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ASSOCIATION OF EUROPEAN AUTOMOTIVE AND INDUSTRIAL BATTERY MANUFACTURERS

WEBINAR #EUROBAT

Battery Solutions for Energy Storage (BESS):

Why a resilient and competitive battery industry is essential for EU energy security and decarbonisation

September 2023

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ASSOCIATION OF EUROPEAN AUTOMOTIVE AND INDUSTRIAL BATTERY MANUFACTURERS

EUROBAT is the leading voice of EU battery manufacturers

The leading association for European **Automotive** and **Industrial Battery Manufacturers** across **all battery technologies**

We promote the **regulatory**, **commercial** and **economic interests** of the European automotive, industrial, and special **battery industries**

We work with stakeholders to help **develop new battery solutions**

We facilitate the **growth of the European battery industry** and support achieving the **EU Green Deal objectives**

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01 Introduction by Bernhard Riegel / Moderator

EUROBAT TF Innovation Leader & Director R&D HOPPECKE

HOPPECKE
POWER FROM INNOVATION

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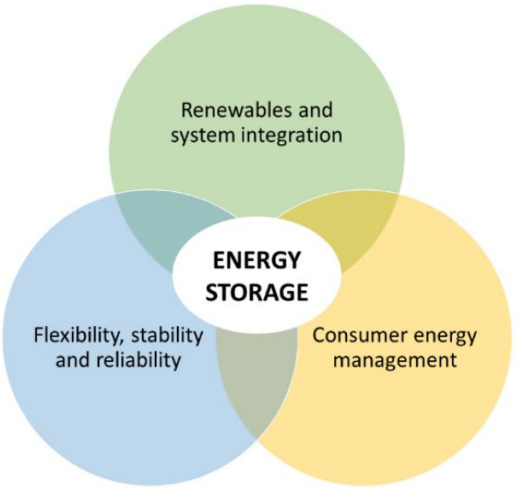
The Battery Manufacturing industry is committed to contribute to the goals of the Commission to deploy a decarbonized and reliable Energy System, with 69% RES share in 2030 and 80% by 2050*

- Energy storage play a crucial role in the current and future energy system. It increase the efficiency and security of energy supply by providing flexibility, stability and reliability;
- Battery Energy Storage Systems (BESS) are recognized as the major flexibility providers to develop a stable and reliable energy system;
- BESS increases the efficiency and maximizes the output of the installed variable RES generation in the system;
- BESS are highly standardized products that can be installed quickly;
- BESS are safe, environmental friendly and highly recyclable;
- The diversity of BESS technologies makes them suitable for many grid functionalities as well as to allow consumer energy management.



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Development of EU & World ES markets (main share by utility-scale BESS):

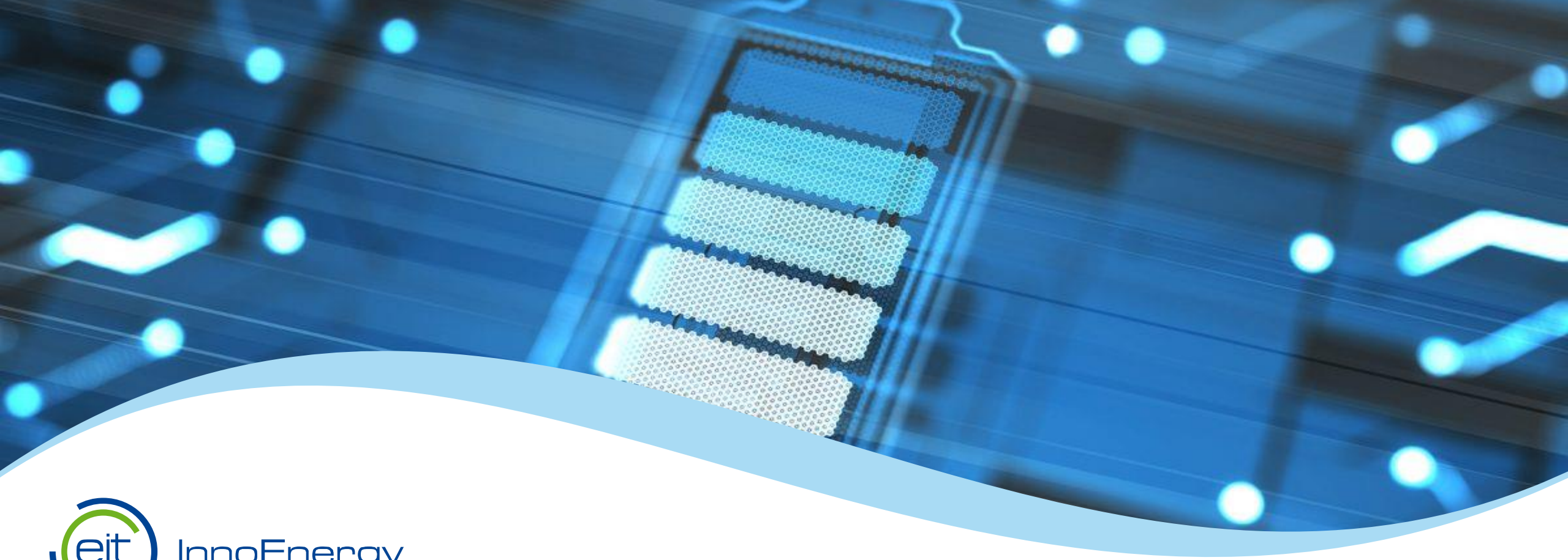
- Worldwide capacity*: to expand 44-fold between 2021 and 2030, reaching 680 GW = 80 GW AGR;
- Drivers in Europe: The Green Deal and REpowerEU action plan.

Different Battery Energy Storage technologies in the energy system are needed:

- To server different applications efficiently (short and long duration ES);
- To support the charging infrastructures, helping to deploy the EV/HEVs and other clean transportation modes;
- To destress the raw material supply chain towards Europe.

Battery manufacturers will provide evidence on:

- Upscaling EU production capacities to meet future EU and Worldwide demand
- info on case studies to show we can deliver real and concrete technical solutions that work, wether located in front of or behind the meter (FTM, BTM)



eit InnoEnergy
Knowledge Innovation Community

EUROPEAN BATTERY ALLIANCE | EBA250

Securing the Competitiveness of the European battery industry in a changing world

Ilka von Dalwigk

Our mission

EUROPEAN BATTERY ALLIANCE | EBA250

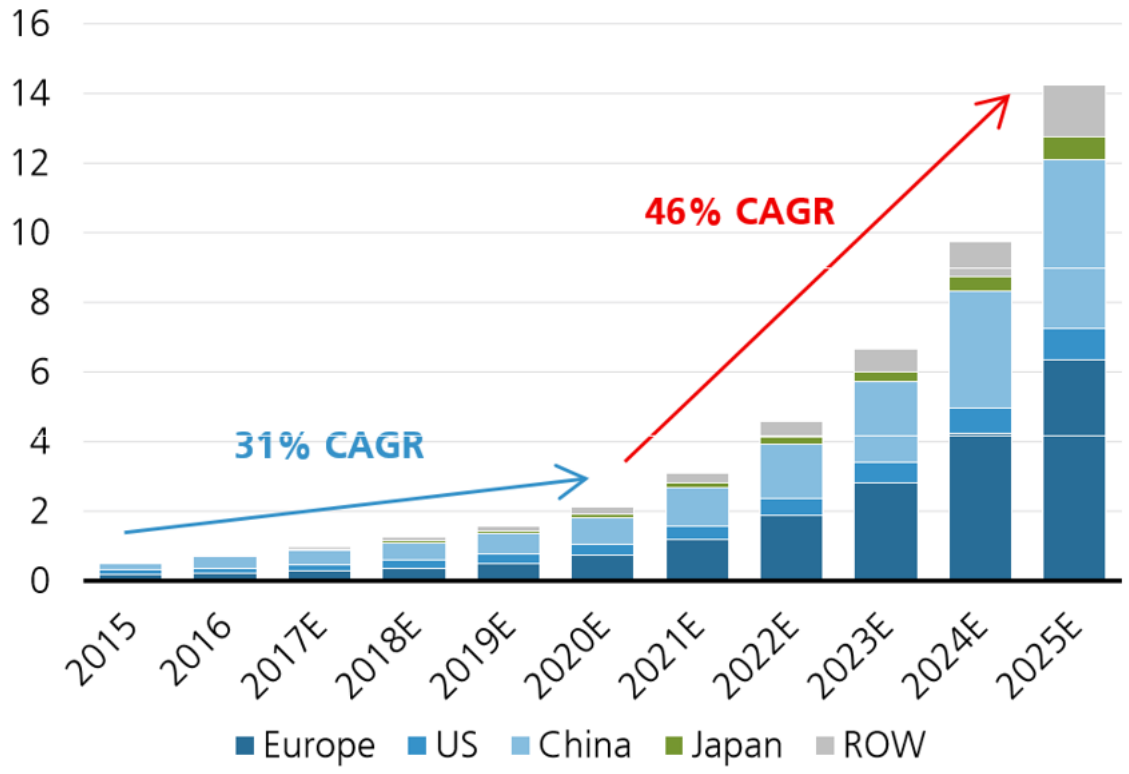
EBA – a blueprint for industrial alliances

“This is where the European Battery Alliance comes into play. […] This is how Europe should always work. We should not just work for our industry, but with our industry.”

- **Mission**: Launched in 2017 by the European Commission to **reshore the battery value chain to Europe** create a resilient, competitive and sustainable battery industry in Europe
- **EIT InnoEnergy** has been **trusted by the European Commission** to drive forward the activities of the EBA250 activities
- We **work with industry and decision makers at EU and Member State level** to boost the growth of a European battery ecosystem
- Our **actions are aspirational, “impact and execution” oriented and developed** with a “can do attitude” **together with our stakeholders**
- Our **stakeholders are the European Commission, interested EU countries, industry,** investment institutions and key innovation and academia stakeholders
- Today we are a thriving, dynamic, inclusive and comprehensive ecosystem with **800+ key stakeholders covering the entire battery value chain**

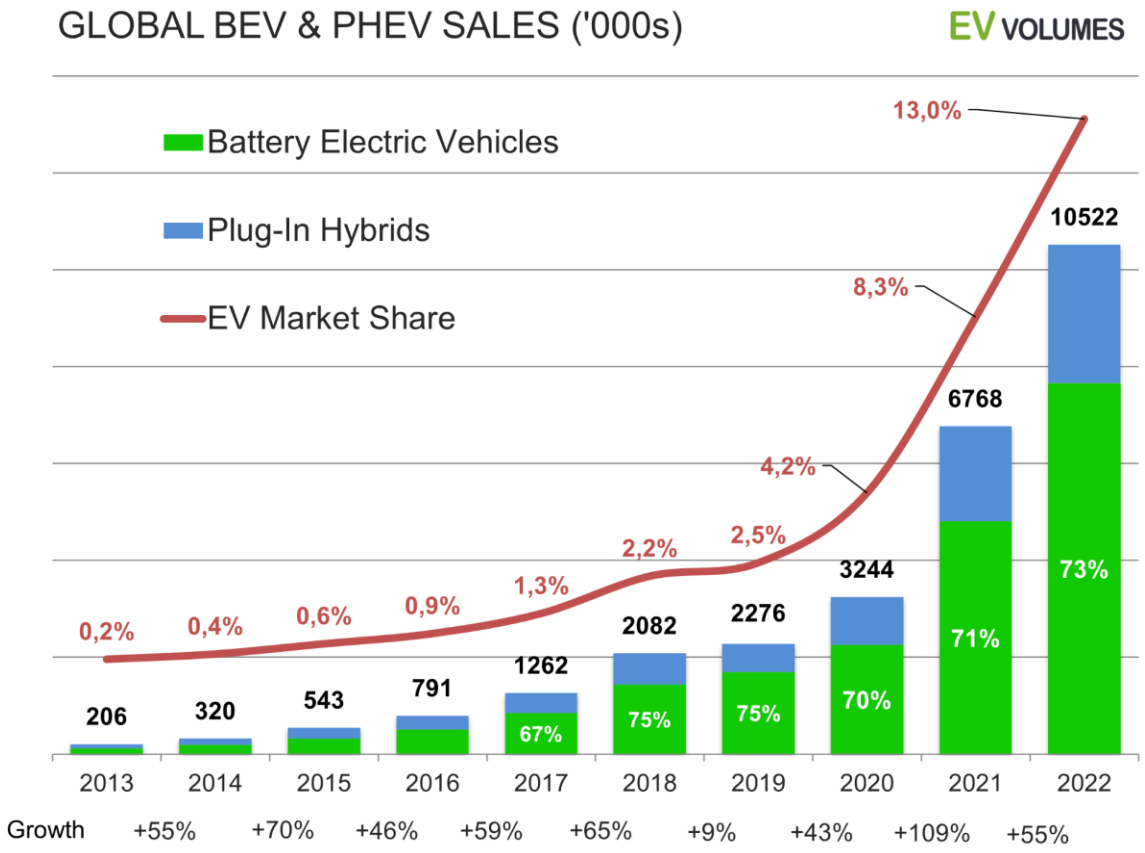
Actual EV market 2022 was 2 x prediction 2017

