Bringing a New car to Market 5a

Regulatory Compliance
Battery Electric Vehicles

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Steps in Bringing a New Car to Market

Introduction

A little history

Automobile industry

Product Planning-Market Analysis & Identification of Opportunities

Understand market trends, consumer preferences, emerging technologies and government regulations

Analyze competitors - identify gaps in the market for new car

Concept and Design

Translate market insights into conceptual ideas for a new car

Collaborate with design teams and engineers to develop innovative and appealing vehicle concepts

Engineering and Development

Design the vehicle - safety, performance, and efficiency

Extensive testing - prototype testing, crash testing, emissions testing and performance testing

Address any design or engineering challenges that arise during the development phase

Regulatory Compliance

Demonstrate safety , emissions, mileage compliance

Certify models' configurations

BEV mandates

Manufacturing Planning:

Manufacturing plan - consider production volume, assembly processes, and quality control

Identify component suppliers establish partnerships

Set up manufacturing facilities and production lines

Production and Quality Control:

Begin production - ensure adherence to quality standards and specifications

Implement quality control measures - identify and address manufacturing defects

Conduct pre-launch inspections and testing - guarantee the reliability and safety of the vehicles

Launch and Distribution

Marketing campaigns to generate excitement and drive sale

Coordinate with dealerships and distributors to ensure a smooth rollout

Monitor customer feedback - address post-launch issues

U.S. Automobile Regulatory Agencies

- **National Traffic and Motor Vehicle Safety Act (1966):**
- This landmark legislation was passed in response to increasing concerns about automobile safety
- It established the **National Highway Traffic Safety Administration (NHTSA)** within the **Department of Transportation** and gave it the authority to set safety standards for motor vehicles and highways

- **Clean Air Act (1970) and EPA:**
- The Clean Air Act, passed in 1970, gave the **Environmental Protection Agency (EPA)** authority to regulate vehicle emissions
- This led to the implementation of emission standards for automobiles to reduce air pollution

- The **Clean Air Act** requires that all engines and vehicles be covered by a **certificate of conformity** before they can enter the market
- The **certificate of conformity** is based on the data developed during specified emissions test procedures
- A **certificate of conformity** demonstrates that the respective engine or vehicle conforms to all the applicable emission requirements for the model year

- **Corporate Average Fuel Economy (CAFE) Standards:**
- In response to the oil crises of the 1970s, Congress enacted the **Energy Policy and Conservation Act of 1975**, which established fuel economy standards for automobiles
- These standards, administered by the **NHTSA,** require automakers to meet certain fuel efficiency targets for their fleet of vehicles

Foreign Automobile Regulatory Agencies

- **European Commission**:
- Oversees the development and enforcement of regulations related to vehicle safety, emissions, fuel efficiency, and consumer protection within the **European Union**
- **Ministry of Land, Infrastructure, Transport and Tourism (MLIT)**:
- Responsible for regulating transportation, including automotive safety and emissions standards, in **Japan**

- **Ministry of Industry and Information Technology (MIIT)**:
- Sets regulations and standards for the automotive industry in **China**, including vehicle safety, emissions, and production
- **Ministry of Road Transport and Highways (MoRTH)**:
- Sets regulations related to road transport, including vehicle safety standards and emissions regulations, in **India**

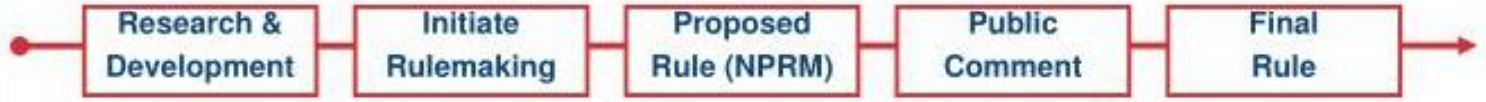
Rulemaking

NHTSA is responsible for developing Federal Motor Vehicle Safety Standards (FMVSS), regulations that establish standards for vehicle safety, fuel economy, and theft prevention. Both these standards and the processes used to establish them must be:

- **U.S. Safety Standards must:**
  - **Meet a safety need**
  - **Be technologically and economically practicable**
  - **Objectively measure compliance**
  - **Be performance-oriented (vs. design restrictive)**
  - **Be appropriate for each vehicle type**
- **Sources of Rulemaking Action:**
  - **Legislation**
  - **Public Petition**
  - **Crash-Data Analysis**
  - **Technology Changes**
  - **International Standards**
  - **Voluntary Standards**
  - **Compliance Issues**

NHTSA Rulemaking

- U.S. Rulemaking Process:



- Initiate / Preliminary Notice
  - At the beginning of the process, a preliminary notice requests information about the problem and solicits suggestions for regulatory solutions.
- Notice of Proposed Rulemaking
  - The NPRM explains the basis for the proposed effective date, seeks public comment within a set period, and may ask about alternative solutions.
- Public Comment
  - The public may provide additional information on compliance issues, suggest changes, or challenge the agency's analyses, assumptions, or policy choices.
- Final Rule
  - Explains the agency's acceptance or rejection of each significant comment, describes changes made, and explains choices among regulatory approaches.

Enforcement

NHTSA's Enforcement activities are legislatively supported by The National Traffic and Motor Vehicle Safety Act and center on upholding the following basic principles:

- **Self-Certification:** Manufacturers must certify that their vehicles and equipment comply with the appropriate FMVSS.
- **Prohibition:** A person may not manufacture for sale, offer for sale, introduce into commerce, or import noncompliant vehicles or equipment
- **Duty to Recall:** Manufacturers must recall (i.e., notify owners and provide remedy for all affected vehicles or equipment) if it learns of a safety defect or noncompliance, or if NHTSA decides there is a defect on noncompliance.
- **Importers are manufacturers:** Per statutory definition.

Fully compliant vehicles or equipment may contain safety defects.

Crashworthiness & Crash Avoidance

The Vehicle Safety Research division's works to foster promising new technologies and to improve the performance of existing systems.

