



European Battery Alliance Fostering a Strategic Value Chain

Ivone Kaizeler

Team Leader – Automotive Unit

Directorate-General for Internal Market,

Industry, Entrepreneurship and SMEs

ALBATTIS Workshop: Battery Cells Manufacturing – Job
Roles & Skills
20.01.2021

European Battery Alliance - Launched in October 2017: VP Šefčovič

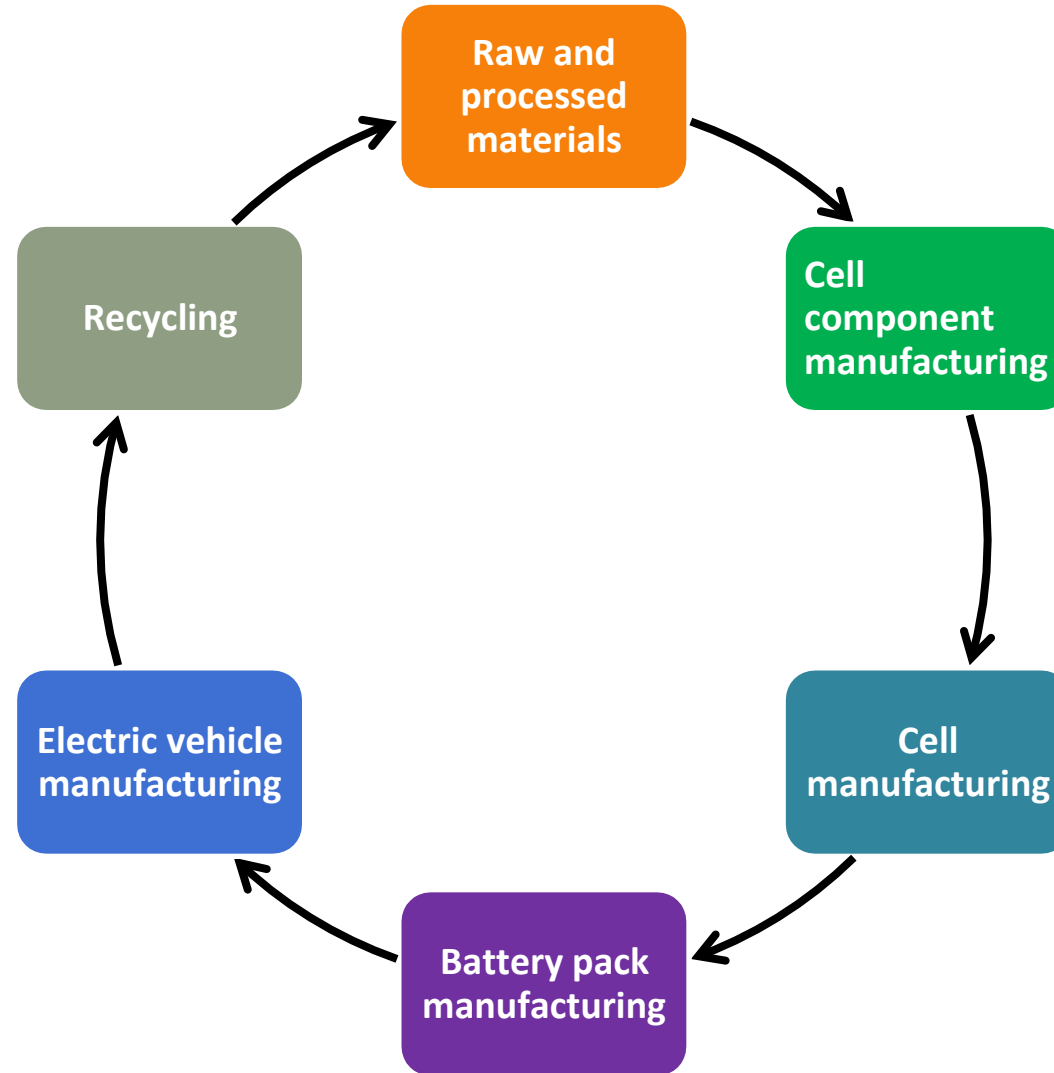
- Battery Action Plan – May 2018

- To establish a **complete, competitive and sustainable battery value chain in the EU** with spillover effects over upstream and downstream industries

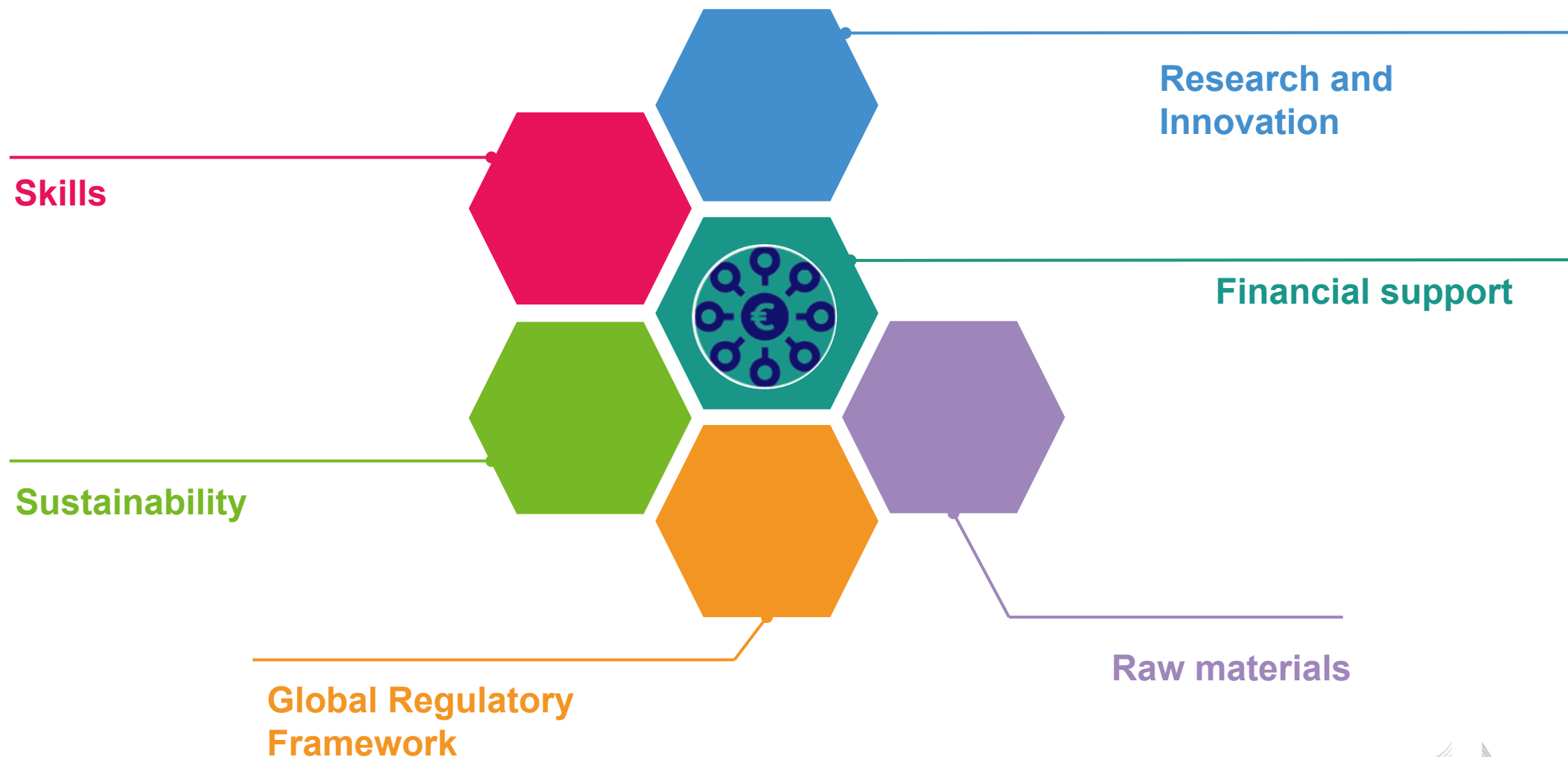
- Who is involved

- Member States
- Industry
- Commission services
- European Investment Bank
- Innoenergy
- Innovation actors

EBA: Covers all segments of the value chain



Instruments: Battery Action Plan, May 2018



Green Deal

The European Green Deal is about **improving the well-being of people**. Making Europe climate-neutral and protecting our natural habitat will be good for people, planet and economy. No one will be left behind.

The EU will:



Become
climate-neutral
by 2050



Protect human life,
animals and plants,
by cutting pollution



Help companies
become world leaders
in clean products and
technologies



Help ensure a
just and inclusive
transition

EBA and Green Deal (COM Dec. 2019)

“Promoting new forms of collaboration with industry and investments in strategic value chains are essential.

The Commission will continue to implement the Strategic Action Plan on Batteries and support the European Battery Alliance.

It will propose **legislation** in 2020 to ensure a safe, circular and **sustainable** battery value chain for all batteries, including to supply the growing market of electric vehicles. The Commission will also support other initiatives leading to alliances and to a large-scale pooling of resources, for example in the form of **Important Projects of Common European Interest**, where targeted time-bound State aid can help build new innovative value chains.”

EBA and Industrial Policy (March 2020): Green, digital and resilient value chains
























“Where identified as necessary, the approach of **industrial alliances** could be the appropriate **tool**. This has already shown its benefit in the area of batteries, plastics and microelectronics.

The European Battery Alliance has managed to move the EU to a position of industrial frontrunner in this key technology.

Alliances can steer work and help finance **large-scale projects with positive spillover** effects across Europe, using the knowledge of SMEs, big companies, researchers and regions to help remove barriers to innovation and improve policy coherence”

Batteries – IPCEI – December 2019

Commission approves €3.2 billion support by seven Member States for project of common European interest for **battery value chain**

Raw and advanced materials	Cells and modules	Battery systems	Repurposing, recycling and refining
BASF  	ACC  	BMW 	BASF  
Eneris 	BMW 	Endurance 	Endurance 
Keliber 	Endurance 	Enel X 	Elemental 
Nanocyl 	Eneris 	Eneris 	Eneris 
Solvay   	FAAM 	Kaitek 	FAAM 
Terrafame 	SEEL 	SEEL 	Fortum 
Umicore  	VARTA 		SEEL 
			Umicore  

2nd Batteries - IPCEI

- 12 Member States
- Coordination by DE
- Over 40 enterprises
- All segments of the value chain
- **Spill over effects: job creation, collaborations with Universities and RTOs**
- Approval is imminent

Battery Regulation – COM proposal 10 Dec 2021

To ensure that only high-quality batteries are placed on the EU market and that those batteries are produced with low environmental impact, using materials that have been obtained in full respect of social and ecological standards. Batteries should also be long lasting and safe. After being used, batteries should be collected and recycled at the end of their life.

