



Emobility at Saft and JCS

43rd LCA discussion Forum - LCA of electromobility - Answers and challenges

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A world leader in high technology batteries



Saft is the world's leading designer, developer and manufacturer of advanced technology batteries for industrial and defense applications.



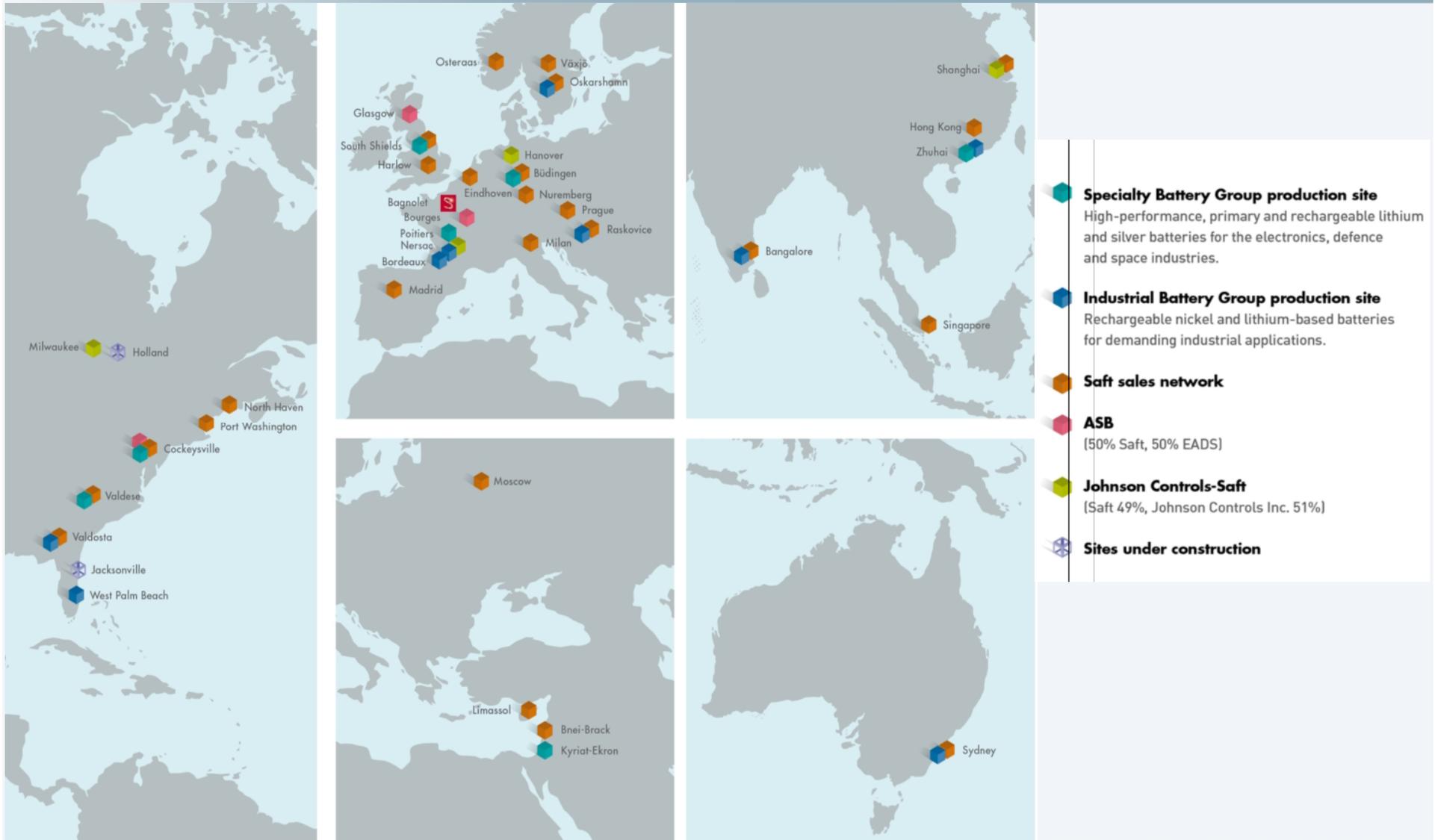
The leading European supplier of specialized, advanced technology batteries for defense and space applications and n° 1 worldwide in lithium-ion commercial satellite batteries.



