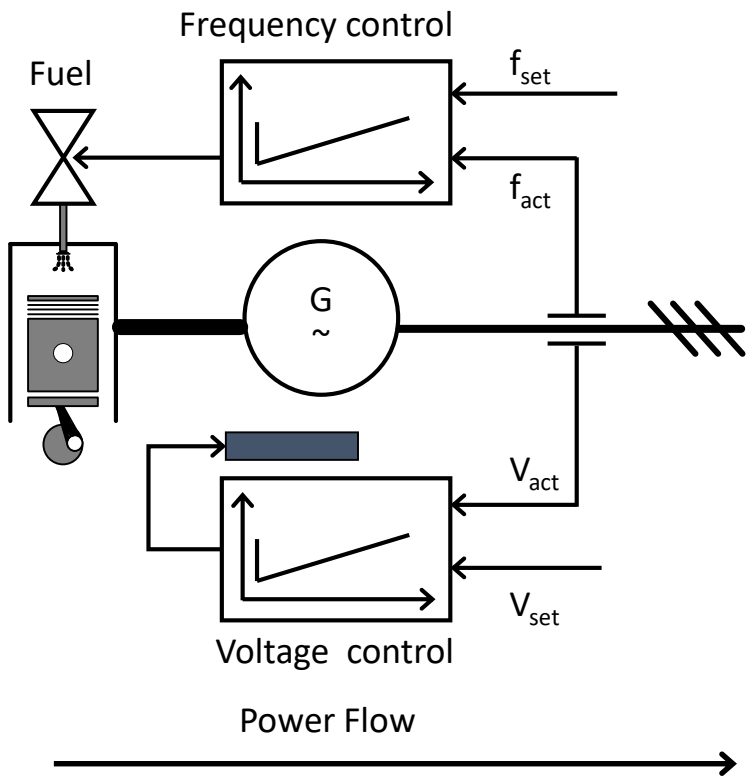
Transition between on- and off-grid



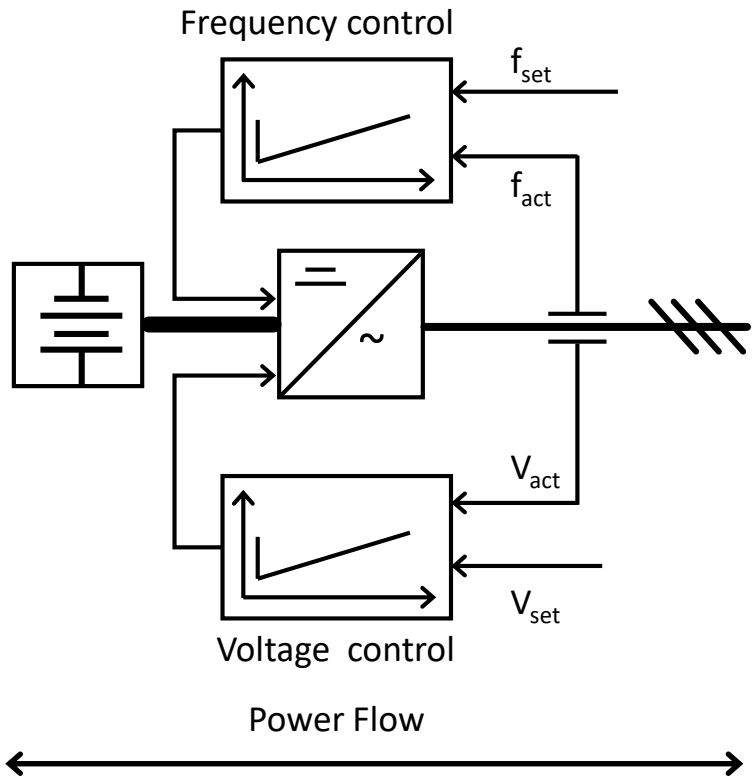
Spinning reserve

BESS applications

Conventional Generator



Virtual Generator

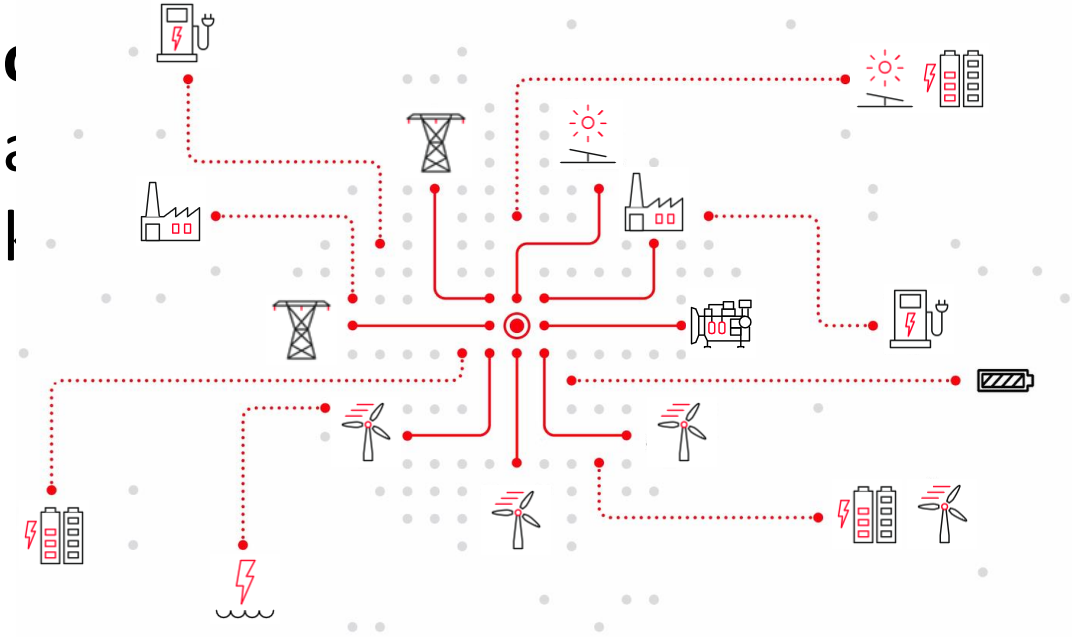


Versatile inverter platform with virtual generator functionality

Hitachi Energy - Grid Edge Solutions

e-mesh Control System

- A Control System which can control all assets in the edge of the grid, to enable safe and **reliable integration**

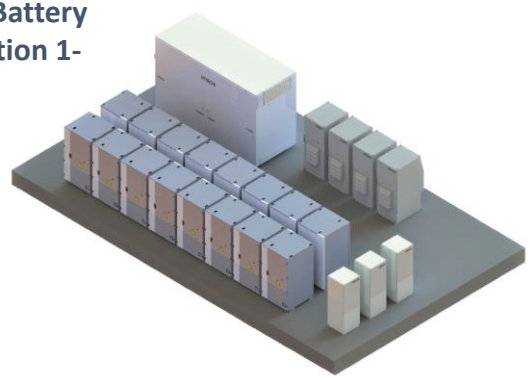


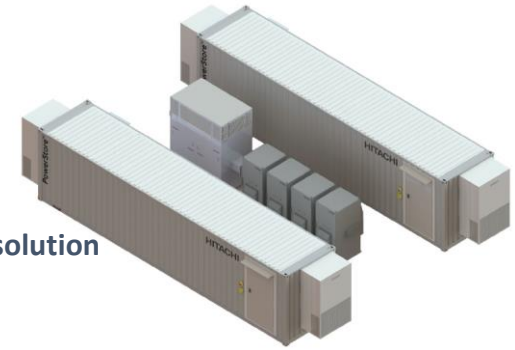
PowerStore Battery System

- **Modular and upgradeable BESS** offering, which can be customized to all applications and industry needs.

Compact solution
up to 1MW

Outdoor Battery Rack solution 1-300MW





Containerized solution
1-100MW

Finland: 90MW BESS

Finnish Utility **TVO** is building a 1.6 GW Nuclear Power Plant “OL3” in Finland. TSO in Finland Fingrid requires approx. 300 MW System Protection assets in combination with the “OL3” Powerplant. Very fast responding BESS (0-90MW in 200ms) is required to support the grid in case an unexpected power dropout from the Nuclear Powerplant.

About the project

- **Project name:** TVO 90MW BESS
- **Location:** Olkiluoto – Finland
- **Customer:** TVO
- **Completion date**: 2023
- One of the largest BESS in Europe and by far the largest BESS in the Nordic region

Customer benefits

- Enables the 1.6 GW Powerplant to operate at 100% output power in combination with several Demand Response Assets:
  - BESS
  - Gas Turbines
  - Industrial plants
- Reserve Market participation
- Blacks start (option)

Solution

- Nuclear Power Plant (1.6 GW)
- **PowerStore** Battery (90 MW / 85 MWh)
- **e-mesh** Control System
- **e-mesh** SCADA
- **e-mesh** Monitor
- **Lifecycle** services


Hitachi Energy

HITACHI

Inspire the Next

Repurposing second-life EV batteries for Energy Storage

Kenneth Långbacka

COO Autocirc Finland

ENERGYWEEK.FI

#ENERGYWEEK

Our purpose is to build and manage an aftermarket company that drives development towards a circular economy within the automotive parts industry.