Thank you

Recovery and Resilience Facility

RECOVERY AND RESILIENCE FACILITY

FINANCIAL SUPPORT TO BOTH PUBLIC INVESTMENTS AND REFORMS

€672.5
billion

Up to

€312.5
billion

in grants

Up to

€360
billion

in loans

#EUSolidarity #StrongerTogether

EBA and Recovery and Resilience Facility

RECOVERY AND RESILIENCE FACILITY

FLAGSHIP AREAS FOR INVESTMENTS AND REFORMS

POWER UP

CLEAN TECHNOLOGIES AND RENEWABLES

RENOVATE

ENERGY EFFICIENCY OF BUILDINGS

RECHARGE AND REFUEL

SUSTAINABLE TRANSPORT AND CHARGING STATIONS

CONNECT

ROLL-OUT OF RAPID BROADBAND SERVICES

MODERNISE

DIGITALISATION OF PUBLIC ADMINISTRATION

SCALE-UP

DATA CLOUD CAPACITIES AND SUSTAINABLE PROCESSORS

RESKILL AND UPSKILL

EDUCATION AND TRAINING TO SUPPORT DIGITAL SKILLS

#EUSolidarity #StrongerTogether

State of the industry –The Battery Global Arms Race

ALBATTIS webinar
20 January 2021

Benchmark Mineral Intelligence Contact:

Caspar Rawles, Head of Prices Assessments [@crawles@benchmarkminerals.com](mailto:crawles@benchmarkminerals.com) / [@CDMRawles](https://twitter.com/CDMRawles)

www.benchmarkminerals.com | info@benchmarkminerals.com

HQ: London, UK | Offices: Fort Lauderdale, Shanghai, Santiago, San Francisco, Tokyo

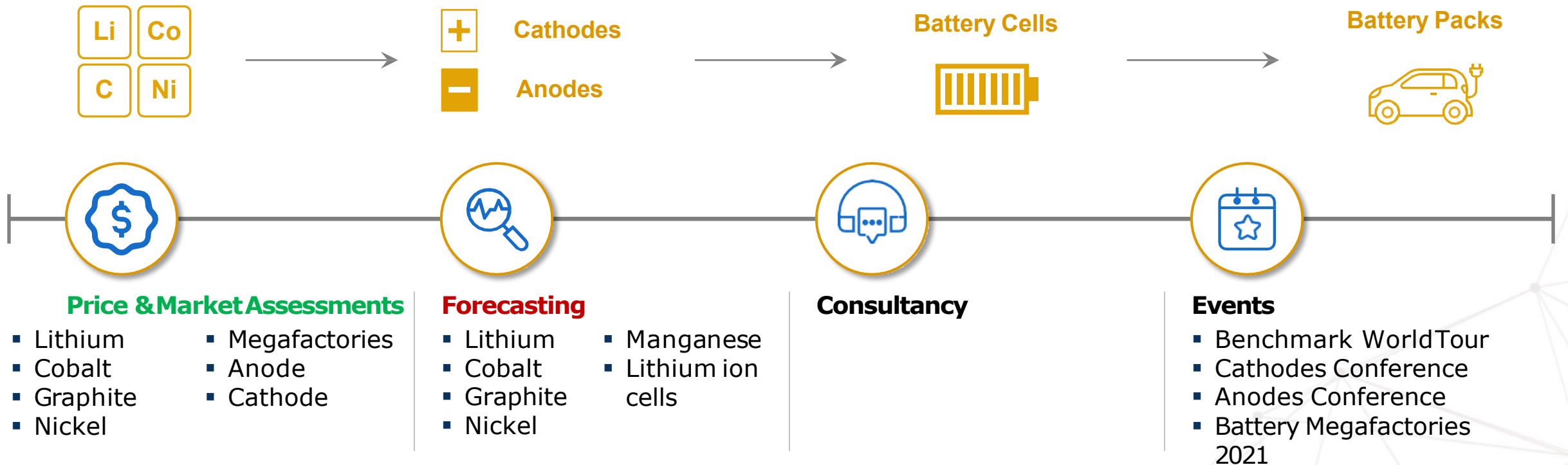
The rise of Benchmark Mineral Intelligence



