BMW GROUP’S ELECTRIFICATION PATHWAY.

SCALABILITY AND FLEXIBILITY

ELECTRIFICATION OF CORE PORTFOLIO

- MINI BEV
- BMW X3 BEV

PIONEERING

- Building-up expertise
- Technology innovation
- Project i

Roll-out i Performance
Upgrade BMW i3

BMW Group Technology Workshops – E-Mobility
OVER 100,000 ELECTRIFIED BMW VEHICLES SOLD YTD 2016.

* Only available in China
Figures are for cumulative sales of BEV and PHEV vehicles
CUSTOMERS ARE WARMING UP FOR E-MOBILITY. FIRST TIME CUSTOMERS OF BEV AND PHEV ARE CONVINCED.

**Favored powertrain next car: 2014 vs. 2016 (Driver conventional car, 1st choice)**

<table>
<thead>
<tr>
<th></th>
<th>Germany</th>
<th>USA</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHEV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>15</td>
<td>17</td>
<td>12</td>
</tr>
<tr>
<td>2014</td>
<td>2</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>BEV (+REX)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>9</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>2014</td>
<td>2</td>
<td>3</td>
<td>9</td>
</tr>
</tbody>
</table>

**Re-Purchasing Interest EV: 2014 vs. 2016 (BEV and PHEV driver)**

<table>
<thead>
<tr>
<th></th>
<th>PHEV owner</th>
<th>BEV owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHEV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>57</td>
<td>1</td>
</tr>
<tr>
<td>2014</td>
<td>34</td>
<td>15</td>
</tr>
<tr>
<td>BEV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>36</td>
<td>96</td>
</tr>
<tr>
<td>2014</td>
<td>25</td>
<td>78</td>
</tr>
</tbody>
</table>

Source: Powertrain Study 2014/16 | June 2016
HOW DO WE DETERMINE THE IDEAL PORTFOLIO FOR E-MOBILITY?
SIGNIFICANT NUMBER OF ELECTRIFIED MODELS ARE ALREADY ON THE STREET.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BMW i3 60 Ah</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMW i3 94 Ah</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MINI BEV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMW X3 BEV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMW iNEXT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BMW i8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMW 530Le*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMW 225xe iPerformance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMW X1 xDrive25Le iPerformance*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MINI BEV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MINI Cooper S E Countryman ALL4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMW i8 Roadster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Only available in China
FLEXIBILITY IS KEY FOR E-MOBILITY.
FUTURE OF ELECTRIFICATION.

- Building-up expertise
- Technology innovation
- Project i

ELECTRIFICATION OF CORE PORTFOLIO
- Roll-out i Performance
- Upgrade BMW i3
- MINI BEV
- BMW X3 BEV

SCALABILITY AND FLEXIBILITY
SCALABILITY AND FLEXIBILITY – FUTURE ELECTRIFICATION BASED ON A MODULAR ARCHITECTURE.

BEV Integration into the BMW Group vehicle architecture

2013 – 2020

PHEV Integration into the BMW Group vehicle architecture

PHEV

BEV

LUXURY

COMPACT

BMW Group Technology Workshops – E-Mobility Page 9
This document contains forward-looking statements that reflect BMW Group’s current views about future events. The words “anticipate,” “assume,” “believe,” “estimate,” “expect,” “intend,” “may,” “can,” “could,” “plan,” “project,” “should” and similar expressions are used to identify forward-looking statements.

These statements are subject to many risks and uncertainties or may be affected by factors outside BMW Group’s control, including adverse developments in global economic conditions resulting in a decline in demand in BMW Group’s key markets, including China, North America and Europe; a deterioration in credit and financial markets; a shift in consumer preferences affecting demand for BMW Group’s products; changes in the prices of fuel or raw materials; disruption of production due to shortages of materials, labor strikes or supplier insolvencies; the effective implementation of BMW Group’s strategic goals and targets; changes in laws, regulations and government policies, particularly those relating to vehicle emissions, fuel economy and safety; and other risks and uncertainties, including those described under the heading “Report on Risks and Opportunities” in BMW Group’s most recent Annual Report.

If any of these risks and uncertainties materializes or if the assumptions underlying any of BMW Group’s forward-looking statements prove to be incorrect, actual results may be materially different from those BMW Group expresses or implies by such statements. BMW Group does not intend or assume any obligation to update these forward-looking statements.
E-MOBILITY

STEFAN JURASCHEK
VICE PRESIDENT RESEARCH AND DEVELOPMENT E-POWERTRAIN
ZERO EMISSION VEHICLE STRATEGY.
CONCERNING VEHICLE SIZE AND OVERALL RANGE.
Technology lead: Lighter, faster, more powerful and more flexible than the competitors.

GOALS OF THE INHOUSE STRATEGY.

- Downright top performance by the use of new technologies.
- Flexibility in the choice of technologies and suppliers.
- Cost structure transparency.
- Modular kit: flexible and scalable.
- Key factor: considerable acceleration of development & production.
CURRENT BMW GROUP PLUG-IN HYBRID & BATTERY ELECTRIC APPROACH.

**PHEV (Plug-in Hybrid Electric Vehicle)**

- **PHEV with coaxial hybrid system**
  (BMW 740e, 330e, X5 40e, ...)

- **PHEV with electric drive axle**
  (BMW i8, 225xe, X1 CN, ...)

**BEV (Battery Electric Vehicle)**

- **BEV (with REX*)**
  (BMW i3)

* *REX (Range extender) optional.*

**Legend:**
- **C** Charger
- **Combustion engine**
- **HV-B** High-Voltage Battery
- **G** Generator
- **I** Inverter
- **EM** E-Motor
- **Power path**
BMW GROUP BEV AND PHEV E-POWERTRAIN COMPONENTS.