The group is now very well-positioned on the developing markets of clean vehicles and renewable energy storage.

**With 4,000 employees worldwide,
Saft is present in 18 countries.**

An International manufacturing network close to its customers



-  **Specialty Battery Group production site**
High-performance, primary and rechargeable lithium and silver batteries for the electronics, defence and space industries.
-  **Industrial Battery Group production site**
Rechargeable nickel and lithium-based batteries for demanding industrial applications.
-  **Saft sales network**
-  **ASB**
(50% Saft, 50% EADS)
-  **Johnson Controls-Saft**
(Saft 49%, Johnson Controls Inc. 51%)
-  **Sites under construction**

The Saft Group in 2009 - Key figures



Space



Defence



Industrial standby



Telecommunication

Specialty Battery Group

€241.6m
43.2 %

High performance primary and rechargeable lithium and silver batteries for the electronics, defence and space industries.

Industrial Battery Group

€317.7m
56.8 %

Rechargeable nickel and lithium-based batteries for demanding industrial applications.



Joint-Ventures:

- Johnson Controls-Saft HEV and EV batteries
 - ASB Group Thermal batteries
- Equity accounted



Metering and Professional Electronics



Aviation



Clean energy storage



Emergency Lighting



Rail and Mass Transit

Saft EV Experience

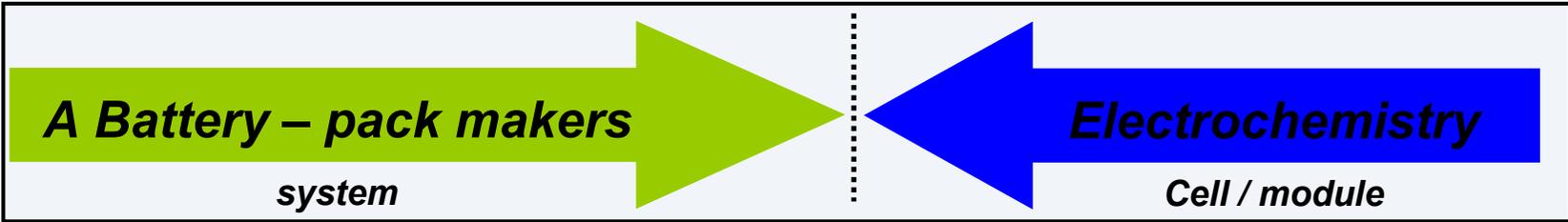
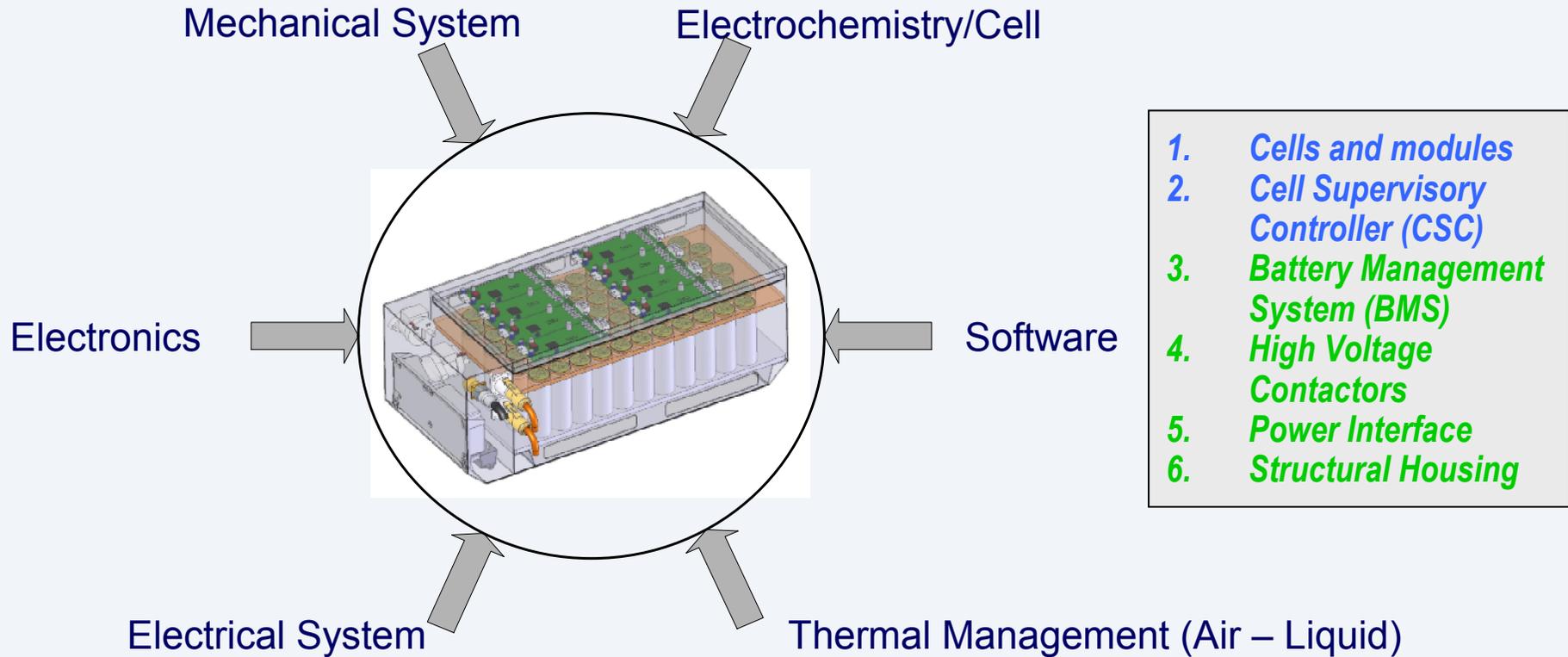
- More than 15 years designing and delivering batteries for Electric Vehicle & Hybrid Vehicles with various electrochemistry: Ni-Cd, Ni-MH and Li-Ion technologies