Founded in Sept 2014,
Launch Jan 2015 = 1 Person
May 2019 = 26 People



Specialised focus on the
supply chain for lithium ion
batteries



Capacity update – Relentless rise in cell capacity

2015



57 GWh

Capacity update – Relentless rise in pipeline cell capacity

2015

TESLA
Panasonic

LG Chem

FOXCONN

57 GWh

TESLA
Panasonic

prime planet
energy & solutions

SK innovation

northvolt

合肥国轩高科动力能源有限公司
HEFEI GUOXUAN HIGH-TECH POWER ENERGY CO., Ltd

SVOLT
蜂巢能源

EVE 亿纬锂能

BAK

DYNAVOLT

CATL

Jan 2021

3.1 TWh

186 plants

LG Energy Solution

SAMSUNG
SAMSUNG SDI

BYD

Envision AESC

FARASIS

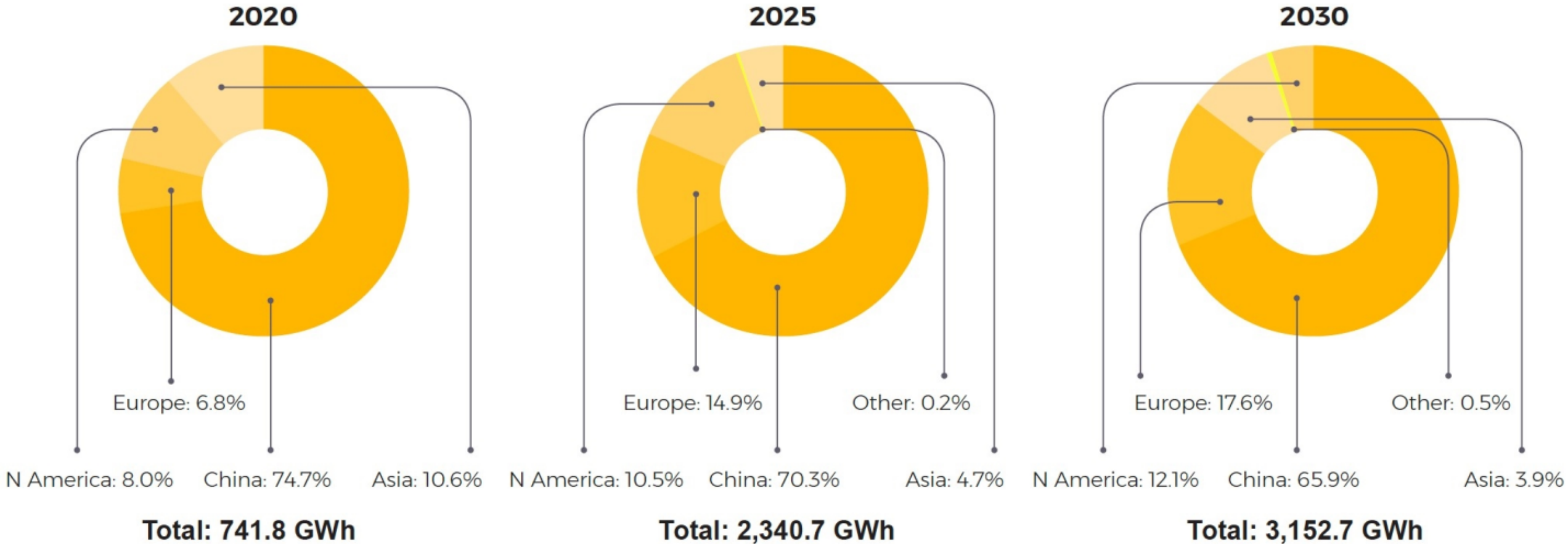
LISHEN

SUNWODA

CALB

SAFT
a company of
TOTAL
PSA
GROUPE
QCC
AUTOMOTIVE BATTERIES

Capacity build out - China dominates the next decade

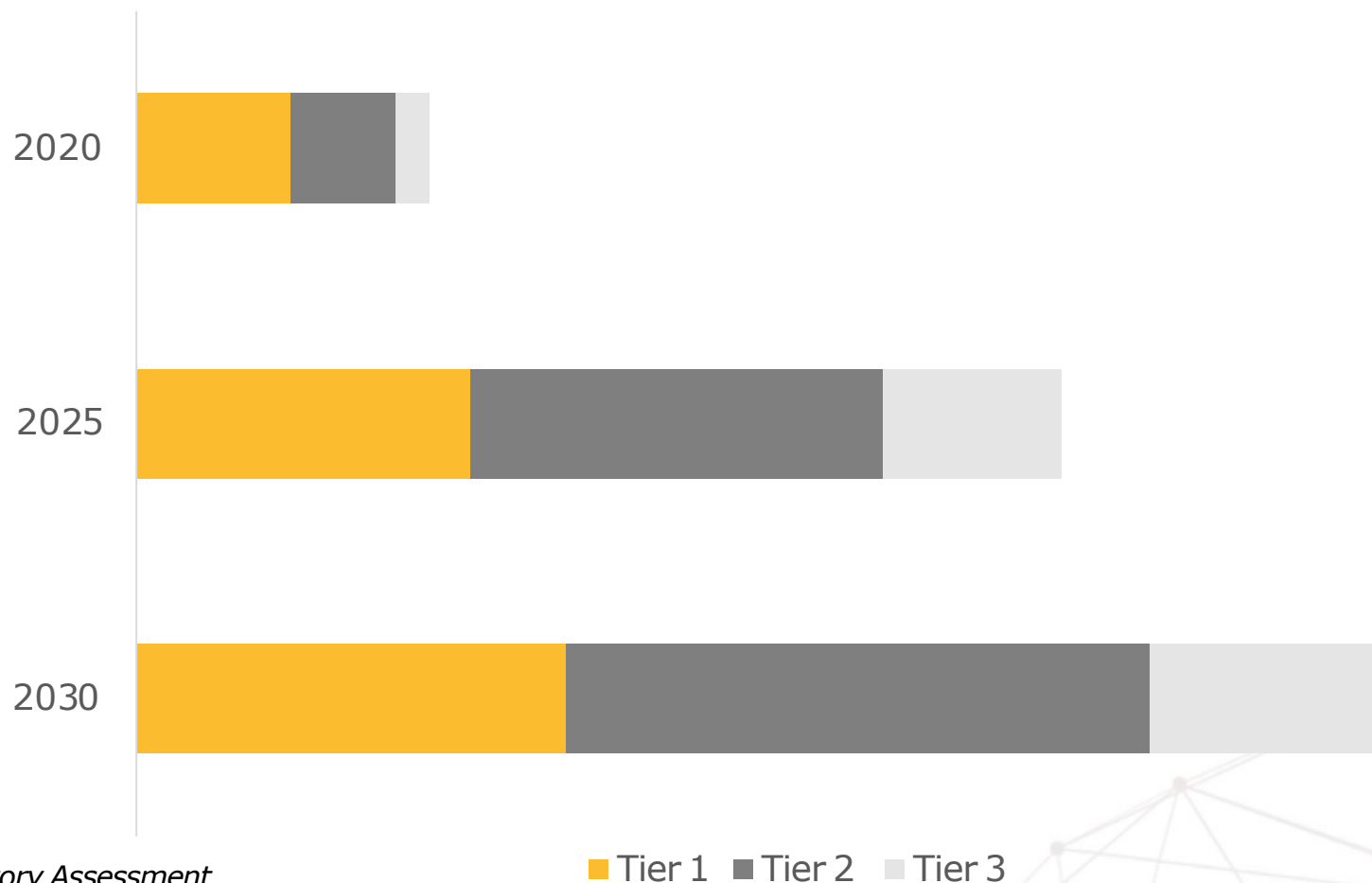


Source: Benchmark Minerals Lithium Ion Battery Megafactory Assessment

Not all cells are created equal - How much of that capacity is ready to supply global automakers

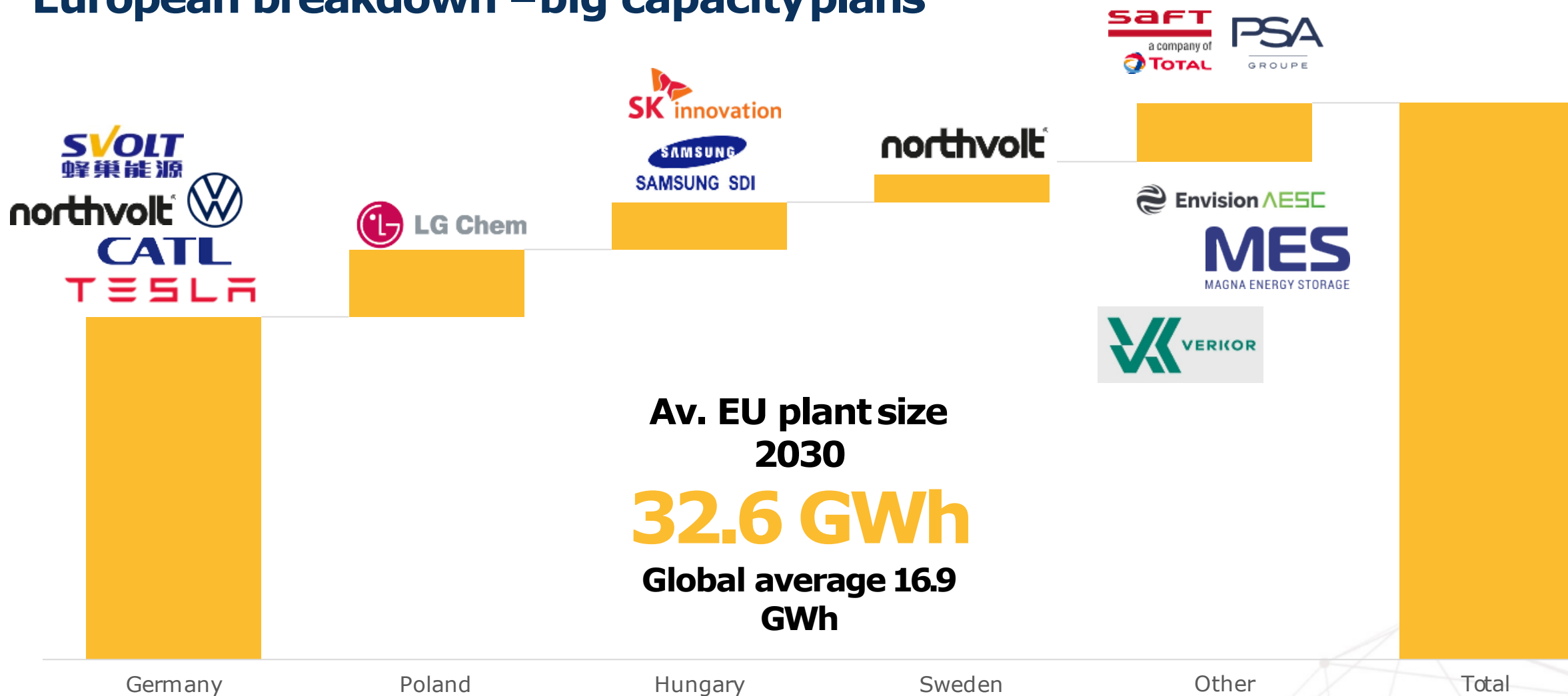
Benchmark Tiering System

- Benchmark introduced tiering system in 2019 to show cell plants ready too supply global EV market
- Europe roughly mirrors the long term average with Tier 1 making up 35% of capacity by 2030