<table>
<thead>
<tr>
<th>BMW i3</th>
<th>BMW i8</th>
<th>BMW X5 xDrive 40e</th>
<th>BMW 330e</th>
<th>BMW 740e</th>
<th>BMW 225xe</th>
<th>BMW X1 CN</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Power Electronics" /></td>
<td><img src="image2" alt="Power Electronics" /></td>
<td><img src="image3" alt="Power Electronics" /></td>
<td><img src="image4" alt="Power Electronics" /></td>
<td><img src="image5" alt="Power Electronics" /></td>
<td><img src="image6" alt="Power Electronics" /></td>
<td><img src="image7" alt="Power Electronics" /></td>
</tr>
<tr>
<td><img src="image8" alt="E-Machine" /></td>
<td><img src="image9" alt="E-Machine" /></td>
<td><img src="image10" alt="E-Machine" /></td>
<td><img src="image11" alt="E-Machine" /></td>
<td><img src="image12" alt="E-Machine" /></td>
<td><img src="image13" alt="E-Machine" /></td>
<td><img src="image14" alt="E-Machine" /></td>
</tr>
<tr>
<td><img src="image15" alt="HV Battery" /></td>
<td><img src="image16" alt="HV Battery" /></td>
<td><img src="image17" alt="HV Battery" /></td>
<td><img src="image18" alt="HV Battery" /></td>
<td><img src="image19" alt="HV Battery" /></td>
<td><img src="image20" alt="HV Battery" /></td>
<td><img src="image21" alt="HV Battery" /></td>
</tr>
</tbody>
</table>
BENEFITS HIGH INTEGRATION. FUTURE GENERATION OF E-POWERTRAIN.
ENERGY DENSITY HAS AN IMPORTANT ROLE IN THE SUCCESS OF ELECTRIC MOBILITY.

<table>
<thead>
<tr>
<th>Combustion engine</th>
<th>Electric powertrain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Efficiency [%]</strong></td>
<td><strong>Efficiency [%]</strong></td>
</tr>
<tr>
<td>Movement</td>
<td>&gt; 90 %</td>
</tr>
<tr>
<td>Emission</td>
<td></td>
</tr>
<tr>
<td>Loss</td>
<td>Loss &lt; 10%</td>
</tr>
<tr>
<td><strong>33%</strong></td>
<td><strong>33%</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Energy density [Wh/l]</strong></th>
<th><strong>Energy density [Wh/l]</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>~10000</td>
<td>~ 9000</td>
</tr>
<tr>
<td><strong>Diesel</strong></td>
<td><strong>Petrol</strong></td>
</tr>
<tr>
<td>&lt; 500</td>
<td></td>
</tr>
<tr>
<td><strong>cell</strong></td>
<td></td>
</tr>
</tbody>
</table>
CHALLENGE TO FULFIL ALL REQUIREMENTS. FROM BATTERY PACK LEVEL TO ACTIVE MATERIAL PROPERTIES.

- Peak Power
- Energy Density
- Temperature Performance
- Specific Energy
- Charge Current
- Lifetime
- Cost
- Safety

**BMW Claim** "Best in Class"

Main technical Target

Anode
Separator
Cathode
BMW GROUP STRATEGY: GLOBAL NETWORK AND IN-HOUSE RESEARCH.

Universities
- TU München
- ZSW Ulm
- Uni Münster
- Hanyang Uni Seoul
- Tsinghua Uni Beijing
- Nanyang Uni Singapore
- Argonne National Lab
- MIT
- Wildcat Discovery

Institutes

Start-Ups

TU München
ZSW Ulm
Uni Münster
Hanyang Uni Seoul
Tsinghua Uni Beijing
Nanyang Uni Singapore
Argonne National Lab
MIT
Wildcat Discovery

...
MATERIAL DEVELOPMENT AND CELL ROADMAP.

<table>
<thead>
<tr>
<th>Energy Density</th>
<th>Cell Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Today</td>
<td></td>
</tr>
<tr>
<td>NCM 111/C</td>
<td></td>
</tr>
<tr>
<td>Li-Ion Optimization</td>
<td></td>
</tr>
<tr>
<td>NCM 622/C</td>
<td>NCM 811/C</td>
</tr>
<tr>
<td>NCM 811/Si-C</td>
<td></td>
</tr>
<tr>
<td>&gt; 2018</td>
<td>&gt; 2021</td>
</tr>
<tr>
<td>&gt; 2024</td>
<td>&gt; 2026</td>
</tr>
</tbody>
</table>

All Solid State solid state electrolyte

Research II  Pre-development II  Series development II

Research I  Pre-development I  Series development I

ca. 10 years

NCM: Nickel, Cobalt, Manganese
PRODUCTION NETWORK WITH STRATEGIC EXTENSION OPTIONS ON THREE CONTINENTS.

- **SPARTANBURG**: High-voltage battery for NAFTA
- **LANDSHUT**: Electric machine
- **DINGOLFING** (lead plant): High-voltage batteries for ECE, Electric machine for global plants
- **SHENYANG**: High-voltage battery for China
- **RAYONG**: Final assembly PHEV
- **Munich**: Planning and technology development, electric powertrain, Prototype electric machine, High-voltage battery, Battery cell, Fuel cell
“Flexible response and speed“ in adaptive production system

Volume induced capacity

- **Reaction time < 12 months**
  - Doubling production capacity until peak-quantity

- **Minimal initial investment**
  - Scalability with manual specification

- **Reduction of manufacturing costs and investments**
  - Compared to predecessor

- **Significant cost reduction**
  - Electric machine & High-voltage battery