Projection 2017



Source: UBS estimates

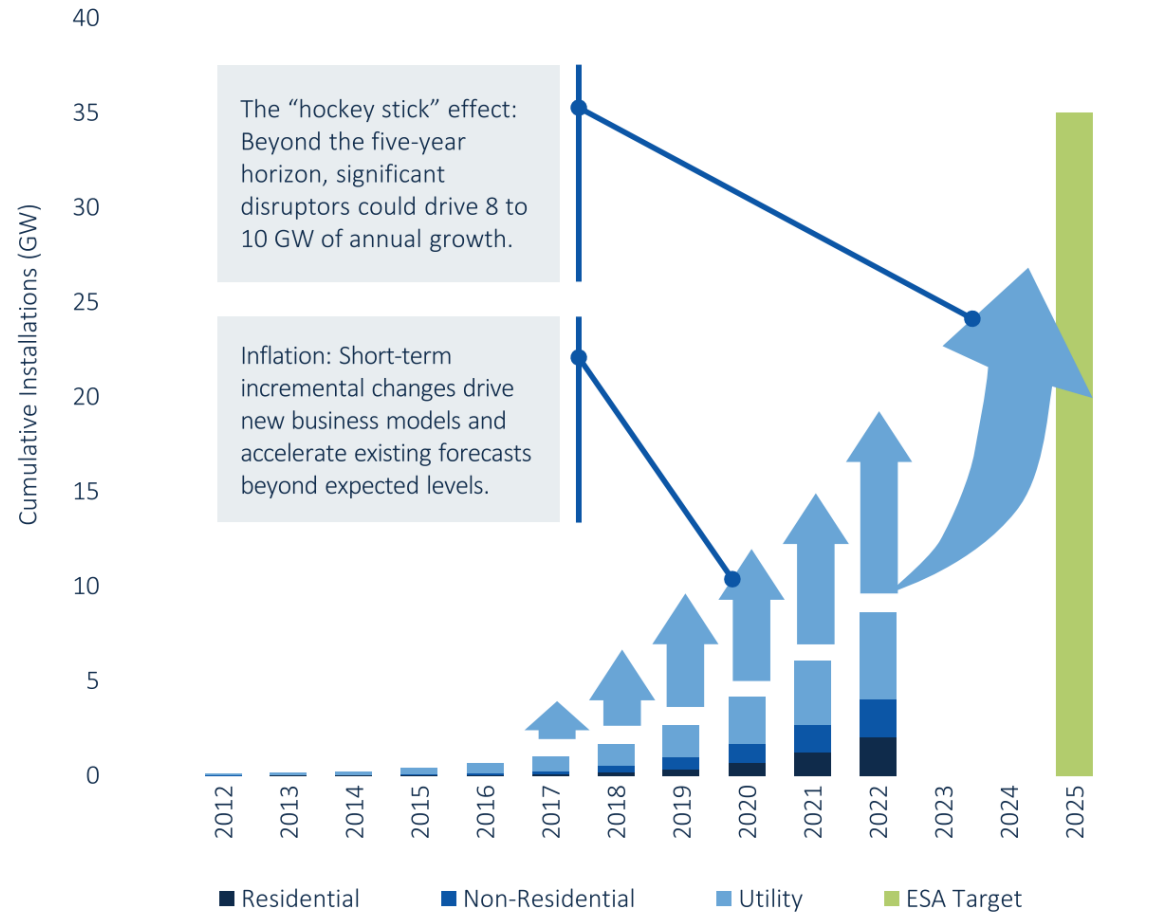
Actual 2023



Actual BESS market 2022 was 4 x prediction 2017

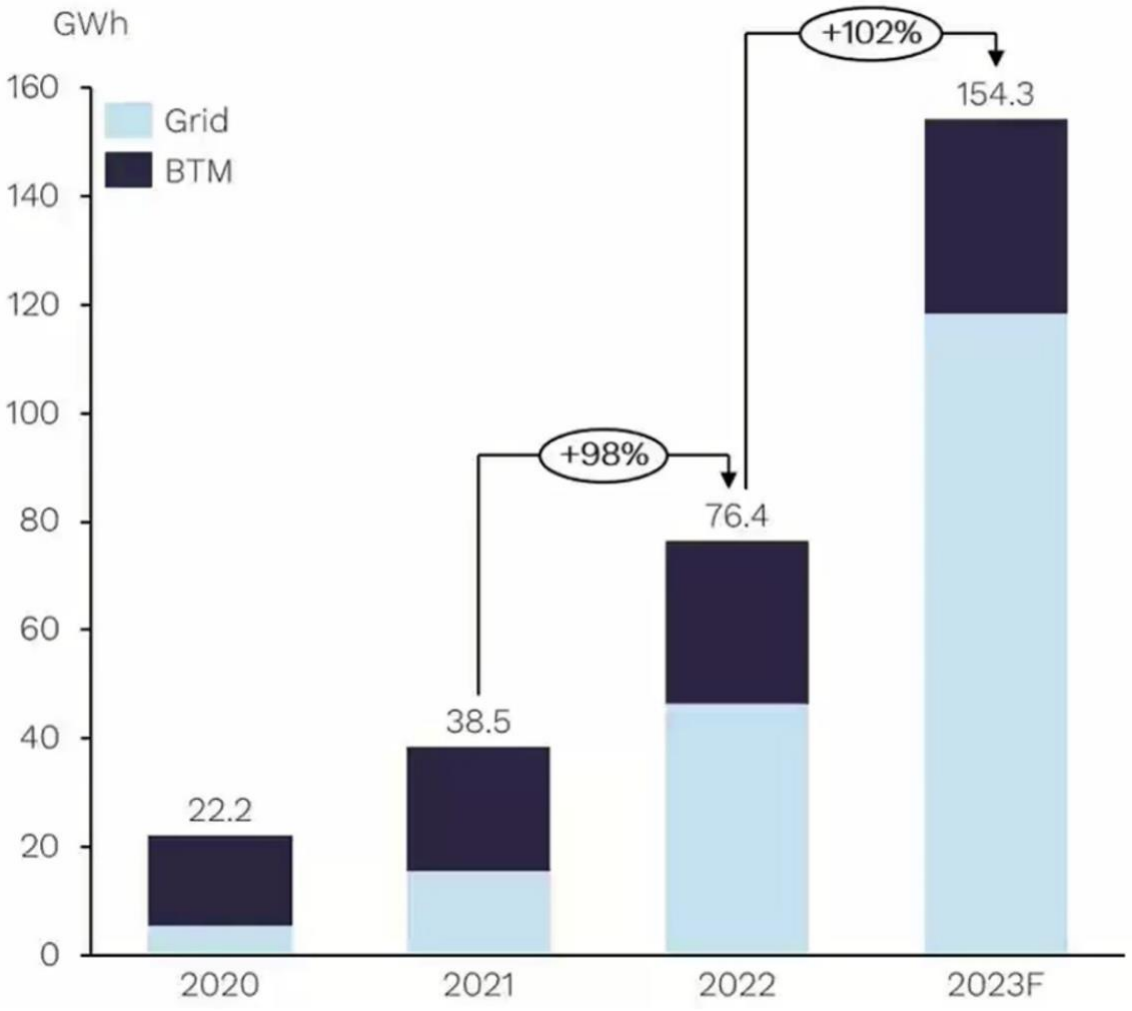
Co-funded by the European Union

GTM Research Total Cumulative 5-Year Forecast



Source: GTM Research

BESS installed capacity outlook by storage type, new additions



Evs still driving the demand for batteries

- EV sales is still growing rapidly in Europe even tough car sales overall is decreasing
- Strong commitments from all OEMs to make the transition to electric drivetrains
- The mythical “price parity” between EV and fossil cars happened – two years earlier than forecasted (High-cost segment)

Mercedes-Benz to go all-electric for vehicles by 2030

26 July 2021, source edie newsroom

Mercedes-Benz has announced plans to move its entire product portfolio to electric vehicles (EVs) by 2030, to be supported by a £34bn investment and plans to run eight gigafactories for battery production.

Renault says electric cars will dominate sales by 2030

June 30, 2021 | by Jack Ewing / The New York Times | Copyright © 2021

ELECTRIFICATION MARCH 02, 2021

Volvo plans to be fully electric by 2030

VW plans to go all-electric in Europe as soon as 2033, US later

MOTORS / CARS MARCH 17, 2021

Audi Will No Longer Develop Internal Combustion Engines

Sep 7, 2021 - 10:59 am

Daimler is done with plug-in hybrids

Similar size and equipment level

Volvo XC60 Diesel	Tesla model Y
52 017 €	48 430 €

- Next focus – “Affordable EVs”
- Charging infrastructure and V2G

Ford, Honda, and BMW create a new vehicle-to-grid company to help EV owners save money

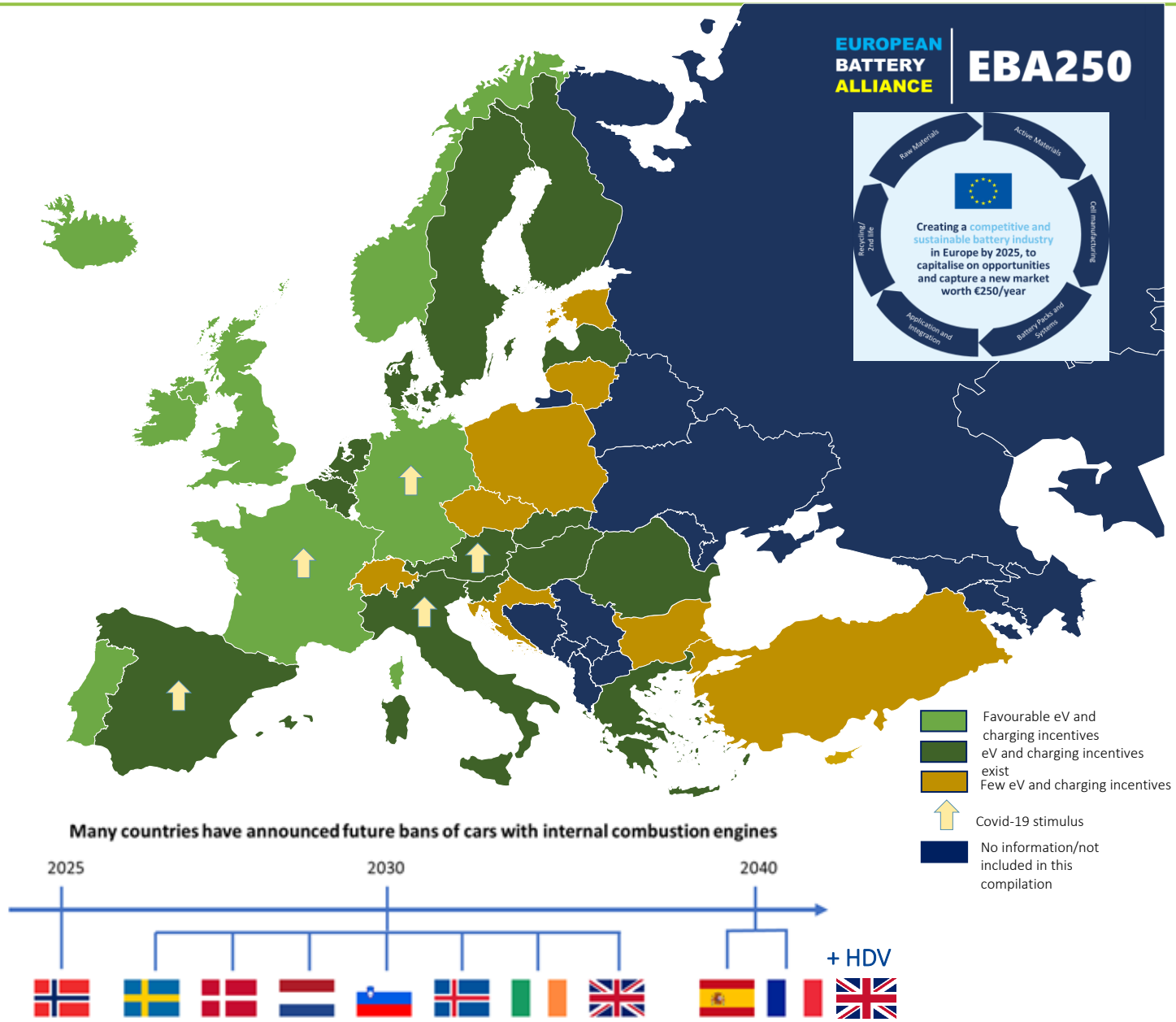
European and member state legislation

- Incentives and taxes
- CO2 emissions thresholds
- CO2 emission targets
- Bans on sales of ICE accelerates phase-out
- Supportive regulatory framework fuelling the shift to electrification

REPowerEU stipulates added capacity of:
- Solar: 320 GW 2025, 600 GW 2030
- Wind: 600 GW by 2030