SEK 1,85 BILLION
Sales

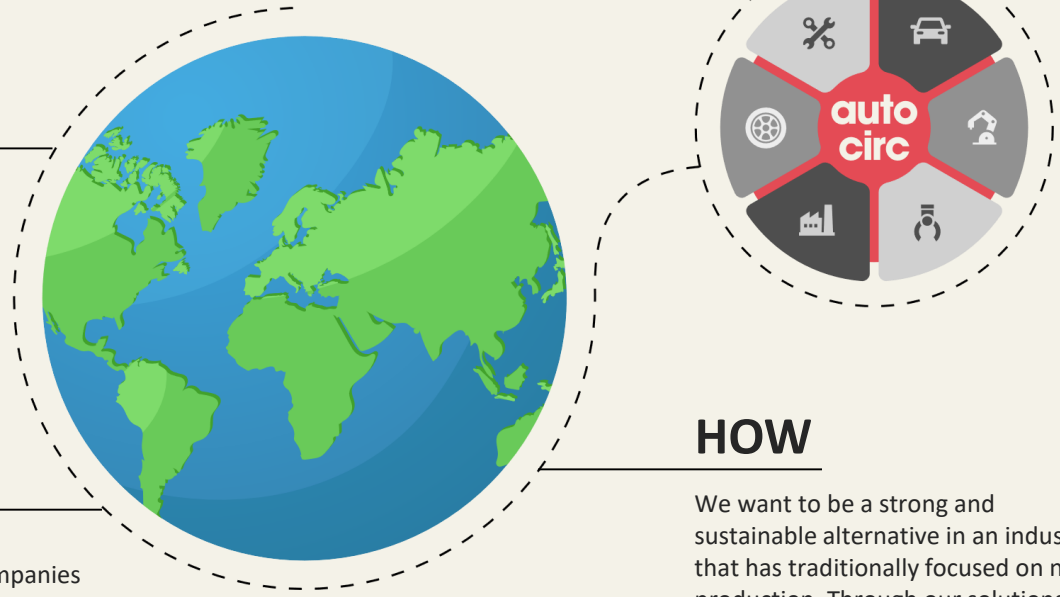
7 Countries
SWE, NO, FI, UK, PL, DE, FR

45
Independent companies

820
Employees

AUTOCIRC

We lead the automotive parts industry to a sustainable future.



VISION

We want to achieve a sustainable future for our planet by promoting the use of reused car parts, both as spare parts and for us in new manufacturing.

MISSION

Starting up and running automotive aftermarket companies that focus wholeheartedly on reuse and recycling of car parts. It contributes to a circular economy and our goal is to be the European leader in this area by 2025.

HOW

We want to be a strong and sustainable alternative in an industry that has traditionally focused on new production. Through our solutions and our circular business model, **we link the value chain** and improve everyday life for our customers and society at large. Our mission is to make the second-hand market the first choice.

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OUR COMPANIES.

February 2023

DISMANTLERS:

Alingsås Bildelar AB (SE)
Autodemontering TT AB (SE)
Autopalsta OY (FI)
Osamyynti AF OY (FI)
Autoverwertung Gmbh Kerstingjohänner (DE)
Bildelslagret i Lidköping AB (SE)
Bildelslagret i Trollhättan AB (SE)
Erikssons Verkstad AB (FI)
Frykmalm i Karlstad AB (SE)
Jämtlands Bildemontering AB (SE)
Kungsåra Bildemontering AB (SE)
Magnus bildemontering AB (SE)
Norrbottens Bildemontering AB (SE)
Redox Bildelar AB (SE)
Riihimäen OY (FI)
Skjeberg Bilopphuggeri AS (NO)
Svensk Bilåtervinning AB (SE)
Svenssons Bildemontering AB (SE)
Trondheim Bil-Demontering AS (NO)
Tröndelag Bildeler AS (NO)
Vimmerby Bildemontering AB (SE)
Växjö Bildemontering AB (SE)

DISMANTLERS:

Beck Export Automobile (FR)
Coram Auto SAS (FR)
Bergen Bildemontering (NO)
Ådalens Bildelar (SE)
Delehuset (NO)

REMANUFACTURERS:

Nordic Motor Center AB (SE)
Styrdon i Sverige AB (SE)
UBD Cleantech AB (SE)

SCRAP & METAL:

Rewinner AB (SE)

CORE TRADERS:

Premier Components UK LTD (UK)

RIMS & TYRES:

Redox Miljöhantering AB (SE)

WORKSHOPS:

Bil & Skadeservice AB Berga (SE)
Bil & Skadeservice AB Helsingborg (SE)
Bil & Skadeservice AB Lund (SE)
Bil & Skadeservice AB Munka-Ljungby (SE)
Bil & Skadeservice AB Klippan (SE)
Erikssons Verkstad AB (FI)
Mickes Lackservice i Perstorp AB (SE)

VEHICLE TRANSPORT & TOWING:

Erikssons Bilbärgning AB (FI)
Bergen Bilhjelp AS (NO)
Voss Bilbergning AS (NO)

WE ARE THE PLATFORM IN A CIRCULAR CONCEPT.

Together with several independent operators, we minimize waste and provide the car parts market with a stable flow of durable spare parts.

By creating a network that reuses and extends the life of used car parts, we can ensure sustainable options throughout the life cycle of the car.

The network consists of companies in dismantling, remanufacturing, scrap & metal, tires & rims, core traders and workshops. **All companies are independent and profitable.** By being integrated into Autocirc's circular business model, the actors create increased value.

This leads to:

- **More recycled car parts => higher insertion rate**
- **Renovation of more parts => higher insertion rate**
- **Recycling of residual material => production of secondary raw material**

Also increases the goal fulfillment of EU Directive 2000/53/EC which aims to increase the reuse of car parts.

Dismantlers

Workshops

Core Traders

Remanufacturers

Rims & Tyres

Scrap & Metal

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AUTOCIRC CONTRIBUTES TO THE UN SUSTAINABLE DEVELOPMENT GOALS.

- Our concept aims to improve circularity within the automotive parts industry.
- Goal 12: By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse.
- Goal 13: Climate action by simplifying, facilitating and informing each car owner of their options and choosing reusing over the purchase of new parts, we help reduce greenhouse gas emissions.
- Today, there is still limited trade between countries, fragmented markets and very little transparency about inventories.

We work for a future where:

- Cross-border integration and trade that balances need and demand.
- Consolidated flow between companies in dismantling and frame trade.
- A platform for trading frames and spare parts.
- A common virtual warehouse with full transparency.

Click here to download our annual and sustainability report.

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AUTOCIRC – PART OF SOMETHING GREATER.

REUSE

Directly reusing entire car parts is the best for both the environment and the economy. We ensure that the parts are defect-free before they are reintroduced to the market.

REMANUFACTURING

Broken parts that are needed on the spare parts market are refurbished and restored to new condition. Creating increased sustainability in more demanded parts is the core of the circular economy.

REPURPOSE

Even the parts that are not needed on the spare parts market are reintroduced on the market, then for a new purpose than the original one. For example, batteries can be used to store energy.

RECYCLE

The material that then remains is split into as many clean fractions as possible, to then be recycled and turned into new, durable car parts in the aftermarket.

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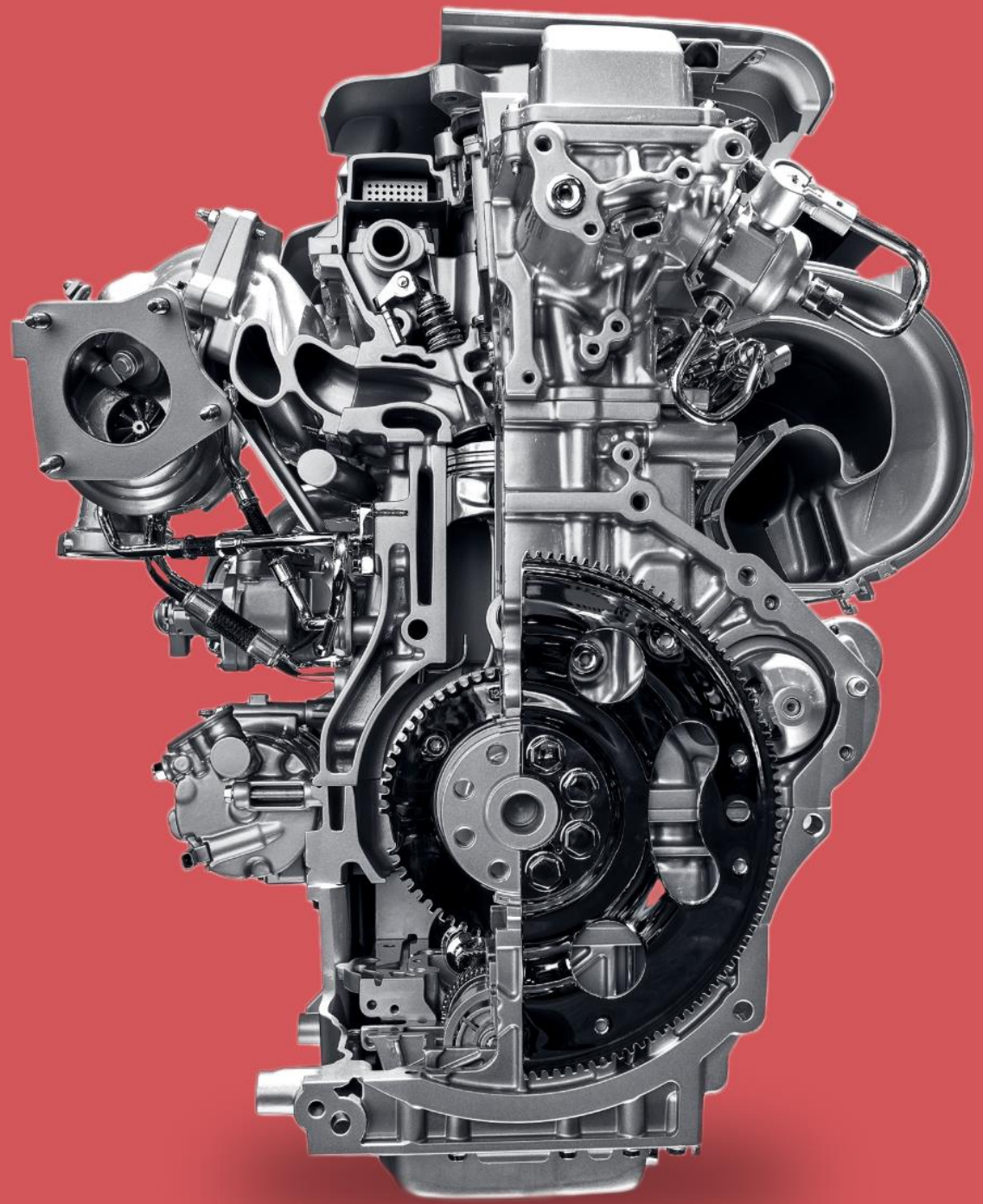
A SECONDHAND MARKET AS THE FIRST CHOICE.