Source: Benchmark Minerals Lithium Ion Battery Megafactory Assessment

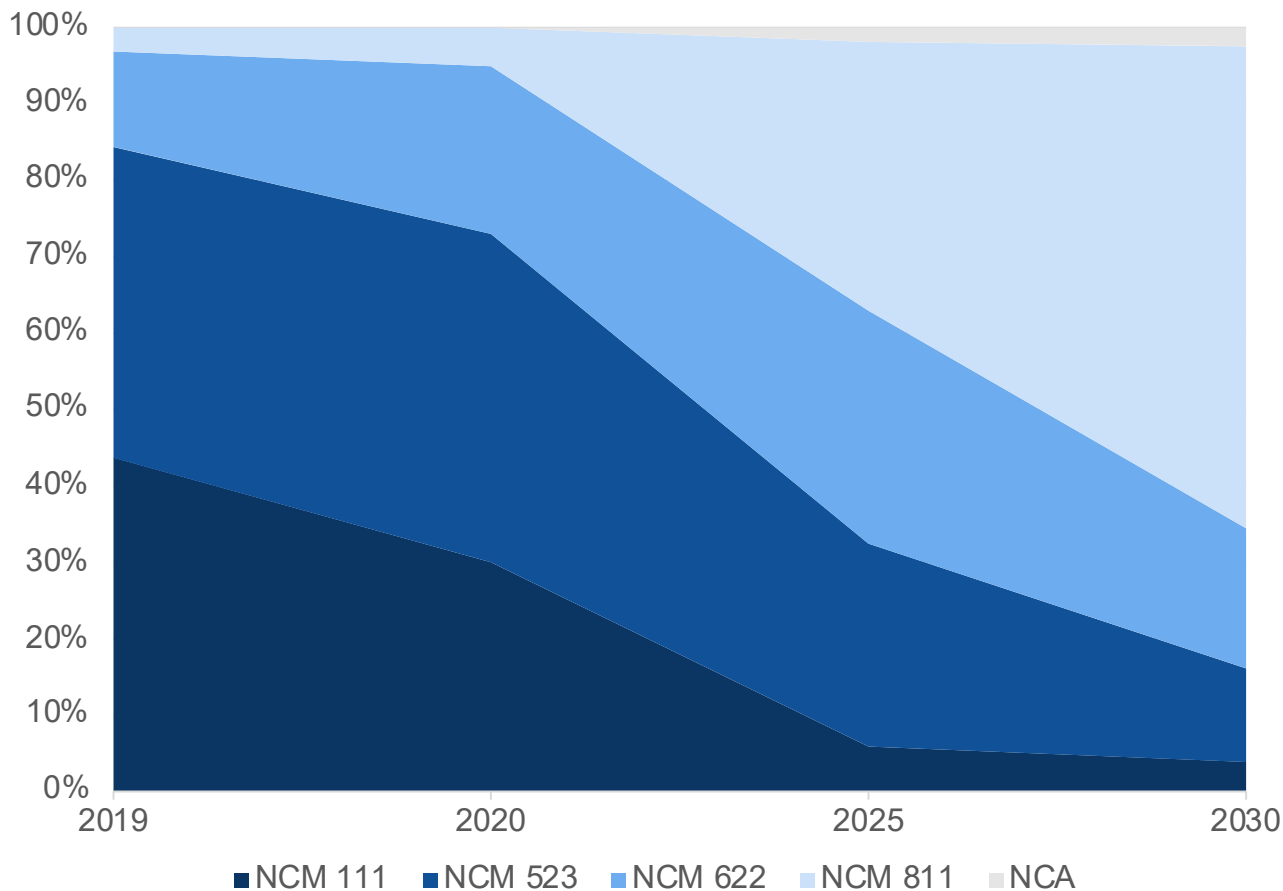
European breakdown – big capacity plans



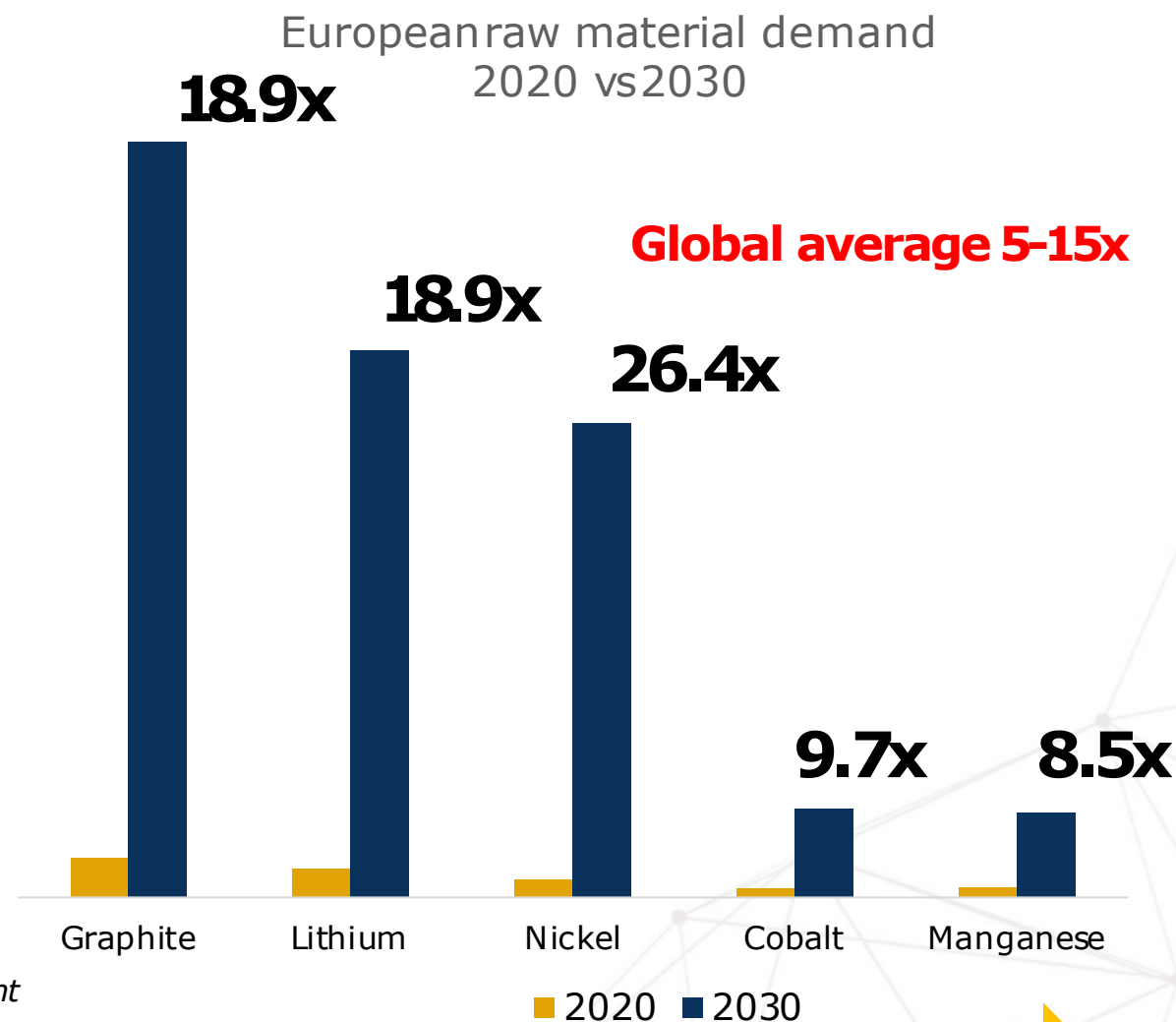
**Av. EU plant size
2030**
32.6 GWh
**Global average 16.9
GWh**

Source: Benchmark Minerals Lithium Ion Battery Megafactory Assessment

European raw material demand growth 2020 vs 2030 to exceed global average

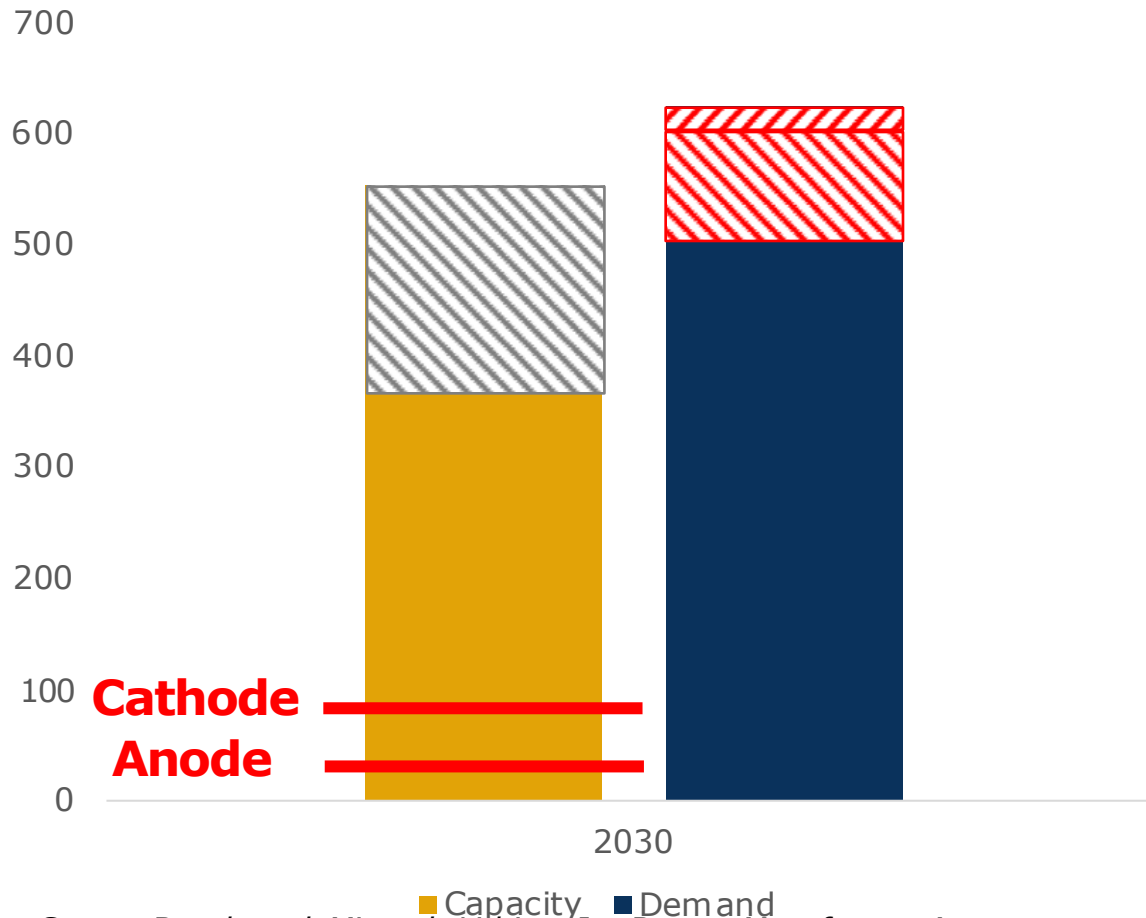


Source: Benchmark Minerals Lithium Ion Battery Megafactory Assessment



Does Europe need more cell capacity?

Capacity vs demand 2030

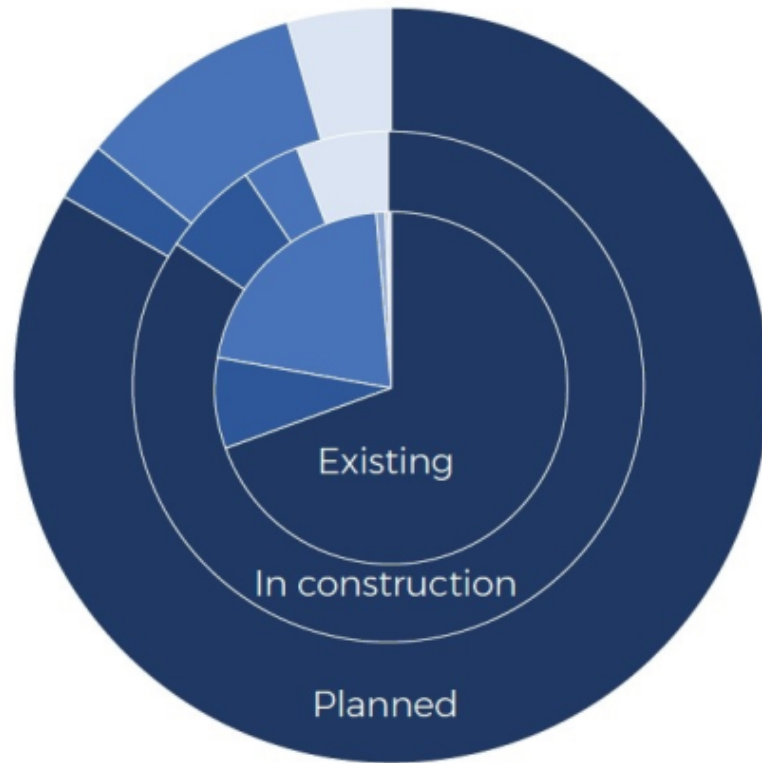


Source: Benchmark Minerals Lithium Ion Battery Megafactory Assessment

- Cell rejects, new line commissioning and ramp up have a huge impact on production levels vscapacity
- Not all listed capacity will build out to planned timelines, some will never make it off the drawing board and consolidation will impact the outlook – changes happening almost every day!
- Whilst space remains for further European cell plants, environment is increasingly competitive and early mover tier 1 players will not give up market share easily
- Having said this, upstream developments are lacking –cathode and anode developments extremely limited

European upstream developments far behind cell capacity

Cathode capacity update



Existing

1,656,670 tpa

In construction

831,500 tpa

Planned

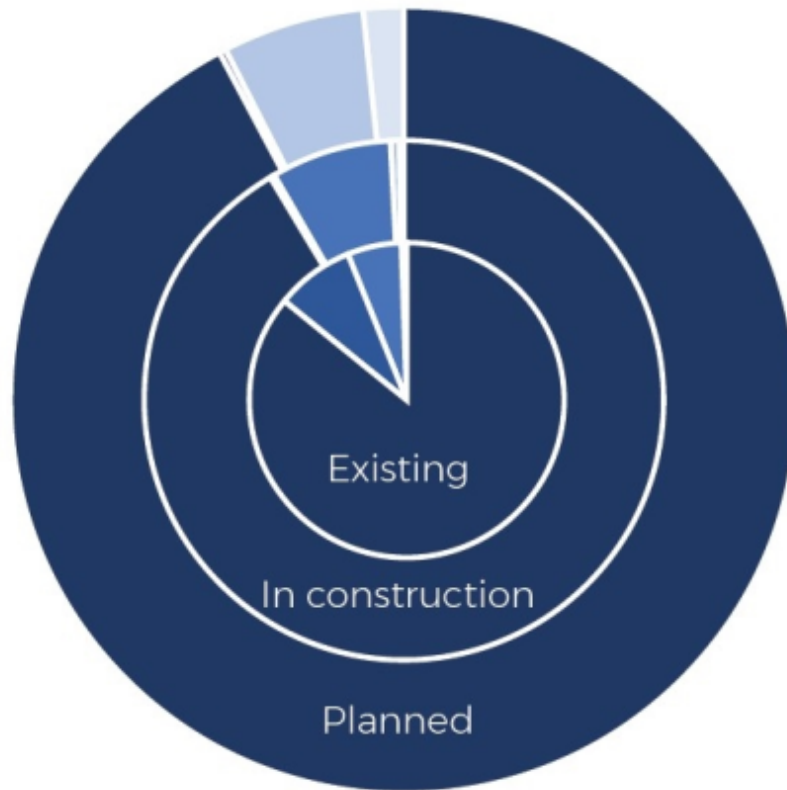
2,075,500 tpa

- China
- Japan
- South Korea
- Asia (other)
- N America
- Europe
- Other

Source: Benchmark Minerals Cathode Market Assessment

European upstream developments far behind cell capacity

Anode capacity update



Existing

812,000 tpa

In construction

680,500 tpa

Planned

1,174,100 tpa

- China
- Japan
- South Korea
- Asia (other)
- N America
- Europe
- Other

Source: Benchmark Minerals Anode Market Assessment



Summary and questions

- Europe as a region has seen significant commitments in new capacity via policy and stimulus –194% increase in forecast capacity in past 2 years. Germany, in particular, has benefitted although large proportion is dependent on the success of 2 projects.
- European investment has focused largely on the downstream and the region needs to strengthen efforts in mid and upstream development. Lack of refining/processing capacity alongside securing raw materials for the region is a growing concern as markets tighten and long-term agreements lock up available supply

Q&A

Battery Manufacturing - Job Roles and Skills Workshop

Alliance for Batteries Technology, Training and Skills
2019-2023

ALBATTS WORKSHOPS, JANUARY 2021

Dr. Anders Norberg, Skellefteå municipality,
Coordinator of the ERASMUS+ Sector Skills Alliances
ALBATTS Project

What is **ALBATTTS**?



