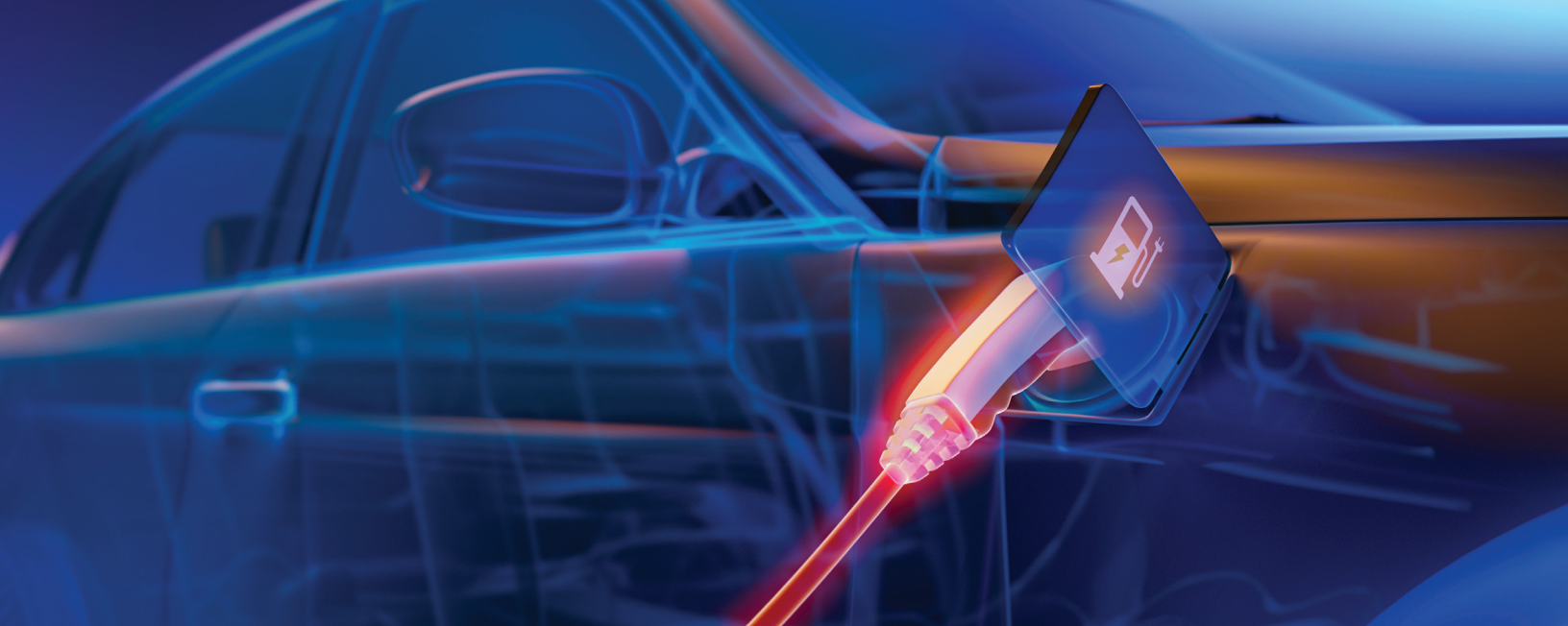




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# **The High Road to California EV Goals: Raising Ambition for High- Quality Domestic Manufacturing Jobs**



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## ■ Executive Summary

In the words of President Joseph R. Biden, countries around the world are currently racing to win the future of electric vehicle (EV) and battery manufacturing. For U.S. workers and communities, the outcomes of this race may alternatively support family-sustaining jobs in a climate-resilient economy, or decimate auto and supply chain employment across whole economic regions. In California, EVs are a particular focus of state economic development and job growth efforts.

This report offers a unique contribution to the debates surrounding the role of high-quality jobs and domestic manufacturing in the EV transition. The industry forecasts and analyses herein show that, if structured appropriately, domestic manufacturing goals in the form of a domestic assembly Buy America policy would not be detrimental to state environmental goals. This report also finds that a Buy America incentive policy would create tens of thousands of high-road, high-quality manufacturing jobs in-state and in-country. This report, additionally, makes the following findings:

## Significant Volumes and a Variety of Domestically-Assembled EVs Will Be Available in California by 2023

- 33 domestically-assembled battery electric vehicle (BEV) models are forecasted to be in commercial production by the end of 2023, including 27 new entrants rolled out between 2021 and 2023.
- Among domestically-assembled BEVs and plug-in hybrid vehicles (PHEVs) expected by 2023, 24 vehicles are expected to fall under the MSRP cap of \$60,000 for California's Clean Vehicle Rebate Program (CVRP). Total domestically-assembled BEVs eligible for CVRP will reach approximately 580,000 units by 2023, and 690,000 vehicles by 2025.

## Domestic EV Production Will Significantly Exceed That Needed to Reach California EV Adoption Goals

- The California Air Resources Board (CARB) projects that to reach 1.5 million zero-emission vehicles (ZEV) on the road by 2025, 397,000 rebates will be required by 2025, or approximately 79,400 rebated vehicles per year.
- By 2023, domestic assemblers will greatly exceed this baseline demand. California rebate consumption would total only 14% of national PHEV/BEV sales.

## Applying 'Buy America' Standards to California Incentives Would Create or Support 47,500 Domestic Manufacturing Jobs Annually

- A domestic-assembly policy for California EV rebates would create or support approximately 6,250 U.S. vehicle assembly jobs each year, and 41,250 supplier jobs per year.
- Policies to incentivize the domestic production of vehicle content—including batteries and other critical electronics including software—would create and support even more U.S. jobs and ensure a secure supply chain.
- Paired with targeted hire policies, a Buy America standard would support access to high-road careers for low-income workers of color, dislocated workers from the fossil fuel industry, and other disadvantaged workers.

This report forecasts that the current trajectory of EV industry growth is consistent with policy goals to leverage up U.S. manufacturing and increase high-road EV jobs for disadvantaged workers. State vehicle and incentive policies can and must foster a domestic auto manufacturing sector capable of supporting a climate-resilient economy, while creating economic opportunities for disadvantaged workers and working-class communities.

