BRIEFING

JUNE 2022

Power play: Unlocking the potential for U.S. automotive trade with electric vehicles

This briefing evaluates automotive vehicle trade dynamics by analyzing the vehicle industry and market trends in the United States and globally. Using a scenario-based analysis of growth in the electric vehicle market and global trade, this briefing quantifies future U.S. electric vehicle wholesale production, sales, imports, and exports and analyzes the trade revenues associated with these activities. It is the third in an occasional series on the political economy of the automotive industry in the United States.[1]

INTRODUCTION AND BACKGROUND

The COVID-19 pandemic and global economic downturn led to greatly reduced light-duty vehicle sales across the industry worldwide. In the first half of 2020, global new registrations decreased by one-third compared to the previous year.[2] In contrast to this unprecedented drop, the electric vehicle market continued its rapid growth, with more than 3.1 million units sold in 2020, a 40% increase from 2.2 million in 2019.[3] This growth is expected to continue. Motivated by the need for clean air, a stable climate, and reduced dependence on fossil fuel, national and subnational governments worldwide

1 The briefing focuses on trade impacts of wholesale vehicles that can be retailed in large quantities, excluding the economic impacts from upstream and downstream material trades. Previous papers in this series are Nic Lutsey, Mikhail Grant, Sandra Wappelhorst, and Huan Zhou, P*ower play: How governments are spurring the electric vehicle industry* (ICCT: Washington, DC, 2018), https://theicct.org/publication/power-play-how-governments-are-spurring-the-electric-vehicle-industry/ and Anh Bui and Peter Slowik, *Power play: Evaluating the U.S. position in the global electric vehicle transition* (ICCT: Washington, DC, 2021), https://theicct.org/publication/power-play-evaluating-the-u-s-position-in-the-global-electricvehicle-transition/

2 International Energy Agency, *Global EV Outlook 2021*, https://iea.blob.core.windows.net/assets/ed5f4484-f556-4110-8c5c-4ede8bcba637/GlobalEVOutlook2021.pdf.

3 Anh Bui, Peter Slowik, and Nic Lutsey, *Evaluating electric vehicle market growth across U.S. cities*, (ICCT: Washington DC, 2021), https://theicct.org/publications/ev-us-market-growth-cities-sept21.

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THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

are setting strong electric vehicle targets and implementing regulatory, consumer, and industrial policies to accelerate market growth.[4]

Many governments are equally motivated by the economic benefits of a growing electric vehicle industry and its flourishing supply chain. This is because having a comparative advantage in global vehicle trade—meaning that a country produces goods at a lower opportunity cost (low production cost per unit of local resources) than its trading partners—is significant for countries that lead the transition to electric vehicles. Related to this in the United States is the Biden administration's call for a 50% electric vehicle sales share in 2030 and its pursuit of policies and investments to strengthen U.S. leadership on clean vehicles, create good-paying jobs, dramatically expand auto manufacturing, and export electric vehicles globally.[5]

Onshoring the electric vehicle industry would provide the United States a comparative advantage for several reasons. First, the expansion of electric vehicle research and development (R&D) creates professional jobs and innovation to make electric vehicles more reliable and efficient, i.e., to offer consumers higher-value vehicles, and to make mass production cheaper if the United States can rapidly secure an integrated supply chain. Second, in the long term, while other markets can produce the mature technologies in internal combustion engine (ICE) vehicles with low-cost labor, thereby competing with U.S. ICE vehicle sales and jobs, U.S.-made electric vehicles would still constitute high-value goods on the global market, with all the advantages that highly developed R&D provides.

Third, establishing domestic battery manufacturing for electric vehicles has a variety of benefits. Historically, countries that have invested in electric vehicle battery production have also experienced a significant increase in electric vehicle production, and consequently, greater exports of electric vehicles and higher associated revenues.[6] In addition, these countries stand to benefit from new employment opportunities, increased domestic electric vehicle sales, reduced fuel and vehicle imports, and expanded exports to other emerging electric vehicle markets as the global shift continues. Advanced batteries can also become crucial in other critical areas, for example, in storage applications for a cleaner grid that future-proofs national climate goals and provides positive economic and environmental externalities. For all these reasons, the U.S. automobile manufacturing industry would face the greatest industry and economic risk if they fell behind in the transition to electric vehicles.

