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## What are Motive Power Batteries?

*Motive power batteries (or traction batteries) are used in off-road applications where the battery energy is used to produce motion*

- Great variety of motive power applications – need for different technologies own specifications
- Several IEC and EN battery standards – performance & safety
- Total installed capacity of motive power batteries in Europe - more than 20 GWh



# Introduction



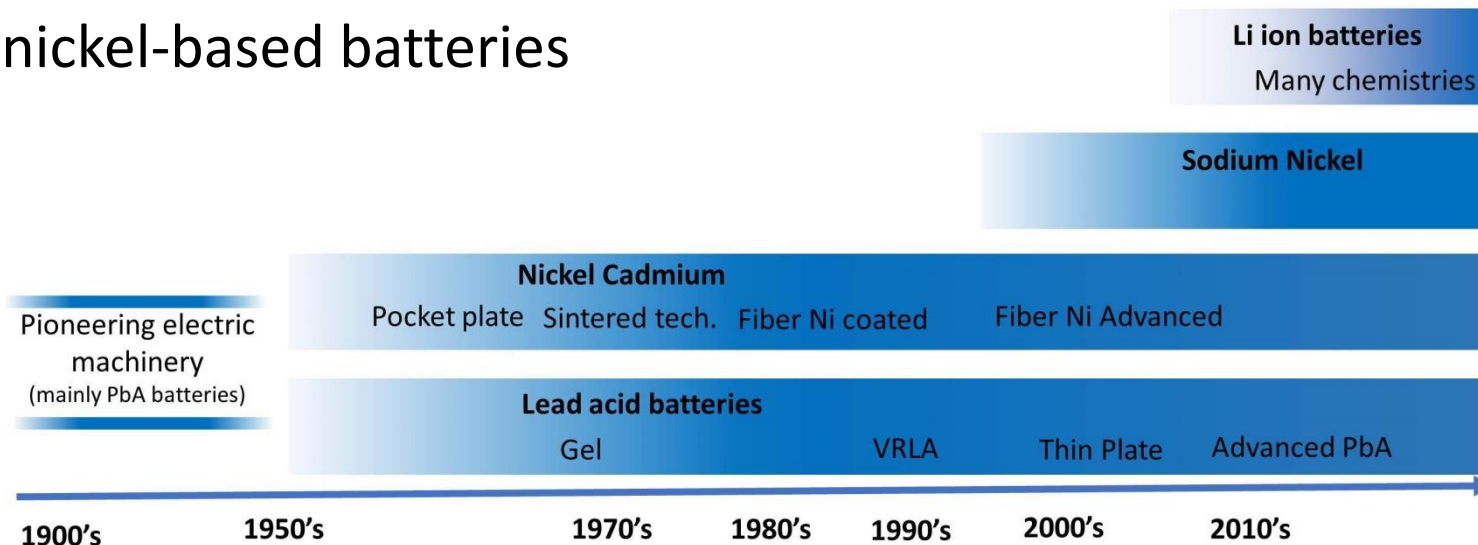
## Applications

- Electric or hybrid electric Forklifts
- Cleaning
- Medical wheel chair
- Construction/agriculture
- Mining
- Golf carts
- Automated Guided Vehicles (AGVs)
- Ground support equipment
- Railway applications
- Electric inland vessels

# Technologies

## 4 major families

- lead-based batteries
- lithium-based batteries
- sodium-based batteries
- nickel-based batteries



# Technologies

## *Lead-based battery technology*

- Flooded lead batteries: Conventional flooded
  - Reliable and survive in harsh environment
- Flooded lead batteries: Enhanced flooded
  - Optimisation the opposing attributes of power, efficiency and lifespan
  - Low internal resistance and significantly improved utilisation of the active mass



# Technologies

## *Lead-based battery technology*

### VRLA : Gel & AGM (Absorbant Glass Mat)

- Maintenance Free
- VRLA gel – particularly robust and are used as standard in material handling, cleaning and mobility applications.
- VRLA AGM – low internal resistance, high energy/power density and fast recharge
  - Particularly suited to the Motive Power sector:  
opportunity charge, fast charge & reduced maintenance/maintenance free characteristics are desired



# Technologies

## *Lithium-based technology*

- Require electronic monitoring and control
  - ⇒ Smart - communication with host application about state of charge (SOC), state of health (SOH), and other vital data
- Low weight and compact size
- High rates of charge & discharge