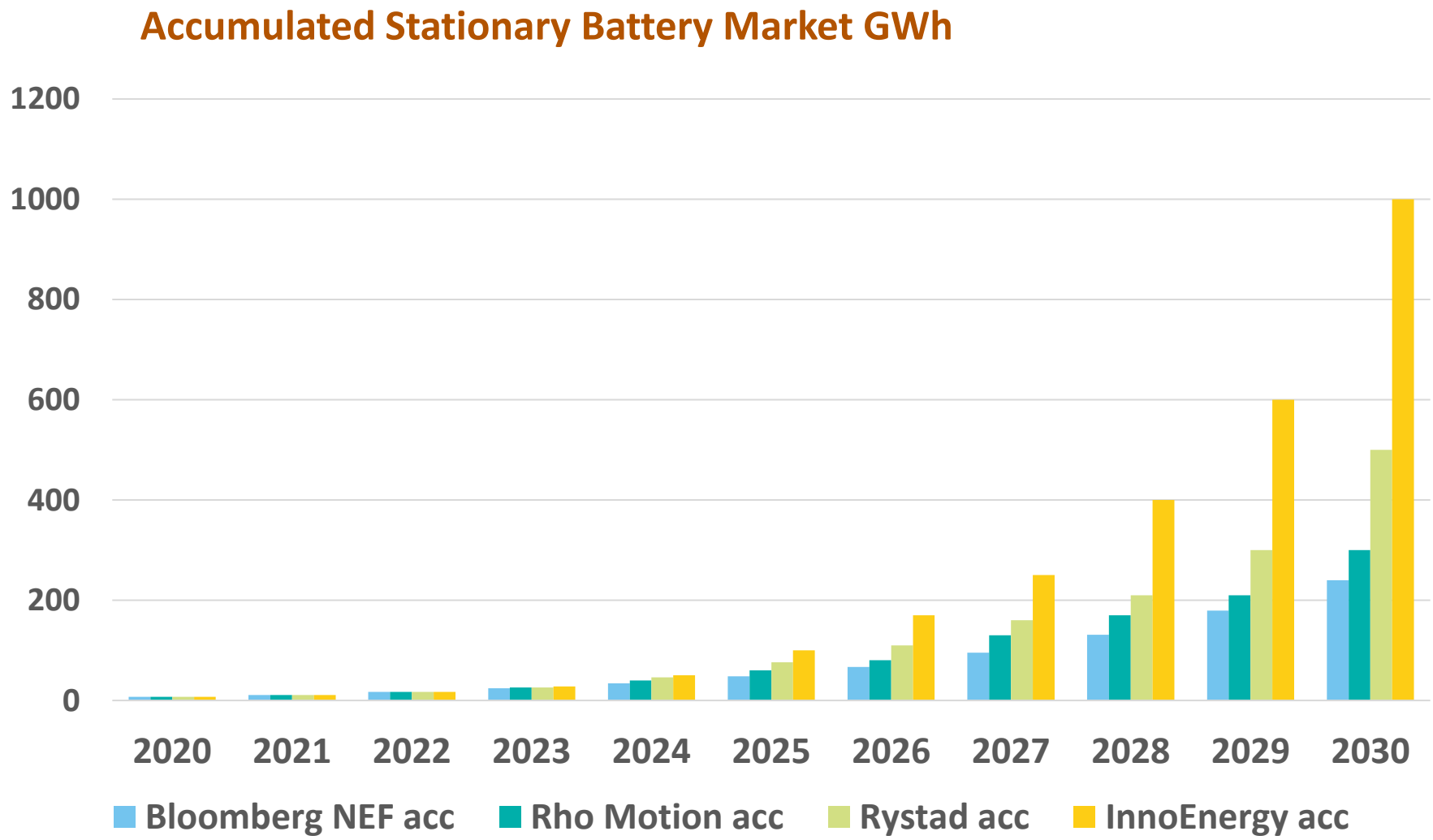
New Electricity Market Design

Goals for:
- Zero emission cars 2035
- Aviation
- Marine vessels



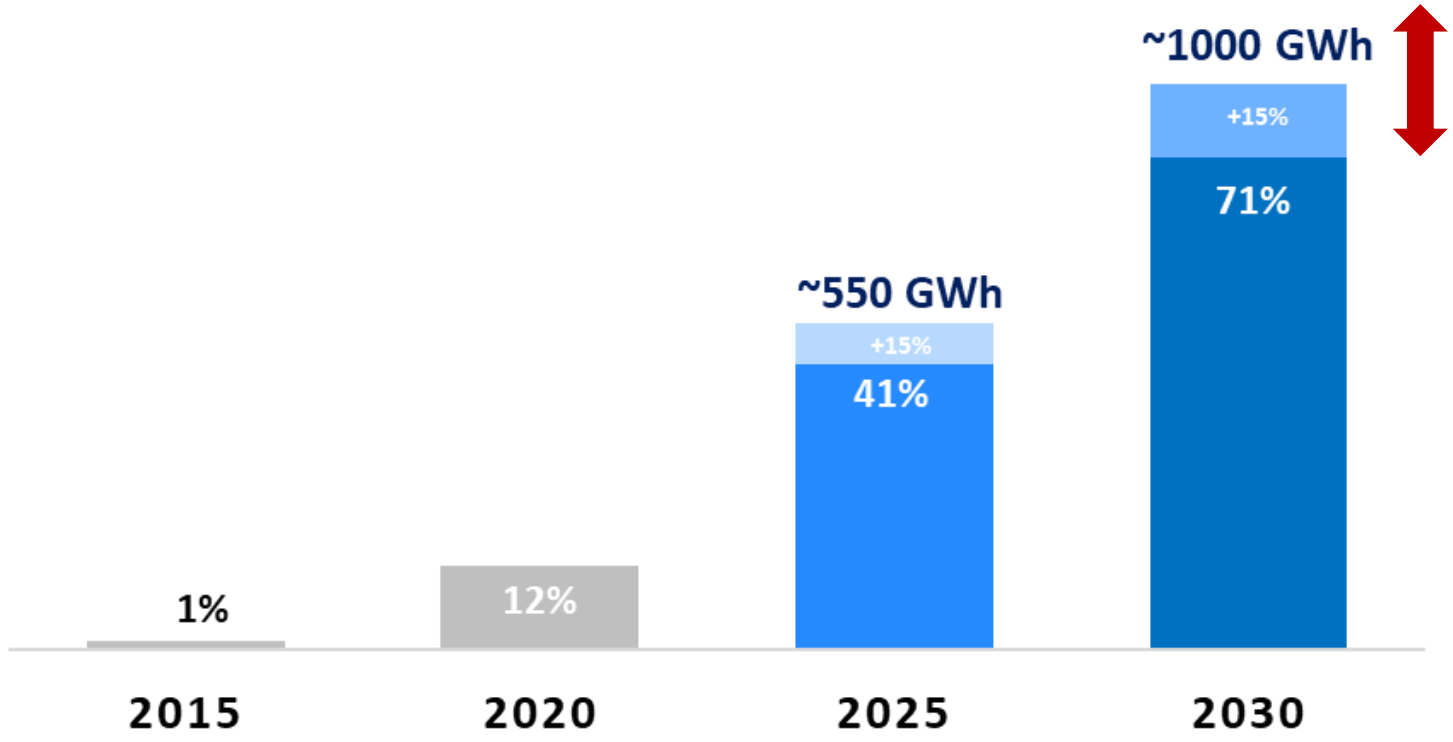
Correlation storage/peak demand vs RES share

Increased RES targets triggers 300 – 1000 GWh accumulated battery capacity and 100 – 300 GWh annual market by 2030



Increased electrification targets increase demand forecasts

Volume-averaged Europe forecast EV+PHEV sales forecast, including 15% for other sectors (HDV, busses, yellow machines etc...



+230 – 430 GWh

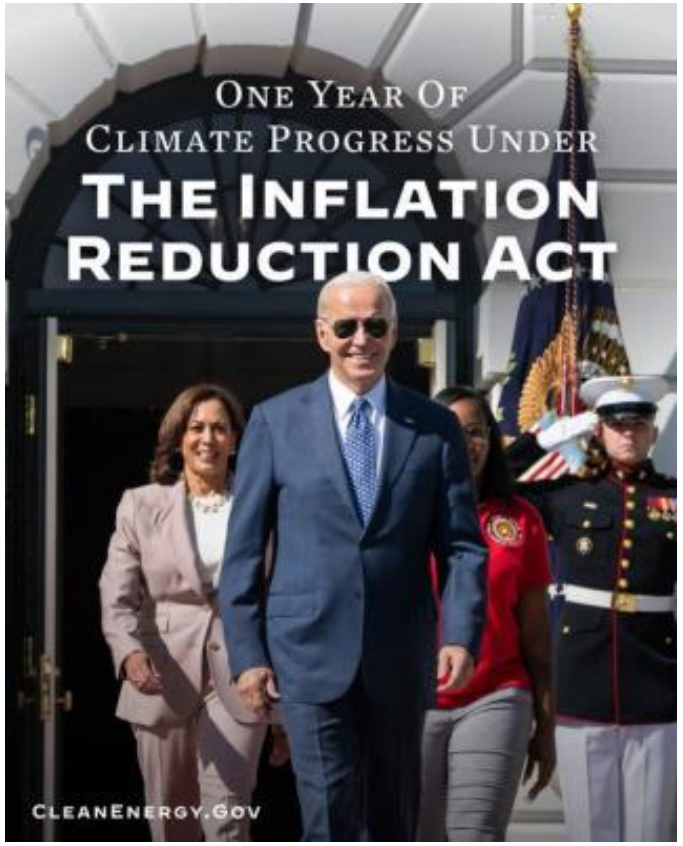
	2020	2025	2030
oup	11%	40%	60%
Stellantis	7%	40%	70%
Renault-Nissan-Mitsubishi	16%	45%	70%
Daimler	2%	25%	100%
BMW	17%	25%	50%
Ford	1%	90%	100%
Hyundai	13%	30%	60%
Toyota	5%	20%	30%
Jaguar-Landrover	9%	30%	60%
Tesla	100%	100%	100%
VolvoCars	29%	50%	100%
Total	**12%**	**41%**	**71%**

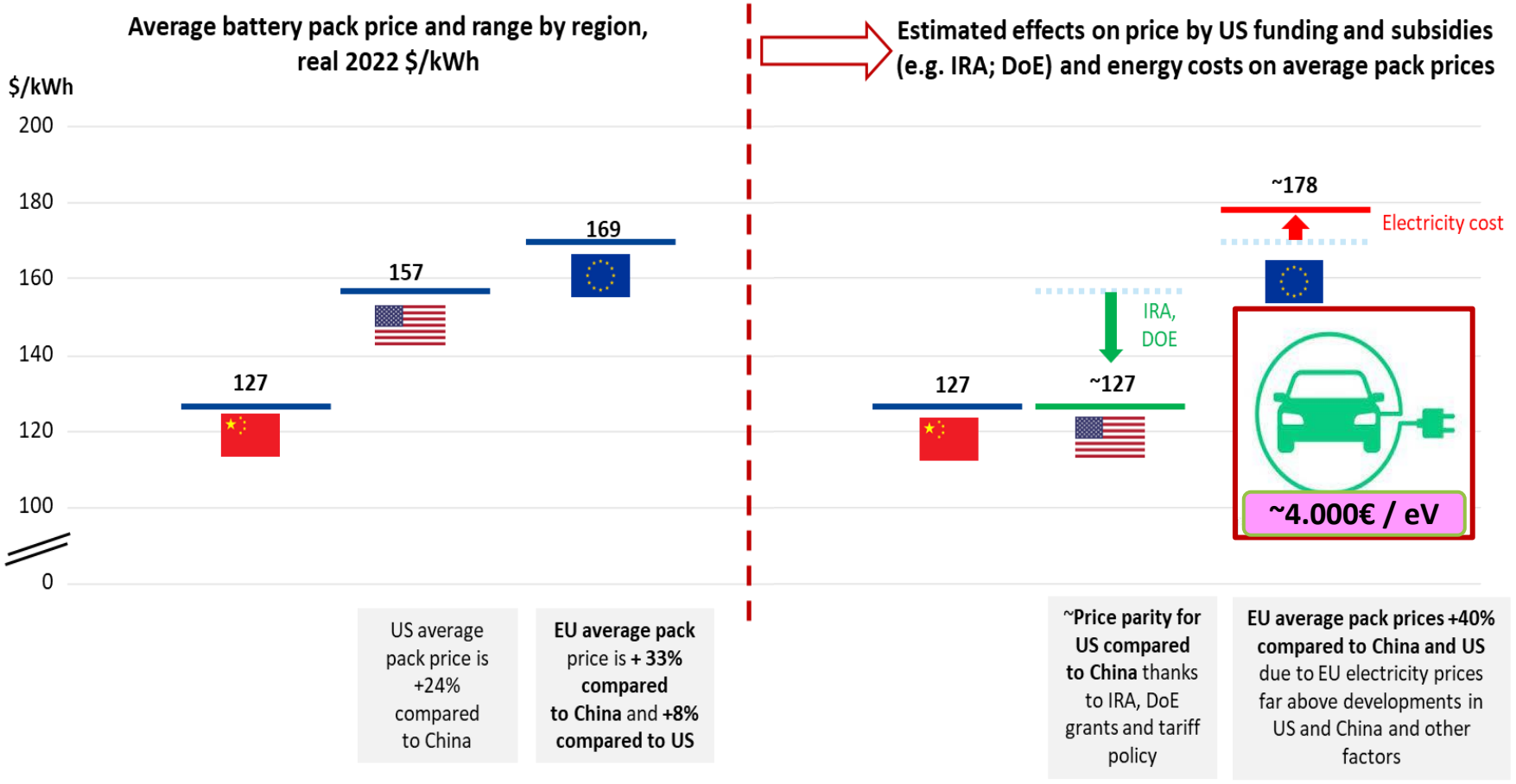
OEM Announcements

EBA250 estimates

An unbalanced global playing field, impacting EU competitiveness

~4.000 Euros price difference per average eV

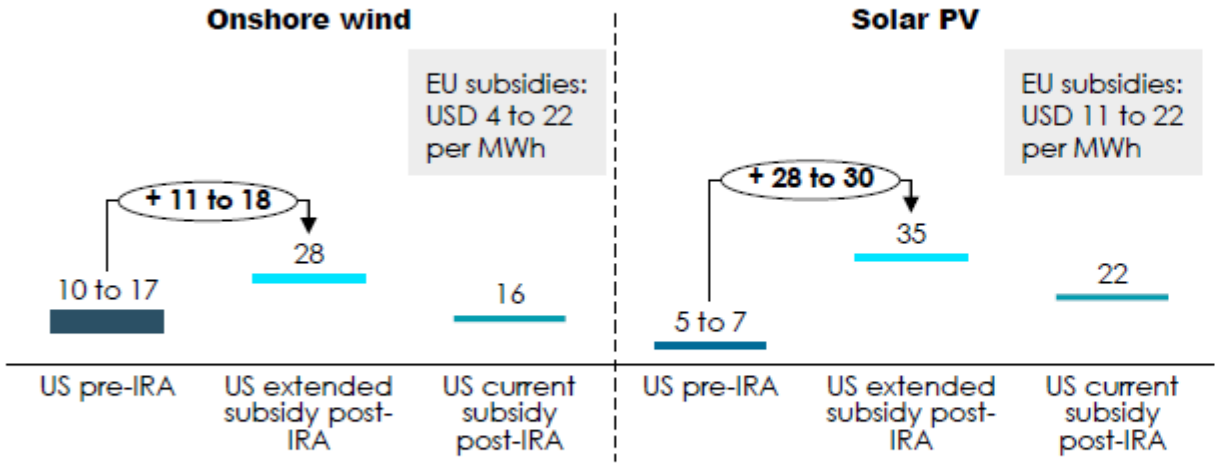




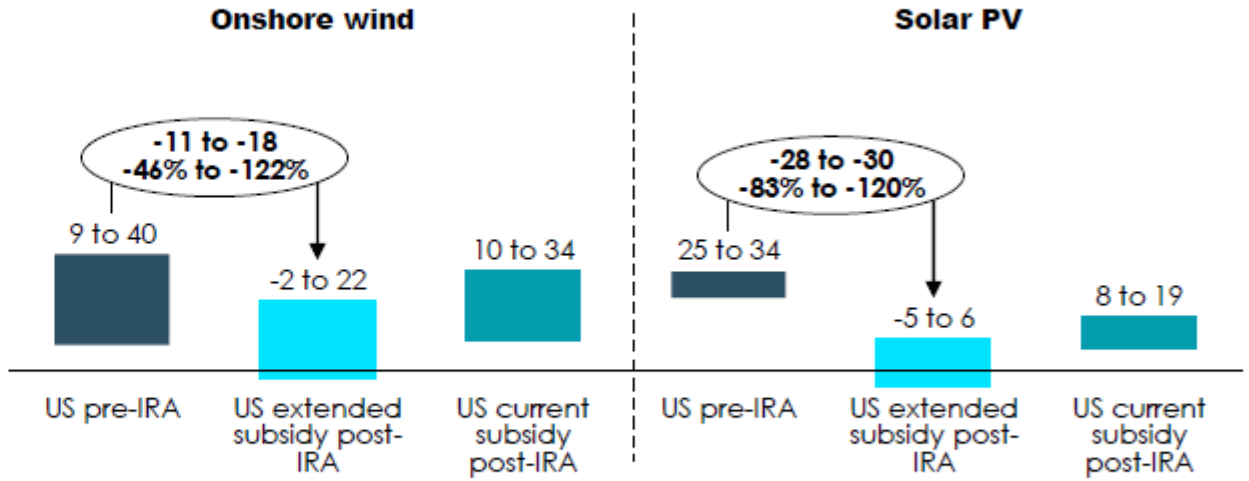
An unbalanced global playing field, impacting EU competitiveness