ANALYSIS OF GLOBAL VEHICLE FLOWS

This section assesses the light-duty and electric vehicle flows among major markets and provides a more detailed analysis of the 2019 U.S. light-duty and 2020 U.S. electric vehicle market metrics, including vehicle production, sales, exports, imports, and trade value.[7]

4 Hongyang Cui, Dale Hall, Jin Li, and Nic Lutsey, *Update on the global transition to electric vehicles through 2020,* (ICCT: Washington DC, 2021), https://theicct.org/publications/global-update-evs-transition-oct21.

5 The White House, Fact Sheet: President Biden announces steps to drive American leadership forward on clean cars and trucks (2021), https://www.whitehouse.gov/briefing-room/statements-releases/2021/08/05/fact-sheet-president-biden-announces-steps-to-drive-american-leadership-forward-on-clean-cars-and-trucks/.

6 Jeff Horowits, David Coffin, and Brennan Taylor, *Supply Chain for EV batteries: 2020 Trade and Value-added Update (2021),* https://www.usitc.gov/publications/332/working_papers/supply_chain_for_ev_batteries_2020_trade_and_value-added_010721-compliant.pdf.

7 We analyze 2019 light-duty vehicle data instead of 2020 due to the effect of COVID. 2019 data is assumed to best represent the light-duty vehicle market dynamics post-pandemic.

LIGHT-DUTY VEHICLES

Global light-duty vehicle production, sales, export, and import trends are shown in Figure 1, as stacked bars for the major vehicle markets and the Rest of World in 2019, based on data from multiple datasets.[8] The major markets are ranked from bottom to top based on volume, with the Rest of World added at the top of each bar. Overall, about 82 million new light-duty vehicles were produced and sold globally in 2019. China had the greatest production volume, followed by Europe. The United States was third in production and sales, with 10.7 million vehicles produced and 17 million sold. Not shown in the figure are the interregional dynamics in markets comprised of many countries such as Europe and the Rest of World.

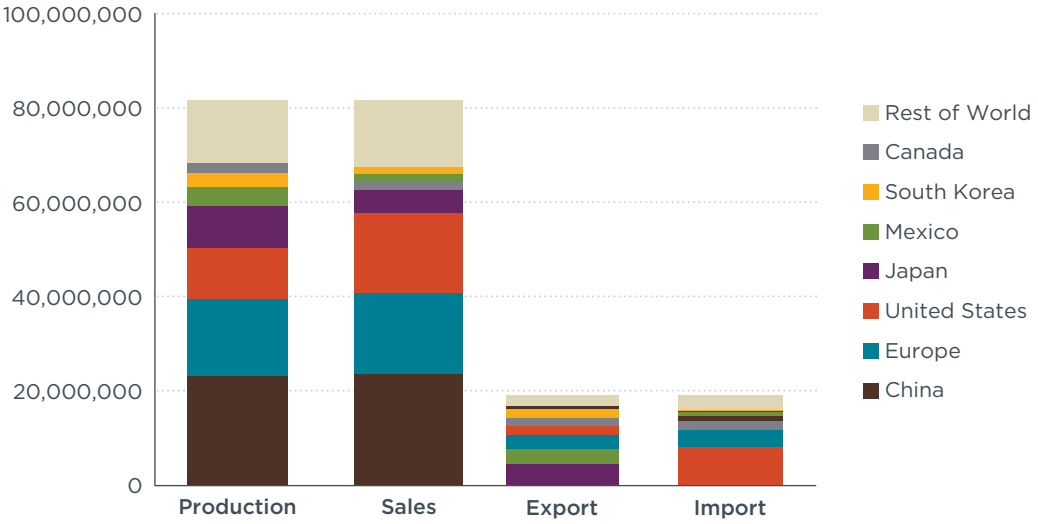

Figure 1. Global new light-duty vehicle production, sales, exports, and imports in 2019

Figure 2 breaks down light-duty vehicle trade and volumes, based on the same 2019 vehicle data used to create Figure 1. New 2019 vehicle production is shown on the left and new 2019 vehicle sales are on the right. The major markets are ordered from top to bottom based on highest 2019 production volume, with Rest of World at the bottom. Color-coded flows from left to right for each market depict export volumes. Of the 82 million light-duty vehicles sold in 2019, about 75% were sold in the market where they were produced. This dynamic roughly holds for electric vehicles from 2017 to 2020, when 80% of electric vehicle sales occurred in the markets where they were produced.[9] In some countries, the share of domestically-assembled light-duty vehicle sales was high, for example in China (95%), Japan (93%), South Korea (82%), and Europe (79%). Meanwhile, the United States produced approximately 48% of its sales. In Mexico and Canada, 34% and 5% of light vehicles sold were produced domestically; the rest were exported.