# Technologies

## *Sodium-based battery technology*

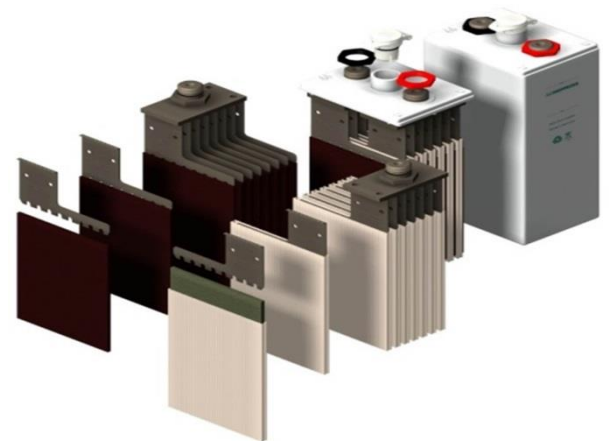
- Mining equipment, naval applications and a range of specialist machinery
  - => work well in these hostile environments
- High energy densities permit long run-times on a single charge
- Zero maintenance requirements



# Technologies

## *Nickel-based battery technology*

- High performance in extreme temperatures: Well suited for very low and high temperatures
- Robust design of the cells – absolutely reliable energy storage even under the most severe operating conditions
- Future development will focus on:
  - increasing cycle life
  - extending temperature range
  - reducing costs



# Technologies

## *Innovation of all Motive Power Battery technologies*

- Drivers for innovation?
  - Regulators are demanding constant improvements
  - Electrification because of health and environmental standards
- Growing demand for storage of renewable energy as part of the development of smart and semi-detached power grids
  - => Division stationary (backup) - motive (cycled) is being blurred
- Through innovation:
  - Safer
  - Better performance for user
  - More environmental friendly
  - Often maintenance free

# Drivers for electrification & Contribution to EU Objectives

*Motive Power Batteries play a key role in nearly all sectors of industry and the economy, either directly or through material handling applications that are central to logistics*

- Emission Reduction as a driver for electrification
  - 'non-road mobile machinery' (NRMM) Regulation
  - Batteries as a primary energy source VS IC-> reduction on CO2 emissions
- Noise Reduction as a driver for electrification
  - Noise is one of the most pressing problems in urban areas
  - Outdoor Noise Directive 2000/14/EC
  - Batteries can ensure that equipment meets the noise limits that are set out – No exhaust/engine noise

# Drivers for electrification & Contribution to EU Objectives

- Service providers to the electricity grid
  - either as demand response providers or as active ancillary services providers (through aggregation).
  - Total installed capacity of motive power batteries in Europe amounts to more than 20 GWh
- Circular Economy: recycling of Motive Power Batteries
  - lead-based batteries
  - lithium-based batteries
  - sodium-based batteries
  - nickel-based batteries
- Innovation
  - Progress in energy storage goes hand-in-hand with the design of new machinery => higher productivity at lower human/environmental cost

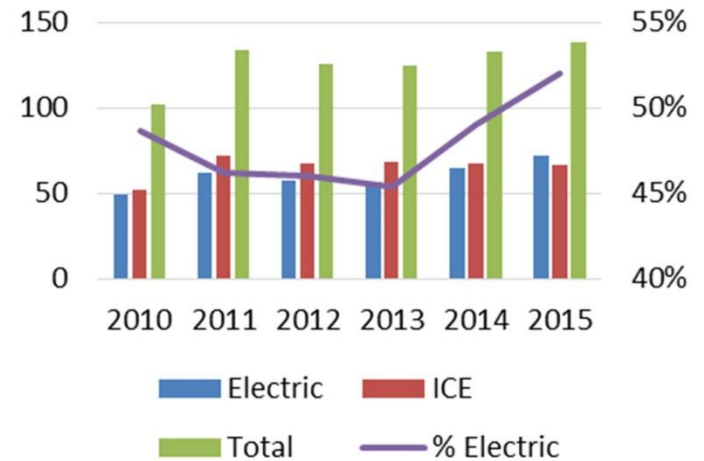
# Example

## *Electrification of Lift Trucks*

### Lift Truck

- Trend towards Electrification
- High performance without CO2 emissions
- No exhaust or engine noise
- Orders in Europe considerably higher compared to the percentage electric lift truck orders worldwide

*ICE and Electric Lift truck orders in Europe*



Source: WITS DATA

## Conclusion

The great variety of motive power applications are covered by different battery technologies, which all have their own specifications to ensure all the specific needs of applications are covered.

All types of motive power batteries have been constantly improved over time, and innovations will continue to be introduced, so that indeed they can continue to contribute to EU objectives.





L.Bisalas, Systems Sunlight #EurobatForum: *technologies cover different applications. Constant innovation ensures contribution to EU objectives*