Building energy storages entirely on second-life batteries and uses also as much recycled materials as possible

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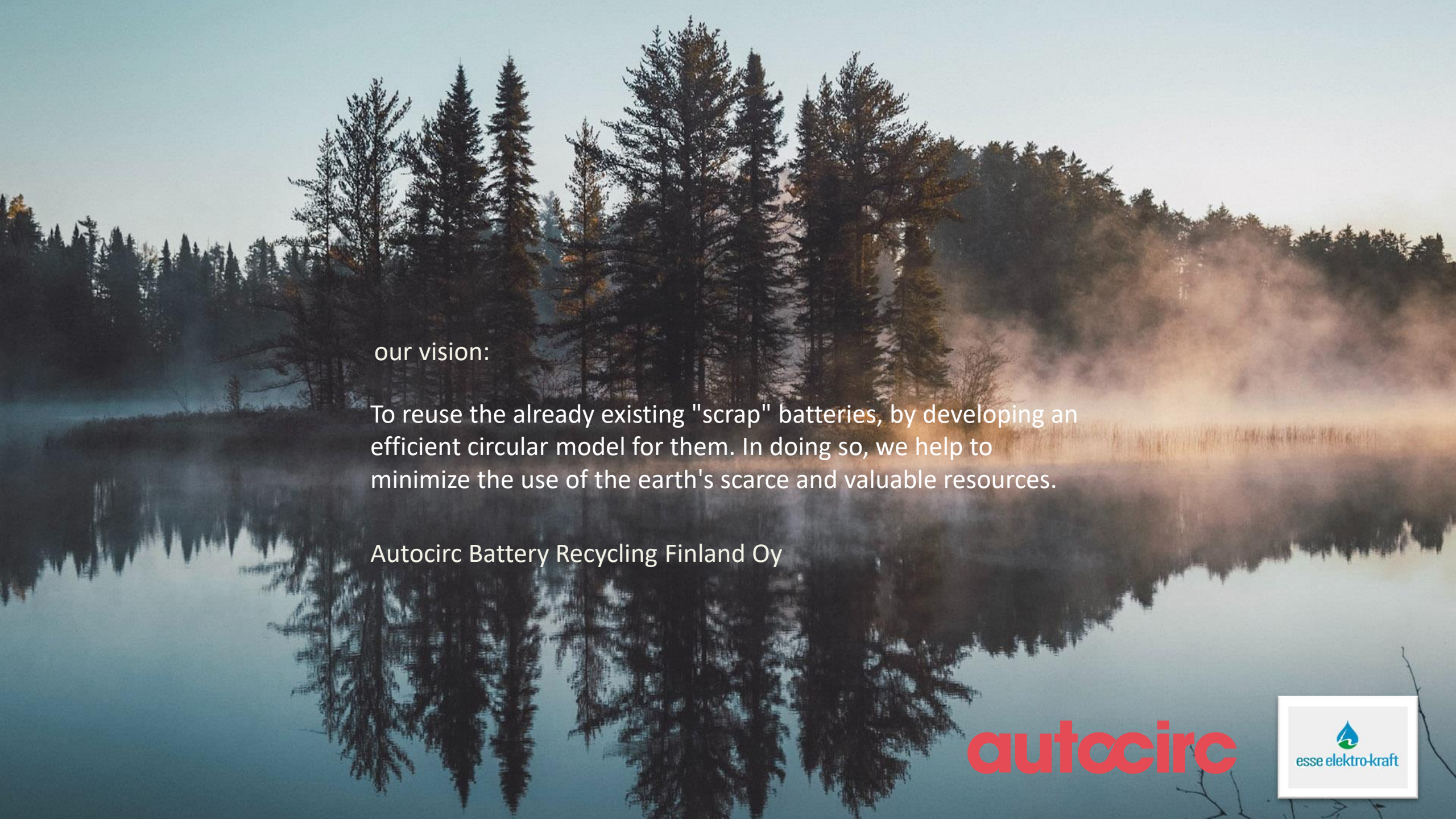
esse elektro-kraft



our vision:

To reuse the already existing "scrap" batteries, by developing an efficient circular model for them. In doing so, we help to minimize the use of the earth's scarce and valuable resources.

Autocirc Battery Recycling Finland Oy

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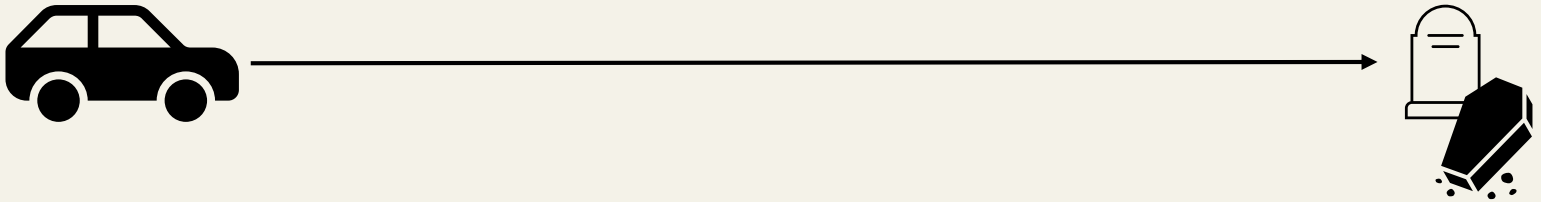
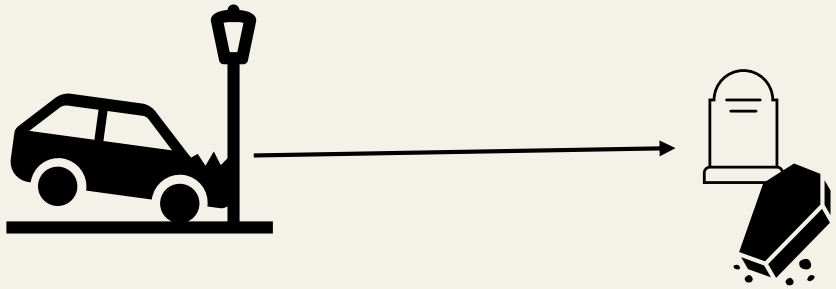
CURRENT SITUATION

The average lifespan of a passenger car is approx. 18 years



The average age of a damaged vehicle is approx. 5 years



We lose 13 years of battery life when an electric or hybrid vehicle is dismantled if the battery is not "actively" used *

* the charging capacity of a li-ion battery deteriorates quickly if it is just stored without use and it can be destroyed in a couple of years.

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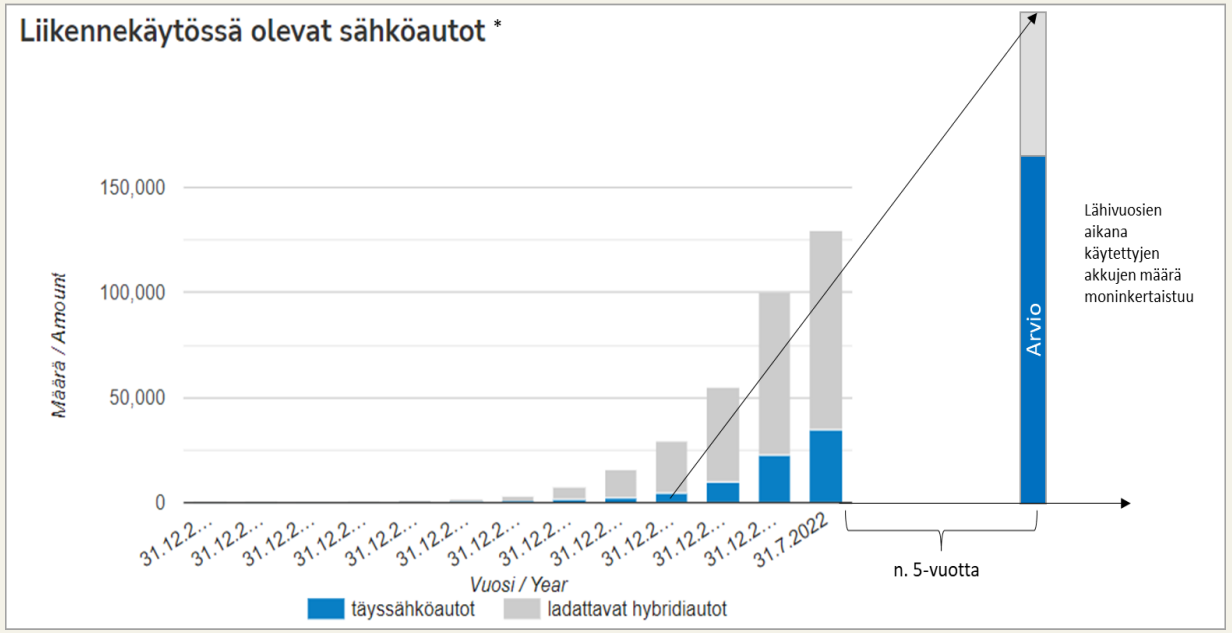
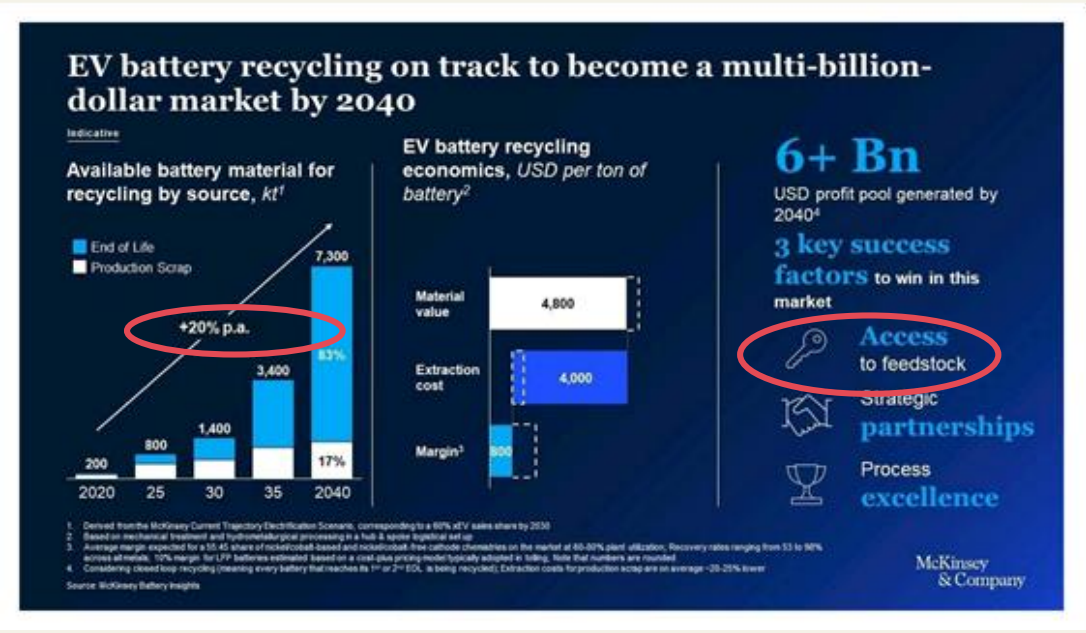
Development and availability of electric cars and recyclable batteries