8 Production and sales data were collected from various sources. International Trade Administration, New vehicle trade data visualization, https://www.trade.gov/data-visualization/new-vehicle-trade-data-visualization; International Trade Administration, Mexico-Country Commercial Guide, https://www.trade.gov/country-commercial-guides/mexico-automotive-industry; Marklines, Vehicle Sales data, https://www.marklines.com/en/vehicle_sales/index; European Automobile Manufacturers Association, *Economic and Market Report: EU Automotive Industry Full-year 2019*, https://www.acea.auto/files/Economic_and_Market_Report_full-year_2019.pdf; United Nation Environment Programme, *Global Trade in Used Vehicles Report*, https://www.unep.org/resources/report/global-trade-used-vehicles-report; Japan Automobile Manufacturers Association, Motor Vehicle Statistics of Japan 2019, https://www.jama.org/motor-vehicle-statistics-japan-2019/.

9 Anh Bui, Peter Slowik, and Nic Lutsey, *Power play: Evaluating the U.S. position in the global electric vehicle transition*, (ICCT: Washington, DC, 2021) https://theicct.org/publication/power-play-evaluating-the-u-s-position-in-the-global-electric-vehicle-transition/.

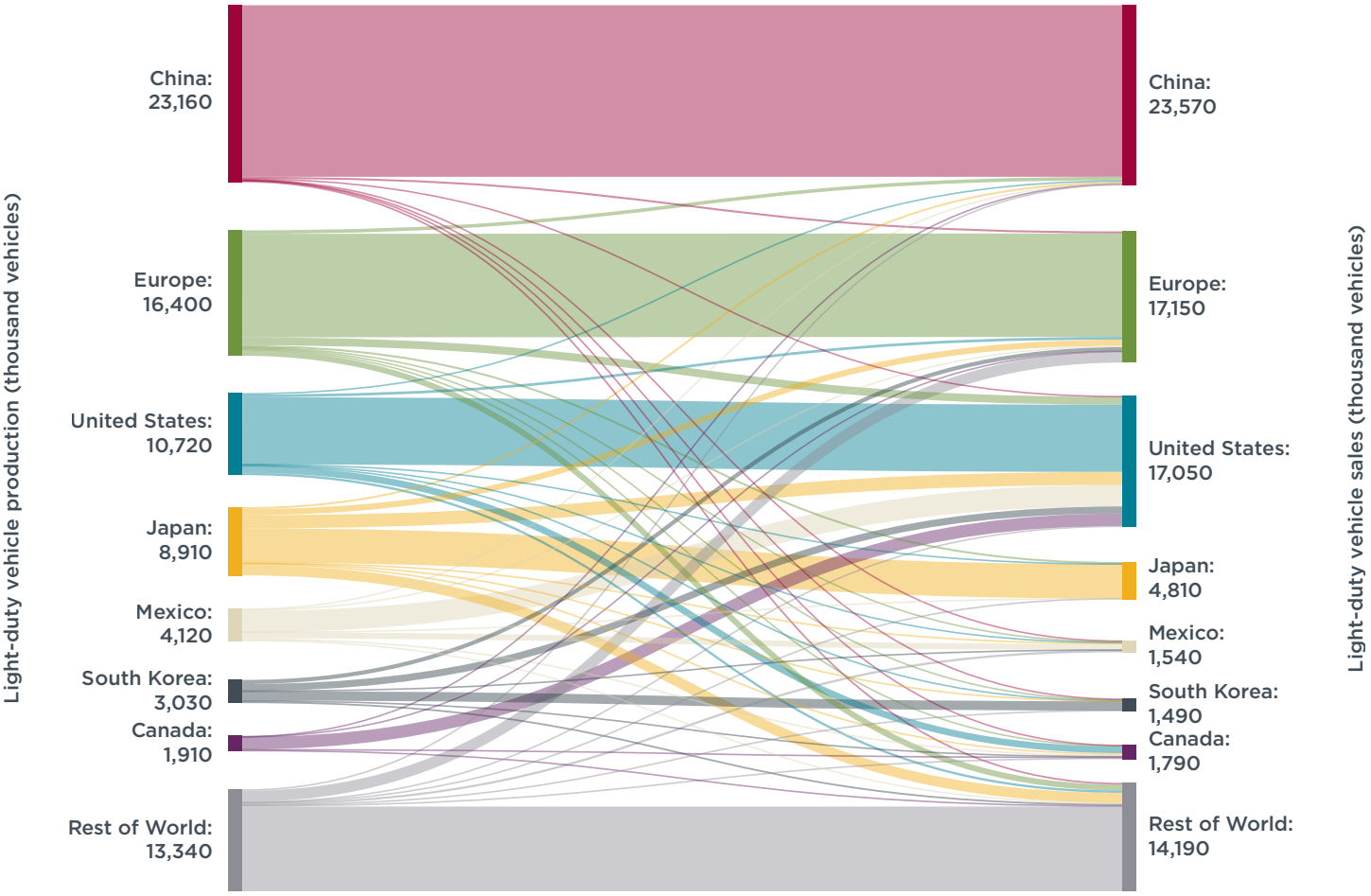

Figure 2. Global new light-duty vehicle flows in 2019

ELECTRIC VEHICLES