- Ni-Cd
- Ni-MH
- Li-ion



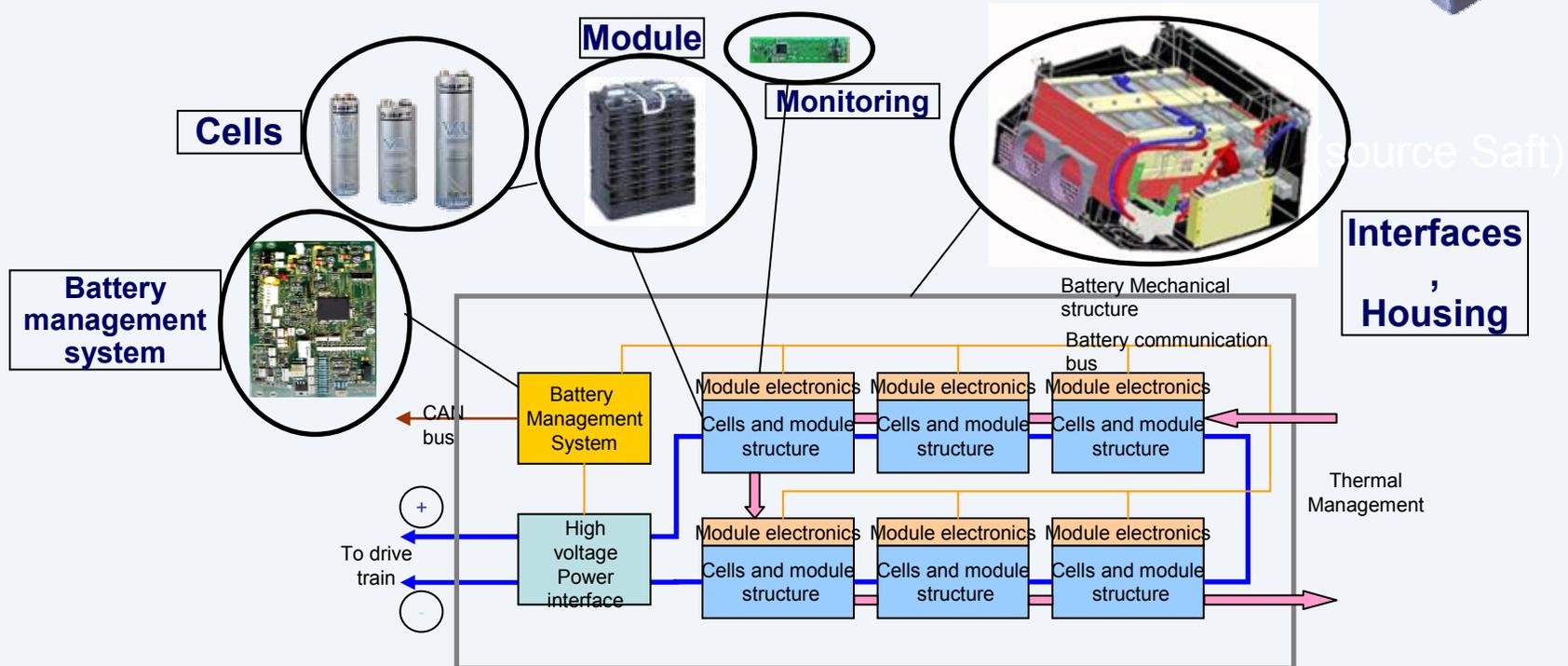
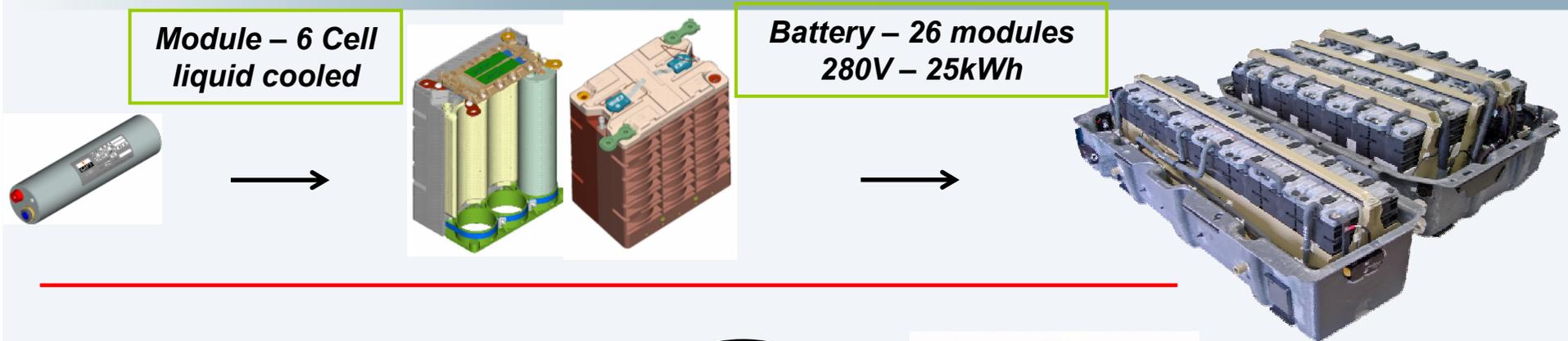


What does it take to build a Complex Battery System?





System architecture



Example of Pilot Automotive Application

- Li-ion batteries for EV and HEV automotive programs:
 - 30 vehicles equipped with SAFT battery system
 - 1million km cumulated



--> 84Ah-300V battery, 200km autonomy
- EV in daily service @ EDF- French post..

Sport Cars - various Championship - HEV/EV

- ANDROS - EV race on Ice
- European Electric F3 Championships



307 cc FySiPac PSA - Hybrid Battery + fuel cell

- Li-ion Battery 13 kWh 41Ah-220V - 75km autonomy



Peugeot Scooters E-vivacity

- Saft has specifically developed new modules of lithium-ion batteries for Peugeot's latest scooter, the e-Vivacity.
- The Saft battery system lodged under the scooter's flat deck provides the e-Vivacity with power that is particularly appreciable for ease of insertion in traffic flows.
- 60 km autonomy