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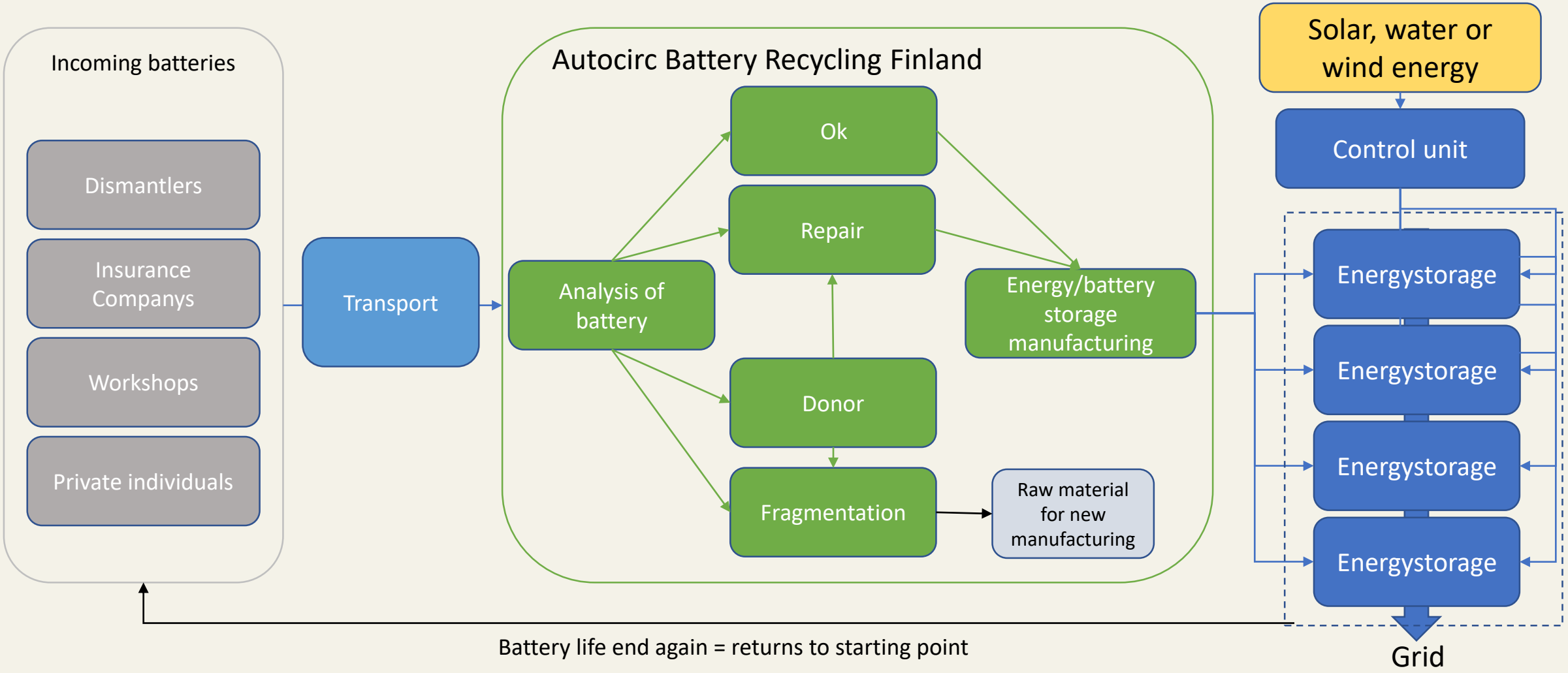
Battery recycling, logic and process



Environmental impact

- Manufacturing a new battery produces emissions ~2842 kg CO_2e (100kWh)
- If the useful life is 18 years = 157kg CO_2e/year
- In Finland, approx. 17,000 cars are redeemed/year, the average age of which is approx. 5 years
- Of which approx. 50% contains a lithium battery in 2027 -> 8500 batteries
- The average size of the battery is approx. 30kWh, the production of which produces 2842 * 0.33 = 950 kg CO_2
- If these are not used, we will produce 950kgCO2 * 8500pcs = **8,075,000** kgCO2 unnecessary emissions per year 2027
- With our concept, by reusing used batteries, we can save a very significant amount of CO2 emissions

Goals for 2023

- Complete the new spaces
- Complete energy storages with a capacity of a total of 3 MWh
- Available on at least the Finnish and Swedish markets
- Investigate the opportunities/market in Norway (Europe in 2024)
- Prepare for "series production" in 2024

Thank you!

- Any questions or answers ☺, don't hesitate to be in contact with us:
- Autocirc: Kenneth Långbacka
  - Kenneth.langbacka@autocirc.com
- Esse Elektro-kraft: Ingvar Kulla
  - Ingvar.kulla@eekb.fi

Accelerating the net zero journey with liquid air energy storage systems

Pedro Guimarães Giorni

Product manager, grid systems
at Sumitomo SHI FW

SFW is part of Sumitomo Heavy Industries' Energy & Lifeline segment

Year 2021

Sumitomo Heavy Industries

€6.6B

Mechatronic

€1127M

Industrial Machinery

€1617M

Energy & Lifeline

€1435M

Logistics & Construction

€2387M

Others

€42M

Sumitomo SHI·FW

SFW global delivery

800+

Successful projects worldwide

America

122

Europe

344

Asia

419

Execution excellence relies on:

- Global team of execution professionals
- Systematic execution of processes and practices providing reliable project delivery
- Owned manufacturing shops and large chain of partners and vendors delivering high quality, in global supply chain
- Extensive knowledge to apply all necessary international and local standards
- State of the art project execution and engineering tools

Agenda

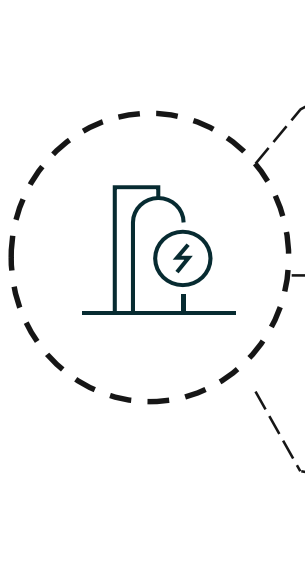
Long Duration Energy Storage (LDES)

Why Long Duration Energy Storage

Key challenges while decarbonizing the power grid

- Demand-supply imbalances
- Changes in transmission flow patterns
- Decrease in system inertia
- System reliability

Need for innovative storage solutions with technical characteristics suitable for operation in different segments of the power grid