Figure 3 shows electric vehicle production, sales, exports, and imports for the markets in 2020, based on data from EV Volumes.[10] The major markets are ranked from bottom to top in each category based on volume, with the Rest of World at the top. As shown, China and Europe had the greatest electric vehicle production and sale volumes; these two markets combined represented about 77% of the 3.1 million electric vehicles produced globally and about 84% of sales, in 2020. The United States is the third largest electric vehicle market in terms of both production and sales, a situation similar to that of the light-duty vehicle market. With about 455,000 electric vehicles produced and 325,000 electric vehicles sold, the United States represents about 15% of 2020 global electric vehicle production and 11% of sales. Smaller electric vehicle markets such as Japan, South Korea, Mexico, and Canada, as well as the Rest of World, had low levels of production and sales.

10 EV-Volumes (EV Data Center, 2020), http://www.ev-volumes.com/datacenter/.

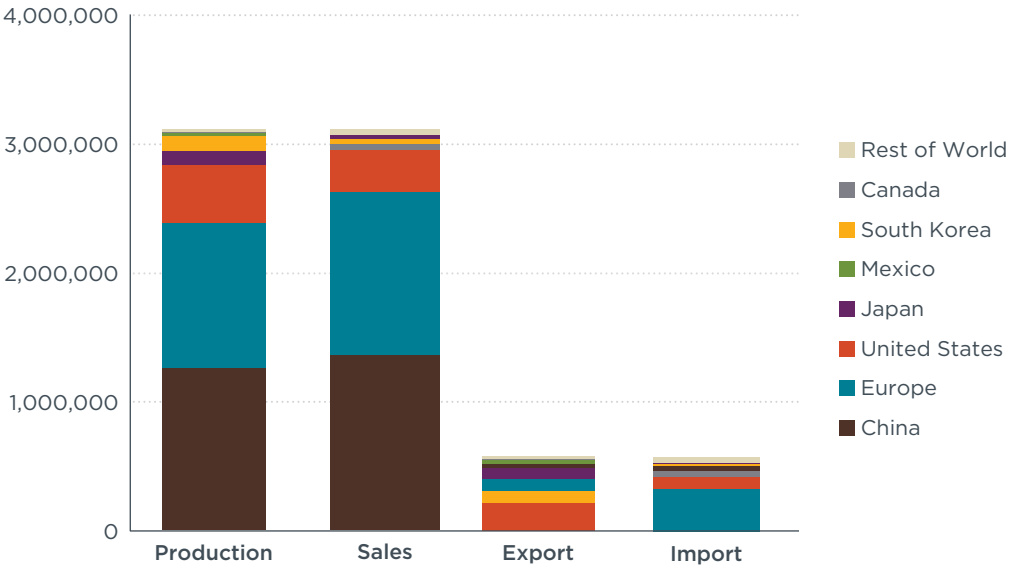

Figure 3. Global electric vehicle production, sales, exports, and imports in 2020 (based on EV-Volumes, 2020)

Figure 3 reveals several additional points about global electric vehicle trade. The United States exported close to 220,000 vehicles, the most of the major markets. The second highest exporter was South Korea, followed by Europe. Overall, the United States, Japan, South Korea, and Mexico are net exporters. With high sales volumes and relatively low production compared to sales, Europe was the biggest net importer of electric vehicles. Electric vehicle exports from Canada and the Rest of World are comparatively limited; they, too, are net importers.