LCOE around zero as the IRA lowers the price of renewable energy

Total effective subsidies in the US
USD per MWh, 2021-values



Levelised cost of electricity including subsidies in the US
USD per MWh, 2021-values



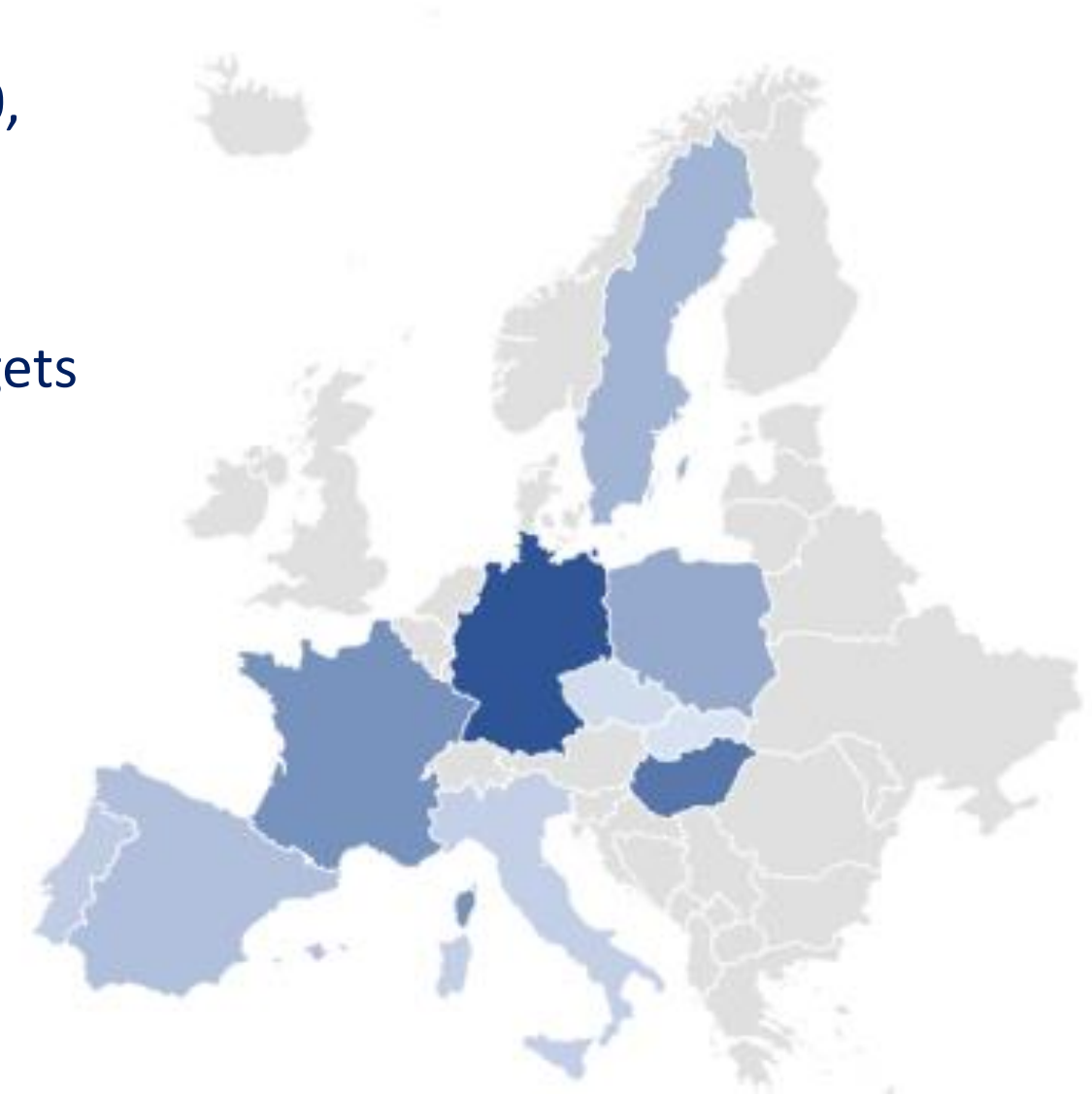
Note: The initial starting point for our calculation is the upper bound of LCOE as shown on previous slides. Subsidies may contain local content requirements for the production of components and sourcing and refinement of materials. See appendix. The main interest of the effect of the IRA on LCOE is through indirect effects. As offshore wind is high cost in the US per prior slide, we have not included it in the above for simplification. Instead focus is on onshore and solar, where through main impacts are to be expected.

Sources: EU current subsidies follow from page 12, Department of Energy (2021) and Sidley (2022).

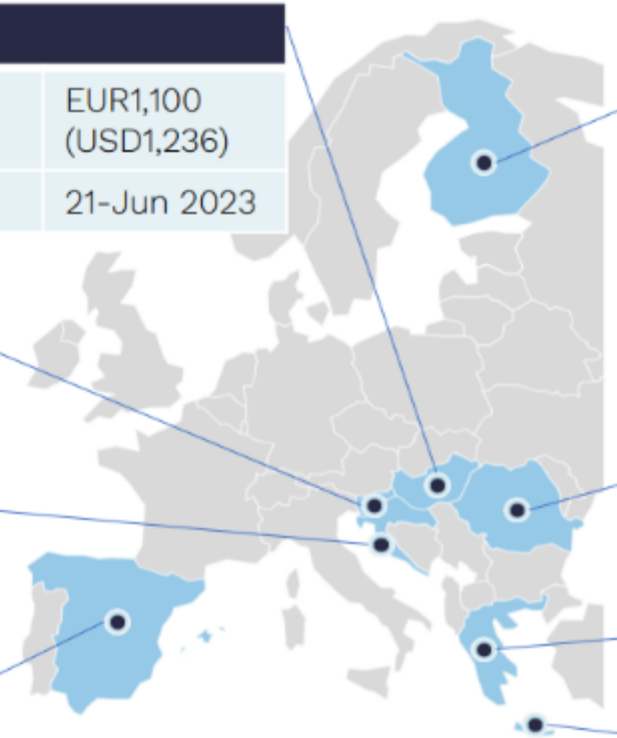
Source: Copenhagen Economics

A combination of new instruments for Europe

- **Temporary Crisis and Transition Framework**
  Relaxation of State Aid with max. of m€150-350, including a matching clause
- **Critical Raw Materials Act**
  Addresses supply chain vulnerabilities with targets for domestic production and diversified supply chains
- **Net Zero Industry Act**
  Simplification of regulatory framework and permitting for net-zero technologies
- **European Economic Security Strategy**
  Proposal for a new Regulation to establish a Strategic Technologies for Europe Platform ('STEP').



BESS Funding



Hungary	
Amount (million)	EUR1,100 (USD1,236)
Date	21-Jun 2023

Finland	
Amount (million)	EUR1,000 (USD1,125)
Date	23-Mar 2023

Slovenia	
Amount (million)	EUR150 (USD169)
Date	6-Mar 2023

Romania	
Amount (million)	EUR103 (USD116)
Date	21-Mar 2023

Croatia	
Amount (million)	EUR20 (USD22)
Date	9-Sep 2022

Greece	
Amount (million)	EUR341 (USD385)
Date	5-Sep 2022

Spain	
Amount (million)	EUR350 (USD394)
Date	7-Jul 2023

Cyprus	
Amount (million)	EUR101 (USD114)
Date	8-Sep 2022

Source: Rho Motion – September 2023

Conclusions

- **Electric Transportation**
  - Driving the development of the battery value chain
  - Affordable cars next focus – impact on battery design
- **Stationary storage next big demand**
  - Expected to have a similar growth as EVs
  - Europe is picking up speed
- **Upstream restrictions in the Li-ion value chain**
  - Added demand for raw materials
  - Alternative chemistries Na-Ion a good contender

Co-funded by the European Union

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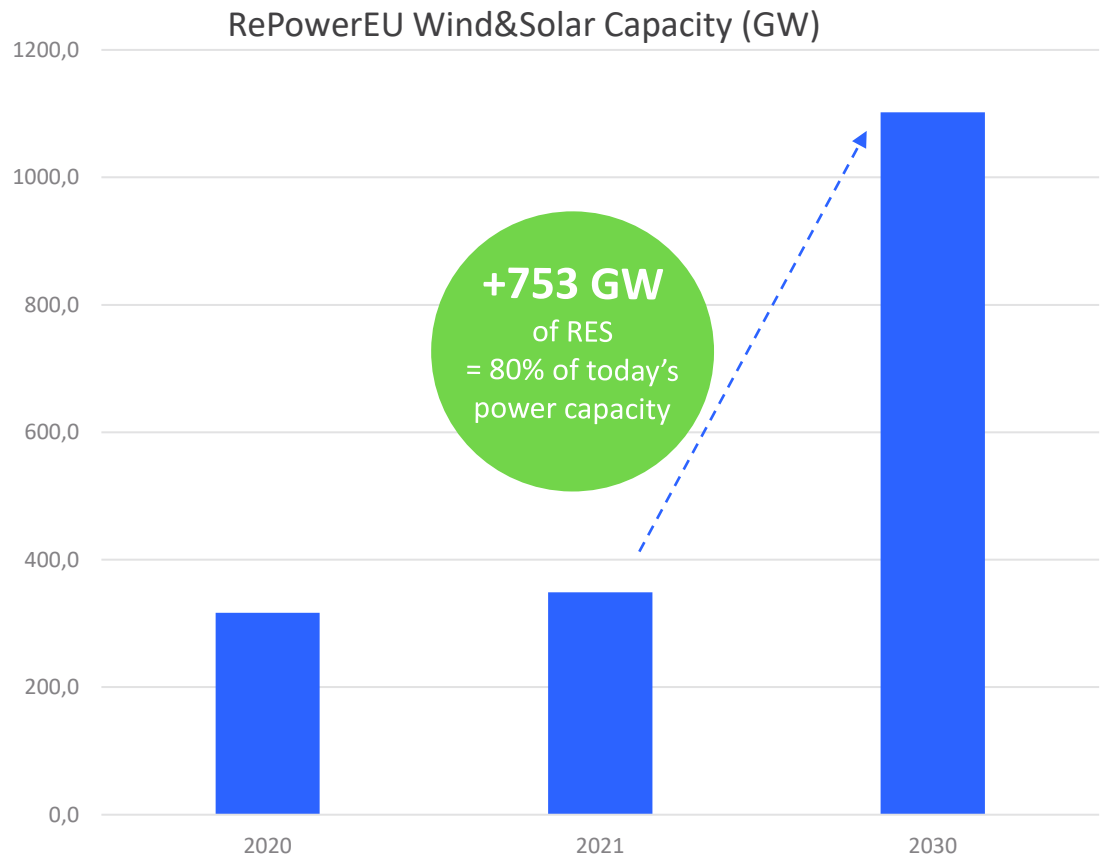
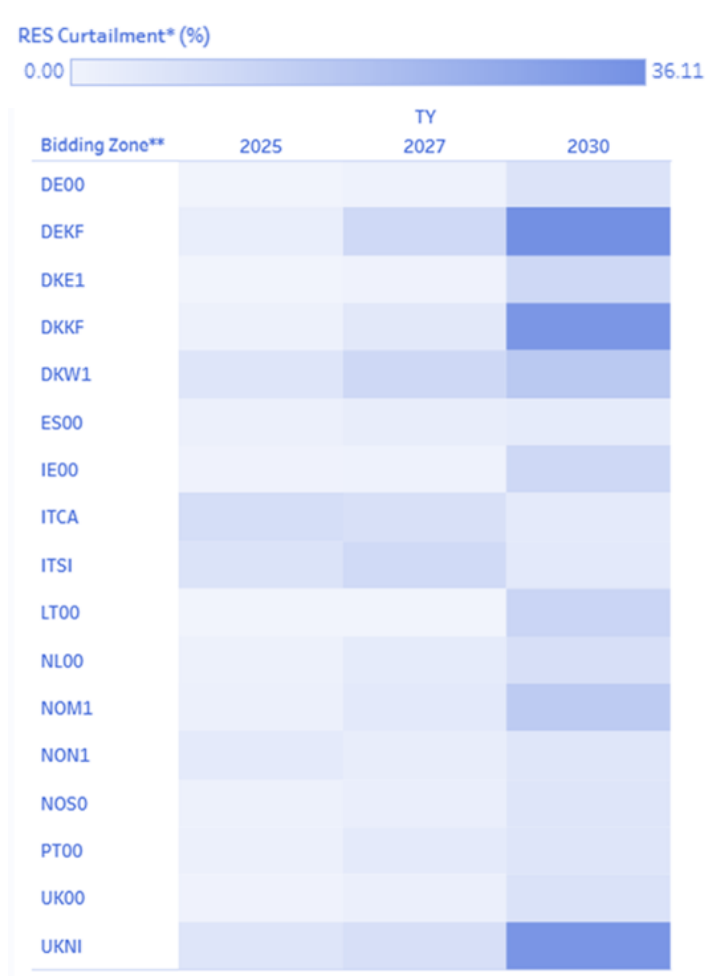
Energy Storage: An enabler of higher integration and utilisation of variable renewables

Eurelectric Presentation at Eurobat Webinar on: Battery Solutions for Energy Storage (BESS)
Wednesday, 20 September 2023