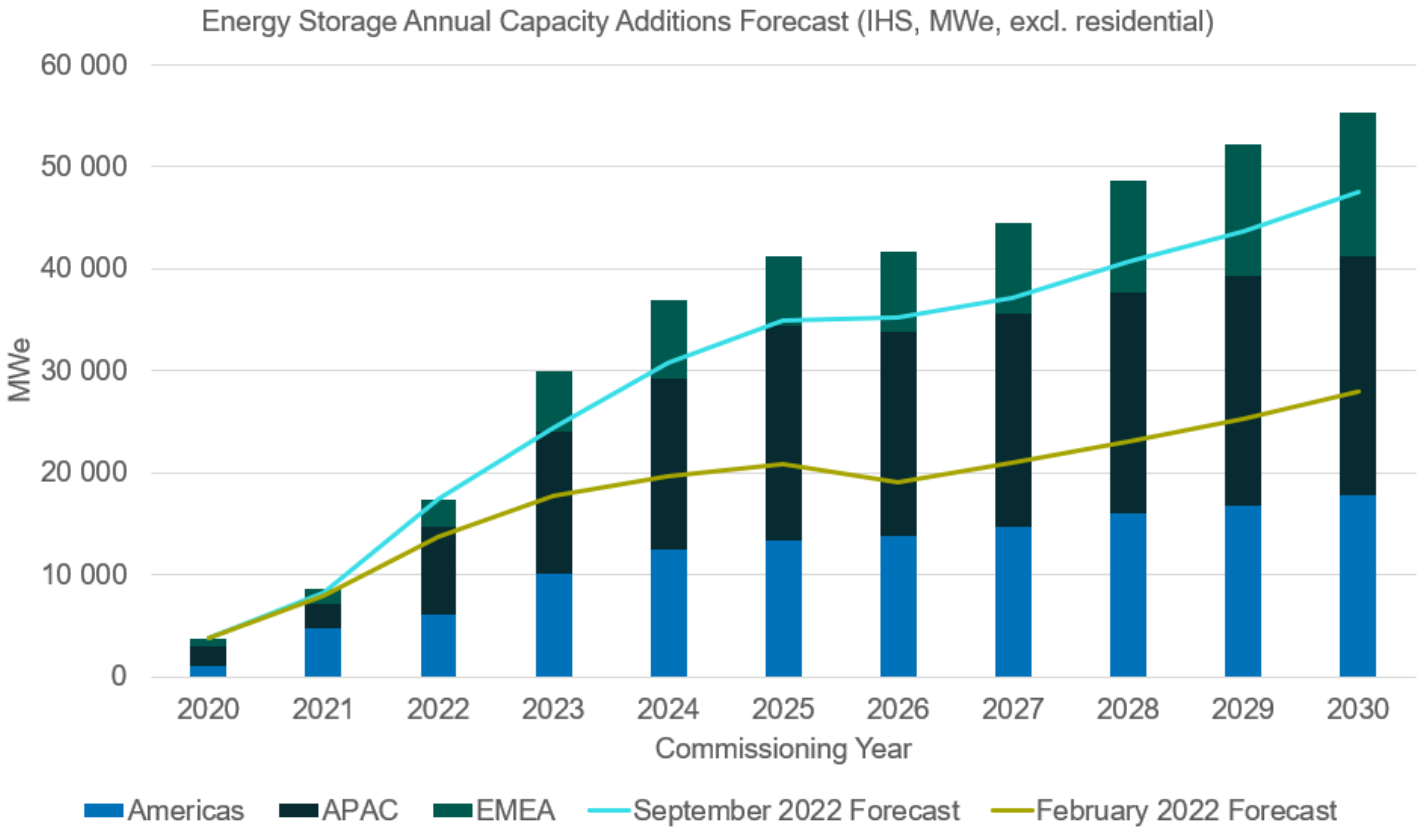


- Net zero energy systems
- Large capacity and power rating, High efficiency, low cost
- Flexibility, Location agnostic, Resiliency, Reliability and Security

Only possible with Long Duration Energy Storage (LDES)

Energy Storage – Forecast upgrades continue despite supply chain issues

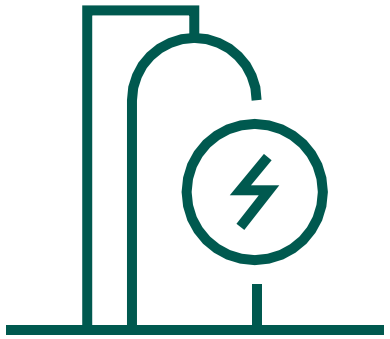
2022 deployments 17GW, growing to 30GW in 2023



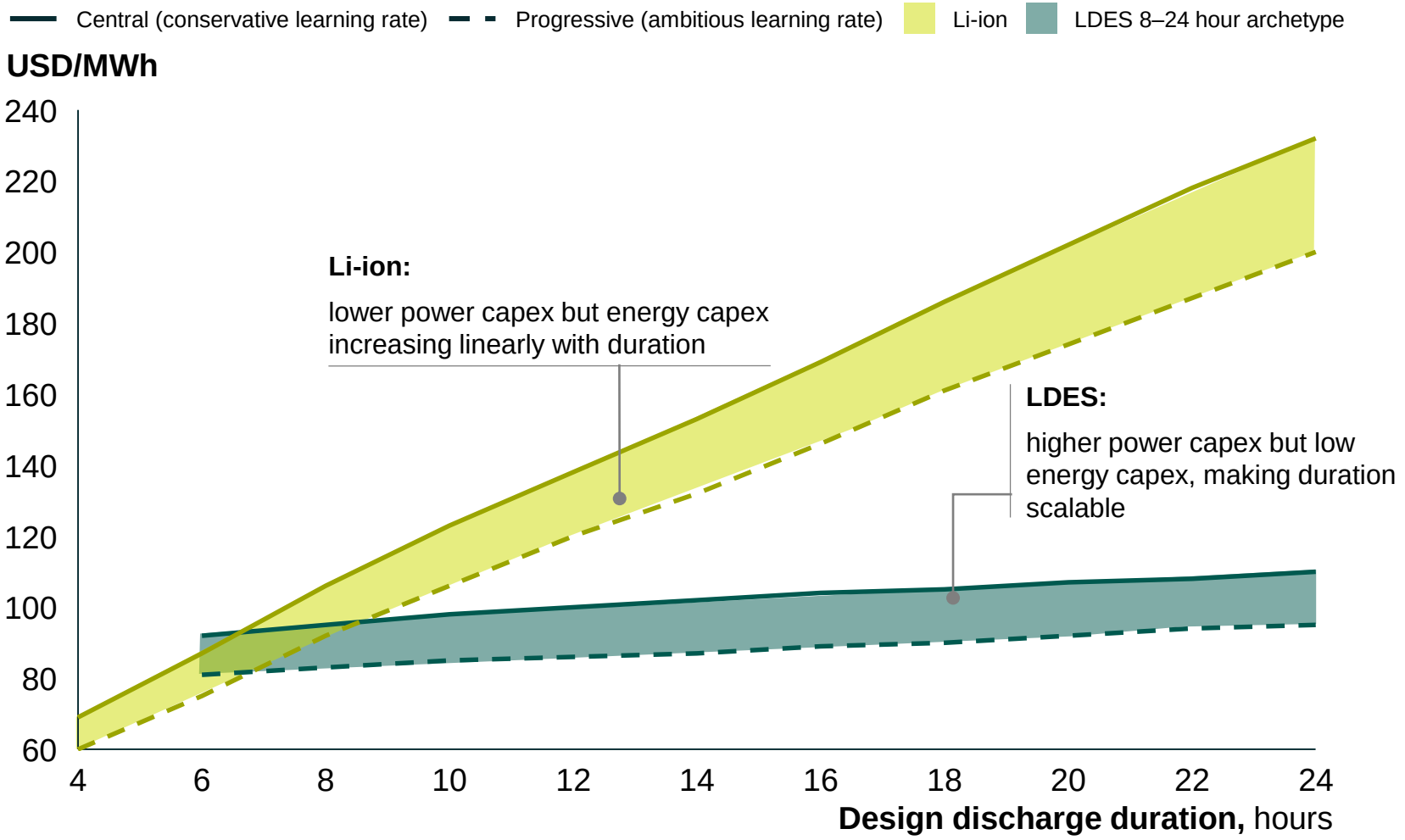
- Forecast upgraded +17% (+56GW) vs. prior forecast from Sep-22
- 40% of 2022 projects delayed due to grid connection delays and long component lead times
- Average duration from below 2h in 2020 to 3.1h in 2030
- Main forecast changes:
  - China (+43GW) – policy mandates & provincial targets
  - Australia (+6GW) – Tenders & objectives
  - UK (+5GW) – Lucrative ancillary services drive project pipeline
  - Canada (+5GW) – Regulatory proposals have driven pipeline
  - USA (-14GW) – Grid connection delays and supply chain issues

LDES becomes more feasible than Li-ion for durations >6-8 hours

>8 hours duration, due to low energy capex, LDES offers lower LCOS



2030 energy storage LCOS competitiveness by duration for selected technologies (USD/MWh)

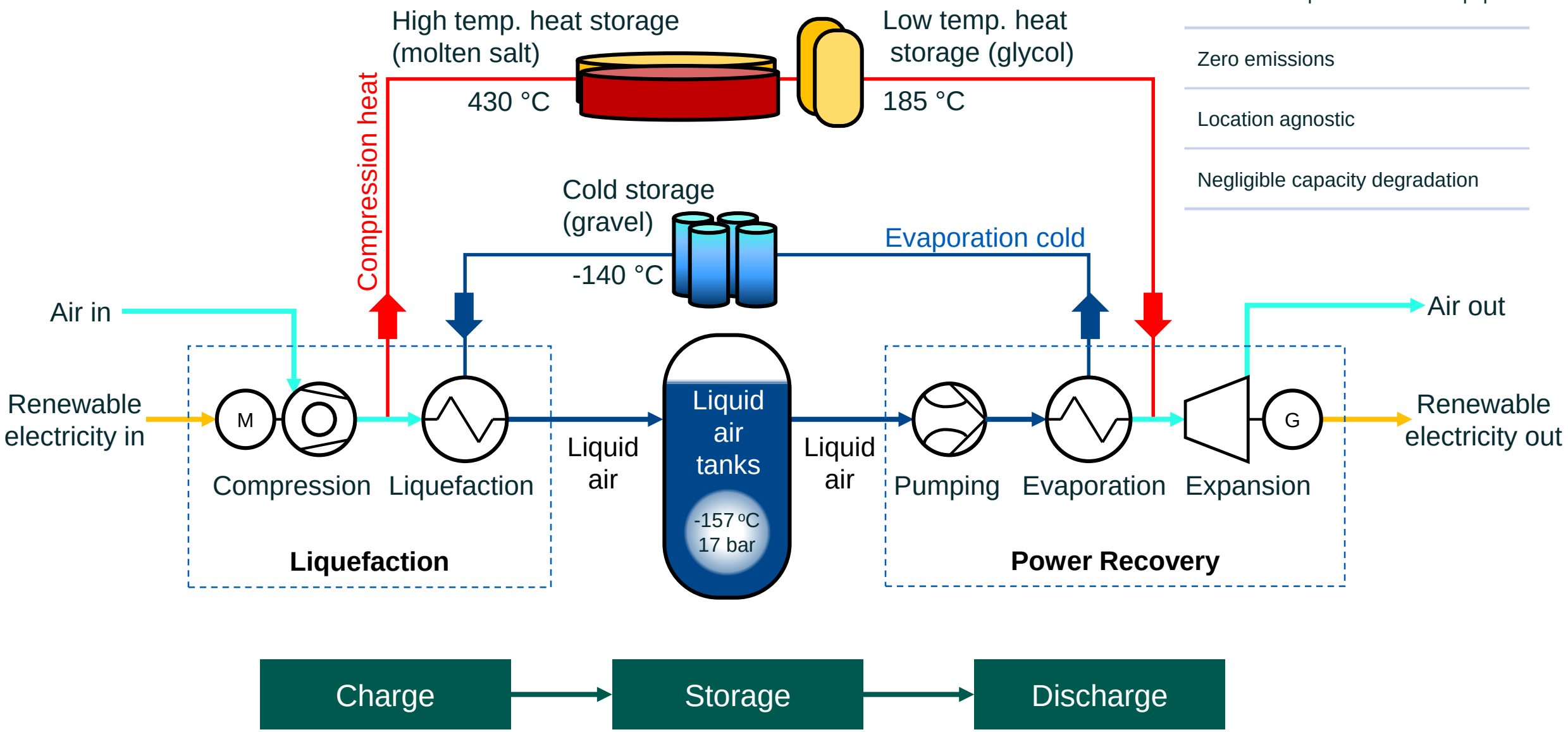


Source: LDES Council member technology benchmarking

The Liquid Air Energy Storage (LAES) technology

Liquid Air Energy Storage (LAES) Schematic

- Established processes and equipment
- Zero emissions
- Location agnostic
- Negligible capacity degradation