Figure 4 provides a more detailed breakdown of the 2020 global electric vehicle trade, using the same data as for Figure 3. Major markets are ordered from top to bottom based on production volume, with Rest of World at the bottom. Overall, more than 70% of the U.S. electric vehicle sales in 2020 were assembled or produced in the country, which is lower than the share of domestically-assembled electric vehicle sales in China (98%), Japan (79%), and Europe (76%).

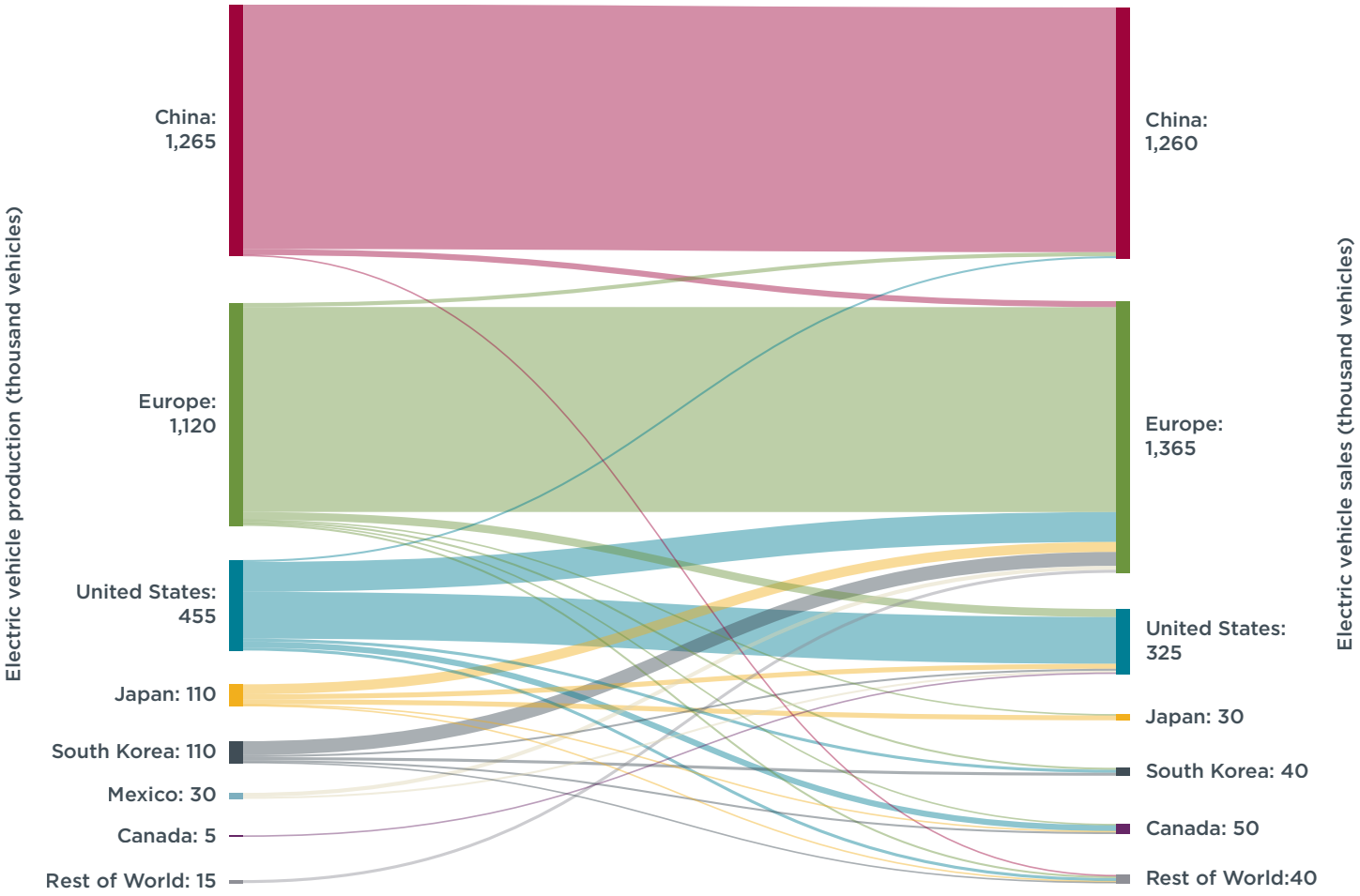

Figure 4. Global new electric vehicle flows in 2020 (based on EV-Volumes, 2020)

