# SCALING UP:
# BATTERY AND ELECTRIC VEHICLE SUPPLY CHAINS

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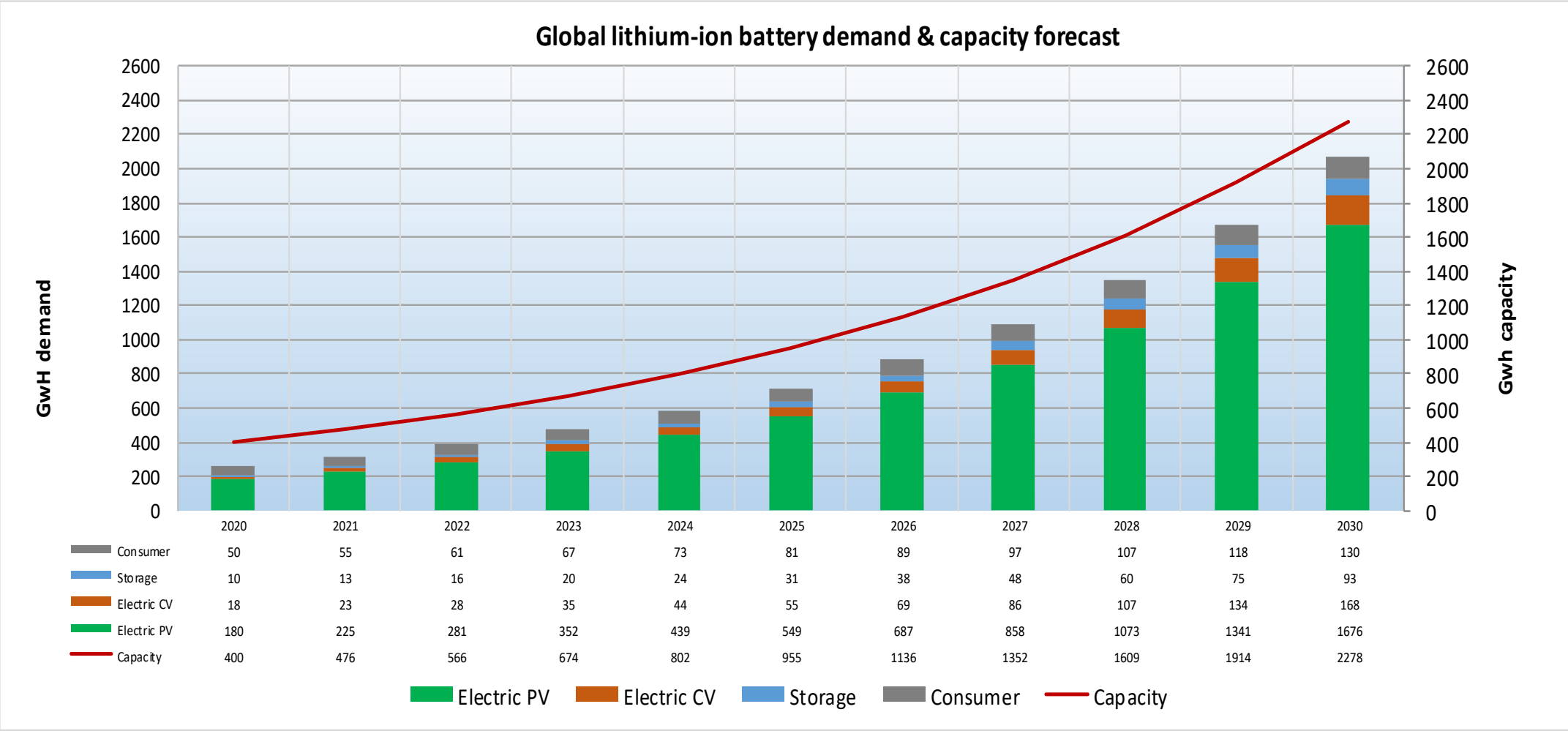
# OVERVIEW

- Global context: Total vehicle sales are expected to fall by ~20% in 2020.
- However, EVs are in a major scale up mode of ~20% per year, increasing market share.
- It is primarily EVs that drive battery demand. (EV ~50 KwH. PHEV ~10 KwH. HEV – 1 KwH)
- This rapid growth creates challenges in building efficient supply chains.
- Companies will need to remain nimble to thrive amid this scale up.
- Successful EV sales growth is fundamentally reliant upon battery supply chains.
- Therefore efficient battery supply chains can be regarded as a competitive advantage.