Johnson Controls - Saft Advanced Power Solutions

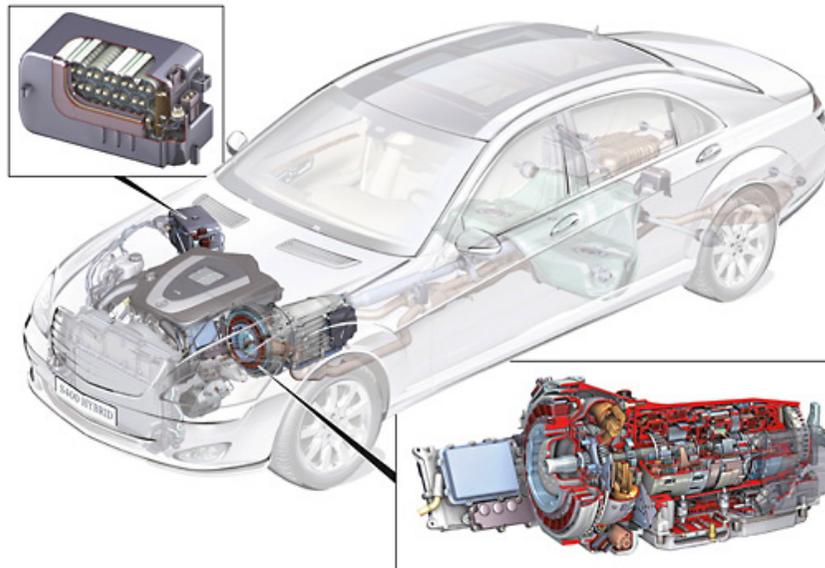
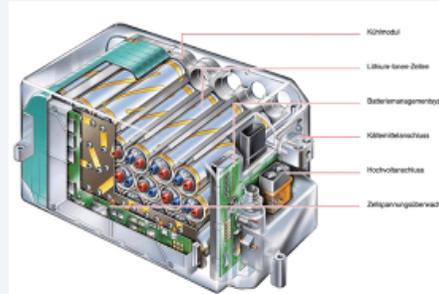
- Saft leveraged its technological expertise to set up a joint venture in 2006 with the US firm Johnson Controls Inc., a Tier-1 automobile supplier, to address the fast-growing EV and HEV market on Li-ion expertise.
- **World's first production facility for Li-Ion hybrid vehicle batteries opened in January 2008**
- The joint venture has already won 7 contracts in Europe and the US:
 - Mercedes S-Class hybrid,
 - Ford PHEV fleet
 - BMW 7 Series ActiveHybrid
 - Azure Dynamic's Balance™ HEV for commercial veh.
 - Ford Transit Connect BEV



JCS - First to Market with Li-Ion Mild Hybrid Application

New S-class S400 hybrid with JCS Li-Ion technology

- Mild Hybrid Battery System (19 kW boost during acceleration)
- SoP mid of 2009
- Located in Engine Compartment : A/C - cooled
- 32VL6P battery



JCS Li-ion Technology

Hybrid systems based on VL6P cell :

- Mass produced by Johnson Controls - Saft
- 7Ah high power cell,.
- NCA type cathode and graphite anode - Cylindrical design, spiral wound type

| VL6P : Power Applications HEV | |
|--|-------------|
| Capacity (Ah) at C/3 @ 4V @25 °C | 7 |
| Diameter (mm) | 38 |
| Length (mm) | 145 |
| Weight (kg) | 0.36 |
| Volume (dm ³) | 0.16 |
| Energy (Wh) | 25 |
| Discharge Power (W) : 10s, 50% SOC, 25 °C - V limit (2.5V) - Current limit (250A) | 1000 730 |
| Discharge Power (W): V limit (2.0V) 10s, 50% SOC, -25 °C | 180 |



Li-ion Battery Production : Factories implemented in Europe and North America

SAFT - European Facility in Bordeaux (France)

- Pilot line in operation for more than 12 years



JCS - European Facility in Nersac (France)

- World's first production facility for Li-Ion Hybrid & Electric vehicle batteries
- Opened January 2008



Saft - North American Facility in Jacksonville (FL - USA)

- Production capability : 8 X European Facility



JCS - North American Facility in Holland (Win-USA)