Figure 4 also provides more insight into the U.S. trade dynamics with other markets. The United States exported 220,000 electric vehicles. About 67% of U.S. electric vehicle exports were sold to Europe, followed by 13% to Canada, 7% to Rest of World, 6% to South Korea, and 5% to China. About 2% were exported to Japan and Mexico. The U.S. imported more than 90,000 vehicles in 2020, of which 41% came from Europe, 29% from Japan, 15% from South Korea, 9% from Mexico, and 6% from Canada.

The electric vehicle import and export volumes have direct implications for the U.S. economy. Figure 5 summarizes the same electric vehicle production, sales, export, and import market volumes for the United States, along with additional information on the revenues associated with international electric vehicle trade in 2020. The dollar value of electric vehicle trade is calculated based on data from EV-Volumes of the volumes and prices of electric vehicle models exported and imported by the United States. The price for each model was based on the estimated minimum manufacturers' suggested retail price (MSRP) in 2020, considering different model trims (option packages). We found that the weighted average export price per vehicle was about $55,000, compared to an average import price of about $52,000.

In the center of Figure 5, U.S. electric vehicle sales of 325,000 units is shown as the combination of imports (red bar) and US-domestic production retained for domestic sales (brown bar). Total U.S. production of 455,000 units is denoted by the brown bar and the green bar (exports). Electric vehicle imports of 90,000 units, representing one-

fourth of total sales, is shown in the red arrow on the left of the figure, along with its corresponding $5 billion in payments. Similarly, the green arrow on the right represents the export volume and its associated revenue, totaling $11 billion. The 220,000 vehicles exported accounted for roughly half of U.S. electric vehicle production.

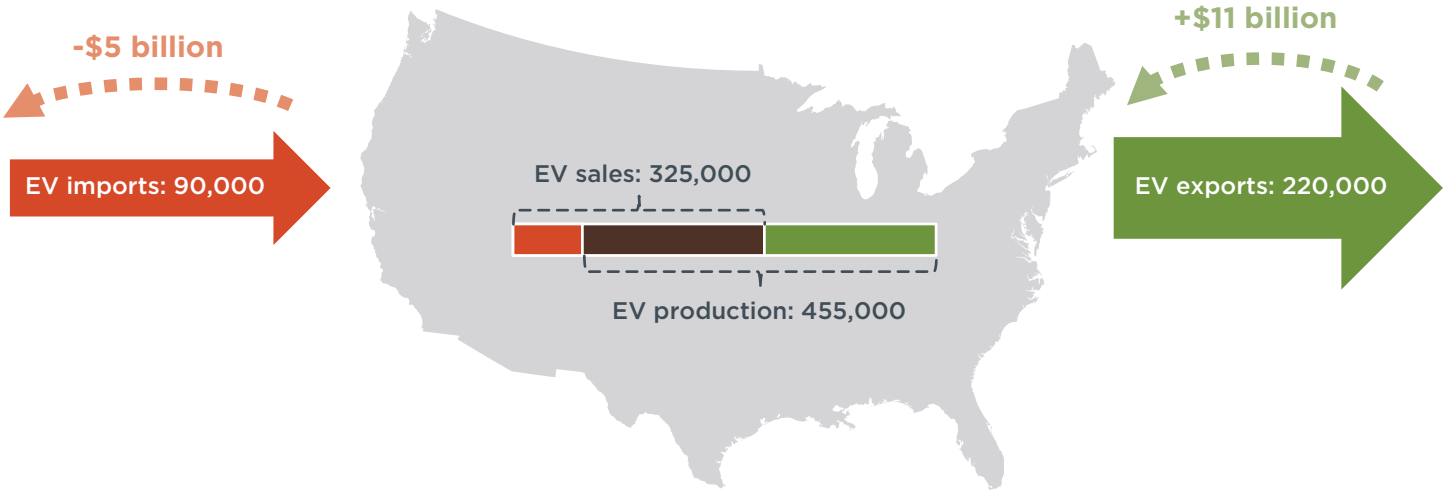

Figure 5. Electric vehicle market metric volumes and trade revenues in 2020 (EV Volumes, 2020)