# GLOBAL LITHIUM BATTERY DEMAND/CAPACITY FORECAST




*Source: Automotive from Ultima Media*

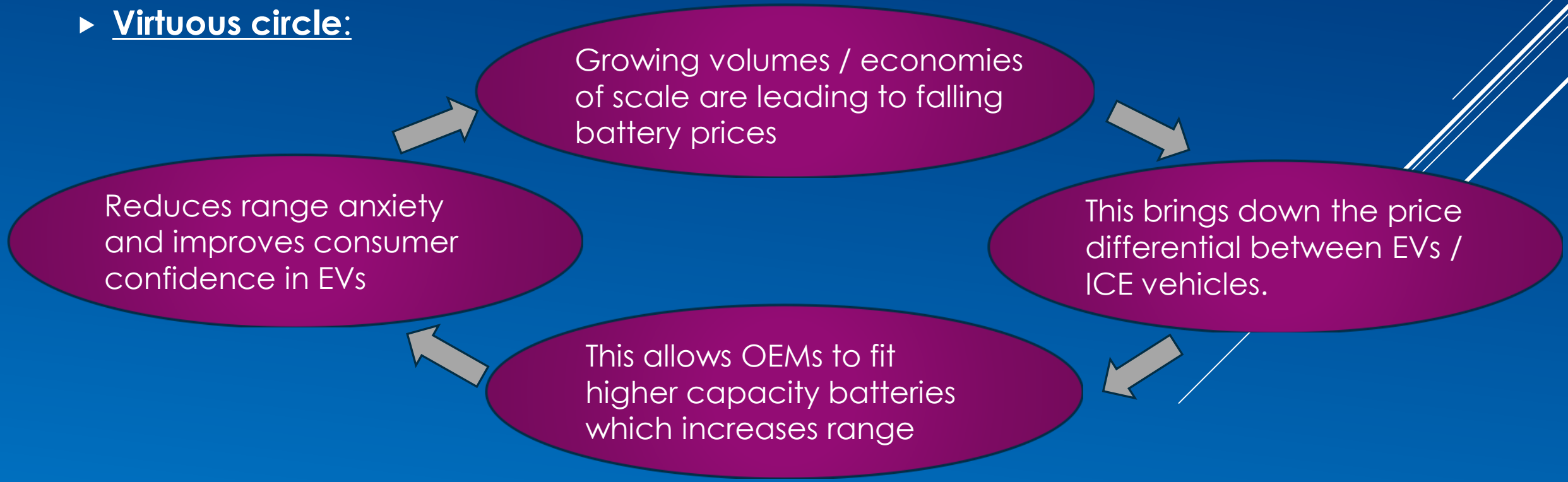
# GLOBAL LITHIUM BATTERY DEMAND/CAPACITY FORECAST

- **Supply side**
- Despite Covid, investment in lithium battery plants continues as they take the long view.
- Production capacity set to reach ~400 GwH in 2020.
- However, that is 'maximum' capacity possible – and that's also across all industry sectors.
- 180 GwH is likely to be produced for ECVs in 2020, equating to ~5.5 million ECVs (EV+ PHEV).

- **Demand side**
- Global EV sales volumes are growing at ~20% a year...
- ...however, the KwH fitted into each vehicle is also increasing at ~5% a year.
- Therefore plant capacity has to rise slightly faster than vehicle sales volumes at ~25% a year.