- Start of operation in 2011
- Production capability : 10 X European Facility

Sustainable Development and LCAs



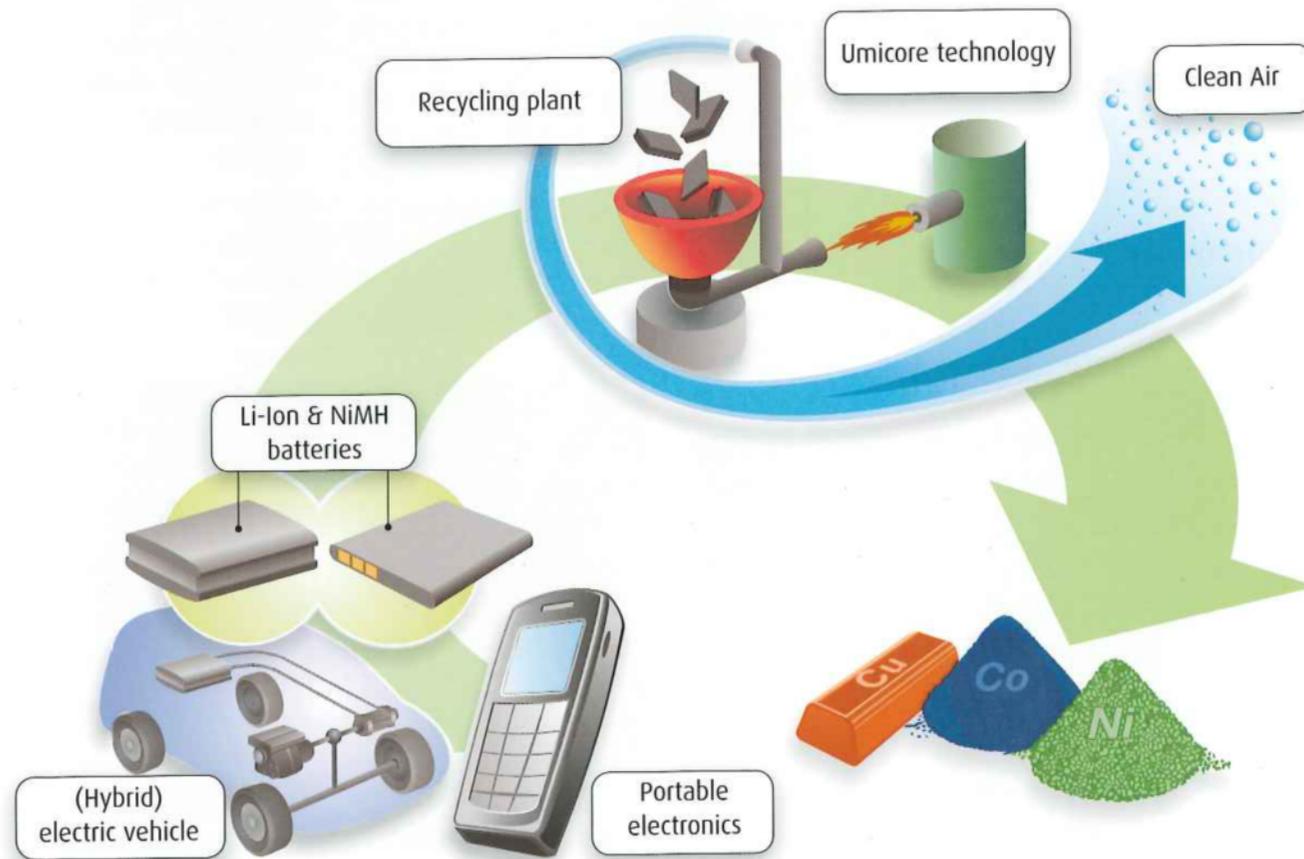
The environment is at the core of Saft's activity

- The environmental impact of each type of battery is considered during design and manufacture and for each phase of the product's life cycle.
- The Company's products contribute to the increased use of renewable energies.
- The Group's environmental strategy have for many years been regulatory compliance and the anticipation of environmental impacts.
- Saft strives to maximize the use of secondary rather than primary raw materials.