Why: REPowerEU demands accelerated RES electrification by 2030

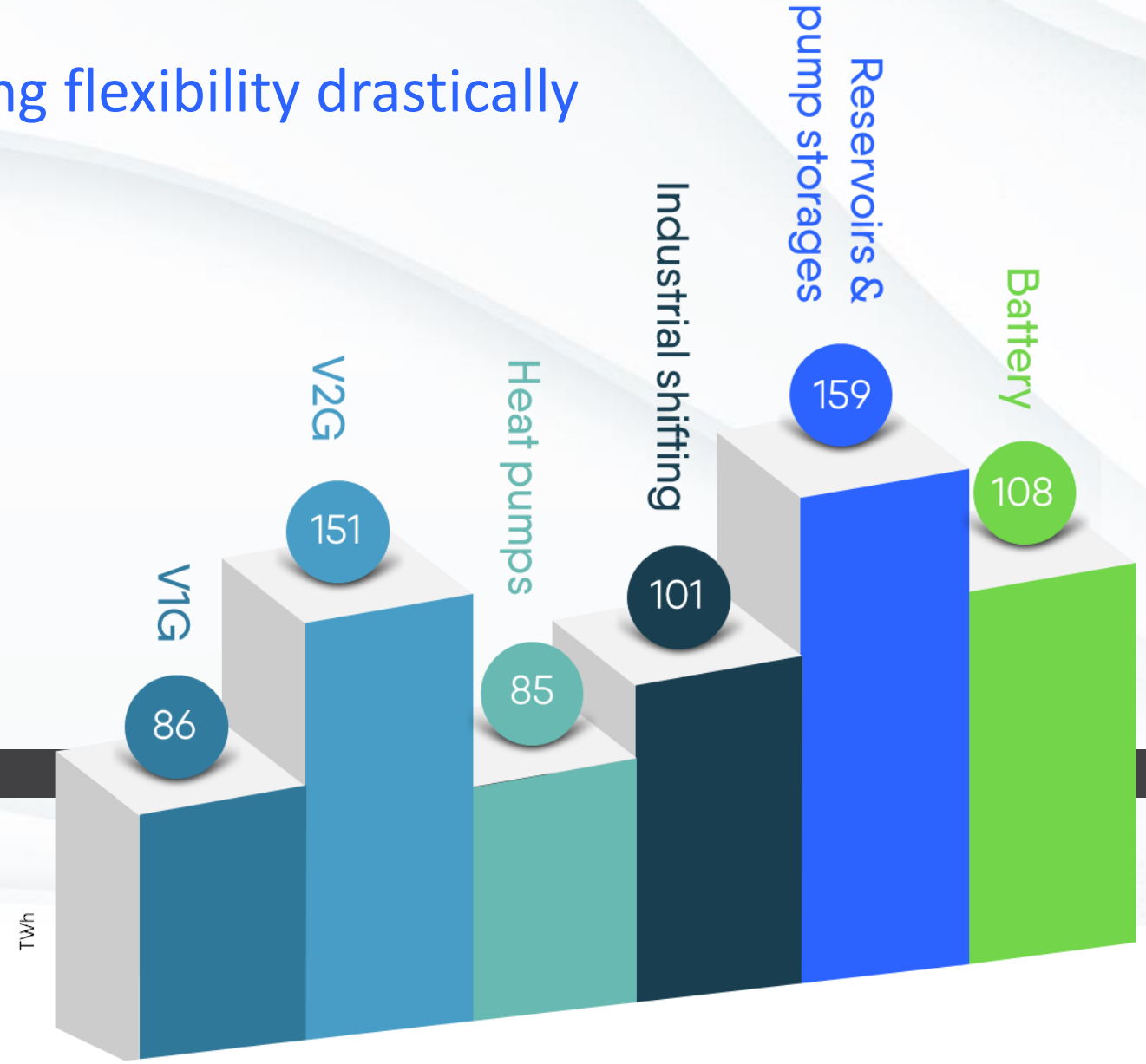


Vs.



In 7 years, the Wind & Solar capacity of EU-27 should **grow to 1102 GW from 349 GW.** However potential high level of curtailments risk slowing down the necessary RES investments unless we boost flexibility offerings

What: Boosting flexibility drastically



In 2022, battery storage reached only 9 GWh. This represents 0,009% of the 108 TWh needed in 2050.
This illustrates how gigantic the leap forward needs to be.

Source: Eurelectric Decarbonisation Speedways Study, June 2023

How: 5 Policy Requests to make storage a key industry in the EU

1	2	3	4	5
Consider storage as a flexibility option	Provide long-term predictability of revenues	Make use of existing funding opportunities for the transition	Build up capacities	Ensure Supply Chain Resilience
✓ Member States to carry out an economic assessment to better understand their flexibility needs and secure cost-efficient adequacy. ✓ System operators should identify system benefits from storage in their network assessments	✓ Stop electricity market interventions that have eroded investors confidence ✓ Implement the Clean Energy Package ✓ Facilitate capacity mechanisms ✓ Ensure adequate remuneration for the multi-service utilisation of storage capacities ✓ Abolish double taxes, charges and grid tariffs issues for storage ✓ Enable PPA development	✓ Launch specific tenders for standalone storage and co-located storage. ✓ Consider storage as one of the flexibility options eligible for competitively-designed EU and Member State funds for the transformation of our energy system.	✓ Streamline permitting (RED IV & NZIA) ✓ Allow for flexible connection agreements	✓ EU Battery Alliance, Critical Raw Materials Act and Net Zero Industry Act are positive steps

Thank you!

Get in touch: agarcia@eurelectric.org

250 participants high-level policymakers Sparks meeting center, Brussels

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01 Dr Andre Haubrock

Empowering the world for renewable energy

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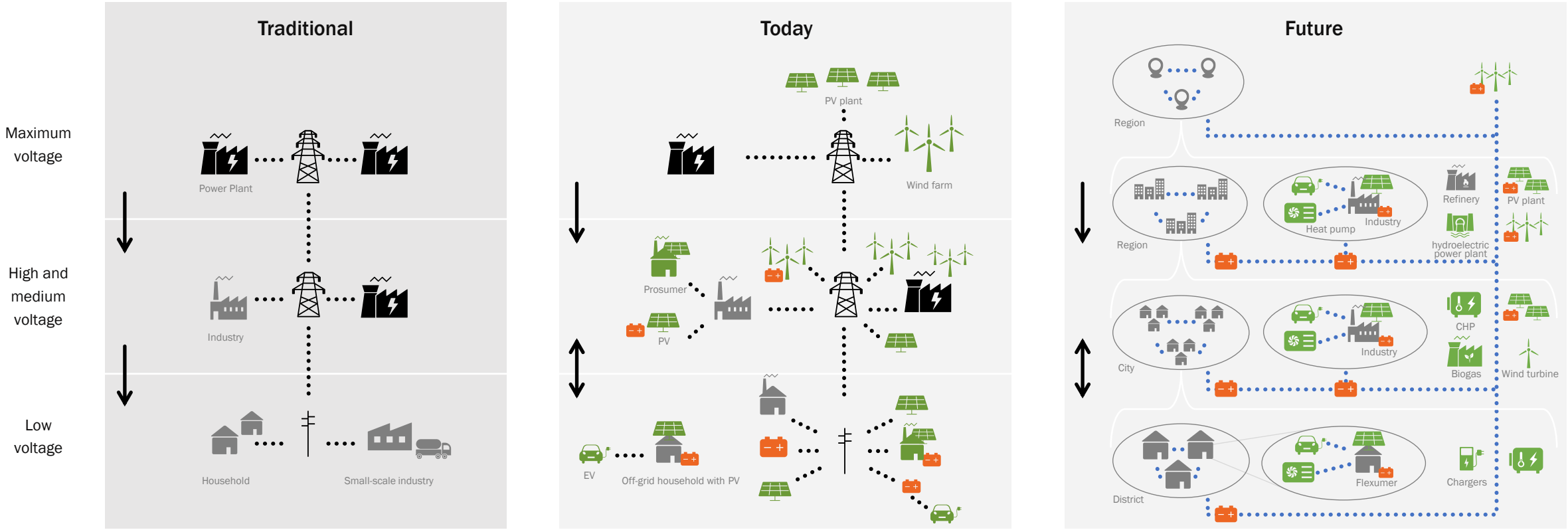
The transformation of the energy system to smart grids

From centralization to decentralization with increasing digitization



Source: Based on Agora Energiewende (2017): „Energiewende 2030: The Big Picture. Megatrends, Ziele, Strategien und eine 10-Punkte-Agenda für die zweite Phase der Energiewende."

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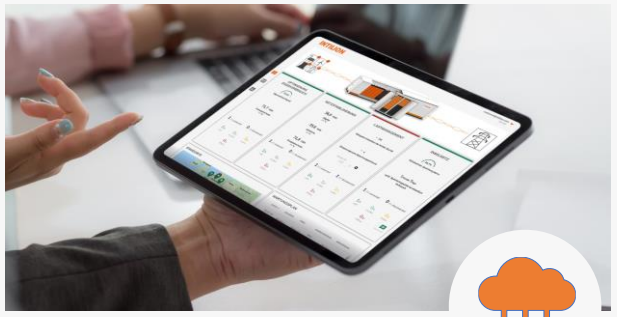
One-stop shop solution for energy storage

INTILION

Intelligent storage systems

- Customized system engineering
- Modular und scalable design
- Storage technology agnostic



Proprietary software

- Dedicated energy management
- Data analytics and cloud connection
- Remote monitoring for predictive maintenance and security

Fulfilment & service

- End-to-end fulfilment with deep grid integration expertise
- Local after-sales service
- Availability guarantee over full-service life

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Our products combine scalability, flexibility, and connectivity

Default solution

Outdoor commercial storage system

Approx. 70 up to 1170 kWh
25 kVA, 50 kVA, and 73 kVA

In-/outdoor

Product scaleable

Indoor commercial storage system

154 – 616 kWh up to 1,200 kWh
25 – 400 kVA in 25 kVA steps

Indoor

Module scaleable

Indoor & outdoor large-scale storage

From 1 up to 100 MWh
From 1000 kVA

Outdoor

Module and product scaleable

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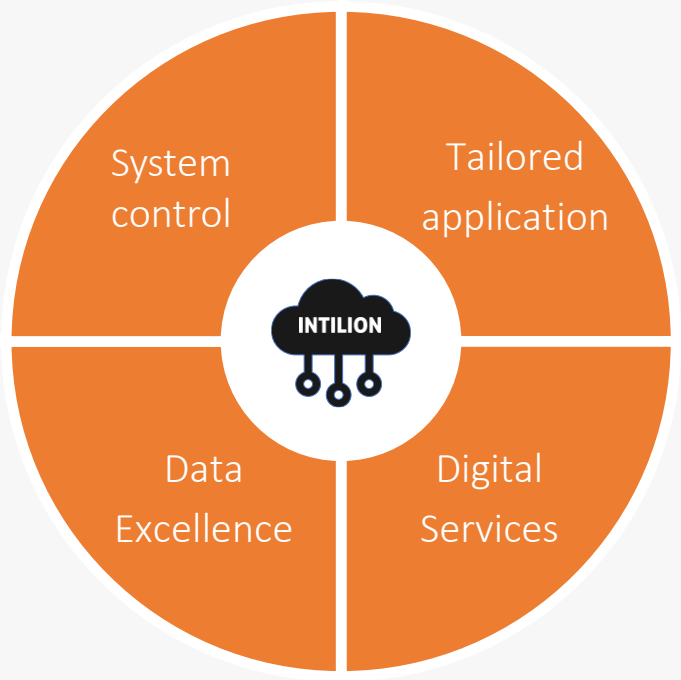
Proprietary software is core to our offering

Ensuring safe operation

- Controlling & managing the components *(cells, converter, air-condition)*
- Collecting system data *(~ 500 datapoints per system in 5 sec. interval)*
- Gateway for real time connection *(LAN, LTE, Modbus, MQTTs)*

Improvement of the algorithm and acceleration of the processes

- Processing of all relevant system data
- Lean processes due to data transparency
- Algorithm improvement based on data analytics for installed base



Design of customized solutions

- Development of customer specific application software
- Manage the entire battery solution & customer application via Energy Management System (EMS)
- Full control of energy flow

Connection across all energy system levels

- Performance & lifetime reporting
- Data cloud & dashboards
- Predictive maintenance based on data analysis

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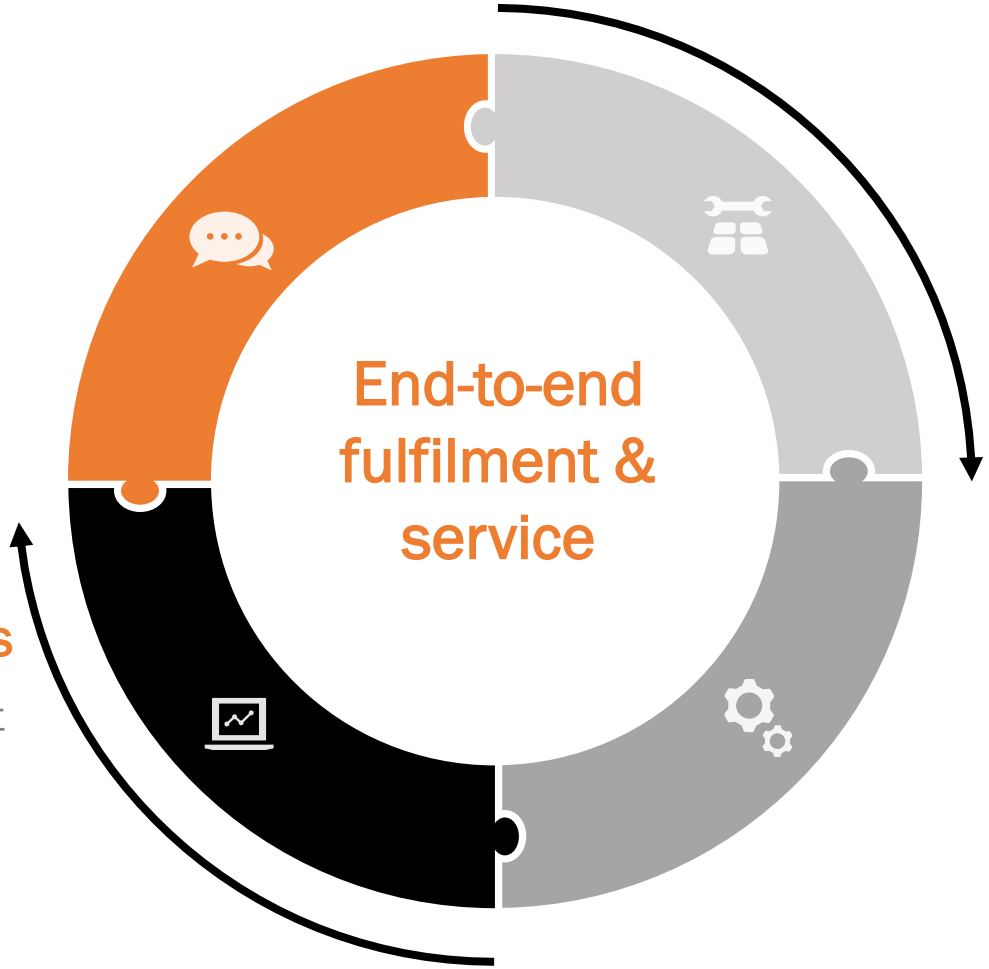
Your turnkey solution – from project planning to recycling

Concept & design phase

- ✓ Energy advisory
- ✓ Solution concepts
- ✓ System design



Installation & commissioning

- ✓ Location management
- ✓ Cold and hot commissioning
- ✓ Integration of network control

Add-on services & analytics

- ✓ Replacement part management
- ✓ Disassembly and disposal
- ✓ Data analysis and operational optimization

Operation & maintenance

- ✓ System operation
- ✓ System monitoring and on-site service
- ✓ Whole-system maintenance