## ■ Purpose

Over the next 5 years, the EV value chain is poised for transformative growth, with a projected annual global value of \$300 Billion by 2025.<sup>1</sup> Countries around the world are racing to *win the future* of this collection of industries, in the words of President Biden.

For everyday people, the EV transition holds the potential to be a boon for family-sustaining jobs in a climate-resilient economy or, alternatively, to decimate whole regions of the United States which depend on manufacturing automobiles and their components. In California, EVs have become a particular focus for state economic development and for high-road job growth goals.

This report seeks to fill a critical gap in the EV and economic development policy literature by evaluating the potential for domestic and California-based manufacturers to supply electric vehicles to domestic and California markets. This analysis evaluates the impact that a domestic manufacturing Buy America policy would have on California's clean vehicle incentive policies and their environmental objectives. The report also projects the significant positive job impacts of such a policy across the domestic auto assembly and auto supply chain sectors.

This report finds that domestic manufacturing requirements—if structured appropriately—would allow California to achieve its environmental objectives while creating tens of thousands of high road jobs for dislocated workers and low-income workers of color in-state and in-country in the auto and auto supply chain sectors.

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<sup>1</sup> European Battery Alliance, About EBA250, Available online at: <https://www.eba250.com/about-eba250/?cn-reloaded=1>



## ■ Introduction

The United States significantly lags behind the European Union and China in researching, developing, manufacturing, and selling electric vehicles to the world. The U.S. share of global EV sales is only one-third that of China and the European Union. China has roughly 800,000 public charging points compared to the 100,000 in the United States.<sup>2</sup> China and the EU both maintain robust industrial policy frameworks that facilitate technology penetration and socialization, localized supply chain development, battery innovation, and growth of localized final EV auto assembly.<sup>3</sup> The problem for the U.S. is both environmental and economic: we need more zero-emission vehicles, and we need to preserve and create high quality auto jobs.

Despite the slow adoption ramp up in the U.S., sales of EVs are expected to grow over the next 10 years. This report forecasts U.S. electric passenger vehicle sales in the 2023 and 2025 timeframes with likely locations of vehicle final assembly points by country, manufacturer, and model. The impact of Buy America domestic assembly policies on the environmental goals of state vehicle incentive programs is then evaluated. This report concludes by analyzing the impact of Buy American policies on auto sector employment, including the final assembly of vehicles and vehicle supply chains.

## ■ Light-Duty Vehicle Market Analysis and Forecast

Sales of electrified vehicles, including BEVs, PHEVs, and regular, mild, and micro hybrids in the U.S. have increased year-over-year since 2016. Battery electric vehicles, however, represent the most promising electrified vehicle sub-segment for industry growth.

Fuel cell vehicles are a niche product and will remain so through 2030, given high upfront cost, lack of infrastructure, and minimal government resources dedicated to resolving infrastructure hurdles.

“Regular” hybrids remain popular low emission vehicles, particularly for Toyota, Hyundai, Ford, and Honda. However, their durability as profit-makers will likely wane as growth accelerates and cost declines in the BEV and plug-in markets.

Plug-in hybrids make up a meaningful share of the low-emission vehicle market and may continue to fill an important niche in the short to medium term; however, PHEVs are being outpaced by BEVs due to regulatory preference, battery cost decline, and charging infrastructure proliferation. Among manufacturers, plug-ins are likely to significantly lag BEV production in terms of volumes, particularly after 2025. Among the PHEV manufacturers, only Stellantis and Toyota currently produce plug-ins in significant volumes.

Battery Electric Vehicle sales grew to 235,000 units in 2018. 450,000 units are expected to be sold in 2021, and by 2025, 1.1 million sales are expected. While Tesla currently dominates the BEV market, the company’s market share is projected to decline from 80% in 2018 to 30% by 2025 as competitors in the field ramp up production. Major near-term growth players in the U.S. BEV market include Ford, GM, and VW, and startups Rivian, Electric Last Mile Solutions (ELMS), and Lucid. Rivian and ELMS also have entries in the heavy-duty fleet market, while Lucid is following Tesla’s approach of starting in the high-end market and eventually moving into the production of vehicles for mainstream consumers.

<sup>2</sup> The White House, Fact Sheet: The American Jobs Plan Supercharges the Future of Transportation and Manufacturing, Available online at: <https://www.whitehouse.gov/briefing-room/statements-releases/2021/05/18/fact-sheet-the-american-jobs-plan-supercharges-the-future-of-transportation-and-manufacturing/>

<sup>3</sup> International Energy Agency, Global EV Outlook 2020, Available online at: [https://iea.blob.core.windows.net/assets/af46e012-18c2-44d6-becc-bad21fa844fd/Global\\_EV\\_Outlook\\_2020.pdf](https://iea.blob.core.windows.net/assets/af46e012-18c2-44d6-becc-bad21fa844fd/Global_EV_Outlook_2020.pdf)

Although BEV sales were less than 2% of U.S. vehicle sales in 2020, by 2030, a significantly greater share of U.S. auto sales are expected to be BEV, on the order of 10-15%. Ultimately, BEV market share will depend on the following factors:

- Regulatory requirements at federal and state levels including fuel economy and ZEV requirements;
- Battery, electricity, and gasoline costs;
- Battery material cost and availability;
- Evolving materials used in batteries;
- Efficiency of batteries which will affect the size of batteries required to meet consumer demand;
- Extent and cost of charging infrastructure;
- Consumer and manufacturer incentives available for electric vehicles; and
- Competitiveness of solid state battery technology.

Federal and state regulatory incentives and vehicle standard policies will be particularly determinative of future BEV sales.

Among all vehicles sold in the U.S. at any price point, the combined BEV and PHEV share of sales has increased from 2.1% in 2018, to 2.4% in 2020, to 3.3% in 2021, and is forecasted to increase to 5.5% by 2023 and 7.0% by 2025. Although sales numbers for individual models will be relatively modest, the increase in total models available augurs faster growth for the electrified segment as a whole.