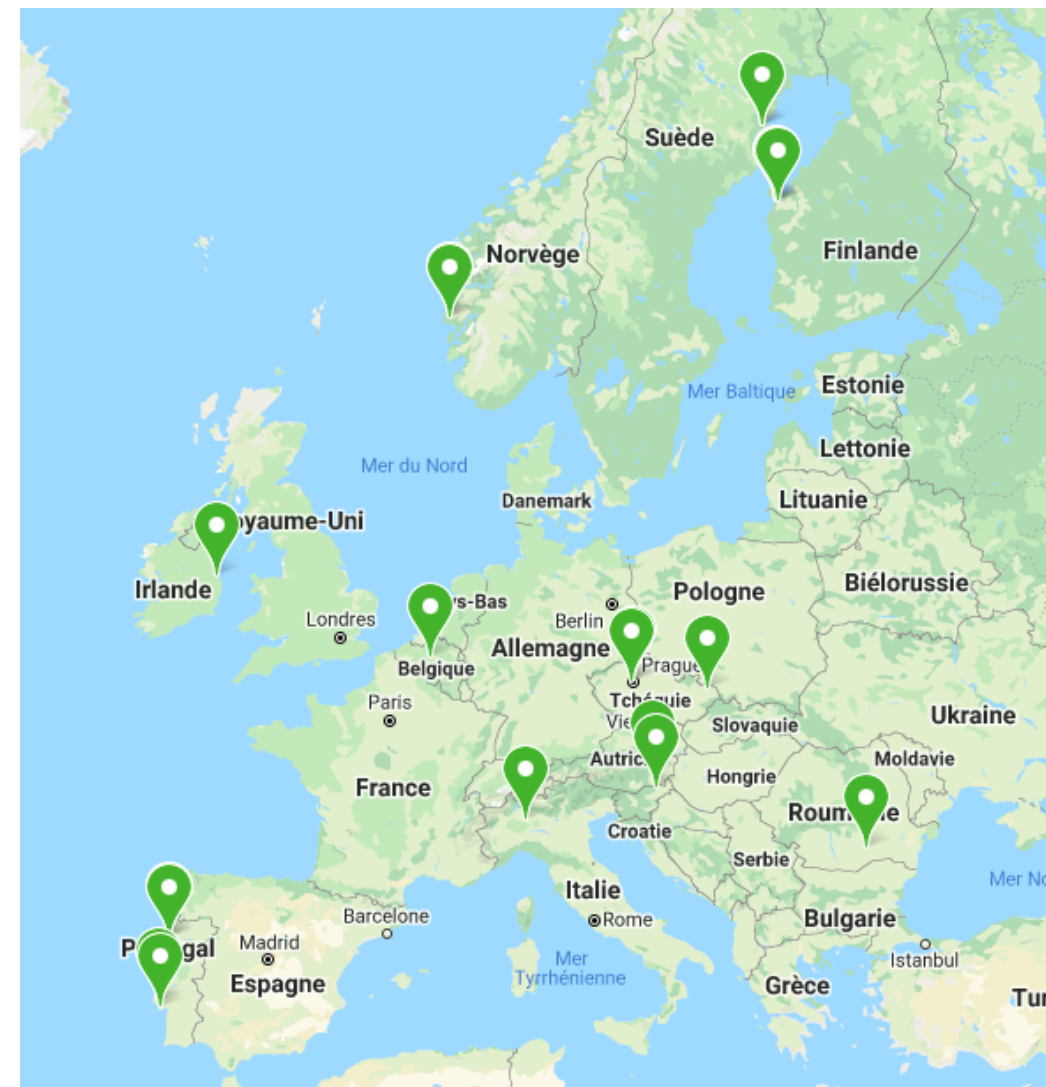
- ⚡ 4-year (2019-2023) Erasmus+ funded project
- ⚡ Blueprint for Sectoral Cooperation on Skills in Battery sector
- ⚡ Contributes to the electrification of transport, green energy and environmental goals in Europe
- ⚡ Gathers demand and supply sides of competences in the battery value chain

What is **ALBATTIS**?



- ⚡ Identification of skills and job roles needs
- ⚡ Enabling education sector to provide education and training for the future workers and specialists needed by the battery sector
- ⚡ Set up clear sectoral skills strategy
- ⚡ Covers the battery life cycle - batteries developed for and used in both stationary and mobile applications

Partners



Co-funded by the
Erasmus+ Programme
of the European Union

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ALBATTIS

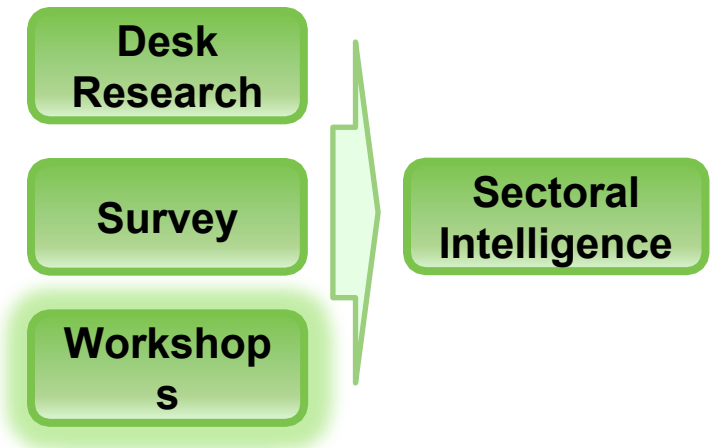
Sectoral Intelligence

***Q1: What is
going on?***



ALBATTIS Workshop Series

- ⚡ Brings stakeholders together to participate on the skills intelligence updates and consult on the latest inputs
- ⚡ Workshop Series starts by 2021 and will be hold till 2023





ALBATTS Workshop Series

BATTERY MANUFACTURING

20 January 2021 - 10:00h / 11:30h

STATIONARY

26 January 2021 - 15:00h / 16:15h

AUTOMOTIVE

27 January 2021 - 14:00h / 15:30h

Desk
Research

Survey

Workshop
s

Sectoral
Intelligence



Please register to other ALBATTS currently planned workshops:

<https://www.project-albatts.eu/en/listnewsevents>



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of the European Union

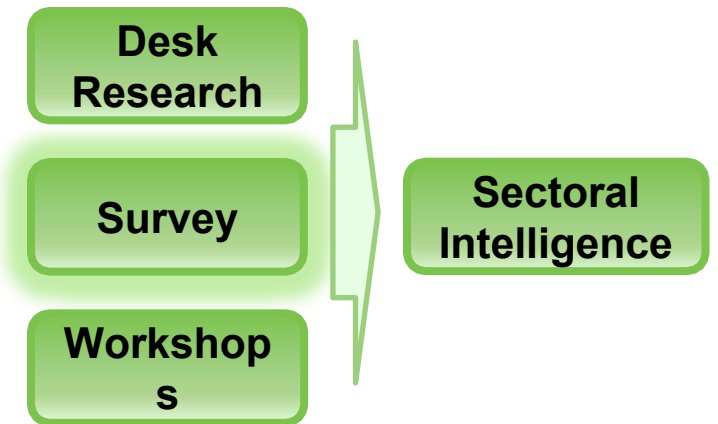
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ALBATTS Online Survey

- ⚡ Online Survey is focused on detailed analysis of skills and job roles needed in the sector

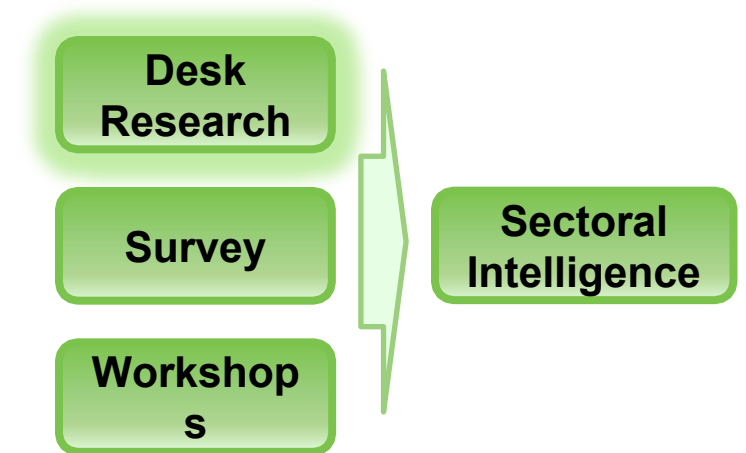
- ⚡ Please, join participate in online questionnaire:
<https://stakeholders.project-albatts.eu/s/survey2020>





ALBATTIS Desk Research

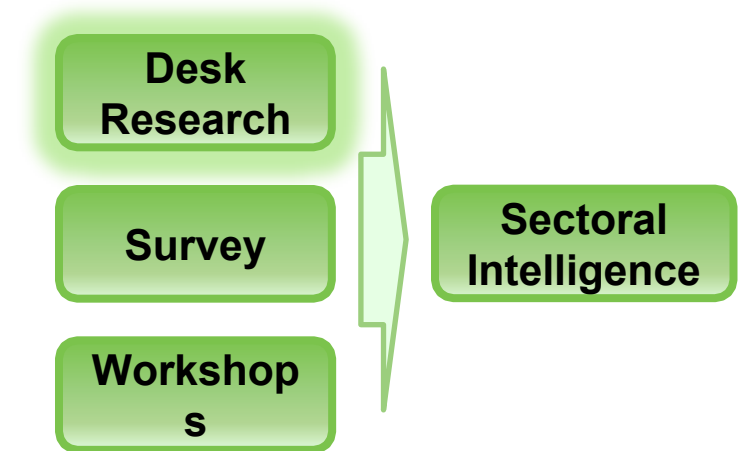
- ⚡ Desk research provide screening of the latest information relevant for skills agenda in Battery Sector
- ⚡ Desk Research starts by 2020 and will be hold till 2023





ALBATTIS Desk Research

- ! ⚡ [D3.3 Desk Research and Data Analysis](#) (Nov 20) - Overview of the Battery Sector
- ! ⚡ [D4.1 Intelligence in Stationary and Industrial Battery Applications – Desk Research Report](#) (Aug 20) – Details related to battery application sub-sector
- ! ⚡ [D5.1 Intelligence in Mobile Battery Applications – Desk Research Report](#) (Aug 20) – Details related to battery application sub-sector





ALBATTIS

Education and Training

Q2: How can we address the education and training needs?