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Year of construction
2022

Sector
Power Supply

Capacity
27.6 MWh

10x

Bavaria, Germany

Primary control power

Grid stabilization at the hydropower plant & backup power for the airport

- ✓ Multi-use case: besides grid stabilization and primary control power, the energy storage system secures the power supply of an airport
- ✓ Integration of the nearby hydropower plant
- ✓ 10 independently operating battery systems
- ✓ Turnkey project consisting of container, converter transformer, software algorithms and complete fulfilment & commissioning
- ✓ Primary control power is a mechanism for stabilizing the power grid by adjusting power generation to power demand at short notice
- ✓ Reliable and effective power supply is only possible with INTILION storage units in order to be able to react to fluctuations in the grid at short notice
- ✓ INTILION's storage solution makes the hydropower plant capable of black-starting and thus ensures the emergency power supply of large consumers in the event of a power outage

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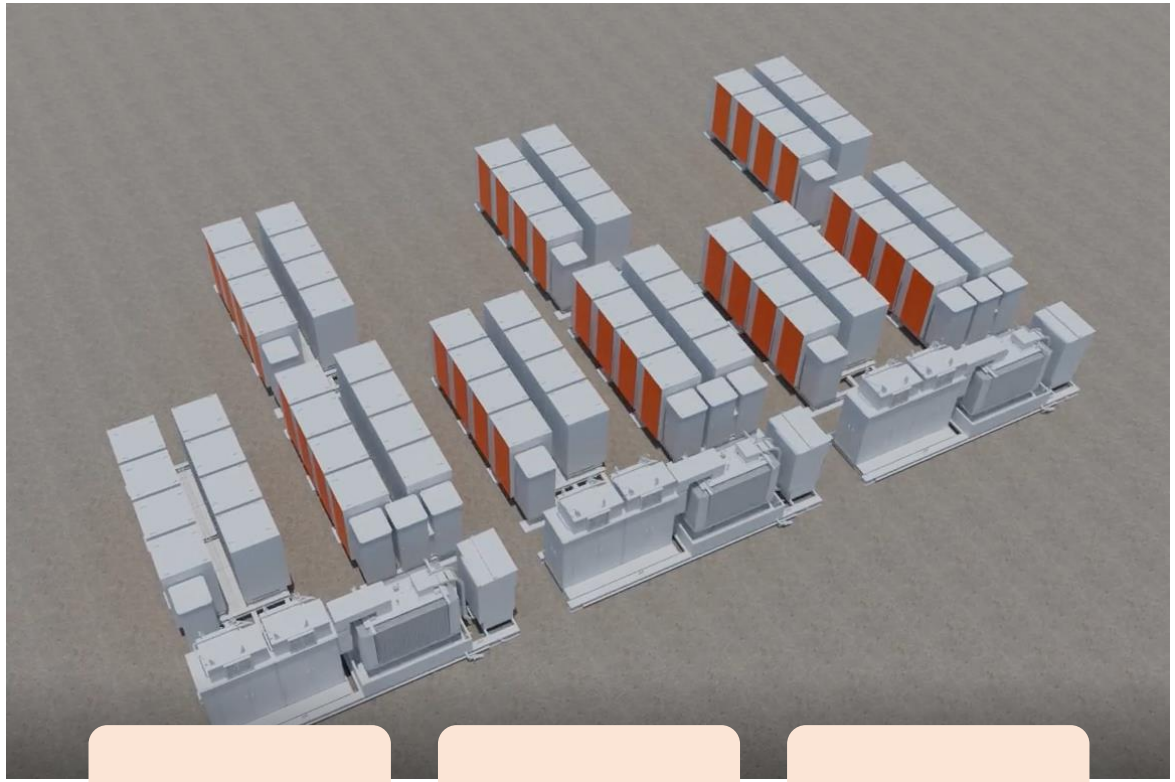

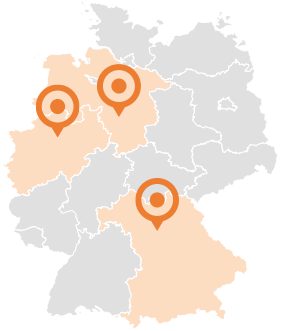

2x

1x

Telecommunication company

– Bamberg, Münster, Hannover, Germany

60 MWh for Telecommunications industry & data centers

- ✓ INTILION | scalecube large-scale storage units deployed at three sites for frequency balancing and balancing services
- ✓ Front-of-the-meter installation for effective grid integration
- ✓ Approximately 26 MWh energy storage systems planned for Hanover and Bamberg locations each
- ✓ Additional 6 MWh energy storage to be installed at the Münster location
- ✓ Construction has already started in Münster

Year of construction
2023 / 2024

Industry
Telecommunication & Data Center

Capacity
~ 60 MWh

INTILION

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INTILION is ready to accelerate the energy transition

- ✓ Highly attractive market for stationary C&I and FTM storage systems: cum 124GWh by 2030, CAGR ~25%[1]
- ✓ Energy storage systems are absolutely necessary to make the energy transition fast, reliable and sustainable
- ✓ Lithium ion batteries are at a high level of technological maturity, now innovation and cost optimization need to be promoted
- ✓ Pure innovation in battery technology (cell) is not sufficient, expertise is needed to make this technology available to the industry and to the electric power grids
- ✓ Comprehensive flexibilization of the electricity market is necessary to fully use the potential of energy storage systems for the economy
- ✓ Comprehensive support for the battery industry in Europe to reduce supply chain risks and increase the competition
- ✓ INTILION with a strong position in Europe is ready to accelerate the energy transition - the relevant solution pillars (hardware, application software, Fulfillment & Service) are in place

1 Wood Mackenzie 08/2023

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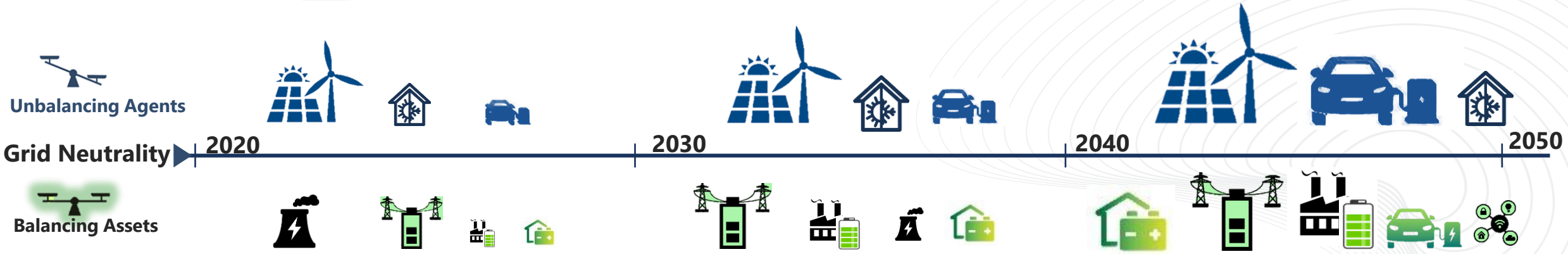
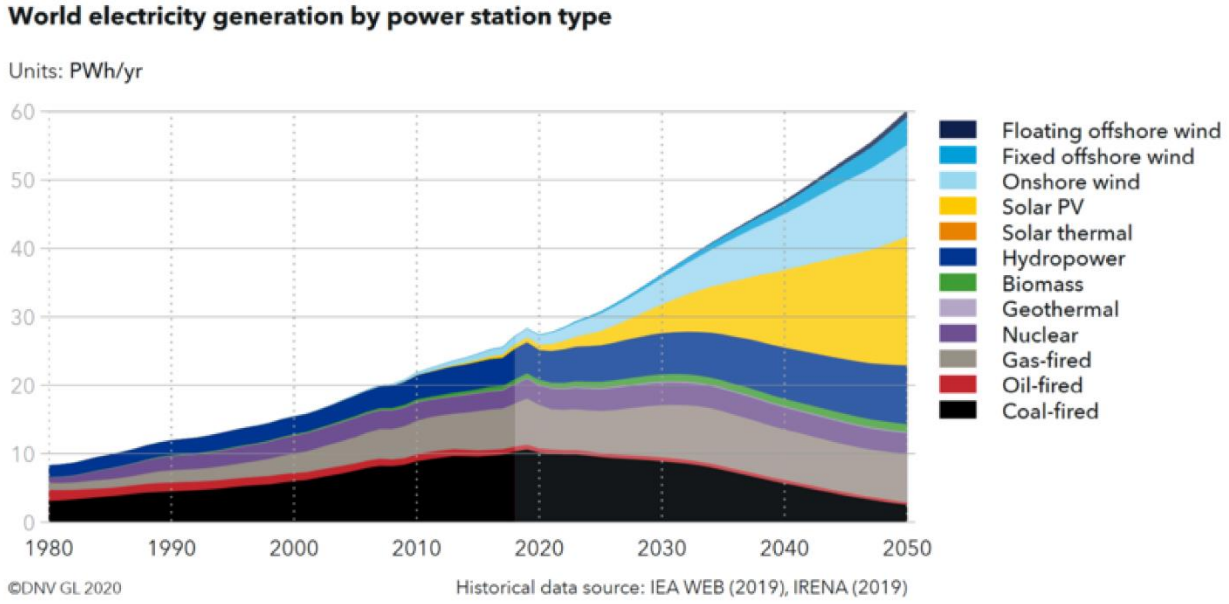
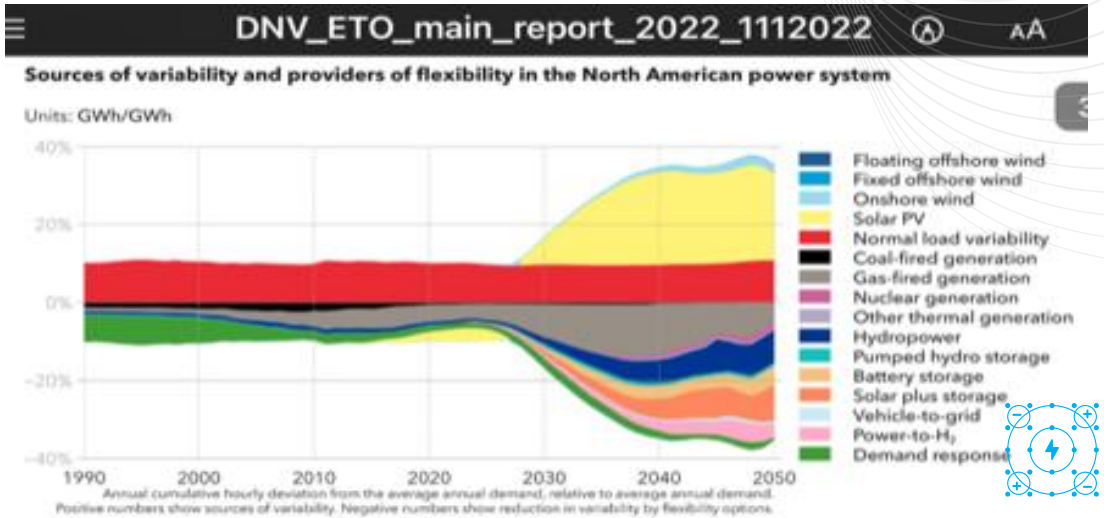
02 | Gianpaolo G. Giuliani

Zero-miles Battery Storage made possible

The evolution of electricity ecosystem: stationary storage potential







~3TWh of grid scale BESS + 9 TWh of C&I/Residential BESS, 2030 to 2050

The real cost of Lithium-Ion batteries

Cells EXW (1 kWh)

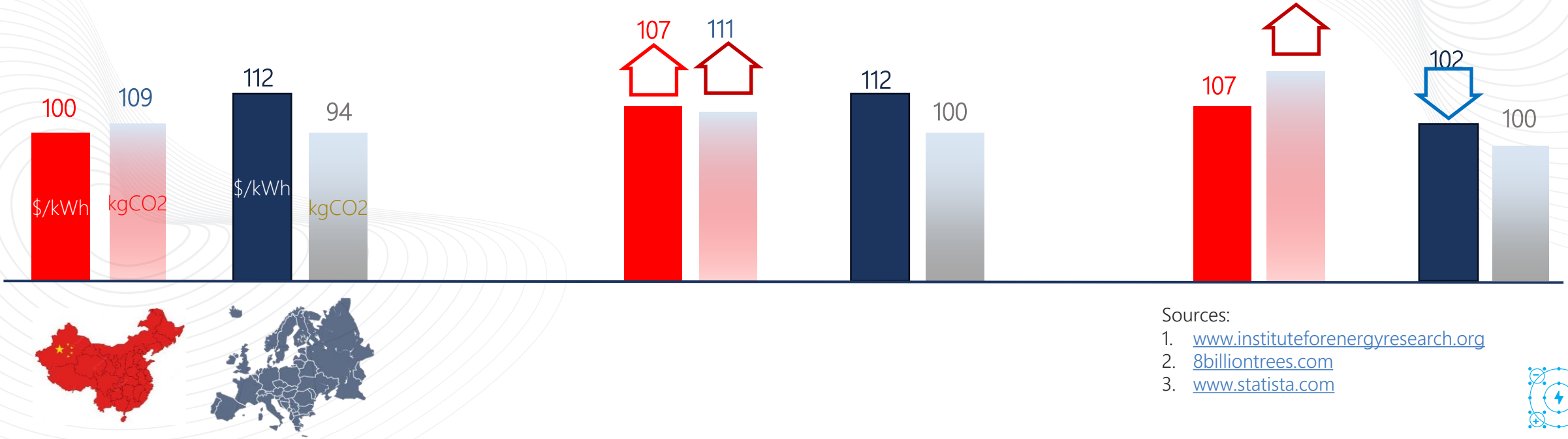
EU 10%-12% more costly
China CO2 emissions +16% [1]

Cells Shipment

China 7% transport + duties
Transport CO2 emissions 2kg/kWh[3]

Vertical integration

10% markup avoided on cells
Pack/re-pack of cells is 1kg/kWh[2]