Crashworthiness strives to reduce the severity and increase the survivability of a crash. Areas of study include:

- Roof Crush
- Vehicle Compatibility
- Rollover Mitigation
- Advanced Restraints
- Ejection Mitigation
- Motorcoach / School Bus Safety

Crash Avoidance technologies are designed to increase vehicle's ability to avoid crashes. Areas of study include:

- Electronic Stability Control
- Lane Departure Warning
- Adaptive Cruise Control
- Blind Spot Detection
- Night Vision
- Active Braking

NHTSA Regulations Current

- **Airbags**
- Mandatory in 1999 for all Passenger Cars, Light Trucks, and Vans (Front Seat)
- **Antilock Brakes**
- Mandatory in 2000 for All New Passenger Cars
- **Backup Camera**
- Mandatory in 2018 on All Passenger Cars, Light Trucks, and Vans
- **Electronic Stability Control**
- Mandatory in 2012 on All Passenger Cars
- **Safety Belts**
- Mandatory in 1968 for All Passenger Cars
- **LATCH (Lower Anchors and Tethers for Children)**
- Mandatory in 2002 for All Passenger Cars
- **Traction Control**
- Mandatory in 2011 on All Passenger Cars
- **Automatic Emergency Braking**
- Mandatory in 2029 in cars and light trucks

NHTSA Regulations Future?

- April 29, 2024 | Washington, DC
- Starting in 2029, vehicle manufacturers must make **automatic emergency braking**, which reduces vehicle and pedestrian crashes, standard in cars and light trucks
  - Making this safety feature standard is part of NHTSA's National Roadway Safety Strategy

- **Blind-Spot Monitoring (BSM)**
- **Forward Collision Warning (FCW)**
- **Intersection Turn Assistance (ITA)**
- **Lane-Centering Assist (LCA)**
- **Lane-Departure Warning (LDW)**
- **Pedestrian Detection**
- **Rear Automatic Emergency Braking (RAEB)**
- **Rear Cross-Traffic Alert (RCTW)**
- **Semi-Autonomous Driving**
- **Autonomous Driving**

Regulatory Compliance

- Most countries have regulations for automotive vehicles
- **Safety Standards**:
- Crashworthiness, occupant protection, braking systems, lighting, and electronic stability control
- Standards such as **Euro NCAP** in Europe and **NHTSA** in the United States set crash-test protocols and safety ratings
- **Emissions Standards**:
- Limit the total pollutants emitted by vehicles, including carbon monoxide, nitrogen oxides, particulate matter, and greenhouse gases
- They can **force** the use of alternative fuels or electrical propulsion

- **Fuel Efficiency Standards**:
- Governments set fuel economy standards to reduce reliance on fossil fuels
- These regulations typically require car manufacturers to improve the **average fuel efficiency** of their fleets over time, often through technological advancements
- **Noise Regulations:**
- Regulations may limit the amount of noise that vehicles can emit to reduce environmental noise pollution
- This includes regulations on exhaust noise, tire noise, and vehicle interior noise levels

Regulatory Compliance

- **Vehicle Certification and Testing**:
- Manufacturers must comply with certification and testing requirements to ensure that their vehicles meet regulatory standards before they can be sold in a particular market
- This includes **emissions testing**, **safety testing**, and compliance with specific technical standards

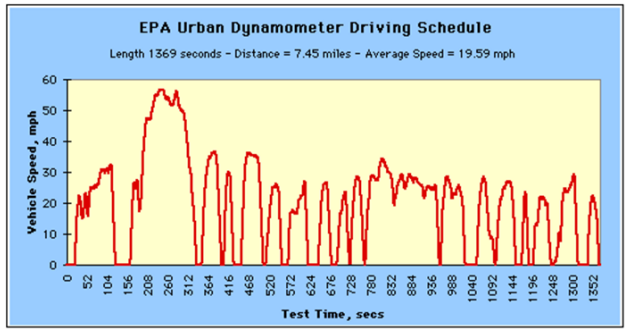
- **Recall and Reporting Requirements**:
- Manufacturers are often required to **report safety-related defects** and conduct recalls if necessary to address issues that pose a risk to public safety
- Regulatory agencies oversee these processes and may impose fines or other penalties for non-compliance

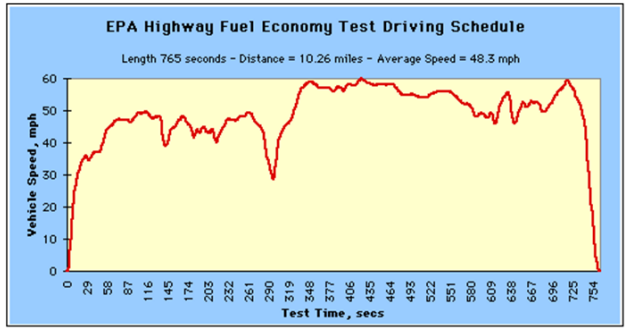
- **Consumer Protection Regulations**:
- Regulations may cover areas such as advertising, warranties, and lemon laws to protect consumers from unfair or deceptive practices in the automotive industry

Regulatory Compliance

Vehicle Emissions Testing

- The **Clean Air Act**
- Cars and light trucks are tested on a chassis dynamometer simulates the operation of a vehicle on the road
- The vehicle being tested drives on the rollers, connected to an electric motor, which simulate the speed and resistance of an actual road
- Chemical analyzers measure compounds from the vehicle exhaust
- To evaluate exhaust emissions and fuel economy performance in a way that is accurate and repeatable, vehicles are driven on the dynamometer over **standard test cycles-** urban and highway
- Simulate urban driving and highway driving
- All the cars are driving the exact same way for our tests
- Evaporative emissions of **volatile organic compounds (VOCs)** from parked vehicles are measured using a **sealed housing emissions device (SHED)**





Regulatory Compliance Federal Motor Vehicle Safety Standards (FMVSS)

- **Federal Motor Vehicle Safety Standards** (**FMVSS**) specify design, construction, performance, and durability requirements for motor vehicles
- The first regulation, FMVSS No. 209, was adopted on March 1,1967 and stipulates the requirements for **seat belts** in roadgoing vehicles.
- **FMVSS** are divided into three categories:
- **Crash avoidance** (100-series),
- **Crashworthiness** (200-series),
- **Post-crash survivability** (300-series)