### Domestic Production Analysis

Automakers plan to pursue diverse vehicle electrification strategies. Thirty-three domestically assembled BEV models are expected to be in commercial production by the end of 2023, including 27 new entrants rolled out between 2021 and 2023. Domestically-assembled vehicles for the purposes of this analysis include Canada-assembled vehicles. Total domestically-assembled BEV production for the U.S. market is expected to reach 675,000 units by 2023, and 865,000 vehicles by 2025. Eleven domestically-assembled PHEV models will be in commercial production by the end of 2023. Domestically-assembled PHEV production is expected to reach 55,000 units by 2023.

**Figure 1:** BEV & PHEV U.S. Sales Forcast Summary, Under \$60,000, Domestically-assembled

Vehicle Type	2018	2020	2021	2023	2025
BEV entries	4	4	7	16	17
PHEV entries	3	4	8	8	8
Total	7	8	15	24	25
BEV volume (000s)	172	209	318	534	649
PHEV volume (000s)	24	6	18	44	44
Total	196	215	336	578	693

Among domestically-assembled BEVs and PHEVs expected by 2023, 24 of these vehicles are expected to fall under the current MSRP cap of \$60,000 for California’s Clean Vehicle Rebate Program (CVRP). U.S. sales volume among these 24 models will total roughly 580,000 combined units per year by 2023.

**Figure 2:** 2023 BEV & PHEV U.S. Sales Forecast, Models Under \$60,000, Domestically-Assembled

OEM	Brand	Model	EV Segment	Launch	Type	State	MSRP
ELMS	ELMS	UD-1	Small van	2021	Full electric	IN	\$ 32,500
Ford	Ford	Escape	Small crossover	2021	Plug in	KY	\$ 33,895
Ford	Ford	Explorer	Midsize SUV	2021	Plug in	IL	\$ 49,855
Ford	Ford	F-150	Full size pickup	2022	Full electric	MI	\$ 39,974
Ford	Ford	Transit	Large van	2021	Full electric	MS	\$ 43,295
Ford	Ford	Unnamed	Midsize crossover	2023	Full electric	MI	\$ 45,000
Ford	Lincoln	Corsair	Small crossover	2021	Plug in	KY	\$ 51,385
Ford	Lincoln	Unnamed	Midsize crossover	2023	Full electric	MI	\$ 55,000
GM	BrightDrop	EV600	Large van	2022	Full electric	ON, CA	\$ 32,500
GM	Cadillac	Lyriq	Midsize SUV	2022	Full electric	TN	\$ 59,995
GM	Chevrolet	Bolt	C car		Full electric	MI	\$ 36,500
GM	Chevrolet	Bolt EUV	Midsize crossover	2021	Full electric	MI	\$ 33,995
GM	Chevrolet	Silverado	Large pickup	2023	Full electric	MI	\$ 55,000
Nissan	Nissan	Leaf	C Car		Full electric	TN	\$ 31,670
Stellantis	Chrysler	Pacifica	Minivan		Plug in	ON, CA	\$ 40,620
Stellantis	Jeep	Gladiator	Full size pickup	2021	Plug in	OH	\$ 52,500
Stellantis	Jeep	Grand Cherokee	Large SUV	2021	Plug in	MI	\$ 45,000
Stellantis	Jeep	Wrangler	Midsize SUV	2021	Plug in	OH	\$ 47,995
Tesla	Tesla	3	C car		Full electric	CA	\$ 39,990
Tesla	Tesla	Cybertruck	Full size pickup	2022	Full electric	TX	\$ 39,900
Tesla	Tesla	Y	Midsize crossover		Full electric	CA	\$ 39,990
Volvo	Volvo	S60	D Car		Plug in	SC	\$ 56,395
VW	VW	ID 4	Midsize crossover	2023	Full electric	TN	\$ 39,995
VW	VW	ID.6	Large crossover	2023	Full electric	TN	\$ 45,000
<b>Total</b>							

In addition to publicly announced product plans for specific vehicles through 2023, automakers have announced major EV investment plans that will further expand the range of domestically assembled vehicles available to the mass market. For example, Hyundai-Kia has announced plans to invest \$7.4 billion in the U.S. by 2025 for EV manufacturing and Ford has announced plans to invest \$1.4 billion in its Oakville, Ontario plant to make EVs.<sup>4</sup> With major automakers planning tens of billions of EV investments in the coming years, incentivizing domestic production will help secure and attract similar investments to the United States.

### Meeting California ZEV Goals with Domestically-Assembled Vehicles

California policy-makers have established the following zero-emission vehicle (ZEV) deployment goals in statute: 1 million ZEVs to be deployed on the road by 2023; 1.5 million vehicles on the road by 2025; and 5 million ZEVs on the road by 2030. In addition to these goals, California’s Governor has also issued an Executive Order banning the sale of new light-duty Internal Combustion Engine (ICE) vehicles by 2035.

California labor unions, environmental, and equity organizations have proposed that these benchmarks may be met while prioritizing domestic production of vehicles, after 2023. To evaluate the achievability of this goal, the analysis below assumes, based on CARB projections, that to meet the 2025 deployment goal of 1.5 million cars on the road, 397,000 rebated ZEVs will be required between 2021 and 2025, or an average of 79,400 rebated vehicles per year. Can domestic assemblers provide this volume of vehicles under a conservative set of market assumptions and while providing sufficient vehicle choice to consumers?

<sup>4</sup> Automotive News, Ford Oakville: From possible closure to Canada’s first EV plant, Available online at: <https://www.autonews.com/manufacturing/ford-oakville-possible-closure-canadas-first-ev-plant>; Hyundai Media Center, Hyundai Motor Group to Invest \$7.4 Billion In the U.S. by 2025, Available online at: <https://www.hyundainews.com/en-us/releases/3318#:~:text=FOUNTAIN%20VALLEY%2FIRVINE%2C%20Calif.,investments%20in%20smart%20mobility%20solutions>



If 580,000 BEV and PHEV units are forecasted to be assembled domestically and sold in the U.S. by 2023 (under CVRP's MSRP cost limits), then 79,400 rebated vehicles would take up only 14% of U.S. PHEV/BEV sales in that year. If sales percentages of ZEVs in California that use a rebate stay consistent at approximately 45% of sales (in 2019), then total ZEV sales in California can be expected to be 174,274 units in 2023. The California market would thus account for 30% of total domestic EV production.