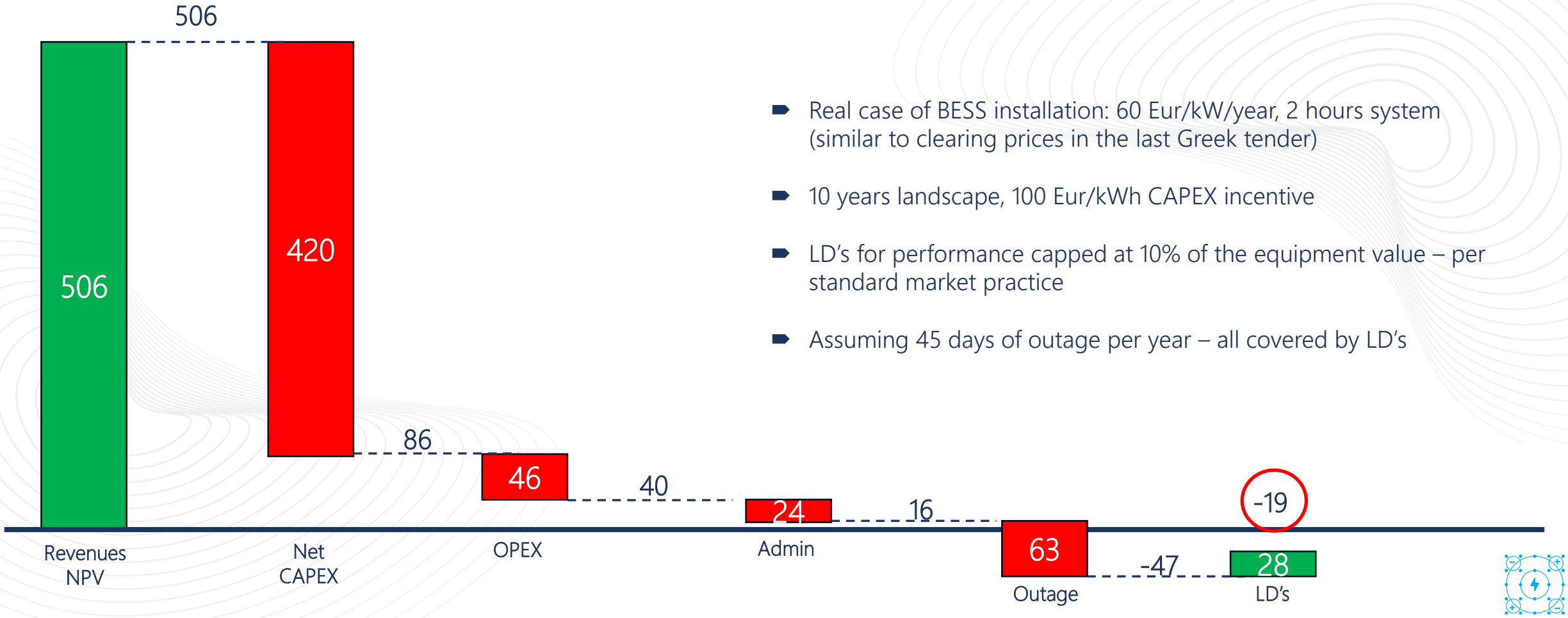


Sources:
1. www.instituteforenergyresearch.org
2. 8billiontrees.com
3. www.statista.com

Vertical integration of Li cells in EU = best option for pockets and planet

The real value of Lithium-Ion batteries

Figures in $/kWh



- Real case of BESS installation: 60 Eur/kW/year, 2 hours system (similar to clearing prices in the last Greek tender)
- 10 years landscape, 100 Eur/kWh CAPEX incentive
- LD's for performance capped at 10% of the equipment value – per standard market practice
- Assuming 45 days of outage per year – all covered by LD's

Reliability is a non-negotiable matter…

Protectionism vs fair measures

- The Biden administration issued an incentive scheme in the USA under the Inflation Reduction Act (IRA) …10% ITC bonus for goods exceeding 40% US content (raised to 55% by 2026)
- All battery manufacturers –including Chinese ones- are looking for ways to settle production units in the US… will this work economically? Will this serve the scope?

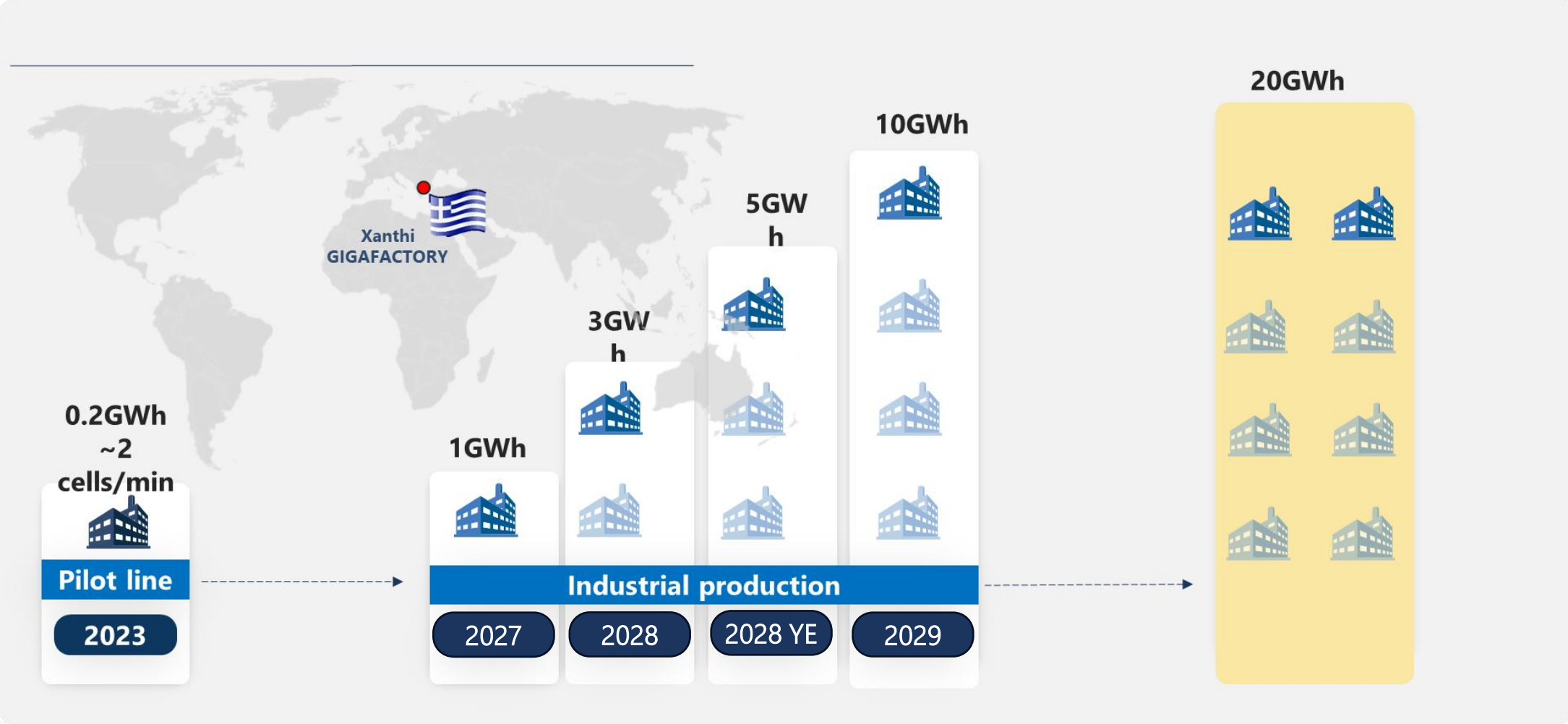
… Some valid alternatives exist:

- 100 Eur/ CO_2 ton excess in EU today => Most China-OEM cells would cost several Eur/kWh more if same penalty applied to GHG footprint of goods
- Other technologies (Solid state, Sodium Ion) seen promising near term => EU labs under bonus/penalty scheme to incentivize trading the IP rights within EU
- Large combined Hybrid Storage solutions => Incentivize projects able to affordably replace conventional power plants by combining different storage & generation assets
- Most Renewable sources excluded from grid services => Open up and mandate dispatchability -> BESS remunerative at an all-happy turnkey price

Sunlight's vision

- Vertically integrated production with three targets: the best safety, the least environmental impact, the least lifecycle cost
- Build cells with the most reliable, proven and automated industrial process available … spend more today to get more tomorrow
- Keep the design of the batteries chemistry-agnostic … Over-bespoken DC solutions have proven to be high-risk investments in this industry
- Technology experts are not enough… energy market experts are going to make the difference … customers' awareness is the key
- De-regulation is the best regulation… energy market is self-adapting
- Liaise with Regulators to foster fair and equal rules in the energy sector…if total CO_2 footprint is the KPI, local battery manufacturing & renewables growth in EU will be largely pursued
- Standardize the EV's battery sector … regulated battery packs will foster competition on technology and innovation and make the "mobile storage" capital more controllable: from a grid knocker to a grid stabilizer

Sunlight's vision: LFP manufacturing industrial plan



European Giga-factory 100% dedicated to stationary & IM applications

Sunlight's vision: State-of-art FtM & BtM solutions

- ✓ Modular, drop-ship
- ✓ 1500V, ~ 1,4MWh,
- ✓ >7000 cycles guaranteed
- ✓ <14 tons

- ✓ Integrated, Scalable
- ✓ air/liquid cooling
- ✓ Advanced EMS +Cloud
- ✓ 100÷500 kW/ 200+ kWh

- ✓ Rugged design
- ✓ 48 VDC
- ✓ 4,6-10 kW

100% vertically integrated EU-made BESS

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THANK YOU

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FREYR

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Gery Bonduelle

03 Transforming the EU grid through resiliency: FREYR proposal with innovative and locally produced Battery Energy Storage Systems

FREYR

What is resiliency?

Grid has to ensure the delivery of reliable electricity to consumers through:

- Reliability
- Redundancy
- Fast recovery
- Adaptability

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Why Low CO2 Electricity Generation is needed?

- Mitigating Climate Change
- Reducing Air Pollution
- Enhancing Energy Security
- Long term sustainability

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Why Energy Storage is needed in this low CO2 emission context?

- Integrating intermittent renewables
- Improving grid reliability
- Managing peak loads
- Reducing infrastructure costs

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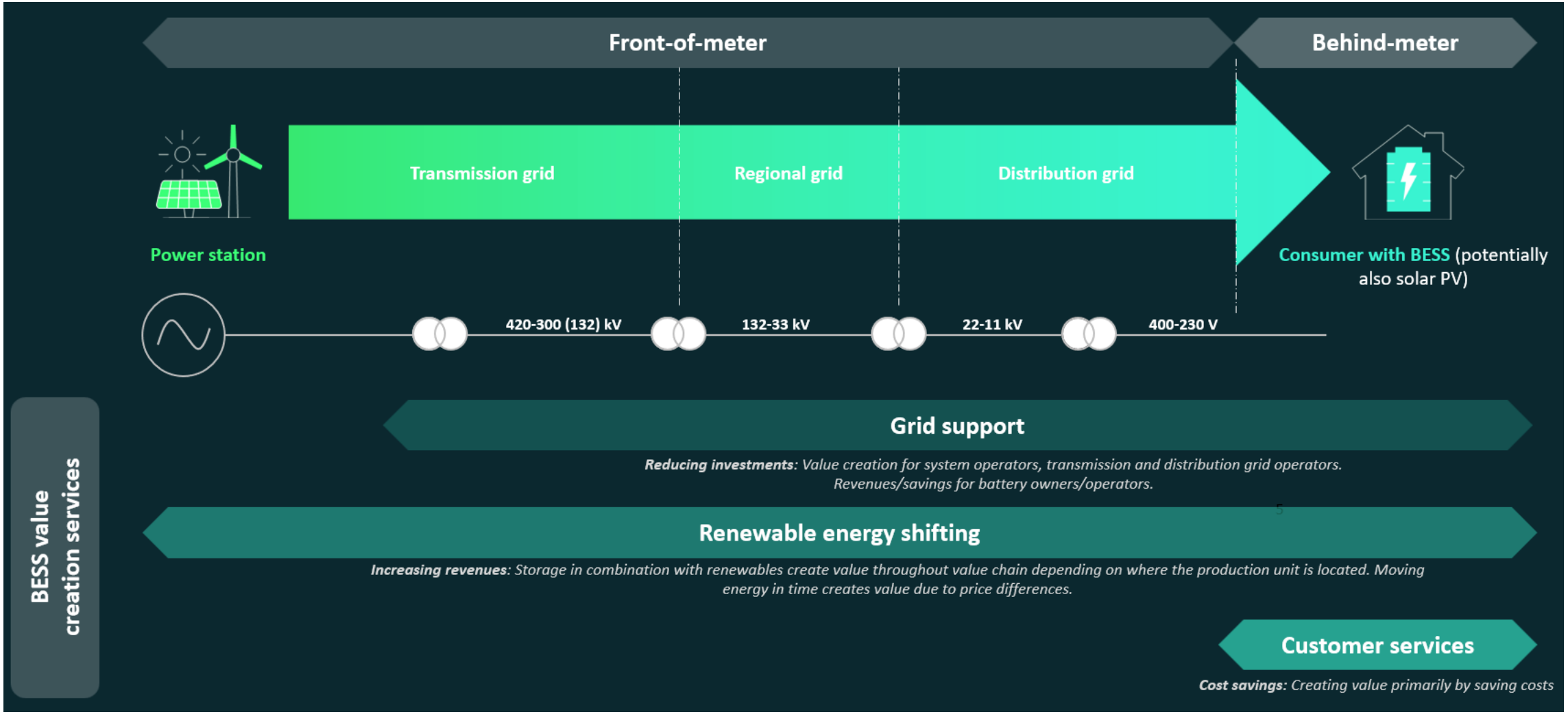
BESS can create value throughout the power system

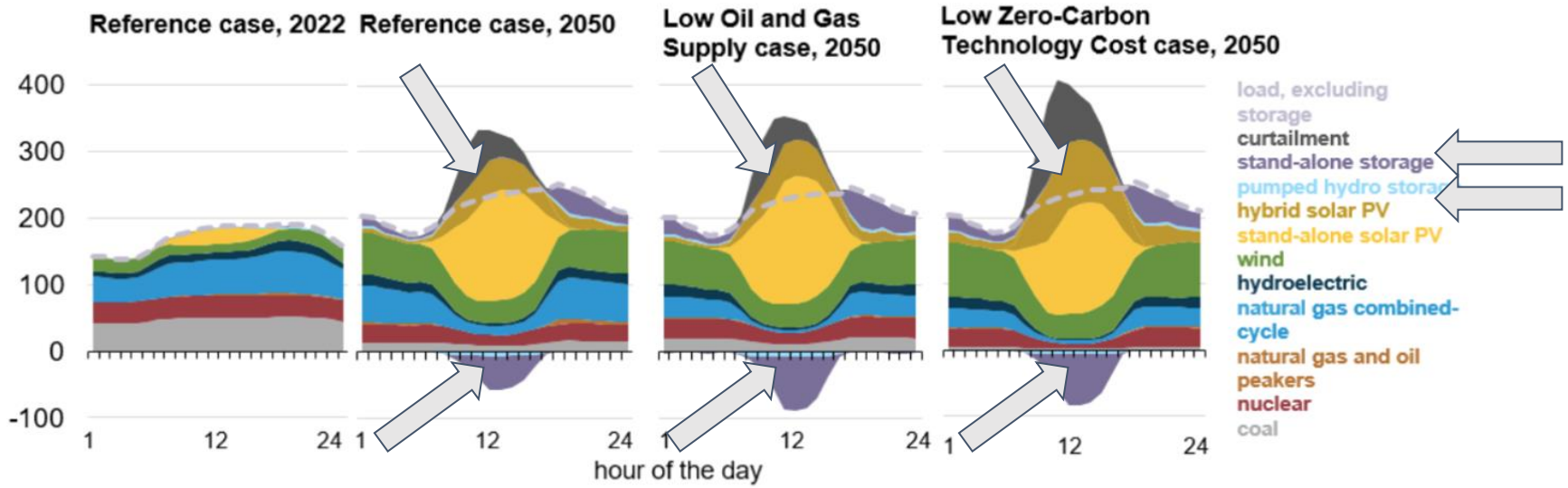


Exponential demand for clean battery solutions:

Example of the USA to eliminate coal and oil for electricity generation

Figure 5.