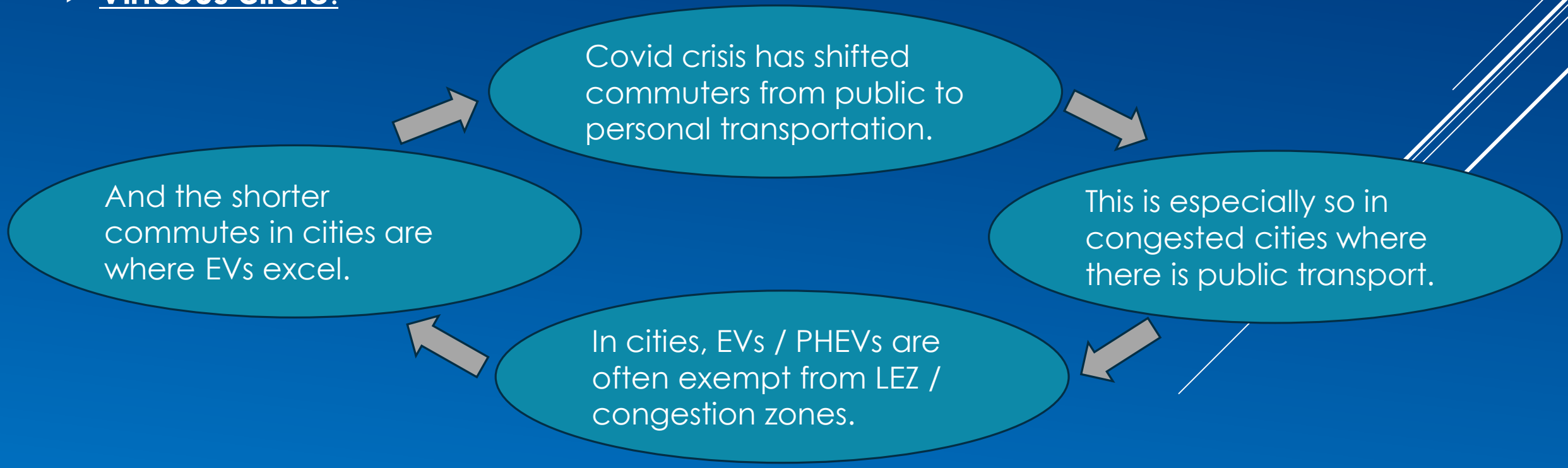
# PRE-COVID: DRIVERS OF ELECTRIFICATION

- CO2 emissions targets for OEMs from 2020/2021 – particularly in Europe and China.
- In response OEMs have put far more low emission vehicles / variants onto the market.
- Government purchase subsidies / tax incentives.
- **Virtuous circle**:

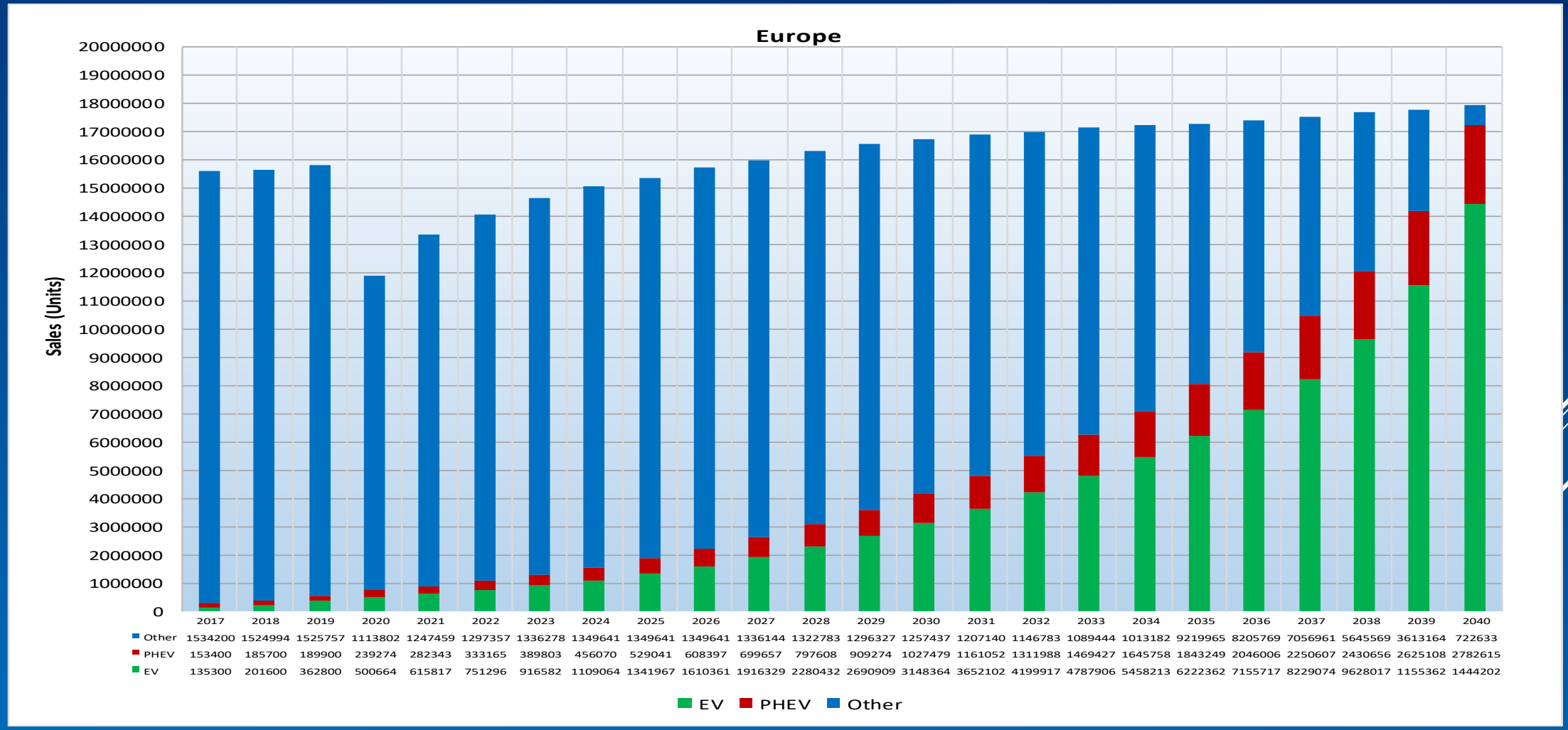


# POST-COVID: DRIVERS OF ELECTRIFICATION

- **Additional factors:** Automotive stimulus packages incentivise low emission vehicles.
- In particular in France, Spain, Germany and Italy – but not the UK or the US.
- China has extended EV subsidies but will phase them out over the next 2 years.
- **Virtuous circle**:



# EUROPE PASSENGER VEHICLE POWERTRAIN FORECAST




*Source: Automotive from Ultima Media*

# EUROPE PASSENGER VEHICLE POWERTRAIN FORECAST

- **Short term outlook**
- In the first half (H1) of 2020, electrically charged vehicles (ECVs) i.e. (EV + PHEV) grew by over 40% but overall vehicle sales fell by -38%.
- We expect some recovery in overall PV volumes in the second half of 2020.
- But our European forecast shows overall PV volumes falling by -25% in 2020.

- **Longer term outlook**
- We expect overall PV volumes to take until 2026 to reach previous 2019 volumes.
- By 2030, ECVs will account for 25% of sales volumes.
- And by 2040, ECVs will dominate with 95% of sales volumes.

# WAITING LISTS – SO WHERE IS THE BOTTLENECK?

Pre-Covid Audi was reporting battery supply chain issues with their supplier LG Chem.


Pre-Covid JLR stopped production due to battery shortages.