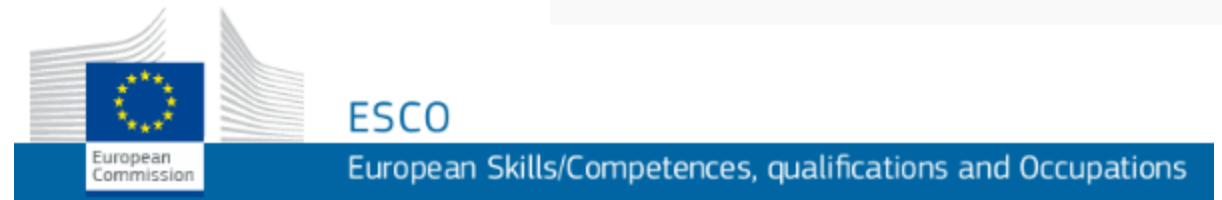


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ALBATTs will...

- Analyse new job roles
- Suggest learning objectives
- Develop course plans
- Develop learning material
- Try out adaptive learning
- Pilot-test innovative courses
- Train-the-trainer guidelines
- Network!
- Use European instruments
- Implement results



To get involved with the **albatts** stakeholders group:

Stakeholder registration [here](#)

Follow us on:

Web: <https://www.project-albatts.eu>

LinkedIn: [LinkedIn](#)

Facebook: [Facebook](#)

Twitter: [Twitter \(@ALBATTTS1\)](#)

Mail: info@project-albatts.eu



Thank you

Presenter

Contact:

anders.norberg@skelleftea.se



Going from 30 to 3000

Albatts Battery Cells Manufacturing Workshop

Katarina Borstedt,
Director of Growth

Challenges & opportunities in recruiting for the battery cell manufacturing ecosystem in the EU

Northvolt Ett – Skellefteå





The ramp up Northvolt Ett

2020

50

2021

500

2023

1500

3000 employees when fully built...

Management, administration
and other support

Engineers

Maintenance

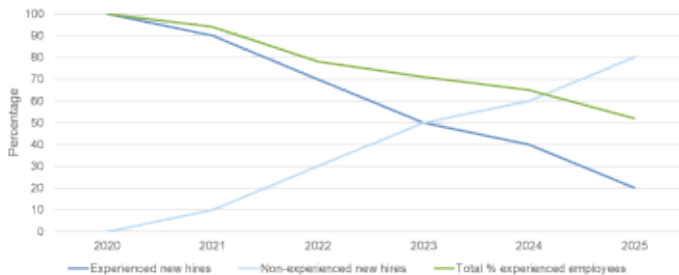
Operations



Three important aspects to ensure a successful growth in the Skellefteå region

1. Experienced vs unexperienced

50% of the direct workers will come from educational programs, with no previous industrial experience



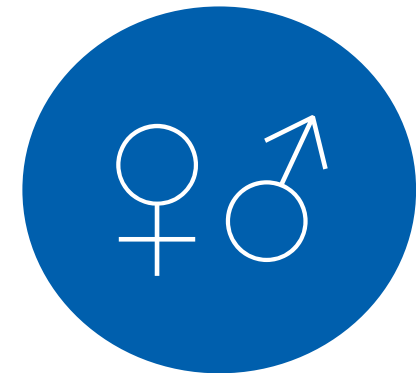
2. Local hires vs relocation

50% will be recruited outside of the region



3. Men vs women

Ambition to build a gender balanced workplace – 50% female workers



Main European recruitment challenges

- ⇒ Absence of (practical) experience from high volume manufacturing scale up
- ⇒ Little European background in battery manufacturing
- ⇒ Lack of understanding from nearby industries on similarities in manufacturing flow

Thanks!



MAGNA ENERGY STORAGE a.s.

INTRODUCTION

- ❑ MAGMANA ENERGY STORAGE (MES) is a Czech Republic based manufacturer of a new type of lithium-ion battery cells – HE3DA battery technology.
- ❑ Pilot line since 2017, first mass production line of 200 MWh/year commissioned to test operations in September 2020, target capacity 15,5 GWh/year.
- ❑ HE3DA s.r.o. is an applied R&D company in the field of lithium-ion battery technology. HE3DA developed a new patented lithium-ion battery technology platform (HE3DA technology).
- ❑ MAGNA ENERGY STORAGE a.s. (MES) is an exclusive licensed producer of HE3DA technology, second production company is being prepared in the USA.



HE3DA BATTERY TECHNOLOGY

Existing lithium-ion batteries

Crucial for renewable energy storage and EV charging infrastructure but dangerous and not efficient

Existing Li-ion Technologies

- ✓ Focus on High Energy Density
- ✓ Unsafe – Highly flammable
- ✓ Difficult to Recycle
- ✓ Limited Cell size
- ✓ Expensive for large energy storage

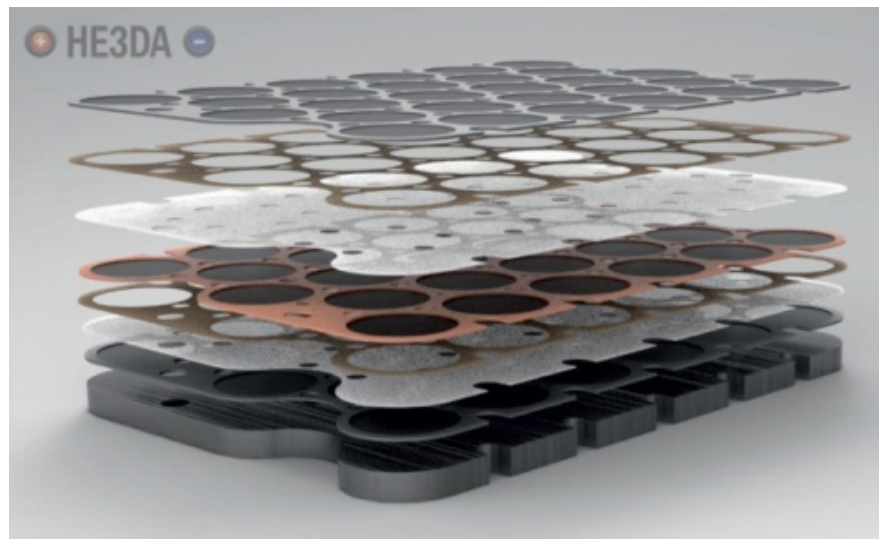
HE3DA Technology

- ✓ Focus on Durability
- ✓ Incomparable Safety – Nonflammability
- ✓ Fully Recyclable
- ✓ Unlimited Cell Size
- ✓ Cost efficient energy storage

HE3DA BATTERY TECHNOLOGY Cont.

We've changed the
ARCHITECTURE of
Li-ion batteries

Patented technology

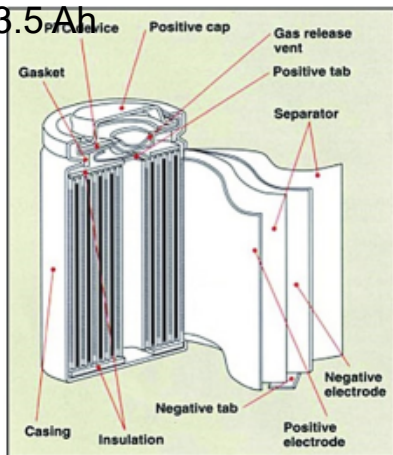


Cell capacity starting at
270 Ah

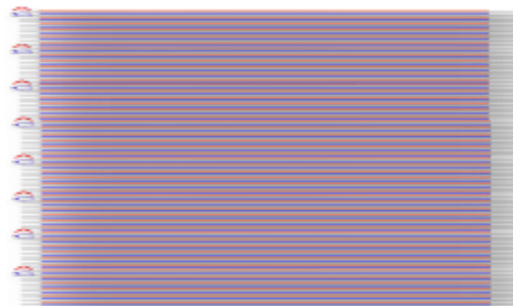
3D HE3DA battery
2000 μm
(2mm)



Cell capacity ending at
3.5 Ah



2D Thin film battery
50 μm (0,05mm)

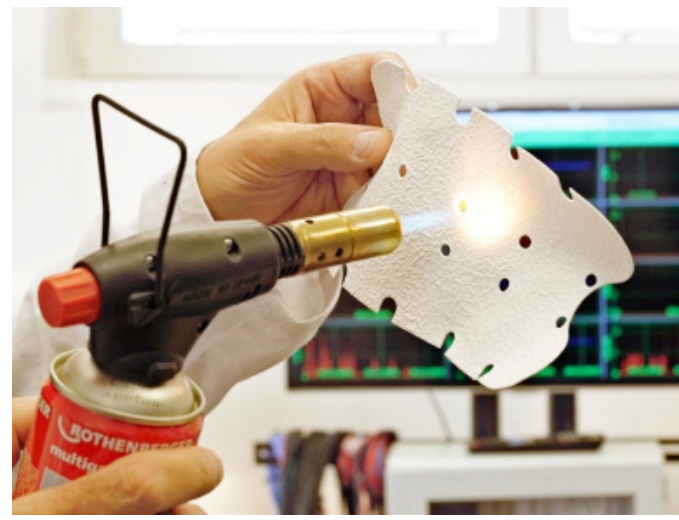


HE3DA BATTERY TECHNOLOGY Cont.