With domestic EV production forecasted to steadily increase, California's consumption of total national BEV and PHEV production will decrease as a percentage moving out towards 2030. In a very conservative scenario, at a 5% Annual Growth Rate of BEV/PHEV production, domestic production will reach 740,000 of CVRP eligible units by 2030. If market growth increases to 15% annually, domestic production will reach 1,400,000 of CVRP eligible units by 2030. The increase of sales to approximately 700,000 by 2025 will make it even easier for California to reach adoption targets with a domestic assembly goal in place.

Furthermore, CARB recommends that for vehicle incentives to be effective in each vehicle class, two or more model choices should be available to consumers. This report forecasts that in all major classes of personal autos, two choices would be available for rebate-eligible vehicles by 2023, with many more available in the most popular segments coming online (Figure 2). More importantly, however, there will be enough domestically-assembled models in the 2023-25 timeframe in popular segments at mainstream prices to allow for the California consumer to participate in the incentivized market at high volume. New opportunities in the 2023-25 timeframe includes several vehicles in the popular pickup, SUV, and crossover utility product segments.

Based on the foregoing analysis, it is therefore likely that a domestic production requirement on incentive-eligible vehicles would not hamper the achievement of the 2025 ZEV adoption goal.

## ■ Buy America Domestic Jobs Projections

According to CARB's Updated Three-Year Plan for CVRP and the ZEV Market, in order to reach California's ambitious climate goals, the state will have to issue approximately 2.1 million rebates over the next 7 years at a rate of 300,000 rebates per year. The cost of these incentives will total \$4.2-\$4.3 billion cumulatively, or \$530 million per year.<sup>5</sup> The 2021 Governor's May budget Revise allocates \$3.2 billion to CARB and sister agencies as a critical step to meeting these climate goals, including \$250 million for manufacturing and supply chain grants.<sup>6</sup>

The St. Louis Federal Reserve Bank estimates the approximate labor productivity for domestic passenger auto manufacturing at 48 cars produced per employee per year.<sup>7</sup> If California adopts a Buy America policy to support the domestic assembly of vehicles, approximately 6,250 assembly jobs would either be supported or created in the United States due to such a policy each year (assuming 300,000 rebated vehicles per year). Furthermore, the Center for Automotive Research suggests that each auto production job in the U.S. generates a multiplier effect of 6.6 additional supplier jobs. Consequently, a Buy America policy attached to California's incentive programs would create or support approximately 41,250 supplier jobs per year.<sup>8</sup> Assembly and supplier jobs created or supported by a domestic assembly policy would total 47,500 jobs per year.

5 California Air Resources Board, Updated Three-Year Plan for CVRP and the ZEV Market, Available online at: [https://ww2.arb.ca.gov/sites/default/files/2020-11/appc\\_id\\_zevmarket\\_update.pdf](https://ww2.arb.ca.gov/sites/default/files/2020-11/appc_id_zevmarket_update.pdf)

6 Los Angeles Economic Development Corporation, EV funding in Governor Newsom's budget, Available online at: <https://laedc.org/2021/05/24/ev-funding-in-governor-newsoms-budget-will-create-jobs-address-climate-change-address-equity-and-grow-local-industry/>

7 St. Louis Federal Reserve, The U.S. Auto Labor Market since NAFTA, Available online at: <https://www.stlouisfed.org/on-the-economy/2019/april/us-auto-labor-market-nafta>

8 Center for Automotive Research, Contribution of the Automotive Industry to the Economies of All Fifty States and the United States, Available online at: <https://www.cargroup.org/wp-content/uploads/2017/02/Contribution-of-the-Automotive-Industry-to-the-Economies-of-All-Fifty-States-and-the-United-States2015.pdf>

**Figure 3:** Projections of Annual Domestic Jobs Supported or Created by Proposed Buy America Policy

Auto Sub-Sector	Jobs Created or Supported
Final Assembly of Vehicles	6,250 jobs per year
Automotive Supply Chain	41,250 jobs per year
All Sectors	47,500 jobs per year
All Sectors (Job Years)	332,500 total job years

Standards for domestic content production (including but not limited to batteries) would also increase the jobs supported and created by state incentive policies. Currently, an average of 70% of the content of a vehicle is sourced from outside of the automaker that performs final assembly of that vehicle. Of that amount, 20-30% of content comes from outside the U.S. or Canada. By enacting domestic content standards, the state could help onshore battery, parts, and other vehicle content manufacturing. Additionally, a domestic content incentive would support the strong California-based EV industry ecosystem, which includes such notable firms as Lucid, Proterra, BYD, AeroVironment, Chargepoint, and others.

### Vehicle Content and Batteries

Currently, China and Korea produce the vast majority of EV batteries, cells, and constitutive battery materials. Even where EV battery ‘packs’ are assembled in the United States, their cells and contents are most often sourced from abroad. Without market intervention, North American content suppliers for internal combustion engines will see significantly decreasing orders over the coming years due to the proliferation of EVs, with a potentially devastating supply chain employment impact on U.S. workers. Engine manufacturers, transmission manufacturers, fuel system manufacturers, and other internal combustion vehicle parts suppliers are all highly exposed to sourcing relocation in the transition to zero-emission mobility. These suppliers collectively employ hundreds of thousands of U.S. workers. On the other hand, certain components such as motors, batteries, and electronics will see strong growth as EV volumes increase.