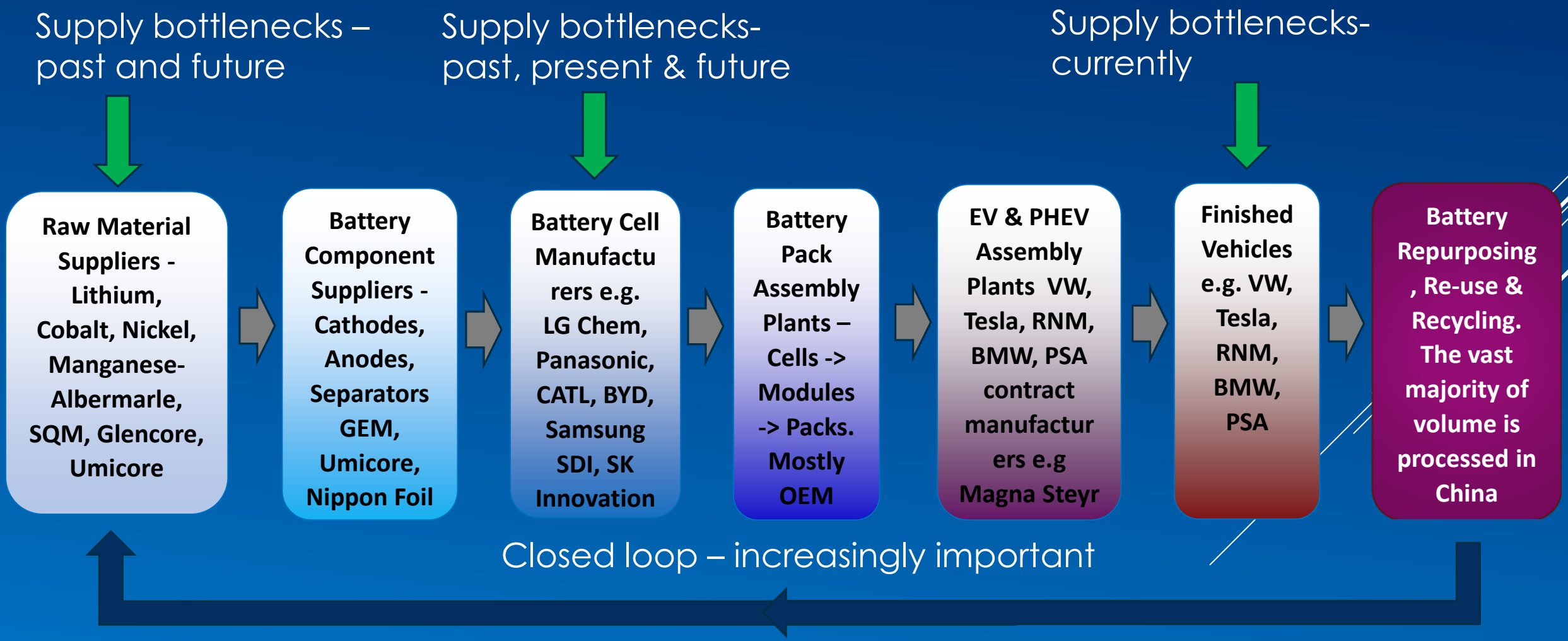
Pre-Covid Mercedes reportedly cut EQC production levels due to battery supply shortages from LG Chem.


Post Covid: Tesla Model 3 reported sales affected by battery shortages

- Model 3 no longer the best selling EV in Europe and overtaken by the Renault Zoe.
- Average waiting time for an EV is ~13 weeks vs. ICE vehicle 7~8 weeks.
- Unexpected surge in demand post-Covid is compounding battery supply shortage as demand is increasingly outstripping supply.
- This demonstrates why battery supply chains are a competitive advantage.

# BATTERY SUPPLY CHAIN

- Batteries have a long and complex supply chain



# LOCALISATION

- Currently battery supply chains are highly regionalised.
- When EV volumes were relatvely low, it made sense to import battery cells.
- As volumes ramp up, it makes less sense to ship large heavy batteries around the world.
- More localisation aka ‘near-shoring’ of battery plants shortens supply chain distances.

| | |
|---|---|
| LG Chem | Poland, Ohio US |
| CATL | Germany |
| northvolt | Germany |
| SK innovation | 2 plants in Georgia, US |

- However, battery components – anodes, cathodes still largely sourced from Asia.
- Raw material supplies still sourced from politically unstable regions (e.g. DRC for Cobalt).