KEY ADVANTAGES

HE3DA® is not just a single battery, but a new technology platform. The use of current active materials on a nano level and innovative design solutions of battery cells enable much greater thickness of electrodes up to 2 mm and orders of magnitude larger cells up to a capacity of 100 kWh. The main competitive advantages of HE3DA technology include:

- ❑ **Safety** - The absence of organic substances other than the electrolyte, degassing valve and ceramic separator ensure safe short-circuit discharge and at the same time eliminate the risk of explosion or uncontrolled combustion, even when exposed to open flames.
- ❑ **Flexibility** - HE3DA technology allows flexible cell design with parameters that correspond to the intended use (capacity, charging and discharging time, price, volumetric capacity, shape, etc.).
- ❑ **Efficiency** - The overall efficiency of electricity storage with HE3DA technology is provided on the one hand by technical parameters of battery cells, on the other hand by low costs for cell production (simple efficient production) and low costs for the integration of cells into battery systems (a small number of cells in the system, low cooling requirements, minimalist BMS).
- ❑ **Recyclability** - An important advantage is also the 100% recyclability of the battery cell at the end of its life. The cell can be easily disassembled, the materials separated and reused.



HE3DA BATTERY TECHNOLOGY Cont.

BATTERY CELLS SPECIFICATIONS

BATTERY CELLS WITH ADJUSTABLE PARAMETERS

- Flexible cell design with parameters that fit the intended use (capacity, charging and discharging time, price, volumetric capacity, shape, etc.)

BATTERY CELLS PORTFOLIO

- Cell capacity 1 and 2 kWh (from 2023 up to 100kWh)
- Electrode thickness 0,5 – 2 mm
 - 1,7 mm electrode cells energy line
 - 0,5 mm electrode cells power line
- Chemistry NMC111, graphite, new chemistries in the pipeline
- Voltage range 2 – 4,3 V
- Recommended operational voltage range 3 – 4,1 V
- Capacity in operational range 85%
- C-rate charge 1 – 0,125
- C-rate discharge 2 – 0,25
- Operating temperature -10 to 80°C
- Cycle life > 100.000 at 10% DOD, 1000 at 100% DOD
- Volumetric capacity 150 Wh/L, 94 Wh/kg
- Battery response rate + 80A to -80A is 40 ms



HE3DA BATTERY TECHNOLOGY Cont.

BATTERY STORAGE : HE3DA vs. CURRENT TECHNOLOGY

BATTERY STORAGE SYSTEM COMPOSITION					
		CURRENT TECHNOLOGY		HE3DA TECHNOLOGY	
EV charger battery storage container capacity	kWh	500	1 000	500	1000
Battery cell capacity	kWh	0,014	0,014	1	2
Battery cell nominal volatage	V	3,7	3,7	3,7	3,7
Number of battery cell	Units	35 714	71 429	500	500
Number of connections on battery cells	Units	71 429	142 857	1 000	1000
Number of chips on cell	Units	35 714	71 429	500	500
Number of battery cell packs*	Units	1 488	2 976	2	2
Number of 900 V lines	Units	147	294	2	2
Number of switches	Units	147	294	2	2
Things that can stop working	Units	144 639	289 278	2 006	2006
Things that can stop working per kWh	Units/kWh	289	289	4,0	2,0

* 90 V pack for current technology assumed

SAFETY		
	CURRENT TECHNOLOGY	HE3DA TECHNOLOGY
Safety	Safety elements build around generally unsafe battery cell: safe discharge battery cells	Inherently safe HE3DA in short circuit, does not explode on mechanical damage or even when exposed to open fire

THERMAL MANAGEMENT		
	CURRENT TECHNOLOGY	HE3DA TECHNOLOGY
Cell operating temperature range	Narrow	Wide
Cooling system	Sophisticated unefficient air cooling	Simple liquid cooling system, cells 20 kWh plus can be cooled by internal electrolyte circulation

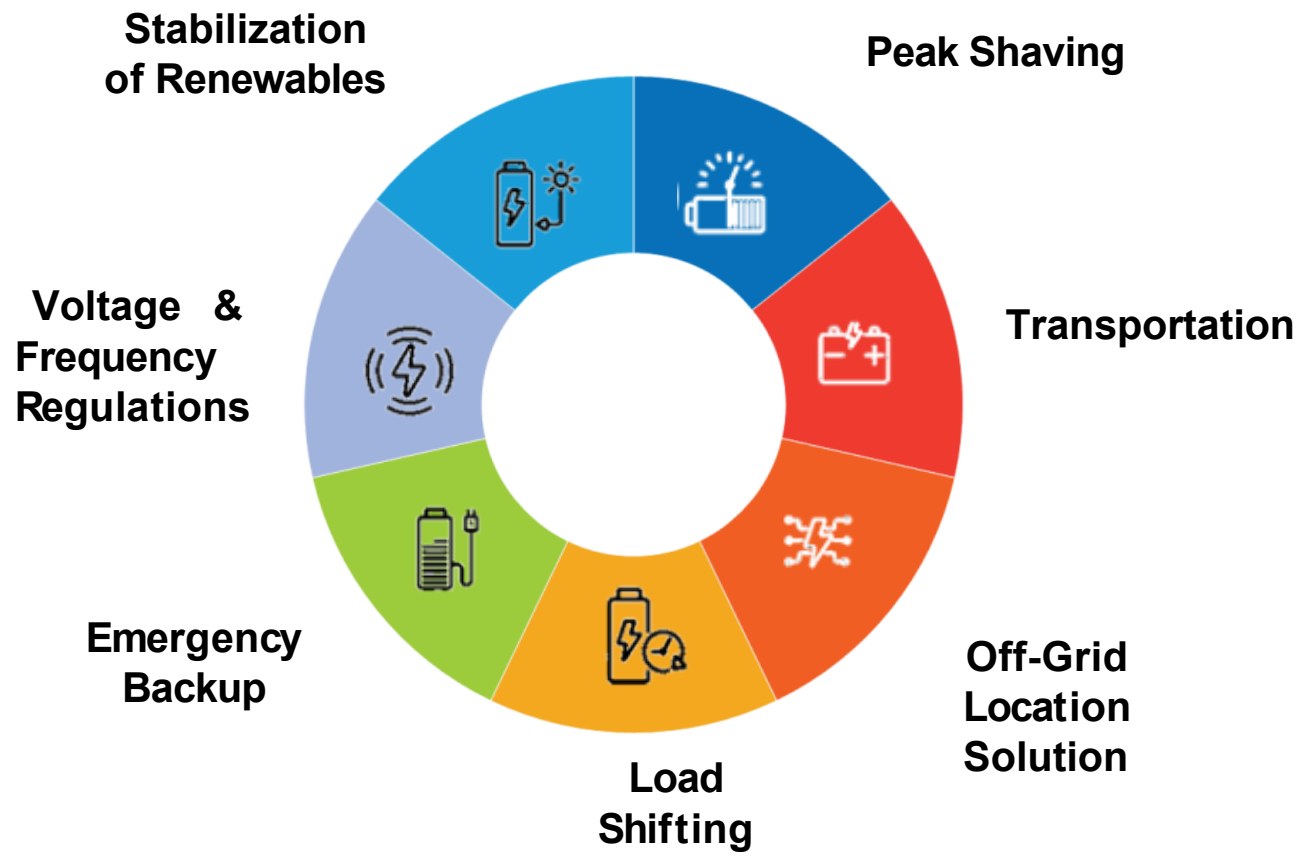
OTHER IMPORTANT FEATURES		
	CURRENT TECHNOLOGY	HE3DA TECHNOLOGY
Recyclability	Difficult to recycle	Fully recyclable

HE3DA technology advantages

The table compares current li-ion cylindrical cells container storage unit with HE3DA storage unit.

- Higher reliability
- Lower O&M costs
- Lower investment costs
- Safety
- Lower electricity losses
 - Lower transformation losses
 - Lower own consumption
- 100% recyclability

SEGMENTS AND PRODUCTS



- ❑ Current focus on stationary eneregy storage applications.
- ❑ Basic division of the storage unit's product portfolio can be done based on the installed capacity:
 - ❑ Small scale: 15 kWh storage systems that can be combined to build up bigger capacity
 - ❑ Large scale: container storage systems, starting at 500 kWh
 - ❑ Custom made systems

PRODUCTS Cont.

LARGE SCALE ENERGY STORAGE

SAFE, EFFICIENT AND COMPACT STORAGE UNITS

- ☐ Starting at 0,5 MWh
- ☐ Custom made box or standard shipping container units (from 10ft to 40ft)
- ☐ Efficient cell integration into a battery storage unit:
 - Small number of cells
 - Low cooling / heating requirements
- Cells are inherently safe
- ☐ Fully recyclable battery cells

1,7 MM ELECTRODES 0,5 MWh STORAGE UNIT

- ☐ Nominal capacity 540 000 Wh
- ☐ Charging current 30–270 A
- ☐ DCinput 1100–90V
- ☐ DCoutput 1100–90V
- ☐ Peak power 540 000 W
- ☐ Operating ambient temperature -30–80 °C
- ☐ Weight 9 500 Kg
- ☐ Dimensions (WxDxH) 2,6 x 2,2 x 2,5 m



PRODUCTS Cont.