Incentives for manufacturers to onshore EV battery and non-battery content production are a meaningful market intervention to support U.S. suppliers and U.S. workers in the transition, to prevent displacement and the economic destabilization of workers’ families. To this end, the Biden Administration’s national infrastructure and jobs plan calls for a \$50 billion investment to bolster U.S. semiconductor manufacturing employment and strategic supply chains. In addition, in its first 100 days, the Biden Administration also identified commercial battery manufacturing and its supply chain as one of four critical supply chains for national strategic support, including prioritization of high-quality jobs.<sup>9</sup> At the federal level, across many policies, decision-makers and stakeholders are in active debate on how to further support auto sector manufacturing expansion and job growth, and encourage Buy American and a strong auto supply chain into the mid-21st century.

While the U.S. is lagging behind China and Europe on developing an EV supply chain, a crucial window is still open for the U.S. to develop a domestic supply chain and for governments to support domestic investment. Ultium Cells, a joint venture between GM and LG, is constructing two battery mega factories in Ohio and Tennessee and plans two additional factories in the U.S. by mid-decade. BlueOvalSK, a joint venture between Ford and SK Innovation, plans to build 60 GWh of battery production capacity in the U.S. by mid-decade, and LG plans to invest \$4.5 billion in U.S. battery production over the next four years.<sup>10</sup> The right combination of policies can help ensure that these investments continue.

<sup>9</sup> The White House, Building Resilient Supply Chains, Revitalizing American Manufacturing, And Fostering Broad-based Growth, Available online at: <https://www.whitehouse.gov/wp-content/uploads/2021/06/100-day-supply-chain-review-report.pdf>

<sup>10</sup> General Motors, Press Release: GM Will Boost EV and AV Investments to \$35 Billion Through 2025, Available online at: <https://investor.gm.com/news-releases/news-release-details/gm-will-boost-ev-and-av-investments-35-billion-through-2025>; Ford Media Center, Ford Commits To Manufacturing



## ■ Conclusion

This report forecasts that the *current* trajectory of EV industry growth is consistent with policy goals to leverage up U.S. manufacturing and high-road EV jobs for disadvantaged workers. California vehicle and incentive policies can and *must* foster a domestic auto manufacturing sector capable of supporting a climate-resilient economy, while creating economic opportunities for disadvantaged workers and working-class communities.



# APPENDIX

## LIGHT-DUTY VEHICLE PRODUCTION PLANS AND PRODUCTION LOCATIONS BY MANUFACTURER

### Alpha Motors

Alpha has designed the Jax, a retro-designed electric crossover with two small doors for the back seats. It is unclear if this product will go into production, as the company lacks the necessary cash for further development and production. A pickup named the Wolf and the Wolf + and the Ace coupe have also been suggested. Alpha is based in Irvine, CA and local production is likely.

### Aptera Motors

The company has (partly) risen from its own ashes in another attempt to provide a three-wheel electric vehicle with high range and an aerodynamic and efficient design, focusing on solar panels to provide electricity. The company is based in San Diego, domestic production is likely.

### Arrival

The UK-based company is planning to build shuttle buses and vans to transport people and/or packages focusing on producing vehicles close to its fleet customers that it anticipates will be buying vehicles to use in a particular region. As a result, it seeks to reduce costs by investing in several micro-factories that can be opened (and closed) quickly and avoids the huge investment of a “regular” automotive factory. They are currently planning production in facilities that are essentially warehouses with production equipment brought in to meet the order and then move to another location. The first U.S. facility is in Rock Hill, SC, followed by a facility in suburban Charlotte, NC. Production could begin in mid-to late-2022.

### Aston Martin

An EV based on the Lagonda sedan has been delayed, while the DBX SUV as an EV is even less likely. This product would be imported from the UK, given the nature of the company and the low volumes that might be sold in the United States.

### Atlis Motor Vehicles

The company is a startup based in Arizona that seeks to build the XT electric pickup truck. Capital is an issue, and the company is crowdfunding to get to production. This would be a reasonable example of the appropriateness of contract manufacturing and will likely be produced in the U.S.—if it reaches that stage.

## BMW

BMW has a long history of electrified vehicles, moving from the purpose-built i3 and i8 to its current strategy of building both plug-in and battery electrics off its existing ICE platforms. This strategy results in a wide array of vehicles mirroring its ICE product line. It makes these vehicles at its existing production plants, which means that only its electrified utility vehicles, made for domestic and export markets in South Carolina, are planned for domestic production.

## Bollinger

This startup plans to produce a boxy SUV known as the B1 and a 1-ton pickup named B2 appearing as electric vehicles as early as late 2021. The battery is large, matching the size of the vehicle, at 120 kWh. A chassis cutaway is also being planned. A commercial van is also planned, known as the Deliver-E, planned for Spring 2022. The vehicle is designed to be a niche product, with volumes limited to 2,000 to 3,000 annually. U.S. production is likely as the company continues to develop its product from its Oak Park, MI location, although it is looking for a contract manufacturer.

## BYD

A variety of product possibilities exist including a plug-in hybrid car known as the Qin, although production at this point is expected to be in China since the company has significant operations there for its light duty vehicles.

## Byton

This is a Chinese company that has sold vehicles in China and hopes to export to the U.S. and Europe. Its export plans are currently suspended, as the company is doing poorly, although it continues to raise funds.

The company hopes to produce a midsize crossover (called the M-Byte) launching in China in early 2022. Foxconn is now involved with Byton and is slated to produce the vehicle in China. A sedan (known as the K-Byte) could appear later. Of course, there is a high likelihood that these plans may be delayed or cancelled in response to trade issues between China and the U.S. Production could move to Korea to avoid tariffs; U.S. production seems unlikely.

## Canoo

Canoo is one of the latest automotive companies to go through a reverse merger as a means to go public and raise money. It plans to offer an electric utility van with rather ungainly names of MPDV1 and MPDV2 as a monthly subscription service, via fleet sales, to carry passenger and/or cargo in a number of configurations. A pickup is also possible, although that would not appear until at least 2023. It hopes to offer its product as soon as early 2022, but the timing and the products the company will offer remains speculative even as a new CEO has just been hired. The company intends to use the micro-factory production approach to reduce the investment required and seeks to produce in the U.S., perhaps at multiple locations.

