THE HIGH VOLTAGE BATTERIES OF THE BMW i3 AND BMW i8.
AABC 2014, FEBRUARY 3TH- 7TH, ATLANTA
AGENDA.

- BMW approach to sustainable mobility: BMW i
- Project targets and requirements
- Technical concepts and solutions
- Summary
BMW i - SUSTAINABILITY DRIVES THE LIFECYCLE.

Integrated approach of BMW i – BORN ELECTRIC.

New vehicle concepts
New materials and recycling
Production concept of the future
New electric drivetrain

New processes
Employees
Pioneering design
New customer focus

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THE PURPOSE DESIGN LIFEDRIVE CONCEPT.

Two separate, independent functional units:

- **Life module**
  High-strength and extremely lightweight passenger cell made from carbon fibre-reinforced plastic

- **Drive module**
  Ideal integration of suspension and eDrive System
ELECTRIC POWERTRAIN: THE BMW eDRIVE SYSTEM.

- **In-house development**
  Key components developed at BMW (power electronics, electric motor and high voltage battery)

- **In-house production**
  Electric motor and high voltage battery assembled at BMW

- **High efficiency**
  Increase range and reduce battery costs

- **Low weight**
  In accordance with the light weight concept i3
REQUIREMENTS FOR THE HIGH VOLTAGE BATTERIES.

- **High power density**
  Enabling BMW typical driving dynamics

- **High efficiency & low weight**
  Increase range and reduce battery costs

- **Lifetime**
  Battery warranty of 8 years

- **Safety**
  No risk in any situation

- **Sustainability**
  Choice of materials & second life use
## BMW High Voltage Batteries: Technical Data

<table>
<thead>
<tr>
<th>Technical Data</th>
<th>BMW i3</th>
<th>BMW i8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage</td>
<td>360 V</td>
<td>355V</td>
</tr>
<tr>
<td>Max. current</td>
<td>409 A</td>
<td>320A</td>
</tr>
<tr>
<td>Energy content</td>
<td>22 kWh</td>
<td>7.1 kWh</td>
</tr>
<tr>
<td>Discharge Power peak</td>
<td>147 kW</td>
<td>105kW</td>
</tr>
<tr>
<td>Total number of cells</td>
<td>96 (1p, 96s)</td>
<td></td>
</tr>
<tr>
<td>Weight (with connections)</td>
<td>233 kg</td>
<td>98 kg</td>
</tr>
<tr>
<td>Charging time</td>
<td>&lt;0.5 h for 80%</td>
<td>2h (AC charge)</td>
</tr>
<tr>
<td>(DC charge)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling</td>
<td>Refrigerant</td>
<td></td>
</tr>
</tbody>
</table>

### BMW i8 High Voltage Battery

- Image of BMW i8 high voltage battery

### BMW i3 High Voltage Battery

- Image of BMW i3 high voltage battery
BMW BATTERY SYSTEMS HAVE A UNIQUE POSITION IN TERMS OF POWER / ENERGY DENSITY.

Specific battery power / 1000 kg vehicle weight
Specific battery energy / 1000 kg vehicle weight

BMW ActiveHybrid 5
BMW i8
BMW i3
BMW ActiveE

Competitors HEV
Competitors PHEV
Competitors BEV

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Concept identical for PHEV / EV application

- Distributed E/E design (BMU, S-Box, CSC)
- Structural rigidity by overall mechanical design
- Light-weight housing (aluminum extruded/diecast)
- Direct refrigeration (single/multi-layer)
- All components serviceable, easy access, (high voltage is protected against contact within battery housing)
- Modular kit HW: same electronic components in both systems
- Modular kit SW: same software and algorithms in both systems, diversity by calibration
- BMU (Battery Management Unit), S-Box (Switch Box) and CSC (Cell Supervising Circuit)
- BMU contains battery management software (e.g. SOC, SOH, diagnosis)
- CSC for cell voltage/temperature measurement
- S-Box: fuse, contactors, current and voltage measurement
TECHNICAL CONCEPT – CELL MODULE.

- Cell number per module (12 v.s. 16): trade-off between package, electronic components and transport regulations
- Cell module is a serviceable unit
- Validation on module level guarantees high quality and reduced costs for derivates
- Meeting UN38.3 standard
- Possibility to use EV and PHEV1 modules for further projects
TECHNICAL CONCEPT – REFRIGERANT COOLING.

- **Cell Lifetime**
  Cooling performance is key factor for lifetime

- **Weight & performance**
  Highest cooling performance at minimum weight and costs (no extra installation in vehicle, use of existing A/C system)

- **Heating option**
  Available for maximum comfort and performance without losing range

- **Complexity of direct cooling**
  Intensive validation and simulation is necessary for complex designs (multi-layer)
LIGHTWEIGHT – A KEY FACTOR FOR FUTURE BATTERY SYSTEMS.

Electric range for EV (based on BMW i3):

Today: 160km / 100miles

Target (2025): 480km / 300miles

* targets based on battery pack 250Wh/kg / 450Wh/lit [P. Lamp, ABAA 6, Chicago 2013]
SUMMARY.

- BMW i as a holistic approach to sustainable mobility
- In-house development of high voltage batteries in third generation
- Purpose design vehicle architecture allows ideal integration in terms of weight & costs
- Powerful, long-lasting and safe high voltage batteries
- Modular kit approach, possibility of use for further electric powertrains at BMW