AUTOMOTIVE

E-Mobility

The Impact of Connectivity/Autonomous Driving on Electric Vehicles

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Addressing the Issues and Opportunities that Drive the Industry
Understanding Levels of Autonomy

**Automated or Cooperative Driving**

- **L1**
  - Automation of single function

- **L2**
  - Automation of 2+ function

- **L3**
  - Limited self-driving automation

- **L4**
  - Self-drive or Human-drive

- **L5**
  - Self-drive only

**Vehicle Ownership**

- **L3 Limited Self-Drive**
  - Assumed as interim solution for testing and refining tech in “limited” real-life conditions
  - *Ex: next-generation of Mercedes, Volvo, Tesla*

- **L4 Self-Drive or Human-Drive**
  - Assumed to be variants of existing vehicle models which generally are already part of core IHS forecasts
  - Autonomous function initially restricted to limited situations

- **L5 Self-Drive Only**
  - No steering controls
  - Geo-fenced and speed-limited to certain urban areas
  - New form of public transit, hence competes beyond passenger cars
  - Impact upon market is treated as incremental opportunity
Autonomous Vehicle Deployment – Sizing at a Glance

L4 + L5 Autonomous Vehicle Volume

\[ \text{L4 + L5 Autonomous Vehicle Volume} = \] \text{Current Total Passenger Vehicle Volume} \]

Market impact split between:
1. **Current** forecast volumes ("replacement" or "optional" technology) and
2. New incremental volume **beyond current** passenger vehicle forecast
Car-based Urban Mobility Reshaping Transportation

Past
- Taxi
- Rental

Owner / Driver

Present
- Taxi
- Ride Sharing
- Rental
- Car Sharing

Owner / Driver

Future
- Autonomous On-Demand Mobility Network

Owner / Driver
Automation Evolving

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L0</td>
<td>No Automation</td>
</tr>
<tr>
<td>L1</td>
<td>Single Function Control</td>
</tr>
<tr>
<td>L2</td>
<td>Multiple Function Control</td>
</tr>
<tr>
<td>L3</td>
<td>Limited Autonomy</td>
</tr>
<tr>
<td>L4</td>
<td>Full Autonomy</td>
</tr>
<tr>
<td>L5</td>
<td>Driverless Autonomy Only</td>
</tr>
</tbody>
</table>

Based on NHTSA Levels of Automation
NHTSA Level 4 comprised of IHS Levels 4+5

Increasing Efficiency via Automation

Strongest operational efficiency incentive for BEVs
Autonomous Driving Causes Disruption

Autonomous Cars will cause massive disruption in the automotive market, especially on powertrains. AD, BEVs and Wireless Charging marry together. Disruption opens up the market.

Many Automaker Start Ups → Atieva, Faraday Future, NextEV, LeEco, Tesla... Focussing on ‘high tech’ (Autonomous Driving, Electric Powertrain, Software, UI/UX...).

ICE was a barrier to new competition, very high entry costs. Shift towards alternative propulsion, CO₂ & Emissions Targets.

The key is targeting the premium BEV sector. Tesla proved these vehicles sell.

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Case Study: Why is Apple Looking at the Auto Industry?

Looking for other markets to expand into:
2015 Revenues: $234B
iPhone Growth Slowing, Limited current product growth
Apple need BIG opportunities to grow

Auto Industry
Auto Sales: $3,000B+ (slow growth)
Auto content value: $20B+ (growing very fast)
Transportation: $5,000B+ (new growth opportunities)

Changes in the Automotive Market:
Becoming Software-Centric (Apple Strength)
Becoming Connection-Centric (Apple Strength)
BEV lowers entry barriers (Apple Opportunity)
New Business Models: CaaS (Disruptive Opportunity)

BEV = Battery Electric Vehicle
Case Study: Why is Apple Looking at the Auto Industry?

What are the possible Apple Product Scenarios?

**BEV Strategy 2020**
- Luxury Self-Driving Car connected and leveraging Apple products
- Apple Hardware & Software designed

**BEV & Self-Driving Car 2025**
- Luxury Driverless Car connected and leveraging Apple products
- Apple Hardware & Software designed

**BEV Far Out Strategy 2030**
- Luxury Driverless Car Local Manufacturing (3D Printing?)
- Apple Hardware & Software designed

BEV = Battery Electric Vehicle
Summary

• 5 Levels of Autonomy – L3 is the interim for testing and refining, L4/L5 is when the car can drive itself without the need for human input.

• Forecasts
  • 2025 is when we will start to see L4/L5 vehicles on the road.
  • In 2035, IHS Markit estimates that there will be ~20 million L4/L5 cars sold which is ~32% of new vehicle sales.
  • In Western Europe, it will take until 2040 before >50% of vehicles are L4/L5.

• Car-based Urban Mobility is reshaping transportation. Moving towards an Autonomous On-Demand Mobility Network (Car as a Service) and away from traditional car ownership.

• Autonomous Driving will cause disruption in the market. L5 Autonomous Driving presents the strongest operational efficiency for battery electric vehicles (and wireless charging).

• Disruption opens up the market to new players, new start-ups. Big opportunities – possible Apple scenarios.
Thank you for listening

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