Several additional points help to put the U.S. electric vehicle trade revenue from Figure 5 in context. Twelve electric vehicle models were exported from the United States in 2020. The Tesla Model 3 had the highest volume, at 132,000 vehicles and an MSRP of $50,000, followed by the BMW X5 45e plug-in hybrid (PHEV) at 18,000 units and a price of $60,000. Tesla Model X was third with 16,000 vehicles exported at an MSRP of $90,000. Other notable models with more than 5,000 vehicles exported include the BMW X3 30e PHEV, Tesla Model S, and Chevy Bolt EV. Overall, Tesla models accounted for 91% of U.S. electric vehicle exports. Europe imported the most U.S.-made electric vehicles at about 140,000 units, of which 75% were Tesla models, and 15% were BMW X5 PHEVs.

The number of electric vehicle models produced in the United States is relatively limited. Of the 59 electric vehicle models sold in the United States in 2020, 47 were imported.[11] The United States imported about 14,500 Toyota Prius PHEVs from Japan at an MSRP of $27,000 per unit, 7,200 Audi e-tron battery electric vehicle (BEV) from Europe at an MSRP of $87,000, and 5,500 Chrysler Pacifica PHEVs from Canada at $40,000 each. Of the 15 global top-selling models in 2020, only three models were produced in the United States, including Tesla Model 3, Tesla Model Y, and Nissan Leaf. By comparison, nine of the 15 global top-selling models were produced in China, and seven were produced in Europe.

UNITED STATES MARKET GROWTH ANALYSIS

This section assesses U.S. electric vehicle production, sales, exports, imports, and associated trade balances, in scenarios in which the U.S. leads or lags the electric vehicle industry.

11 Model export and import was corroborated using Marklines data on automakers' model production by plant, Marklines EV sales by model, and EV Volumes sales.

We developed several market scenarios to quantify a variety of economic potentials. In three sale scenarios, U.S. sale goals impact production and export, and in three import scenarios different levels of U.S. dependence on other electric vehicle markets are assumed. Together, the nine scenarios provide a comparison between future scenarios, illustrating the broader economic opportunities and risks for the United States.

The three sales scenarios are incremental, moderate, and accelerated electric vehicle sales. Under the incremental sales scenario, annual US electric vehicle sales increase to 3.2 million by 2030, accounting for approximately 20% of 2030 U.S. light-duty vehicle (LDV) sales.[12] In this scenario, we sum electric vehicle production from U.S. assembly plants based on existing and announced electric vehicle volumes. Under the moderate sales scenario, U.S. electric vehicle sales reach 5.5 million by 2030 (30% of 2030 U.S. light-duty vehicle sales), consistent with the analysis of automaker electric vehicle goals and investments summarized in previous ICCT briefings.[13] For the accelerated sales scenario, U.S. electric vehicle sales, including BEVs, PHEVs, and fuel cell electric (FCEVs), are assumed to increase to 8.7 million, which is approximately half of 2030 U.S. light-duty vehicle sales and consistent with President Biden's 2021 Executive Order.[14]

The three import scenarios are low, medium, and high levels of imports of electric vehicles as a share of sales in the United States. From 2018 to 2020, close to 70% of U.S. electric vehicle sales were domestically produced. This means approximately 30% of U.S. electric vehicle sales were imported. For the low import scenario, this rate lowers to 10%. Because customer preferences vary by model, it is realistic to assume that each market will continue to import some electric vehicles. For the medium scenario, imports are 20% of total U.S. electric vehicle sales in 2030 based on President Biden's plan to strengthen the domestic supply chain and grow jobs for the automotive sector.[15] This reflects the share of sales imported in the European electric vehicle market that had experienced high growth in 2020. Under the high import scenario, we assume the United States retains the 2020 import share of 30% by 2030.