## Daimler

To date, Daimler's electrification strategy has been to build its products off its ICE platforms. It is now transitioning to a dedicated EQ platform, serving as the basis for cars and utility vehicles. Because China and the EU have stiffer electrification requirements, those locations have become the production sources for most of its electrified vehicles. The EQE and EQS Utilities will be built at Mercedes' Vance, AL plant, with batteries produced at that facility (albeit with significant import content) and battery trays supplied from a nearby Dura facility. While Mercedes will offer a variety of other electric vehicles, it does not anticipate sourcing U.S. sales from a U.S. facility excluding the two larger utilities.

## ELMS

Electric Last Mile Solutions is quickly moving to production of its UD-1 delivery vehicle which will be sold to fleets beginning in late 2021. An existing plant in Mishawaka, IN has been purchased and can handle the company's planned expansion.

## Faraday Future

The company continues in financial crisis; a special purpose acquisition company is being considered, but liquidation is more likely than success. Their initial product has been named the FF91 and is a sports car priced at almost \$300,000 with production projected to start in Spring 2022. The FF81 may follow as a crossover. Volumes are said to be under 10,000 units, but as noted, a lot has to go right before these vehicles and volumes are a reality. Current production plans are for assembly in China.

## Fisker

The company's founder, Henrik Fisker, has gone through a number of iterations for the electric vehicle market, but it is now focused on the Ocean crossover. It will be produced by Magna in Steyr, Austria. Magna is providing content to the vehicle, project management, and assembly. The company has ambitions to grow in volume and product variety including a pickup concept called the Alaska and it might find its way to produce a low-cost vehicle for the Chinese market built by Foxconn.

Fisker states that they are looking at a North American production with Foxconn, stating that they are looking at an existing location being developed in Wisconsin or a new facility in Mexico. Given Foxconn's track record on meeting its employment and investment goals outside China, these expectations should be modest.

## Ford

Ford's electrification strategy is evolving from an all-hands-on-deck approach encompassing the EcoBoost ICE engine and hybridization to a more "aggressive" strategy focusing on plug-ins and BEVs. The company is relying on the strength of its most popular brands (e.g., Mustang, F-150, and Transit) to engage customers with capability and performance while meeting increased regulatory requirements. It has also reversed its earlier strategy of outsourcing battery development and procurement to bringing at least a significant portion of this capability in-house. Ford will produce some of its electric vehicles at two Mexican facilities, but many of its EV models will be built at U.S. facilities including the F-150 Lightning, e-Transit, Plug-in Escape, Corsair, Lincoln Aviator, and Explorer. Ford is also investing \$1.4 billion to build BEVs at its Oakville, Ontario plant starting in 2025.

Ford has signed an MOU with SK Innovation establishing a joint venture to manufacture battery cells and arrays in the U.S., with locations to be determined. Its joint venture with Volkswagen could result in some battery production in Europe, particularly since it has adopted an all-electric goal for the continent by 2030. Ford's corporate positioning as an American company and strong regulatory requirements may result in more U.S. investment beyond its recently announced Ion Park development in Dearborn and its onsite assembly plant for the F-150 Lightning in Dearborn.

## General Motors

GM has made its intentions to be a leader in electrification clear via a series of announcements and investments over the last couple of years. It has embraced full electrification and rejected plug-in hybrids in the belief that the inclusion of two powertrains is expensive and does not meet its goals. While it is spending some effort on fuel cells, it clearly has focused its efforts on battery electric vehicles. Its joint venture with LG Energy Solution serves two purposes: 1) to ensure that it has ready access to batteries as its needs grow and 2) to minimize its direct investment by having its partner take the lead while that partner can also sell products to other manufacturers.

The Chevy Bolt has put GM in second place for U.S. EV sales. GM will offer a larger crossover version of the Bolt and is pivoting to electrifying its high-priced vehicles including Hummers (marketed under the GMC brand) and Cadillacs. That said, it will be selling Chevrolet crossovers, building versions of this vehicle for Honda and Acura, and a Silverado EV.

Batteries and associated controls will be provided via its joint venture with LG, with production in Lordstown, OH and Spring Hill, TN. Vehicle production will initially be focused on Factory Zero in Hamtramck, MI, Ingersoll, Ontario, Canada (for the BrightDrop EV600 van), Spring Hill, TN, and Ramos Arizpe, Mexico. Even with a number of products built at Factory Zero, it will take several years for the available capacity there to be utilized. The current generation of the Bolt (and the associated Bolt EUV) will continue to be built in Lake Orion, MI, although the Bolt is likely to be phased out at the end of its current product cycle.



If GM meets its high ambitions for electrification, one would expect that electric vehicles could be produced at any number of its plants around the world, including a number in North America. Given the significant unused capacity that it has, greenfield investment in new locations is unlikely.

### **Hercules Electric Vehicles**

A luxury electric pickup known as the Alpha with 300 miles of range and 1000 horsepower may be shown soon which the company hopes could appear late in 2022 or early 2023, but this is a speculative endeavor. There has been discussion that Hercules would use the Nissan Titan platform as the base for this vehicle. While Hercules does have some industry partnerships for its batteries, the outlook for this company is poor. The production location for this vehicle is not clear.

### **Honda**

Honda is a laggard in full electrification of its products and only provides the Clarity at this time, which is exported from Japan. In the next few years, Honda will rely on its partnership with GM to provide EVs under its Honda and Acura brands. It is also working with GM on autonomy and fuel cell development.

### **Hyundai (including Kia)**

Hyundai seeks to be a leader in vehicle electrification and has committed to \$7.5 billion in investment in North America in electrification and automated vehicles. It currently has a number of vehicles across the spectrum of electrified vehicles and has plans for additional plug-ins and BEVs across its Hyundai, Kia, and Genesis brands. It is using the Ioniq name as a sub-brand for a number of Hyundai BEVs and the EV name for its Kia products. Unlike some of its competitors, it continues to invest in plug-in vehicles. At this time, all of these vehicles are built in Korea and exported to the U.S. This builds upon its supply chain for batteries and other electronics which is also based in Korea. It could potentially utilize LG and SK Innovation for batteries as they are establishing domestic production, but appears to have no plans to do so at this time.