LARGE SCALE ENERGY STORAGE

FEATURES

SAFETY

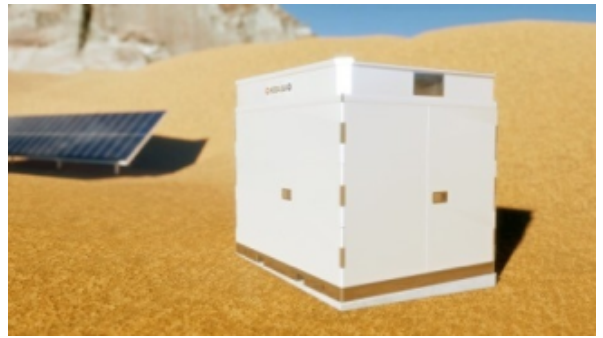
- ☐ Inherently safe battery cells
- ☐ Safe discharge in short circuit
- ☐ Cells do not explode when exposed to fire

EFFICIENCY

- ☐ Efficient battery cell production
- ☐ Efficient cells integration into a storage system (small number of cells, efficient thermal management)
- ☐ Operational efficiency
- ☐ = low cost of kWh stored during battery lifespan

SUSTAINABILITY

- ☐ Fully recyclable battery cells



APPLICATIONS

CUSTOMER APPLICATIONS

- ☐ Demand charge reduction
- ☐ Storage and renewables self consumption
- ☐ Power reliability and backup
- ☐ Power quality

E-VEHICLES INFRASTRUCTURE

- ☐ Battery balanced EVchargers

DISTRIBUTION NETWORK APPLICATIONS

Energy and ancillary services

- ☐ Frequency regulation
- ☐ Renewables firming and smoothing
- ☐ Load following
- ☐ Wholesale arbitrage
- ☐ Black start / voltage support

Capacity

- ☐ Local capacity
- ☐ Distribution investments deferral
- ☐ Reserve capacity

UTILIZATION EXAMPLES

CITY CENTER EV CHARGER

- ☐ DC charger, technology placed underground (2x150 kW or 10x30 KW)

INDUSTRIAL CUSTOMERS / COMERCIAL BUILDINGS SMART GRID

- ☐ Renewables integration, peak shaving, power quality, reliability and backup, EV charging

VIRTUAL BATTERY

- ☐ Efficient centralized energy storage for multiple households enabling wide range of micro grid functions

HOSPITALS AND OTHER CRITICAL INFRASTRUCTURE

- ☐ Uninterrupted power supply, potential to utilize other battery storage benefits

ISLAND OPERATIONS

- ☐ Storage enabling autonomous energy systems

RENEWABLE SOURCES

- ☐ Turning unpredictable sources into stable and predictable

GRID AND DISRIBUTION NETWORKS

- ☐ Flexible tool for grid and distribution networks operators

PRODUCTS Cont.

SMALL SCALE ENERGY STORAGE

FEATURES

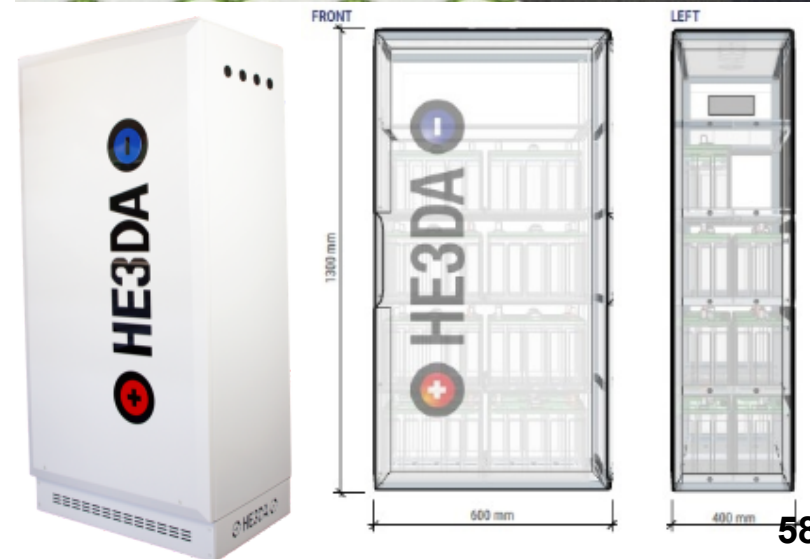
- ❑ Safety - the first truly safe li-ion storagesystem
- ❑ Efficiency - efficient hardware and operations
- ❑ Sustainability - fully recyclable battery cells

UTILIZATION

- ❑ Renewable sources integration
- ❑ Peak shaving
- ❑ Power quality, reliability and backup
- ❑ Island operations

1,7 MM ELECTRODES 15 kWh STORAGE UNIT

- ❑ Nominal capacity: 15 000 Wh
- ❑ Continuous current: 35 A
- ❑ DCinput: 45 - 61,5 V
- ❑ DCoutput: 45 - 61,5 V
- ❑ Continuous recommended load: 25 A
- ❑ Continuous maximum load: 100 A
- ❑ Operating ambient temperature: -30 to 80 °C
- ❑ Weight: 200 Kg
- ❑ Estimated number of cycles 5000
- ❑ The life cycle expectancy: 20 years



PRODUCTS Cont.

HE3DA BATTERY BALANCED EV CHARGER

- ❑ Efficient way to add charging capacity in locations with grid capacity constraint.
- ❑ Flexibility to divide the charging capacity (grid plus battery) into different charging speed outlets, both when designing new location or in real time in a location with needed infrastructure, for example:
 - Xunits 150 kW superchargers in a city center
 - 3Xunits 50 kW chargers in a shopping mall parking
 - 10Xunits 15 kW chargers in an office building parking
 - or any combinations of the above.
- ❑ Efficient DCarchitecture, lower transformation electricity losses, lower investment costs.
- ❑ Scalable system, easy to add storage capacity and charging outlets.
- ❑ Potential to place the technologies underground under a parking space in city centers.
- ❑ HE3DA battery storage safety, recyclability and other benefits.
- ❑ Potential to use the storage for renewables integration, peak shaving, backup, system services etc..

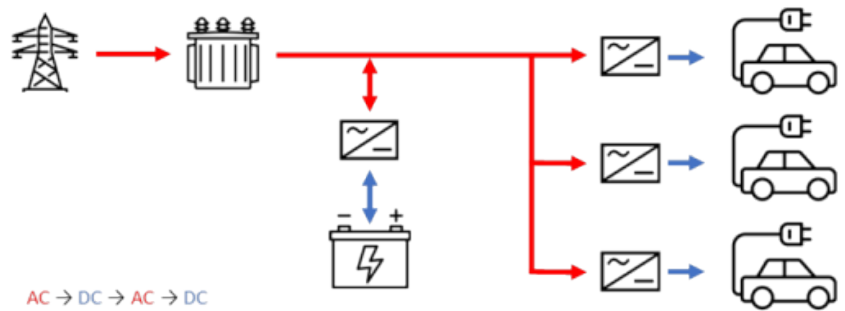


PRODUCTS Cont.

HE3DA BATTERY BALANCED EV CHARGER

Current architecture

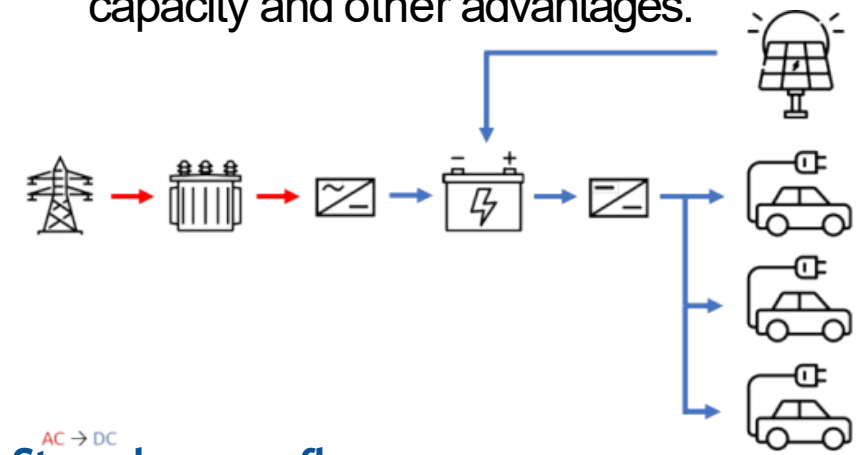
- ❑ The battery storage is currently used primarily to eliminate the cost of electricity purchased in peak hours.
- ❑ The setup of the system is inefficient due to high investment costs as well as high electricity transformation losses.
- ❑ Safety is an issue.



Stored energy flow
AC → DC → AC → DC

HE3DA architecture

- ❑ The HE3DA storage is utilized to maximize the sales of the charging location and minimize the purchase cost of electricity sold.
- ❑ The technology setup brings lower investment costs, lower electricity losses, lower O&M costs, safety, flexibility of dividing the charging capacity and other advantages.



Stored energy flow
AC → DC

PRODUCTS Cont.

HE3DA BATTERY BALANCED EV CHARGER



SHOPPING CENTERS and COMMERCIAL BUILDINGS

- ☐ Storage unit is safe to be placed in indoors garages
- ☐ Flexible distribution of charging power
- ☐ Renewables integration, peak shaving, backup etc.



CITY CENTER SUPERCHARGER

- ☐ Compact technology can be placed underground
- ☐ Superchargers or a larger number of slower outlets
- ☐ Easily scalable in time as EV penetration grows



RESIDENTIAL AREA

- ☐ Scalable solution for dense residential areas
- ☐ Flexible charging power distribution in realtime
- ☐ Potential to use the storage as virtual battery



FUEL STATION

- ☐ Simple transformation of a fuel station into a supercharger
- ☐ Renewables integration, peak shaving, backup etc.

PRODUCTS Cont.

OTHER FIELDS OF DEVELOPMENT

MARITIME TRANSPORTATION

- ❑ Ongoing construction of the first HE3DA electric boat which shall serve as prove of concept, HE3DA e-boat shall be put into operation by end 2020 and shall be used for extensive testing.
- ❑ Our objective: Clean transport from China to Europe with one stop for charging from solar power on Arabian Peninsula = first electrified route by 2023.



ROAD TRANSPORTATION AND MACHINERY

- ❑ Ongoing development of battery units and power trains for trucks, forklifts, construction technology, mining technology, military vehicles and other heavy machinery.
- ❑ Development of an electric racing truck for Dakar rally as a test of the technology in the harshest conditions in partnership with Loprais Team.



PRODUCTION CAPACITY DEVELOPMENT

- Investment sum to date 54 mil. Euro, subscribing equity and discussing with EIB and other institutions to finance capacity expansion.
- First line into commercial operations in 1Q2021, two more lines added into the existing facilities in 2021-2023 to have full battery cell production portfolio.
- Land for second production building acquired, capacity ramp up to 15,5 GWh shall be done with structure of production lines based on market requirements and demand build on the production of the first three lines.

	20	2021				2022				2023				2024				2025				2026			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Building 1																									
Line 1/energy cells, 1,7mm																									
Line 2/power cells, 0,5-1,0mm																									
Line 3/new chemistry																									
Building 2/0																									
Building 2/Phase 1																									
Building 2/Phase 2																									
Line 4/1GWh																									
Line 5/5x1GWh																									
Line 6/9x1GWh																									

PROJECT				
CONSTRUCTION				
TEST OPERATIONS				
OPERATIONS				

PRODUCTION CAPACITY		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Production capacity (year end)	MWh	0	200	300	500	1 500	6 500	15 500	15500	15500	15500
Available production capacity	MWh	0	151	275	366	749	4 007	11 012	15500	15500	15500

CONTACT

Václav Binar

Executive Board Chairman

Tel.: +420 777105225

Email: binar@magnastorage.cz

MAGNA ENERGY STORAGE a.s.

Parizska 68/9

110 00 Prague

Czech Republic