Lithium-ion Recycling (source Saft – Umicore)

Battery to Battery: closing the battery loop process



LCA of electromobility: Main challenges (1/2)

■ Need of **robust primary data for LCA at cell level:**

- Very often, no LCI of active materials like NCA or LiFePO_4 for Li-ion batteries available in LCA databases

■ Life (in years) very different:

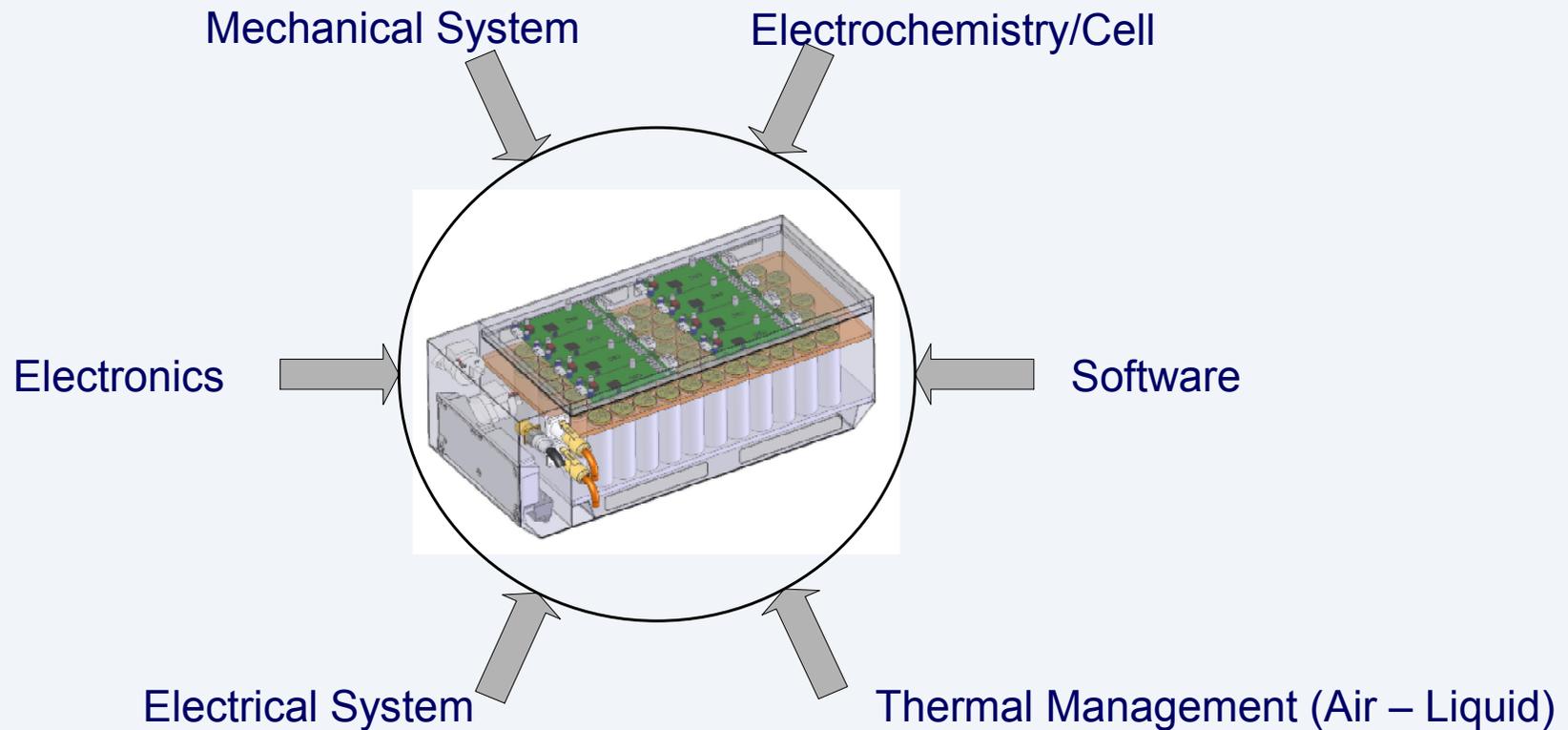
- from one chemistry to another within the same technology (NCA versus LiMn_2O_4 or LiFePO_4)
- Depending on the use phase: cycling or calendar life

⇒ **Difficult definitions of reference flows for a given FU,**

⇒ **No possibility to use only a black box “Li-ion batteries” as available in some softwares**

LCA of electromobility: Main challenges (2/2)

- **Complex battery system** to be taken into account in the LCA



- Probable need of **a PCR-like guidance for LCA of e-mobility**

LCA of electromobility: Main challenges

THANK YOU FOR YOUR ATTENTION
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