101 Controls and Displays
102 Transmission Shift Position Sequence, Starter Interlock, and Transmission Braking Effect
103 Windshield Defrosting and Defogging Systems
104 Windshield Wiping and Washing Systems
105 Hydraulic and Electric Brake Systems
106 Brake Hoses
108 Lamps, Reflective Devices, and Associated Equipment
110 Tire Selection and Rims for Motor Vehicles with a GVWR of 4,536 kg (10,000 lbs.) or Less
111 Rearview Mirrors
113 Hood Latch System
114 Theft Protection and Rollaway Prevention
116 Motor Vehicle Brake Fluids
118 Power-Operated Window, Partition, and Roof Panel Systems
119 New Pneumatic Tires for Motor Vehicles with a GVWR of more than 4,536 kg (10,000 lbs.)
120 Tire Selection and Rims for Motor Vehicles with a GVWR of more than 4,536 kg (10,000 lbs.)
121 Air Brake Systems
124 Accelerator Control Systems
125 Warning Devices
126 Electronic Stability Control Systems
131 School Bus Pedestrian Safety Devices
135 Light Vehicle Brake Systems
136 Electronic Stability Control Systems for Heavy Vehicles
138 Tire Pressure Monitoring Systems
139 New Pneumatic Radial Tires for Light Vehicles
141 Minimum Sound Requirements for Hybrid and Electric Vehicles

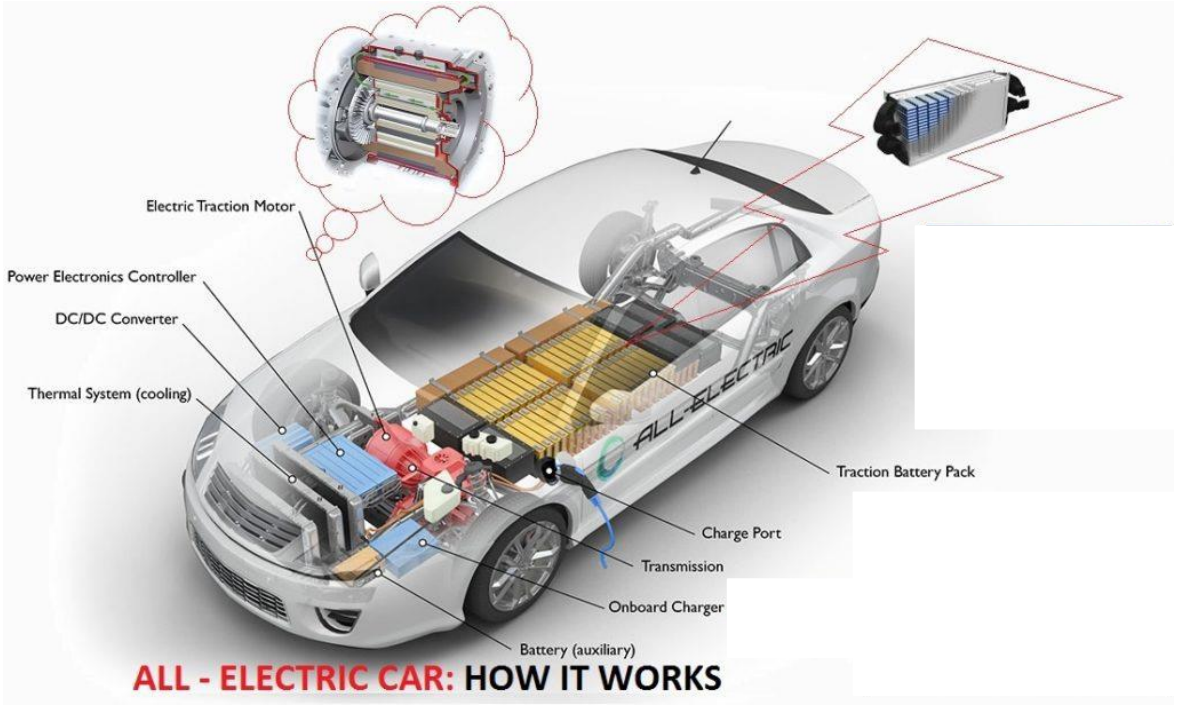
Regulatory Compliance Federal Motor Vehicle Safety Standards (FMVSS)

201 Occupant Protection in Interior Impact
202a Head Restraints
203 Impact Protection for the Driver from the Steering Control System
204 Steering Control Rearward Displacement
205 Glazing Materials
206 Door Locks and Door Retention Components
207 Seating Systems
208 Occupant Crash Protection
209 Seat Belt Assemblies
210 Seat Belt Assembly Anchorages
212 Windshield Mounting
213 Child Restraint Systems
214 Side Impact Protection
216a Roof Crush Resistance Upgraded Standard
217 Bus Emergency Exits and Window Retention and Release
219 Windshield Zone Intrusion
220 School Bus Rollover Protection
221 School Bus Body Joint Strength
222 School Bus Passenger Seating and Crash Protection
223 Rear Impact Guards
224 Rear Impact Protection
225 Child Restraint Anchorage Systems
226 Ejection Mitigation

301 Fuel System Integrity
302 Flammability of Interior Materials
303 Fuel System Integrity of Compressed Natural Gas Vehicles
304 Compressed Natural Gas Fuel Container Integrity
305 Electric-Powered Vehicles, Electrolyte Spillage and Electrical Shock Protection
403 Platform Lift Systems for Motor Vehicles
404 Platform Lift Installations in Motor Vehicles
500 Low-speed Vehicles

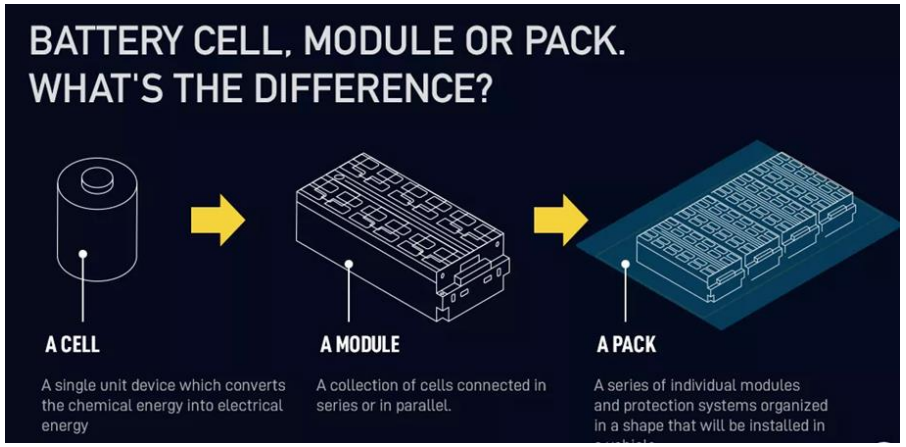
Battery Electric Vehicles (BEV) Unique Features

