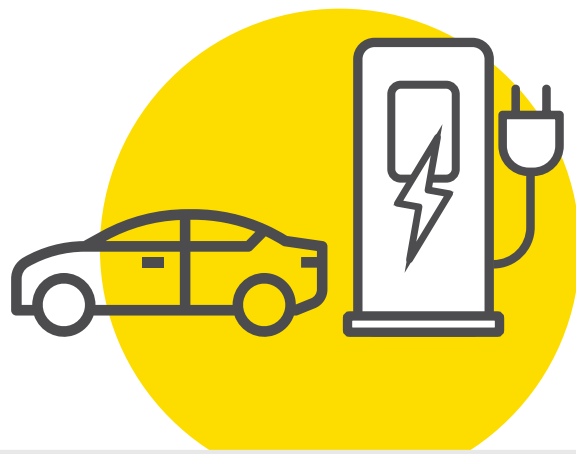


The Evolution of Electric Vehicles and Factory Automation

Are Electric Vehicles closer to mainstream production than we think?

ELECTRIC VEHICLES COST LESS THAN HALF AS MUCH TO OPERATE AS GAS-POWERED CARS



Average cost to operate an Electric Vehicle in the U.S.

\$485/yr

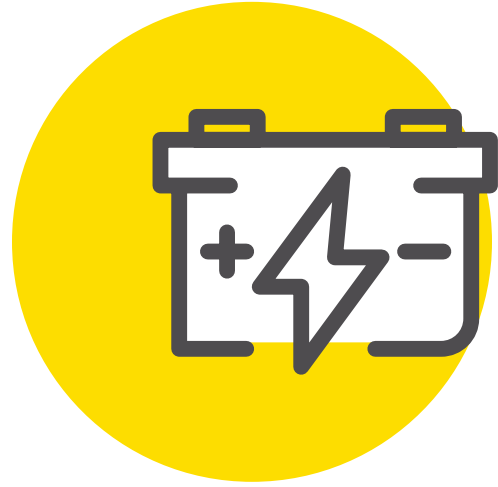


Average cost to operate a Gas-powered Vehicle in the U.S.

\$1,117/yr

MODERNIZING INFRASTRUCTURE TO SUPPORT THE RISE OF ELECTRIC VEHICLES

- It is projected that as soon as 2030, the majority of new cars on the road will be electric
- Fast Charging Stations becoming more widely available
- Development of new wireless charging standards in future EVs
- Ultimately, charging EVs will become easier, less labor-intensive, and more widely available in the future



A CLOSER LOOK AT ELECTRIC VEHICLE BATTERIES

- The battery is the most expensive part of an electric vehicle.
- Energy density improvements could mean
 - » A proportional shrink in the size and price of the battery
 - » Power, range, and performance is still achieved
- As battery prices drop significantly, EVs are more affordable for consumers, significantly increasing demand

A MIDSIZE, ELECTRIC VEHICLE IN THE U.S.

In 2015 the battery made up **>57%** of the total cost



In 2019 the battery makes up **33%** of the total cost



In 2025 the battery will be only **20%** of the total cost



A Transformational Change for the Automotive Industry

95% FEWER COMPONENTS WITH ELECTRIC VEHICLE PRODUCTION



COMPONENTS ELIMINATED

- Pistons, Crank, Cams
- Radiator
- Alternator
- Transmission
- Driveshaft
- Exhaust System



COMPONENTS ADDED

- Electric Motor
- Gear Box
- Battery Pack
- Inverter
- Charging Station

FOCUS ON BATTERY AND SENSOR MANUFACTURING REQUIRES LIGHT-WEIGHTING AND MIXED MATERIAL JOINING

An Emerging Demand for Automated Production of Electric Vehicles



POWER BATTERY PRODUCTION

- Battery Assembly

EV STRUCTURE PRODUCTION

- Battery Tray and Frame Assembly
- Cooling Tray Install
- Cooling Hose Assembly

EV DRIVE TRAIN PRODUCTION

- Motor Assembly
- Drivetrain Assembly
- Final Assembly

PARTNER WITH A COMPANY THAT OFFERS THE RIGHT ROBOT MODELS AND FACTORY AUTOMATION SOLUTIONS TO SUPPORT EVERY AUTOMATION TASK REQUIRED FOR EV PRODUCTION

- Welding
- SPR & Sealant
- Rivets
- Self-piercing Rivets
- Machine tending
- Assembly
- Force Sensing
- Nut Running
- Vision Inspection

Sources:

<https://www.energysage.com/electric-vehicles/costs-and-benefits-evs/evs-vs-fossil-fuel-vehicles/>
<https://www.cnn.com/2019/08/14/perspectives/batteries-lithium-ion-innovation/index.html>
<https://www.bloomberg.com/opinion/articles/2019-04-12/electric-vehicle-battery-shrinks-and-so-does-the-total-cost>
<https://www.energy.gov/timeline/timeline-history-electric-car>
<https://www.landmarkdividend.com/ev-charging-stations/>