100% carbon free electricity – always!

LAES systems provide crucial services for the power grid and support electrification of rural areas in a sustainable way

Energy Shifting

- Intra-day
- Inter-day
- Weekly storage

Net zero eco system

- Integration with external sources of heat or cold such as LNG plants
- Waste heat from liquefaction to other industries, for example district heating

Grid services

- Rotational inertia
- Frequency support
- Voltage support
- Reactive power
- Spinning reserve

Isolated systems

- Decarbonizing smelting operations
- Reducing fuel consumption
- Enhancing security of energy supply

Flexible deployment

- Decoupled charging and discharging power
- Customized long energy duration
- Location agnostic

Future proofed asset

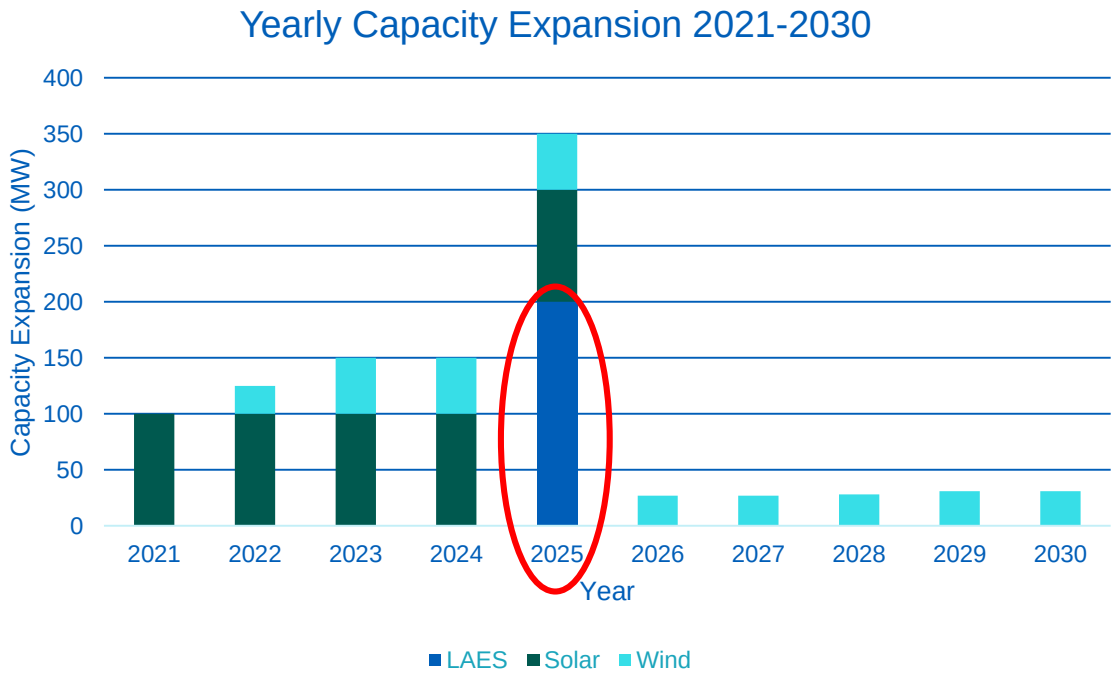
- Lifetime >30 years
- Negligible capacity degradation
- Highly scalable
- End of life recycling
- Circular economy
- Low supply chain risks

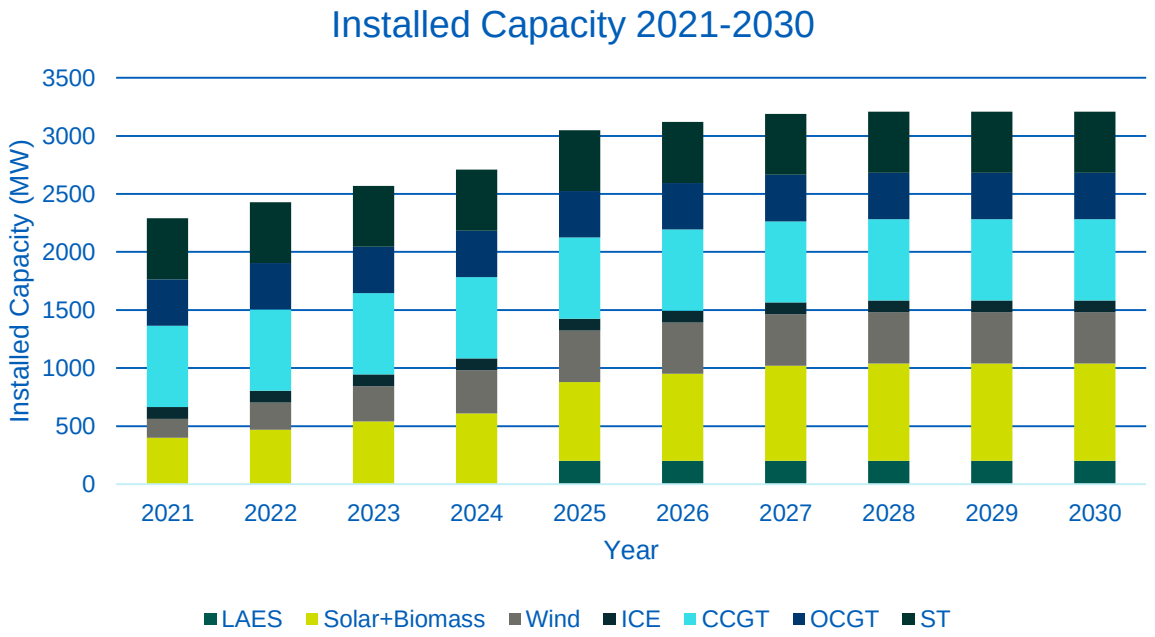
LAES is a scalable, ultra-flexible, location agnostic long duration energy storage system

Case Studies

Decarbonizing the power grid using LAES

Capacity expansion in the Cyprus power grid between 2021-2030

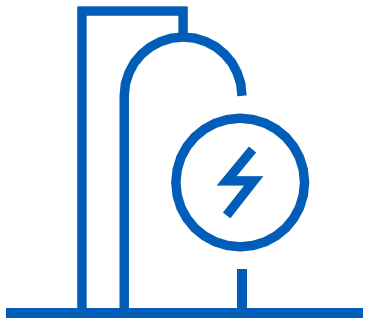




- Capacity expansion results show that the LAES has a role to play in the energy transition
- The overall levels of curtailment would probably increase once the transmission network is taken into consideration - increased role for the LAES
- Model can be provided with the option to increase the share of other storage technologies to provide more objective results

Liquid air storage will provide significant benefits for the power system

LAES allows the system to better utilize renewable energy and maintain grid stability

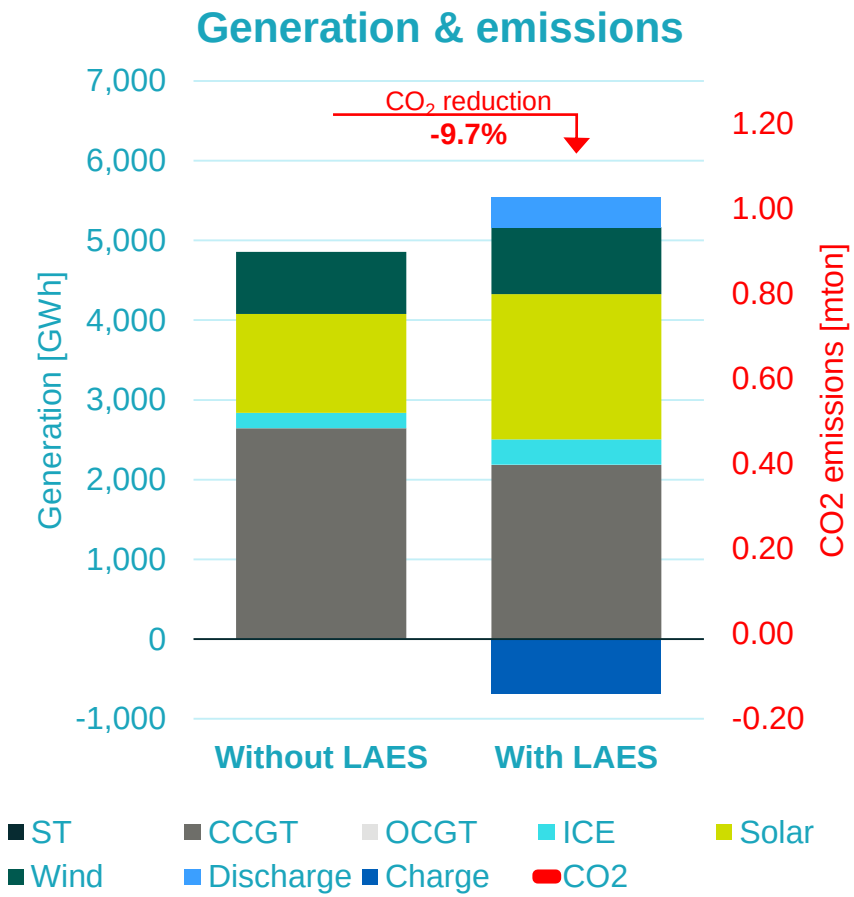


Reduced CO_2 emissions
-9.7%

Increased utilisation of wind power
8.0%

Increased utilisation of solar power
46.6%

Reduced fuel consumption
-17.3%



Case study: Decarbonising captive industry in India

LAES allows captive industry in to switch to renewable energy

Hedging agaist future price scenarios

PV capacity	**150 MW**
LAES discharge capacity	**25 MW**
LAES charge capacity	**100 MW**

Banking scheme
Renewable energy can be fed into the grid at one time and withdrawn from the grid at another time without cost and still be considered renewable, i.e. the grid is responsible for the balancing the renewables.