- **Battery:** each electric car needs the auxiliary battery that gives electricity to power car accessories.
- **Charge port:** The charge port serves the electric car to connect to an external power supply. It uses for the traction battery pack charging.
- **DC/DC converter** do converting higher-voltage DC power from the traction battery pack to the lower-voltage DC power.
- **Electric traction motor** – is a motor that drives the car`s wheels. Some traction motor can perform both function such as drive and regeneration.
- **Onboard charger** serves for converting incoming AC electricity to DC power for charging the traction battery.
- **Power electronics unit** is a controller manages the flow of electrical energy delivered by the traction battery.
- **Cooling system** maintains a normal operating temperature range of the engine, electric motor, power electronics, and other components of electric car.
- **Traction battery pack** is the some battery that stores electricity and transfer it to electric traction motor using.
- **Transmission of electric car** transfers mechanical power from the electric traction motor to drive the wheels.



ICEV and BEV Differences

- **Powertrain**
- The main components of an ICEV powertrain—the engine and auxiliary systems, such as the alternator, starter, and fuel and exhaust systems—are **unnecessary** in a **BEV**
- They are replaced by a **battery pack** and an **electric motor**
- The **battery pack** consists of **modules** that contain **battery cells**, a **battery management system** that monitors performance, a **thermal management system** to cool the battery, i**nterconnects**, and **housing**
- **Multispeed gearboxes** used in ICEVs are replaced by a **single-speed transmission** in BEVs

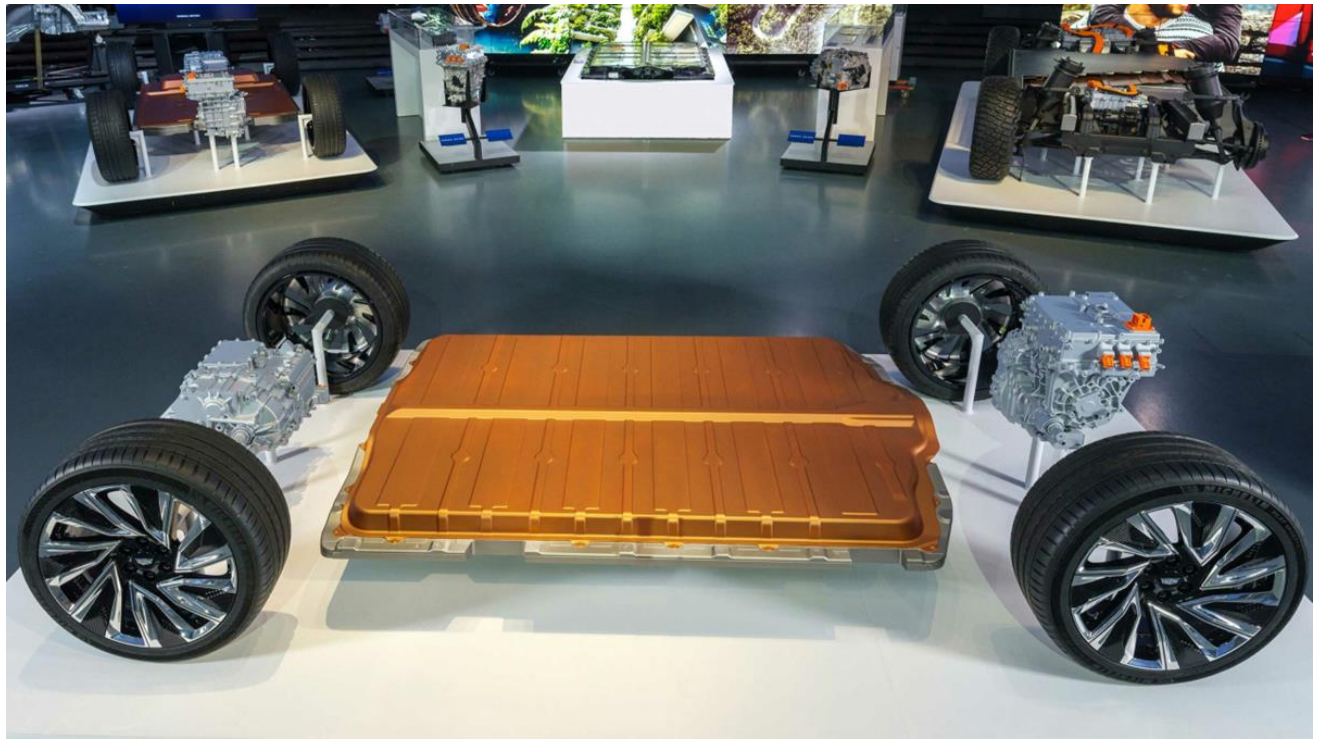


- **Power Electronics**
- This covers all the **equipment essential for running BEVs** but are not in pure ICEVs
- Included, among other things, are **DC/DC** and **DC/AC converters** and **power electronics controllers**

- Primarily because of their more complex powertrains, **ICEVs** include many more components than electric cars
- An **ICEV** powertrain may have more than 1,000 components
- A **BEV** powertrain generally has only a few hundred (not counting each individual battery cell separately)
- Nevertheless, the **content per vehicle** of **BEVs** is actually about 30% higher than that of I**CEVs**, primarily because of the cost of batteries

Battery Electric Vehicles (BEV)

