The Roadmap to an Electrified Car Market

How will Targets for the End of the Combustion Engine be Met?

Al Bedwell, LMC Automotive

LBMA/LPPM Precious Metals Conference Barcelona, October 16, 2017
• European Electrification in a Global Context

• What’s Driving Change in Europe

• Update on Current Situation

• Outlook

• Wrapping Up
• BEVs in use were just 0.1% of pass cars & US light in 2016 (1mn of 1bn)
• After 10+ years of sales, only Japan has really embraced electrification
• China is unique due to 50% BEV share of electrified sales
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Europe

- UK: 2040, no IC-only car sales; Oxford 2020?
- France: 2040, no IC car sales (?); Paris 2030
- Germany: No date; says UK/FR approach is ‘right’
- Norway: No ban, but sales by 2025 ‘should be ZEV’
- Austria, Denmark, Ireland, Netherlands, Portugal, Spain: EV targets

Elsewhere

- India: 2030, all passenger cars to be battery electric (!?)
- Japan, Korea: No ban, EV targets set
- China: Studying timeline to IC ban
- US: No nationwide target, some states have EV targets
• CO₂ fell less sharply in 2016: SUV boom & falling diesel share?

• Post-2021 target announcement may be imminent

International comparison:
- China 2025 gm/km CO₂: 93
- US 2025 gm/km CO₂: 100
Europe: A Move from Diesel to Electric?

W. Europe Passenger Cars: Diesel versus Electrification

- Diesel decline started in 2011 but accelerated after the VW problems
- Much diesel is being substituted by gasoline, but also by HEV (not by BEV)
- Share of all electrified types reached 5.7% in July of this year
Europe: The Pressure on Diesel Keeps Building

Stuttgart to begin selective banning of diesel cars 21/2/17

High court rules UK plans to tackle air pollution are illegal 2/11/16

Diesel vehicles will disappear sooner than expected says EU industry chief 4/4/17

Sadiq Khan warns diesel cars could be banned in London 20/2/17

Drivers of older diesel cars to be charged extra £10 to enter London 17/2/17

Diesel ban in Munich one step closer after court decision 1/3/17

VW, PSA, FCA & Renault to be referred to prosecutors in Europe over diesel

Madrid vows to ban diesel-fuelled cars by 2025 2/12/16

Paris to phase out diesel cars by 2024 Olympics 12/10/17
Europe: More Pain for the Diesel Car Market

Diesel Market Evolution: W. Europe Cars, Base Case

- Nervousness about investing in diesel is growing (for OEM and car buyer)
- But core strengths of diesel mean it will endure at least in some segments
Europe: Those Pesky Car Buyers Keep Choosing SUVs

- The shift to crossover types seems relentless and has an impact on CO₂
- Example: Kia Stonic 1.4 gas MT has FE/CO₂ 10% worse than Rio 1.4L MT
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Share reached a new peak in recent times on strong FHEV demand.

But for most car buyers the *plug-in* offer simply isn’t compelling (yet).
• Transparent incentive schemes that mitigate higher prices work best
• Inconsistent/poorly communicated ones = boom & bust/little impact

Electrified % of New Car Sales

Norway hybrid/EV

Circa 50%

Germany hybrid/EV

Aug-17: 3.5%

Source: LMC Automotive Global Hybrid & EV Forecast

Europe: Well Structured Incentives = Solid Growth
Europe: Support for Plug-ins Varies Hugely

Electrified Sales by Market & Macro-Type, YTD Aug 2017

- SP + IT: Weak infrastructure, unstable incentives = low plug-in sales
- Norway’s big incentives lead, but only ZEV schemes will endure

Source: LMC Automotive Global Hybrid & EV Forecast
• Hyundai has hits with the Niro & Ioniq (but hard to make money)
• VW has seen its electrified share fall further this year
Europe: Few new BEVs, but Current ones Improving
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## Europe: OEMs are Racing to Meet Expected Demand

<table>
<thead>
<tr>
<th>OEM</th>
<th>Strategy Overview</th>
<th>HEV + BEV</th>
<th>BEV</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMW group</td>
<td>15-25% of sales electrified by 2025. Mix of standalone &amp; bespoke BEVs</td>
<td>??</td>
<td>12 by 2025</td>
</tr>
<tr>
<td>Daimler</td>
<td>Electrified versions of all M-B range by 2022, Smart all BEV 'at some point'</td>
<td>50 by 2022</td>
<td>&gt;10 by 2022</td>
</tr>
<tr>
<td>FCA</td>
<td>Half of FCA fleet electrified by 2022</td>
<td>50% by 2022</td>
<td>??</td>
</tr>
<tr>
<td>Ford</td>
<td>13 new electrified vehicles globally in next 5 years</td>
<td>13 by 2022</td>
<td>1st dedicated BEV 2020</td>
</tr>
<tr>
<td>Hyundai-Kia</td>
<td>Electrify core models, plus standalone BEVs</td>
<td>31 by 2020</td>
<td>8 by 2020</td>
</tr>
<tr>
<td>JLR</td>
<td>New models all hybrid or EV from 2020</td>
<td></td>
<td>At least 1 by 2020</td>
</tr>
<tr>
<td>PSA</td>
<td>Electrify core models, no standalone BEVs</td>
<td>11 by 2023</td>
<td>4 by 2023</td>
</tr>
<tr>
<td>R-N</td>
<td>New common electrified electrified platforms</td>
<td></td>
<td>12 ZEV by 2022</td>
</tr>
<tr>
<td>Toyota</td>
<td>Hybrid remains core tech, BEV mass production from 2020</td>
<td></td>
<td>Several by 2020</td>
</tr>
<tr>
<td>Volvo</td>
<td>All new models hybrid or EV from 2019, no IC-only by circa 2024</td>
<td>80 by 2025</td>
<td>5 by 2021</td>
</tr>
<tr>
<td>VW</td>
<td>At least 1 electrified version of all models by 2030</td>
<td></td>
<td>50 by 2025</td>
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</tbody>
</table>

