Future Challenges for Automotive Power Electronics: An Industry Perspective

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Power Electronics Spoke Launch Event
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Structure

- UK economy
- Market value
- Trends
- Challenges and opportunities
- Conclusions
Best year in a decade for British car manufacturing as exports reach record high

British manufacturers made more cars in 2015 than any year since 2005 when 1,595,697 vehicles were produced. Production increased 3.9% on 2014, with output at 1,587,677 overtaking pre-recession levels for the first time.

Ref: www.SMMT.co.uk Posted at 00:01 on 21 January 2016.
Across the value chain:

- Materials
- Components
- Power system
  - Invertors, drives and convertors
- Applications

USD 200+ bn is the expected value of the power electronics market by 2018. Industry currently accounts for about a third of this market, automotive for a quarter - but automotive is set to take over as the key sector.

By 2020 automotive players in all regions must dramatically step up their investment in electric technology to meet upcoming emissions and fuel efficiency targets driven by regulatory changes.

Ref: Roland Berger, titled 'Powering Ahead: developments in power electronics mean a prospective bonanza for smart players the strategy
Tougher emissions regulations will encourage OEMs to invest in e-mobility.

<table>
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<tr>
<th>CO₂ reduction</th>
<th>Corresponding fleet targets</th>
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<td>95 (3.9)</td>
<td>80 (3.3)</td>
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<tr>
<td>50%</td>
<td>70 (2.9)</td>
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1 Anticipated for 2020, average for gasoline and diesel internal combustion engines
2 Relative to 2010 baseline
SOURCE: ICCT; McKinsey
Industry Driver - Trends

As More Proof Shows Oil Prices Aren’t Killing EV Sales, Carlos Ghosn Predicts a Rosy Future for Plug-Ins

Electric Cars are Losing the ‘Battle’ to Low Oil Prices

With no end in sight to bargain-basement fuel, sales of electric and hybrid vehicles have stalled.

Charging points for Electric vehicles - Trends

CHARGE POINT TYPES

There are four main EV charging types:
- Slow (up to 3kW) which is best suited for 6-8 hours overnight;
- Fast (7-22kW) which can fully recharge some models in 3-4 hours;
- and Rapid AC and DC (43-50kW) which are able to provide an 80% charge in around 30 minutes.

ZAP STATS – 15 FEB 2016

- 10353 CONNECTORS
- 3833 LOCATIONS
- 1905 RAPID CONNECTORS
- 191 LAST 30 DAYS

Ref: https://www.zap-map.com
Power Electronic interfaces: Future cities


• Industry 4.0 –
  • Moving towards digital manufacturing
  • Factory of the future

Ref: Roland Berger, titled ‘Powering Ahead: developments in power electronics mean a prospective bonanza for smart players the strategy’
The BIS report “Power Electronics: A Strategy for Success” identified 3 cross industry issue:

- Disruptive technologies
- A deep-routed skills shortage
- Lack of strategic funding that stifled innovation particularly in SMEs and start-ups

The BIS report goes on to propose 5 challenges:

- Lack of cohesion and representation
- UK needs to be an exemplar low-energy/low carbon economy
- Ensure the UK remains at the forefront of Innovative PE design and manufacture
- To ensure a good supply of talented PE engineers
- To improve access and exchange of leading technology
Challenges and Opportunities

● Reversal in the “hollowing out of the supply chain” – Moving towards UK “local sourcing content”
● Established companies in market should focus on:
  ● Improving customer intimacy
  ● Maintaining a technological lead
  ● Keeping costs low
● Concurrent R&D, design and manufacture
● More system thinking integrated approach
  ● Partnerships, co-development
  ● Across OEMs, supply chain and Universities
Power electronics roadmap

- **High power density inverters**
  - 11kW/kg + 9kW/l
  - 12kW/kg + 12kW/l
  - 14kW/kg + 13kW/l

- **Low cost inverters**
  - 7.9$/kW
  - 5$/kW
  - 3.3$/kW

- **High temp inverters**
  - ~90°C
  - >150°C

- **IGBT(SiC/GaN/SiC) drive**

- **Power electronics monitoring**

- **Autotuning invertors**

- **Resonant convertors**

- **PE system level integration**

- **Integration of invertors & motors**

- **Integration of DC/DC & chargers**

- **Prototype**

- **Production**

Source: Automotive Council Technology Group 2013
Crossing the "Valley of death"
Crossing the “Valley of death”
Conclusions

● UK Automotive is successful
● External factor affecting industry:
  • Legislation CO², fluctuations in the price of oil
● Some of the trends
● Challenges and opportunities
Questions