Unique Features



GM Ultium Battery Pack

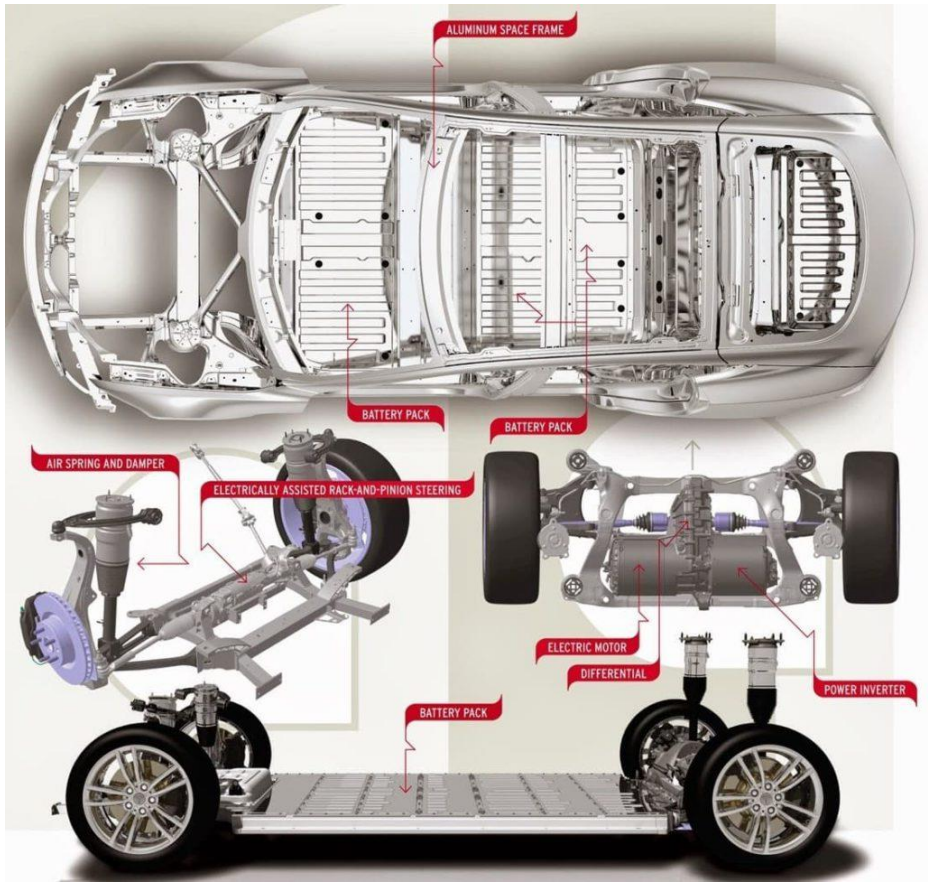
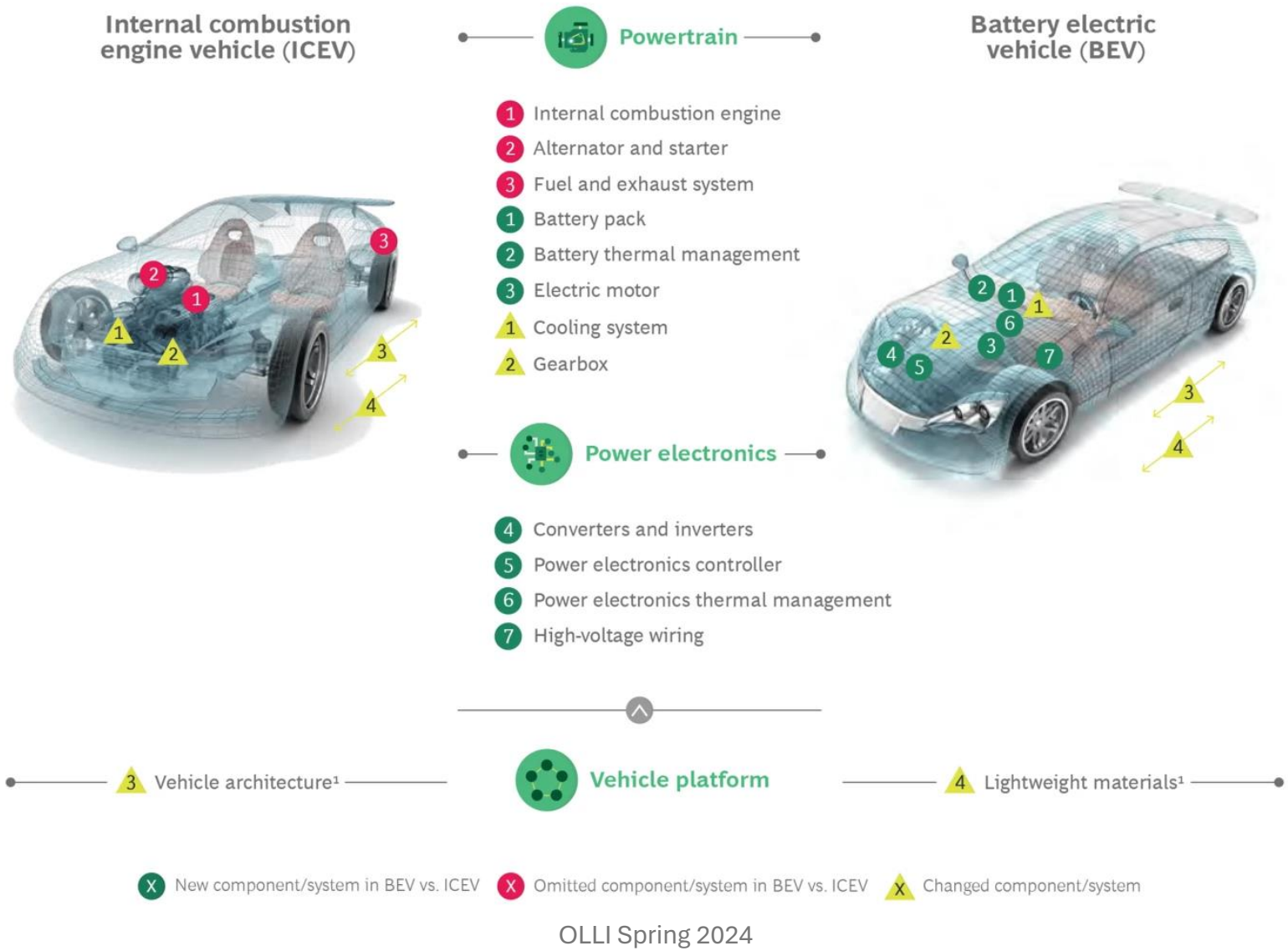