Minimum 100 new BEVs by 2025
Europe: ....and so are Others
• **Claimed** range of mass market cars rose by average 40% for 2017MY
• Battery pack wholesale cost is reckoned to be circa $200/kWh in 2017
• Battery cost dropped 80% over 6 years, $100/kWh possible by 2020?
• Charge point infrastructure problems include investment & grid issues
• New generation hybrids start to achieve real volume from 2018
• BEVs accelerate from mid-2020s, reaching 15% of market by 2027
• Fuel cells remain niche over *this* time period
• IC-only disappears well before 2040!
• FCEV gets in to the picture
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NEV ‘cap and trade’ scheme will be introduced from 2019 after a 1 year delay.

OEMs will have to achieve a NEV score of 10 points in 2019, 12 in 2020.

OEMs selling at least 30,000 cars will have to comply, buy credits or face fines.

Source: LMC Automotive
China: NEV - Traditional OEMs

- Traditional giants continue to lead the market, and occupy more than 90% market share
- China OEM vs. Global OEM

China OEM:
- Geely
- BYD
- BAIC
- SAIC
- JAC & JMC

Global OEM:
- VW
- GM
- Renault-Nissan
- Volvo
- Mercedes-Benz & BMW

VW, 15k/Y
Toyota: 8k/Y
BMW, 15k/Y
BAIC, 240k/Y
Hyundai, 15k/Y
Mercedes, 8k/Y
SAIC, 140k/Y
VW, 50k/Y
GM, 50k/Y
Geely, 200k/Y
Lynk, 15k/Y
Volvo, 15k/Y
BYD: 250k/Y
GAC: 140k/Y
Toyota: 15k/Y

Traditional giants continue to lead the market, and occupy more than 90% market share.

China OEM vs. Global OEM
Sanmenxia: Suda, ¥2.65 (Bn.), 100k/Y

Lanzhou: Zhidou, ¥0.89 (Bn.), 40k/Y

Chongqing: Jinkang, ¥2.51 (Bn.), 50k/Y

Shijiazhuang: Chery, ¥3 (Bn.), ?k/Y

Qingdao: BJ EV, ¥1.15 (Bn.), 50k/Y

Huai’an: Min’an, ¥2.50 (Bn.), 50k/Y

Suzhou: Qiantu, ¥2.02 (Bn.), 50k/Y

Changzhou: BJ EV, ¥10 (Bn.), 400k/Y

Wuhu: Chery, ¥2.05 (Bn.), 85k/Y

Jiaxing: Hozon, ¥0.97 (Bn.), 50k/Y

Hangzhou: Changjiang, ¥0.80 (Bn.), 50k/Y

Hangzhou: Wanxiang, ¥2.75 (Bn.), 50k/Y

Nanchang: Jiangling, ¥1.33 (Bn.), 50k/Y

Jiujiang: BJ EV, ¥14.0 (Bn.), 10k/Y

Putian: Yudo, ¥1.89 (Bn.), 65k/Y

Beijing: BJ EV, ¥1.15 (Bn.), 20k/Y

Tianjin: NEVS, ¥4.27 (Bn.), 50k/Y

- In construction or in planning
China: NEV - New Players (Applying)

- **Nanjing:** Bordrin, ¥10 (Bn.), 100k/Y
- **Nanjing:** FMC, ¥11.6 (Bn.), 300k/Y
- **Wuxi:** Yogomo, ¥3 (Bn.), 150k/Y
- **Changzhou:** Chehejia, ¥5 (Bn.), 300k/Y
- **Wuhan:** NextEV, ¥30 (Bn.), 200k/Y
- **Wuhu:** Zhiche, ¥3 (Bn.), 100k/Y
- **Deqing:** LeSee, ¥20 (Bn.), 400k/Y
- **Huzhou:** Youxia, ¥11.5 (Bn.), 200k/Y
- **Wenzhou:** VM Motor, ¥6.7 (Bn.), 200k/Y
- **Jinhua:** Leap Motor, ¥2.5 (Bn.), 50k/Y
- **Ganzhou:** Sinomach, ¥8.0 (Bn.), 100k/Y
- **Shangrao:** AICEV, ¥13.3 (Bn.), 150k/Y
- **Zhaoqing:** Xpeng, ¥10 (Bn.), 10k/Y
Outlook for Electrification by Technology

World Passenger Cars & US Light Trucks

- **Mild hybrid with 48V** becomes the leading electrified technology
- **10%** of global car sales are BEV in 2027: 10mn vehicles
- **We think FCEV** is coming but remains is a technology for the 2030s

Source: LMC Automotive Global Hybrid & EV Forecast
## Wrapping Up

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<th>Risk</th>
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<td><strong>Risk</strong></td>
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<tr>
<td>Battery EVs will be a viable mass market alternative to conventional IC by mid-next decade</td>
<td>Charging infrastructure does not roll out as expected – home charging will dominate, but public network needed</td>
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<tr>
<td><strong>MHEV</strong></td>
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<td><strong>Energy</strong></td>
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Focused  >  Smart  >  Responsive  >  Flexible

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