Hourly U.S. electricity generation and load by fuel for selected cases and representative years
billion kilowatthours



Data source: U.S. Energy Information Administration, *Annual Energy Outlook 2023* (AEO2023)
Note: Negative generation represents charging of energy storage technologies such as pumped hydro storage and battery storage. Hourly dispatch estimates are illustrative and are developed to determine curtailment and storage operations; final dispatch estimates are developed separately and may differ from total utilization as this figure shows. Standalone solar photovoltaic (PV) includes both utility-scale and end-use PV electricity generation.

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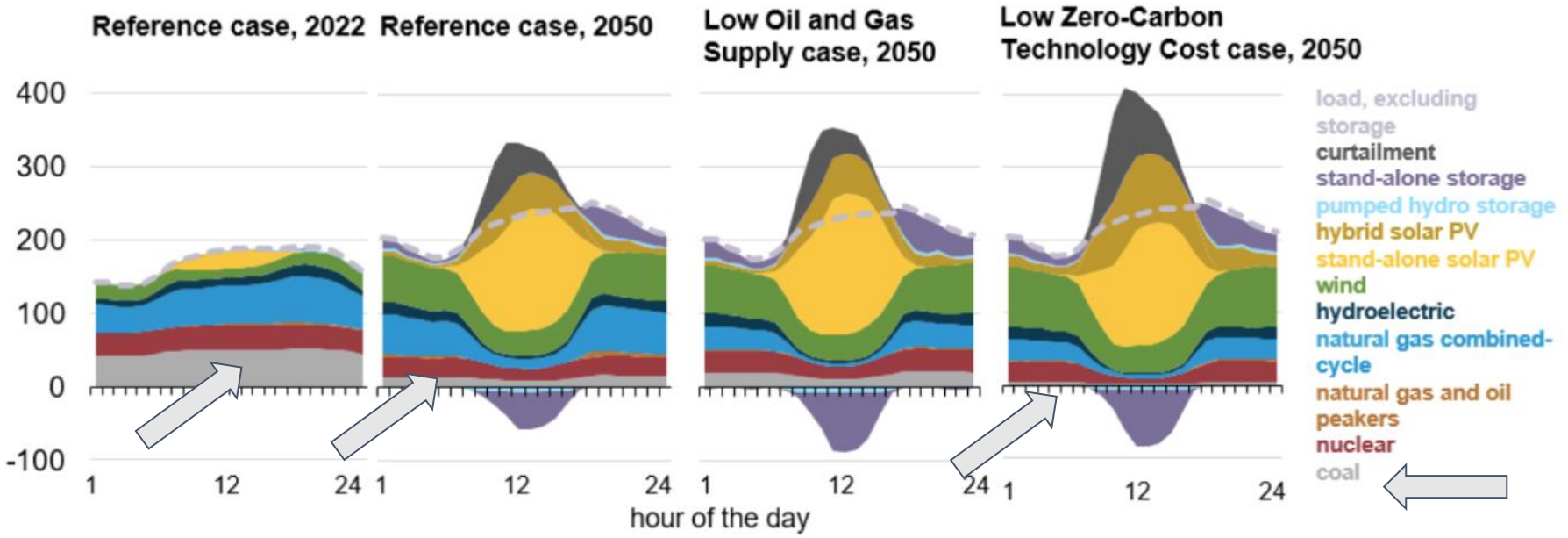

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Europe?

Is there an opportunity to displace CO2 emissions during electricity generation?

- UK is showing it’s possible
- Italy is showing it’s possible

WE JUST NEED *BATTERIES!*

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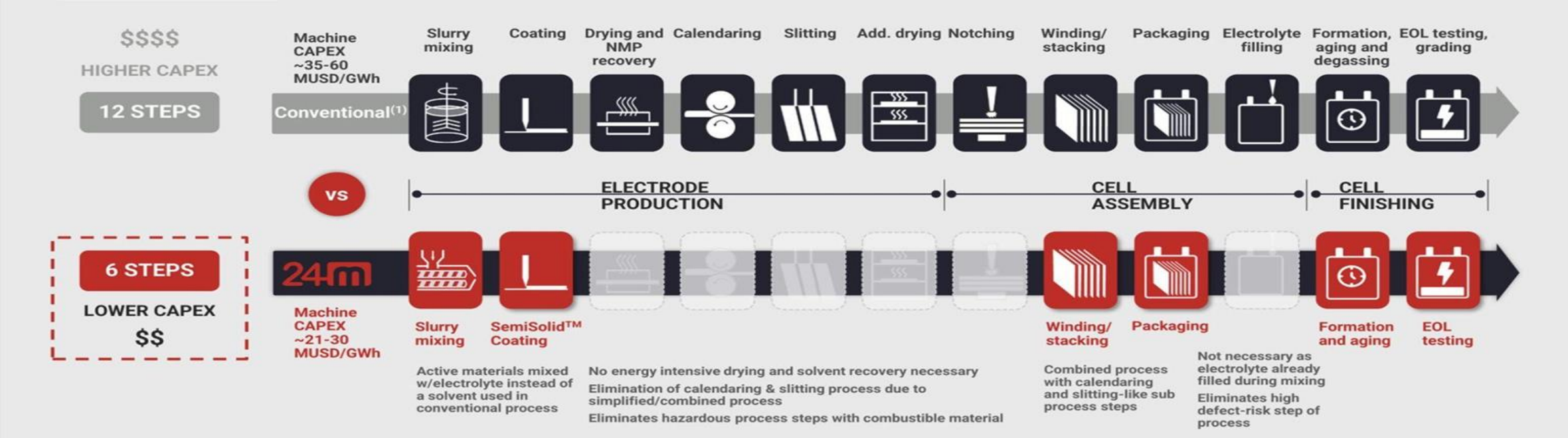
Process at a glance: Simplified Manufacturing Process



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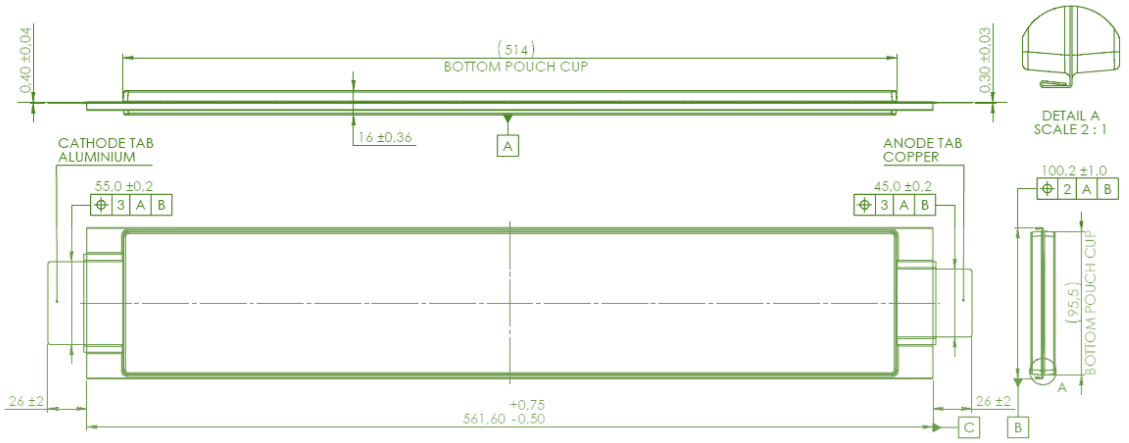
Product: Less Material in the cell with thicker electrodes

- Li-Ion
- LFP - Graphite Pouch Cell
- 7300 cycles
- 79 Ah
- Optimised for C/4



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Integration at a glance

- Partnership in Europe with Nidec
- JV Created in 2022
- Co-located with cell production
- Integrated Module Production
- Integrated DC Bloc Production

Nidec Energy AS

Products

The new generation in energy storage

Our engineering teams are already in the advanced design stage for the next generation battery modules, racks and DC blocks specifically for stationary energy storage systems. Our goal is to produce competitive batteries with a reduced environmental impact. Products will start their certification process mid-2024 and be ready for production in 2025.

CQP status

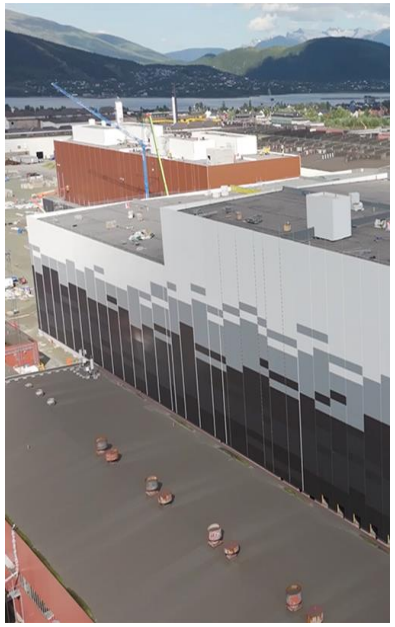
Progress Plan/Key Milestones

- First cells assembled and charged: June 25th, 2023
- Additional progress:
  - Additional PLE commissioning packages completed
  - Testing program for Nidec underway
- Sample production targets: 3Q/4Q 2023
  - All processes automatic
  - Targeted approval of first samples
- Fully integrated production line: 4Q 2023
- Continuous improvements: 1Q 2024

GigaArctic status

Construction progressing according to plan

- Deployed $54 million of capital expenditures at Giga Arctic during 2Q 2023
- Finalizing the weatherization of north and east buildings
- Next phase of construction predicated upon financial incentives associated with expected Norwegian IRA response



Next steps

+ Produce fully automated cells in our CQP	2023
+ Validate Products with our customers	2023 - 2024
+ Finalize financing of GigaArctic Finish construction SOP	Mid 2025
+ Finalize financing of GigaAmerica Start construction SOP	Mid 2025

Conclusion

- A resilient CO2 free European Grid will require Battery Energy Storage
- FREYR Battery is committed to produce locally clean, next-generation batteries
- CQP officially opened, Giga Arctic and Giga America in progress
- Our plan is to get SOP and Products available for customers in 2025

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FREYR is mass-producing the next era in lithium-ion cells.
Less materials to build. Less energy to make. At GWh scale.

We believe in making these batteries cost-competitive.
United with our partners, our goal is to accelerate the decarbonization of our energy systems to mitigate the worst effect of the climate crisis.

FREYR. FOR A BATTERY *POWERED* FUTURE.

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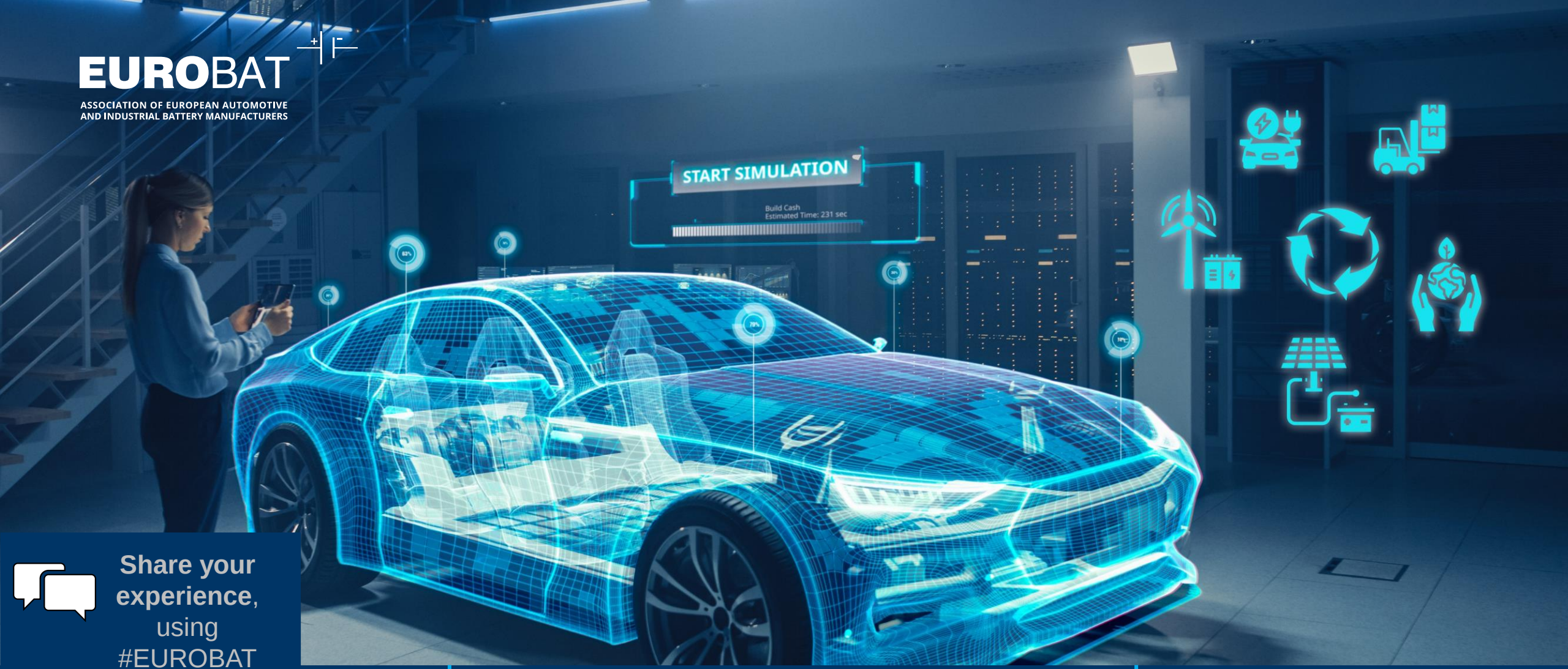

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