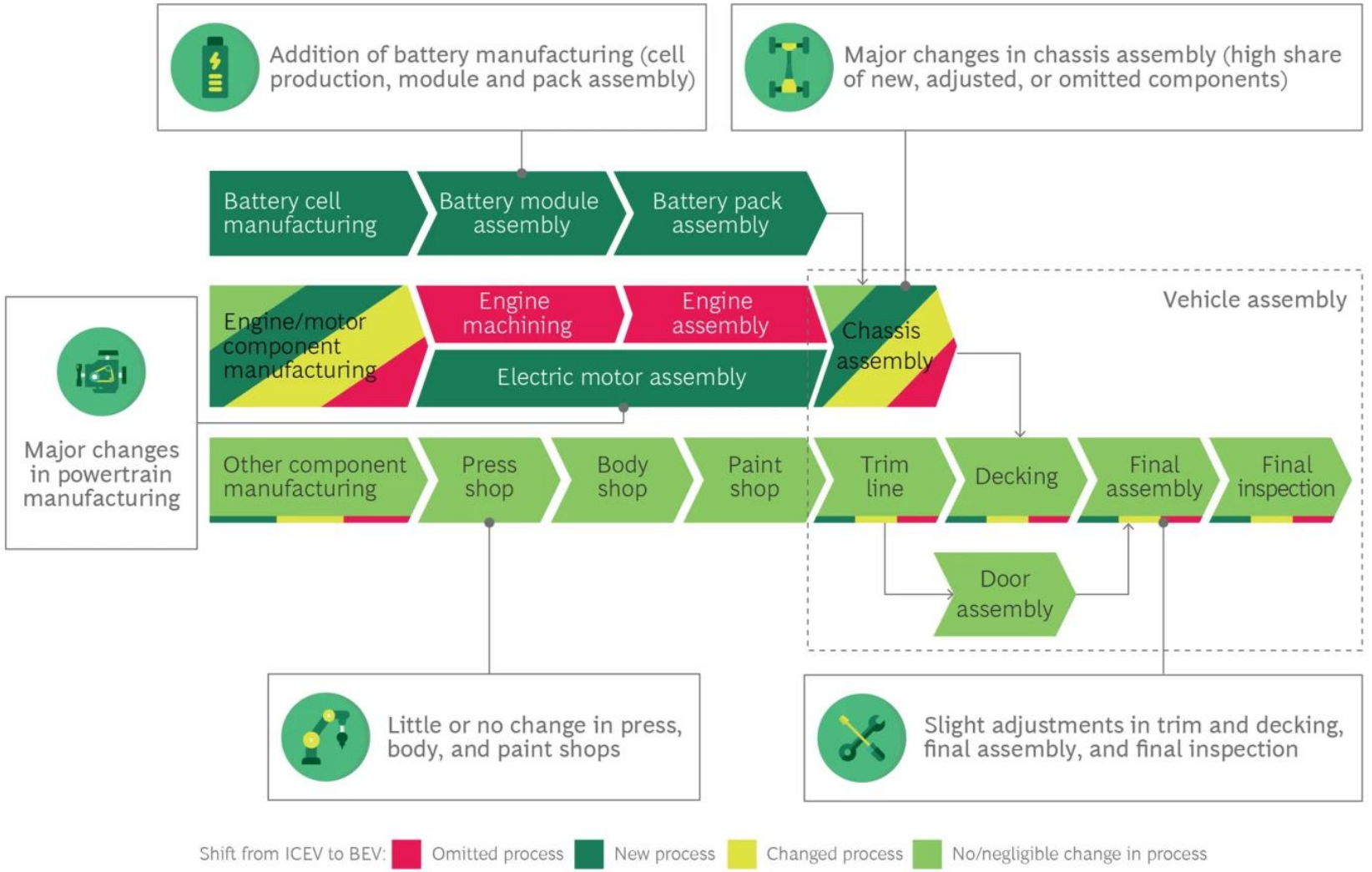
Exhibit 1 - The Differences Between BEV and ICE Vehicles Arise from the Differences Between Powertrain and Power Electronics



ICEV and BEV Differences Manufacturing

- The most important difference is the replacement of the traditional engine with an electric motor
- This eliminates the complex and labor-intensive assembly of **ICE**s and allows focus on relatively simple electric motors
- Automakers can generally deploy more automated equipment to build them
- **BEV** production will have to master new manufacturing processes, such as coiling, impregnation or sealing of wiring, and quality control for more complex electrical systems
- There are also significant differences in the manufacture of **BEV** components
- Instead of the elaborate casting and machining processes necessary to make crankcases, cylinders, camshafts, and rods for ICEs,
- Less complex machining methods can be used to manufacture and install components for electric motors, which include rotor hubs, stator hubs, magnets, and bearings
- The switch to **BEV production** affects not only **OEM**s and their **suppliers** but also **producers** of equipment for manufacturing **ICEs**
-

Exhibit 2 - How the Shift to BEVs Will Affect the Automotive Value Chain



Differences ICEV and BEV

- The other distinct difference in powertrain production is the **integration of battery packs**
- Automakers can assemble **battery packs** in-house by piecing together **battery modules**
- **Cells** that go into the battery modules are typically produced by **specialized suppliers**, often from the consumer electronics industry and headquartered in Asia
- Delivery of those **battery cells** requires a well-functioning **supply chain**, since automakers cannot store large inventories of battery modules, because of the potential fire hazard and the degradation of batteries over time
- Automakers must create a **seamless just-in-time** production process for that aspect of BEV manufacturing

- Manufacturing distinctions exist in other functions as well
- **BEV** manufacturers are especially focused on **reducing - vehicle weight** ecause the multiple battery packs in their vehicles are extremely heavy
    - The battery pack alone of the **Tesla Model S** weighs more than half a ton
- **Model S** bodies are made chiefly with aluminum, which is lighter than steel
- However , aluminum is trickier to work with in a factory
    - Stamping and welding

Differences ICEV and BEV

- The **common wisdom** that BEVs are less labor intensive in assembly stages than traditional vehicles is inaccurate
- **Labor requirements** for assembling BEVs and ICEVs are **comparable**
- **BEVs** require manufacturing high-voltage wiring converters and inverters, installing motor-charging units, and connecting battery cooling tubes
  - BEVs have three thermal systems
  - ICEVs have two
- Also, some **BEVs** have an additional **front trunk,** which involves the extra step of assembling interior lining that's not necessary in ICEV production
- Moreover, some parts of the BEV manufacturing process require **greater attention to quality control**, thus adding more complexity to the effort
- For example, additional **quality checks** are necessary to make sure that no nuts, bolts, or other small parts are mistakenly left in the battery pack, which could cause it to overheat and catch fire