### **Indigo Technologies**

Indigo is a startup hoping to produce lightweight delivery vehicles with a small low-priced “last-mile” van-like product. Range will be in the 150-200 mile range with a battery ranging in size from 20 to 30 kWh and a retail price of \$20,000 to \$23,000. The company would like to begin production in late 2022 and is looking for contract manufacturing, making a U.S. location possible.

### **Kandi Technologies**

This company hopes to export small electric vehicles (a two-seat car and a crossover) from Chengdu, China priced in the low \$20,000s with a distributor located in Texas. Kandi has a relationship with Geely, but this is clearly a speculative situation that remains in the “unlikely” category.

The car is called the K27 and is boxy and unattractive. The K23 is the crossover which looks modern and more attractive. The car has a top speed of 63 miles per hour and 100-mile driving range from a very small battery pack, while the crossover can hit 70 miles per hour and has a range of 180 miles.

### **Karma**

Full electric vehicles are being developed. The GSe-6 is a car with a starting price of \$82,000 before incentives. The GS-6 is a plug-in designed to slot below the Revero GT and planned for 2021. This is an aggressive timetable with production planned for California. They are hoping for sales of 15,000 annually at some point, which is obviously aggressive. A GX-1 SUV has been shown for production in China in 2022. Failure is more likely than success, with additional products that could range from a supercar to delivery vans. The company is cutting costs in order to enable these ambitious plans, but has recently raised \$100 million. That amount is not sufficient to bring these vehicles to production.

## Lightyear

Lightyear is a Dutch company which is planning an electric vehicle named the One which will have solar panels on the roof which will reduce charging times. If it appears in the U.S., it might appear in 2022 or beyond, but U.S. production is unlikely.

## Lordstown Motors

This company has taken control of GM's Lordstown plant (albeit with the help of its former owner) and plans to build the Endurance (electric) pickup beginning this year. A van (stated by the company to be available by Fall 2022) and an SUV are also being planned. Both of these products are based on the Endurance. The company says it has 20,000 orders, with fleet orders representing the bulk of its production. It is seeking a \$250 million federal loan.

Lordstown is affiliated with Workhorse and the latter's failure to obtain a major contract from the US Postal Service has hurt the prospects of Lordstown. A major fire of a prototype and the failure of a launch vehicle have soured the outlook for this company, perhaps beyond repair.

Hindenburg Research has produced a report stating that the company is unlikely to meet its publicly stated plans. While Hindenburg is a short seller and thus would profit from a drop in the stock, it was correct in a similarly negative view of Nikola (see below).

## Lucid

The company's founder was a key player in the launch of Tesla and it is taking a similar route by starting with a high-end car, followed by an SUV, with other products to follow. The vehicles will be built in Casa Grande, AZ which is being built with expanded production in mind.

## Mazda

The small size of the company makes it dependent on partners for new technologies and products. Mazda has teamed with Toyota for a new crossover at a plant in Alabama which will be offered in hybrid form. Mazda is launching the MX-30 as an ICE, plug-in, and BEV, but it will not be a major player with this Japanese-produced vehicle which makes too many compromises given its multiple identities.

## McLaren

It seems like every high-end sports car manufacturer wants to get into electric vehicles, so why not McLaren? Their entry is said to be a plug-in hybrid named the Artura with production as early as this year. Other vehicles are possible, but production in the UK is the most likely result.

## Mitsubishi

Mitsubishi is now part of the Renault Nissan Alliance and its electrified products will be provided through those affiliations. The weakness of the brand in the U.S. market makes production of its vehicles in the U.S. unlikely.

## Mullen Technologies

This Spokane-based company was partnering with China-based Qiantu to manufacture and sell a luxury battery-electric sports coupe known as the Dragonfly K50. That effort appears to have floundered, but the company still hopes to sell a crossover called the MX-05 in mid-2022. The vehicle would be imported if and when it reappears.

## Nikola Motors

Nikola has seen its fortunes ebb in recent months even though it has a number of agreements with reputable companies including Bosch, IVECO, and GM. It had planned to produce an EV-powered pickup named the Badger, with GM providing content, design assistance, and production. As GM firmed up plans for the product, Hindenburg Research, a private equity fund, released a stinging report that contained a range of criticisms of the company that were mostly confirmed. The company remains in business and is focusing on Class 8 products, but the pickup is unlikely to be built.

## Nio

Nio is based in China, and has begun sales and production in that country. Nio's plans include an SUV designed as a Tesla Model X fighter that would debut in China followed by a potential U.S. launch with JAC Motors as the manufacturer, also in China. U.S. production is extremely unlikely, although JAC has sought a location in Mexico for its products and conceivably Nio's. This strategy remains in place, but is very unlikely.

## Nissan

Nissan and its Renault partner were early players in electrification with the LEAF and the Clio. In the U.S., the LEAF has been a disappointment even after its update in 2018. Nissan is attempting to improve its fortunes in electric vehicles with the launch of the Ariya later this year. This product will be imported from Japan and local production of Nissan's limited electric vehicle production is unlikely. The investment in batteries and production in Tennessee did not work well for Nissan and thus the company is unlikely to invest here again, particularly given the company's difficult finances.

## Rivian

Rivian is months away from production of its own truck and sport utility for consumers as well as purpose-built vehicles for Amazon. Its products are seeking a specific market, with backing from Cox Enterprises and a well-funded fleet customer. Rivian also has two light duty models slated for production, the R1S and the R1T. Production is occurring at the former Mitsubishi facility in Normal, IL with batteries supplied by Samsung SDI using batteries produced in China.

## Stellantis

The company is behind most of its competitors on electrification and current plans beyond mild hybridization include only plug-ins with production where the ICE vehicles are made in Windsor, Ontario, Toledo, OH, Detroit and Warren, MI.

## Subaru

Subaru's electrification plans are modest and are linked to its partnership with Toyota. Volumes for the North American market are limited to the Solterra electric vehicle and Crosstrek plug-in, both of which are imported from Japan.