CUSTOMER

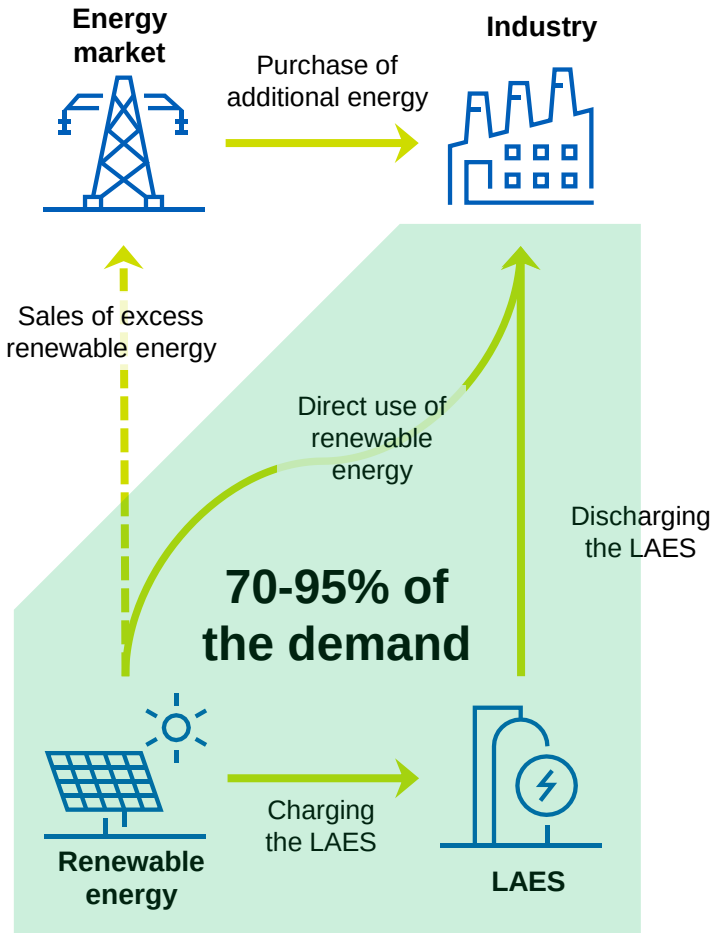
- Manufacturing industry in India
- 24/7 operation with stable load

CURRENT ELECTRICITY SUPPLY

- Wind generation off site and transported thought the grid
- Using ”banking scheme” provided by the grid to achieve 80-90% renewable energy share

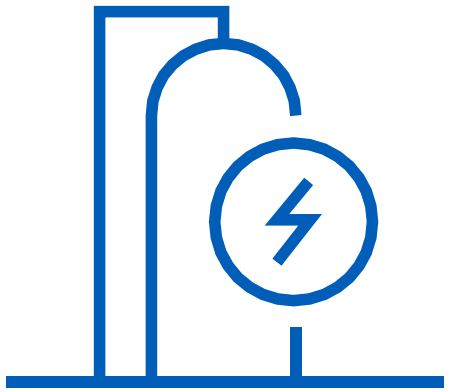
FUTURE

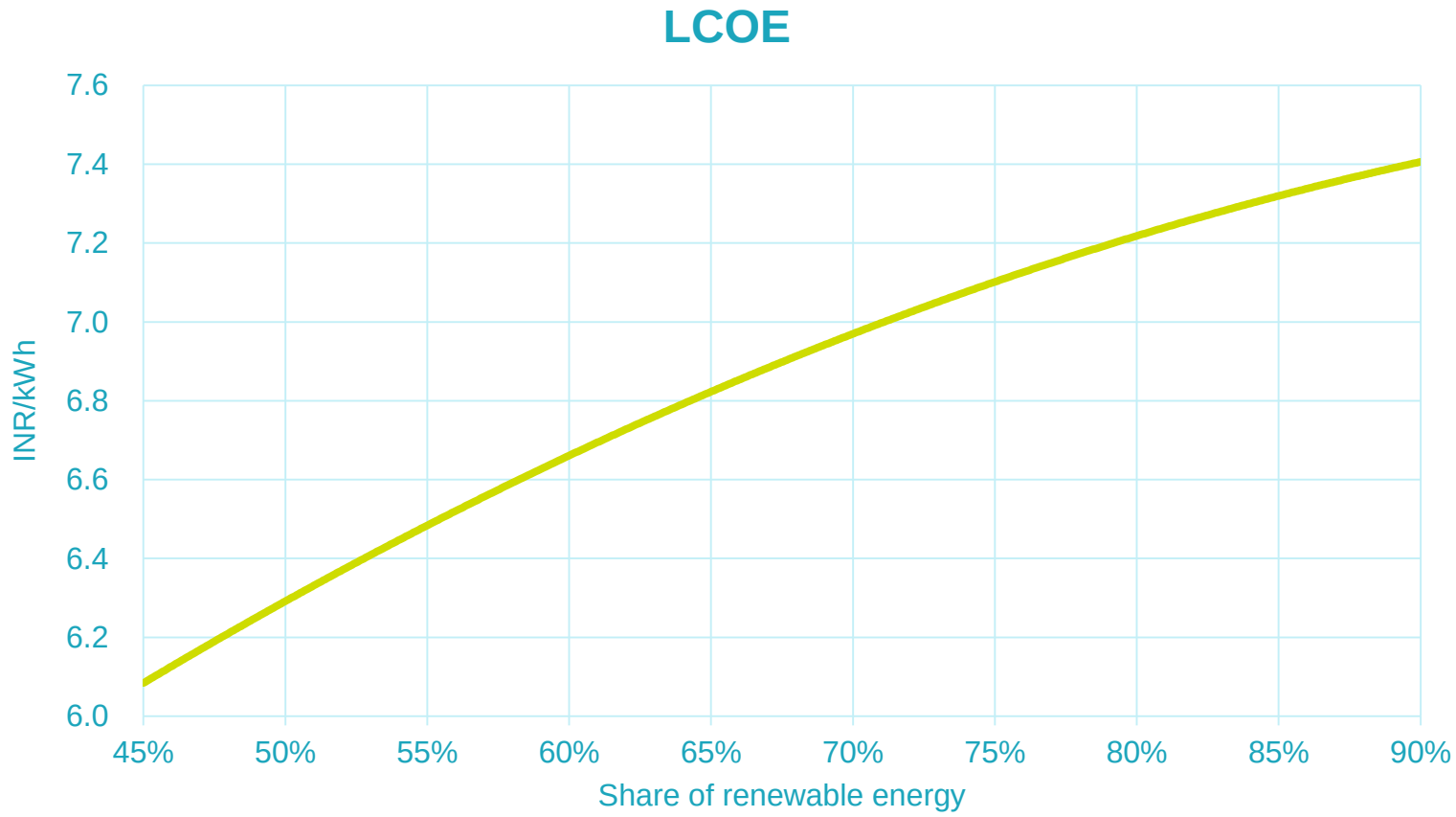
- Banking scheme will disappear
- To decarbonise they are required to have access to hour-by-hour renewable energy



The levelized cost of electricity (LCOE) is linked to the desired share of renewable energy penetration

For **7 INR/kWh** an industry can be **70% renewable**

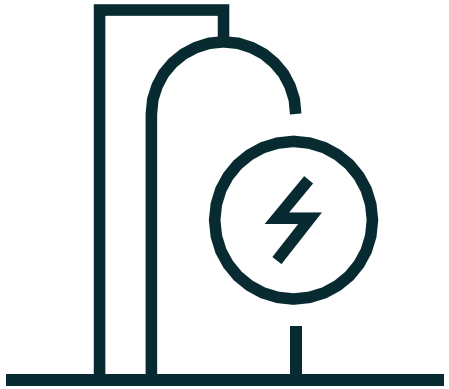




Key Takeaways

LAES – Bridge to a net zero ecosystem

- LDES capacity deployment is set to exponentially increase over the next few years
- LAES is a proven LDES technology which can increase the utilization of renewable energy sources and consequently accelerate the net zero journey
- LAES can provide several ancillary services, thereby contributing to grid reliability and providing investors with additional revenue streams
- LAES can bridge multiple energy streams and material flows while utilizing well established processes and mature supply chains