Differences ICEV and BEV

- Factory infrastructures differ as well
- Plants dedicated solely to BEV manufacturing do not require **vehicle exhaust extraction system**s in the final inspection area
- But that savings is offset by the special **equipment** needed to handle the **added weight of the batteries**
- This includes the machines necessary to ferry battery modules and packs around the factory and the **reinforced chassis conveyor** or other transport systems required to move the assembled vehicles at the end of the line
- These infrastructure changes can make the conversion of manufacturing facilities into BEV assembly facilities difficult to do without expensive retrofitting

Exhibit 3 - Breaking Down the Differences in Assembly of BEVs and ICEVs

Assembly of BEVs

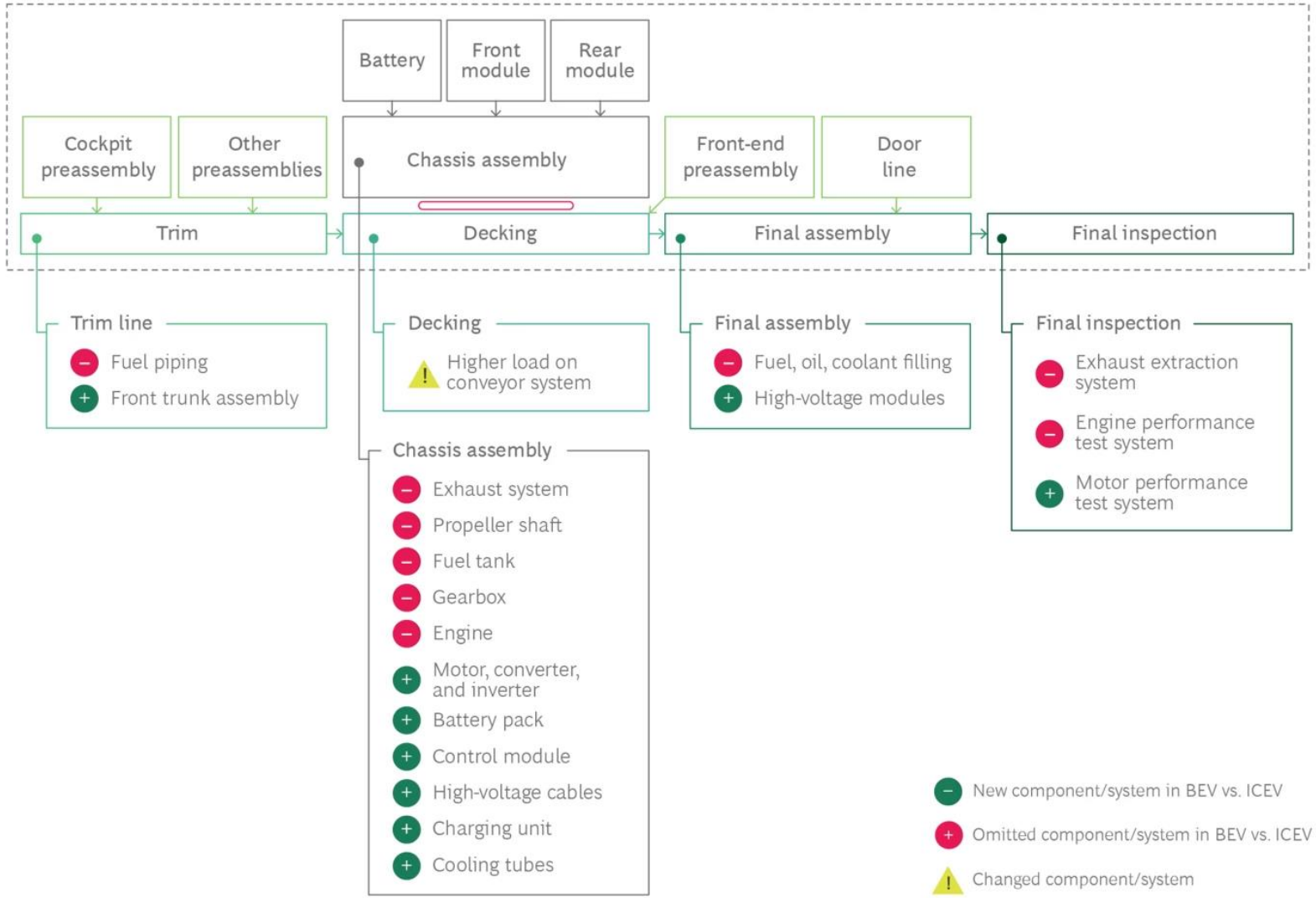


Exhibit 4 - Labor Requirements for BEVs and ICEVs Are Similar

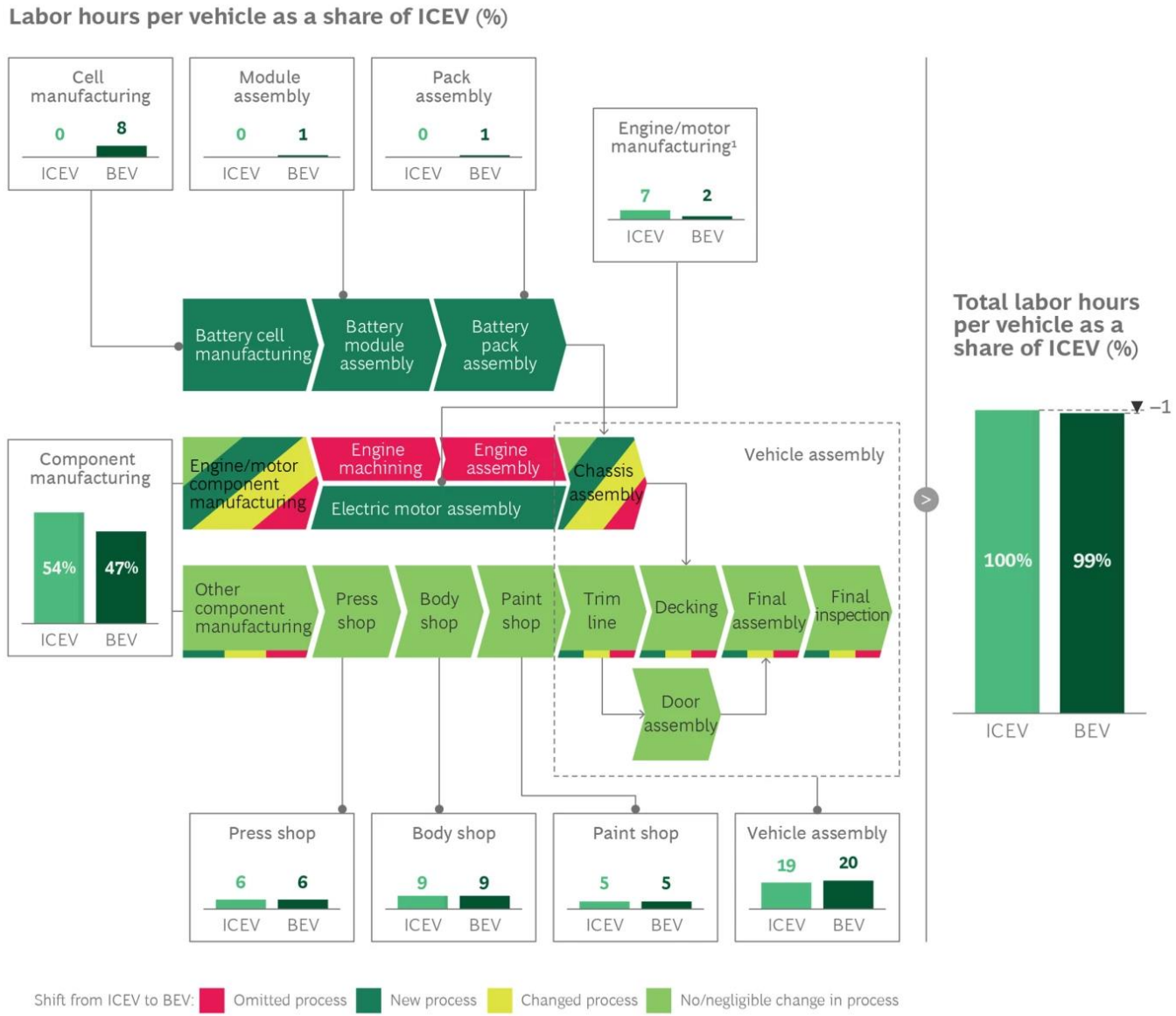
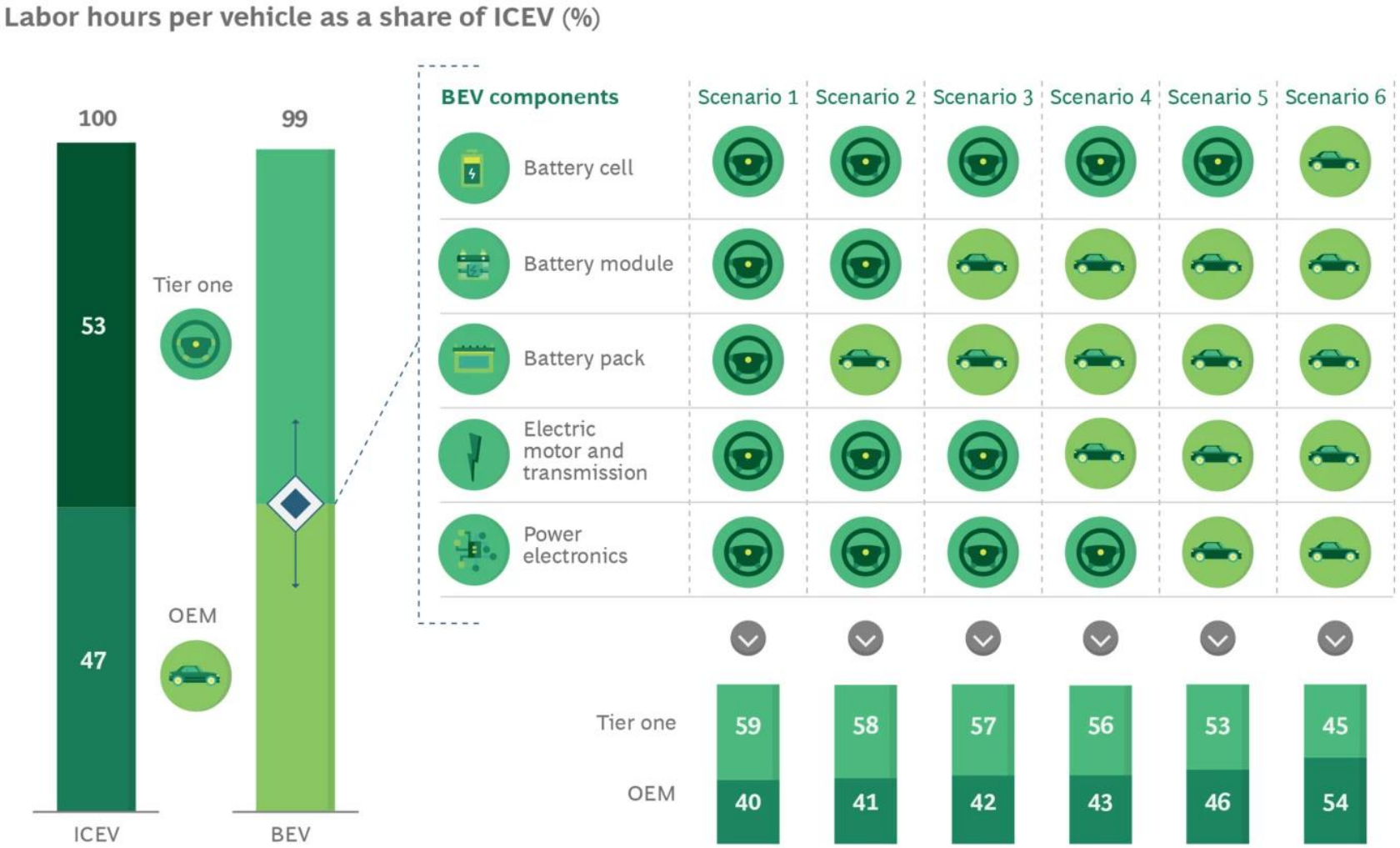


Exhibit 5 - The Level of BEV Outsourcing Will Affect the Change in Value Added



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