# CHALLENGES – INBOUND LOGISTICS

- The Covid crisis has unexpectedly accelerated EV / PHEV demand.
- Complexity - Batteries can be transported as single cells, modules, or complete packs.
- Complete battery packs are also getting heavier typically weighing 300kg – 500kg.
- Lithium – Ion batteries are defined as “dangerous goods”.
- Regulation on transporting batteries varies by region / jurisdiction.

# SINGLE SOURCING → MULTI-SOURCING

- To mitigate battery supply bottlenecks OEMs have moved towards multi -sourcing.
- Furthermore, OEMs are increasingly regionalising their suppliers for regional markets -
- Tesla uses Panasonic for cars destined for NA / Europe, LG Chem for Asia, CATL for China.
- VW uses LG Chem, Samsung SDI and SKI for EU, CATL for China and SKI for NA from 2022

| OEM | Past cell supplier | Future cell suppliers |
|---|---|---|
| Tesla | Panasonic | Panasonic, CATL, LG Chem |
| VW | Samsung SDI | Samsung SDI, SKI, LG Chem, CATL, NorthVolt |
| PSA | LG Chem | LG Chem, CATL and SAFT in future |
| Volvo | LG Chem | LG Chem, Samsung SDI, CATL |

*Source: Automotive from Ultima Media*

# JOINT VENTURES & ALLIANCES

- There is an increasing trend for OEMs to have battery plant JVs with cell suppliers.
- For the cell supplier this reduces their investment cost and gains a reliable customer.
- In return the OEM gets increased security of supply e.g. Tesla / Panasonic.
- For smaller start-ups, such as Fisker, there is a move towards forming consortiums to achieve the same buying power for batteries as with larger OEMs.

| OEM | Battery cell company | Location |
|---|---|---|
| Tesla | Panasonic | Nevada |
| VW | Northvolt | Germany |
| Groupe PSA / Opel JV Automotive Cell Company (ACC) | SAFT | Two sites in France & Germany |
| Fisker & consortium of other start-ups | 'top 5' player | - |

*Source: Automotive from Ultima Media*

# CHALLENGES - FINISHED VEHICLE LOGISTICS

- EVs are typically 200-300kg heavier than equivalent ICE vehicles.
- Charging infrastructure remains an issue, as EVs need to be delivered charged.

- **Road**

EVs reduce load factors as car carriers reach the weight limit before the space limit.

- **Rail**

China still does not accept dangerous goods on trains so EVs cannot be moved by rail across China.  Road or sea has to be used instead within Chinese borders.

- **Shipping**

RO-RO vessels require EVs to be charged. Ports need extensive charging infrastructure.

# CONCLUSIONS

- At the industry level, battery supply chains are central to the electrification of the fleet.
- Post-Covid the pace of EV adoption has accelerated significantly.
- For each company, efficient battery supply chains are a clear competitive advantage.
- Localisation is increasing as EV volumes rise – leading to rapidly evolving supply routes.
- Increasing trend for OEMs to invest in battery plant JVs with cell suppliers.
- To mitigate battery supply bottlenecks OEMs have moved from single to multi -sourcing.
- Therefore, exploiting changes in the battery supply chain creates business opportunities.

# THANK YOU

- Current reports :
- ***Automotive Headwinds Align Into A Perfect Storm***
- ***Climate Change vs. Carmakers***
- ***Powertrain Forecast To 2030***
- ***Automotive Tier Supplier Profit Analysis 2020***
- ***Global New Vehicle Demand Forecast 2020-2030: Covid-19: The Long Road Ahead***

- Upcoming reports :
- ***ECG Business Intelligence***
- ***Automotive Battery Supply Chain Analysis 2020***

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