Thank you

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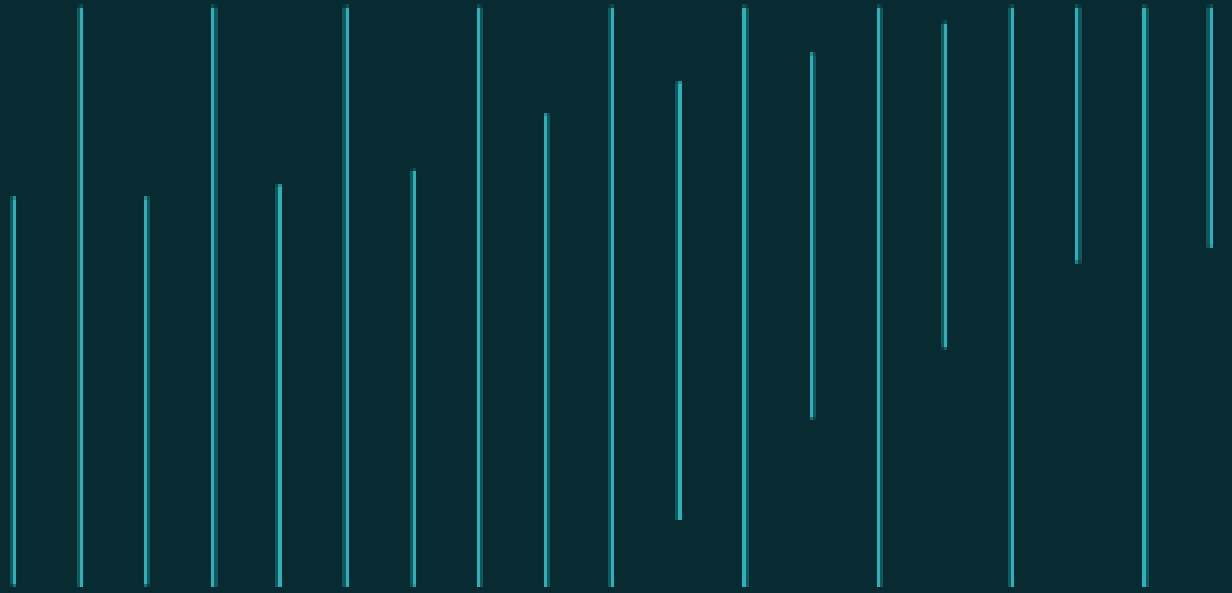

Sumitomo SHI FW

Moderator

Cynthia Söderbacka

Project Leader in the Faculty of Technology &
Novia University of Applied Sciences

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Panel topic: Systems Diversifications in Energy Storage Needs and Business Models in Future Energy Systems

Jens Nybäck
Proposal Manager, Africa & Europe,
Energy Storage & Optimisation, Wärtsilä

Björn Nyberg
Solution Manager, Hitachi Energy

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Kenneth Långbacka

Chief Operating Officer (COO), Autocirc Finland

Veikka Pirhonen

Director, Energy Flexibility Management, Siemens Oy

ABB Danfoss Energiateollisuus GREAT Hitachi Energy VAASA. VASA. VAASAN SÄHKÖ VAMK VASEK VEO Wapice WESTENERGY WÄRTSILÄ

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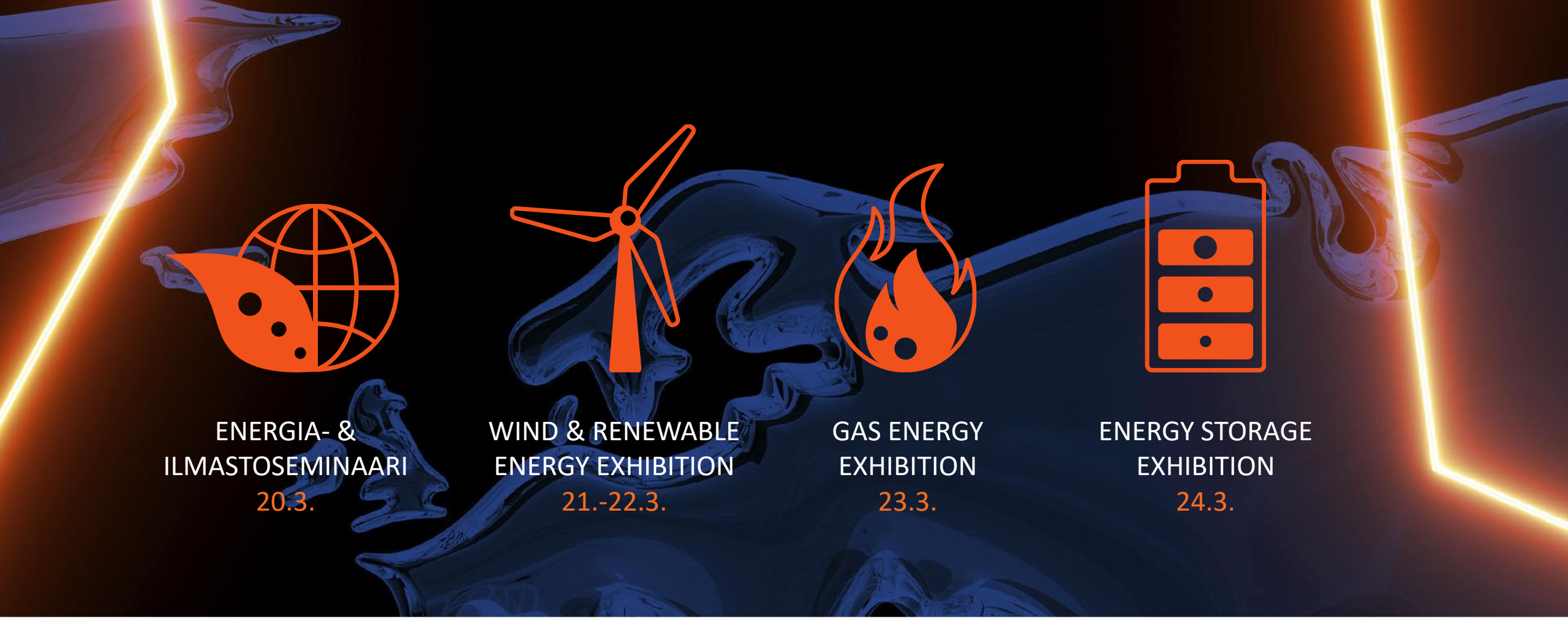
Vinoth Jayaraman

Solution Manager, Huawei Technologies (Denmark) ApS



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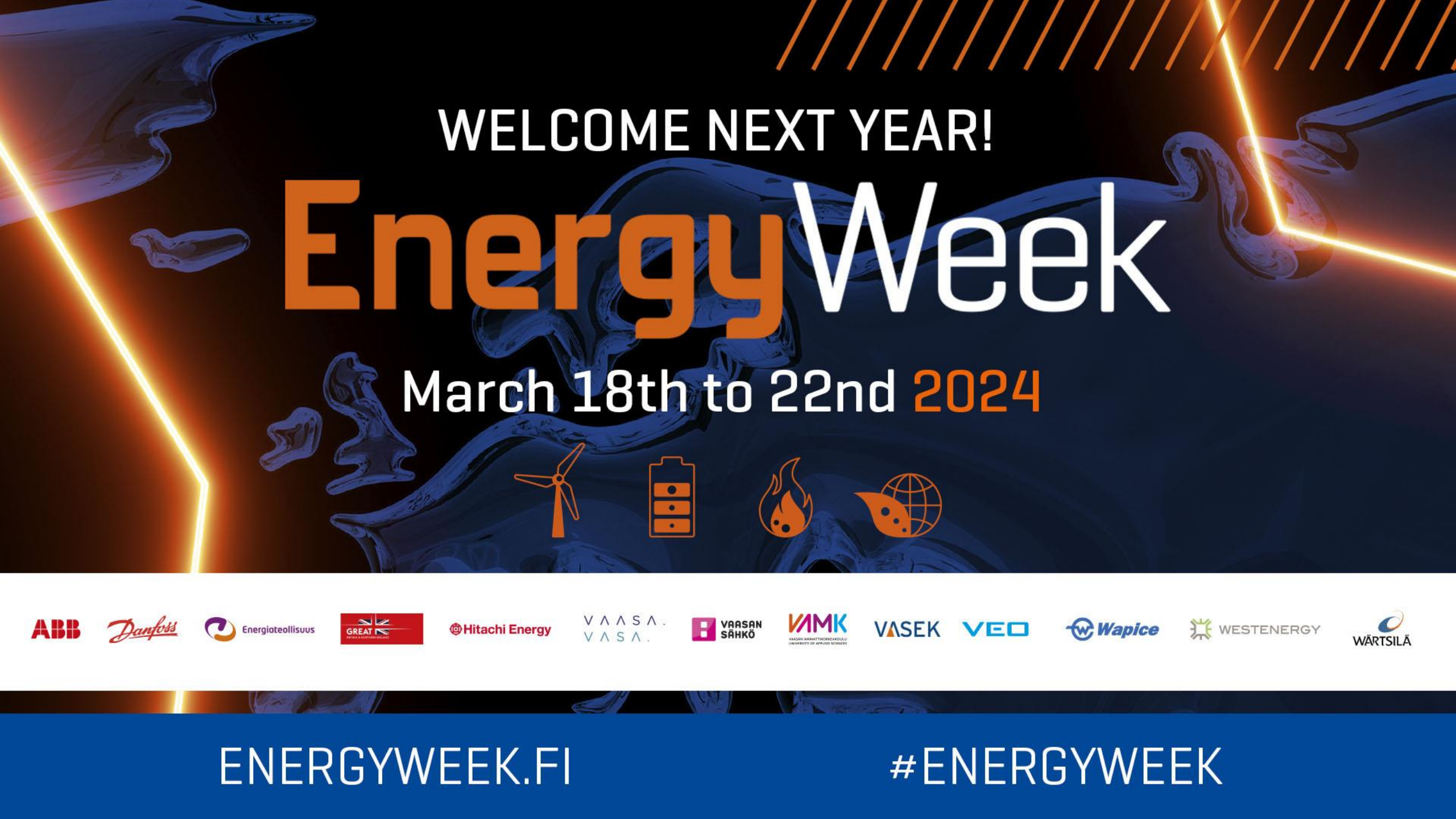
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