## Tata

The Jaguar and Land Rover brands have been fully committed to diesel power, although they recently have pivoted to electrification. Even so, their electrified entries are limited in the near-term and are produced in Europe given their limited volume.

## Tesla

Tesla has led in sales of BEVs and continues to expand its lineup with the Cybertruck and additional production capacity in a new plant in Austin, TX which will produce the Cybertruck and provide additional volume of the Model Y. Batteries are supplied from the Gigafactory in Nevada which is slated to build the Semi Class 8 truck.

## Toyota

Toyota is playing catchup on BEVs, with a new product for each of Toyota and Lexus launching in 2022 with production in Japan. Plug-ins of the RAV4 and Prius are also produced in Japan. Hybrids for this market are produced here given their significant volume.

## Volvo

Volvo offers a range of plug-ins and BEVs, which is not surprising given its ownership by Geely and the need to meet Chinese vehicle requirements. While a variety of cars and utilities are offered in plug-in or battery-electric form, only the S60 plug-in and XC90 BEV will be produced in the United States. This is because these two products will be produced for all markets in all versions in South Carolina.

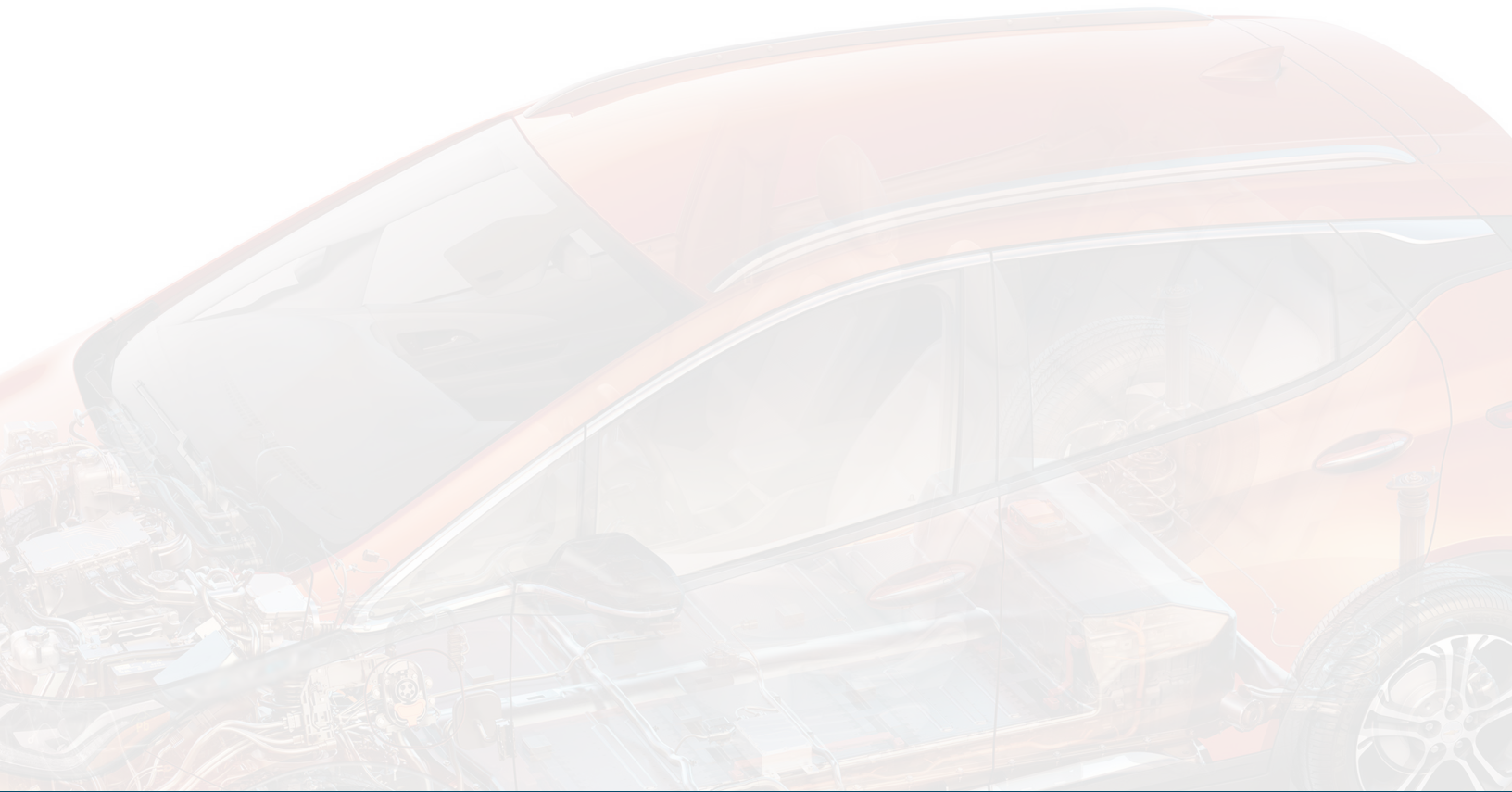


## VinFast

This is a Vietnamese startup backed by a wealthy individual currently building cars for the local market. His ambitions include battery electric vehicles which he notes will be exported globally including to the United States by 2022. This is obviously an ambitious and unlikely goal, with U.S. production even more of a long-shot.

## VW

VW has sought to pivot from the Dieselgate scandal to go all in on electrification of its vehicle fleet across all of its brands. While some plug-in vehicles remain, the focus is on full electrification. While a significant number of entries are for high-end buyers served by Audi and Porsche, vehicles offered by the VW brand are becoming more important which will lead to increased volumes. Vehicles are currently imported from Belgium, Germany, Hungary, and Slovakia, but the VW ID.4 and ID.6 will be produced in Chattanooga, TN. Batteries for these vehicles will be provided by the SK Innovation plant in Georgia. It seems unlikely that Audi and Porsche vehicles will be produced here since the volume of these vehicles is relatively modest, even when serving multiple markets. Production in China is also growing and that country may become an export base.



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