Other assumptions cover the annual increase in vehicle production, sales, and export and import volumes from 2020 to 2030, and vehicle prices in trading. In all scenarios, the vehicle volume for production, sales, exports, and imports each year is scaled up using the compounded annual growth rate based on the 2020 and 2030 volumes. About half of electric vehicle production was exported in 2020. With the shift to electric vehicles to replace internal combustion engine (ICE) vehicles in production and sales, export dynamics by 2030 potentially resemble the relatively stable light-duty vehicle export market between 2017 and 2019. We simplify the electric vehicle export volume to constitute 20% of total U.S. electric vehicle production and to reflect approximately 25% of U.S.-assembled electric vehicle sales. In reality, this volume

12 We assume 2030 light-duty vehicle sales return to a more stable pre-pandemic volume and are close to average US light-duty vehicle sales between 2015 and 2019, which ranged from 17.1 to 17.6 million vehicles. Data from Marklines, Vehicles sales data.

13 Anh Bui, Peter Slowik, and Nic Lutsey, *Power play: Evaluating the U.S. position in the global electric vehicle transition*; Peter Slowik, Nic Lutsey, and Chih-Wei Hsu, *How technology, recycling, and policy can mitigate supply risks to the long-term transition to zero-emission vehicles* (ICCT: Washington DC, 2020), https://theicct.org/publications/mitigating-zev-supply-risks-dec2020; EV Atlas Hub, Global Private Investment, https://www.atlasevhub.com/materials/private-investment/.

14 The White House. Fact sheet: Presiden Biden announces steps to drive American leadership forward on clean cars and trucks.

15 The White House, Fact sheet: The American Jobs plan (2021), https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/31/fact-sheet-the-american-jobs-plan/?utm_source=EV+Hub&utm_campaign=a500a393a6-.

varies based on multiple influences such as federal policies and automakers' strategies. Regarding vehicle cost, we assume most imported and exported vehicles reach cost parity with light-duty vehicles in the domestic market by 2028 and remain close to that price until 2030.[16] Put simply, the 2020 export price of $55,000 and import price of $52,000 per vehicle are assumed to decline gradually to approximately $35,000 per unit by 2030.

The three sales dynamics and the three import variables combine to create a nine-scenario matrix. Table 1 summarizes the electric vehicle production, sales, exports, and imports in 2030 for these scenarios. The import volume is the highest at the top right corner under accelerated sales and low imports. Total electric vehicle production is the sum of exports and U.S.-assembled sales, which is the difference between total sales and imports. Production is highest on the top left corner with accelerated sales and low imports. The lowest production level is found in the bottom right corner in the incremental sales and high imports. Similar dynamics are observed for the export volume. The scenarios in blue text that represent different tiered-production and sales will be further displayed and discussed in the next section.

Table 1. U.S. electric vehicle production, sales, exports, and imports in nine market scenarios in 2030

	Low imports (10% EV sales)	Medium imports (20% EV sales)	High imports (30% EV sales)
Accelerated sales (50% LDV sales)	**Production: 9.7 million** **Sales: 8.7 million** **Exports: 1.9 million** **Imports: 870,000**	Production: 8.7 million Sales: 8.7 million Exports: 1.7 million Imports: 1.7 million	Production: 7.6 million Sales: 8.7 million Exports: 1.5 million Imports: 2.6 million
Moderate sales (30% LDV sales)	Production: 6.2 million Sales: 5.5 million Exports: 1.2 million Imports: 550,000	**Production: 5.5 million** **Sales: 5.5 million** **Exports: 1.1 million** **Imports: 1.1 million**	Production: 4.8 million Sales: 5.5 million Exports: 960,000 Imports: 1.6 million
Incremental sales (20% LDV sales)	Production: 3.6 million Sales: 3.2 million Exports: 730,000 Imports: 320,000	Production: 3.2 million Sales: 3.2 million Exports: 650,000 Imports: 650,000	**Production: 2.8 million** **Sales: 3.2 million** **Exports: 570,000** **Imports: 970,000**

Figure 6 illustrates the key findings for wholesale electric vehicle production, sales, imports, and exports based on the three scenarios in blue text from Table 1. The symbol representation from Figure 5 is applied to this figure. The United States exports the most and imports the least in the accelerated sales with low imports scenario, generating a $37 billion surplus, which is the difference between export and import trade revenues. In contrast, United States had a $14 billion deficit in the incremental sales and high imports scenario. With moderate growth and import, the country "breaks even" as export and import price are at parity.

16 Nic Lutsey and Michael Nicholas, *Update on electric vehicle costs in the United States through 2030* (ICCT: Washington DC, 2019), https://theicct.org/publications/update-US-2030-electric-vehicle-cost.

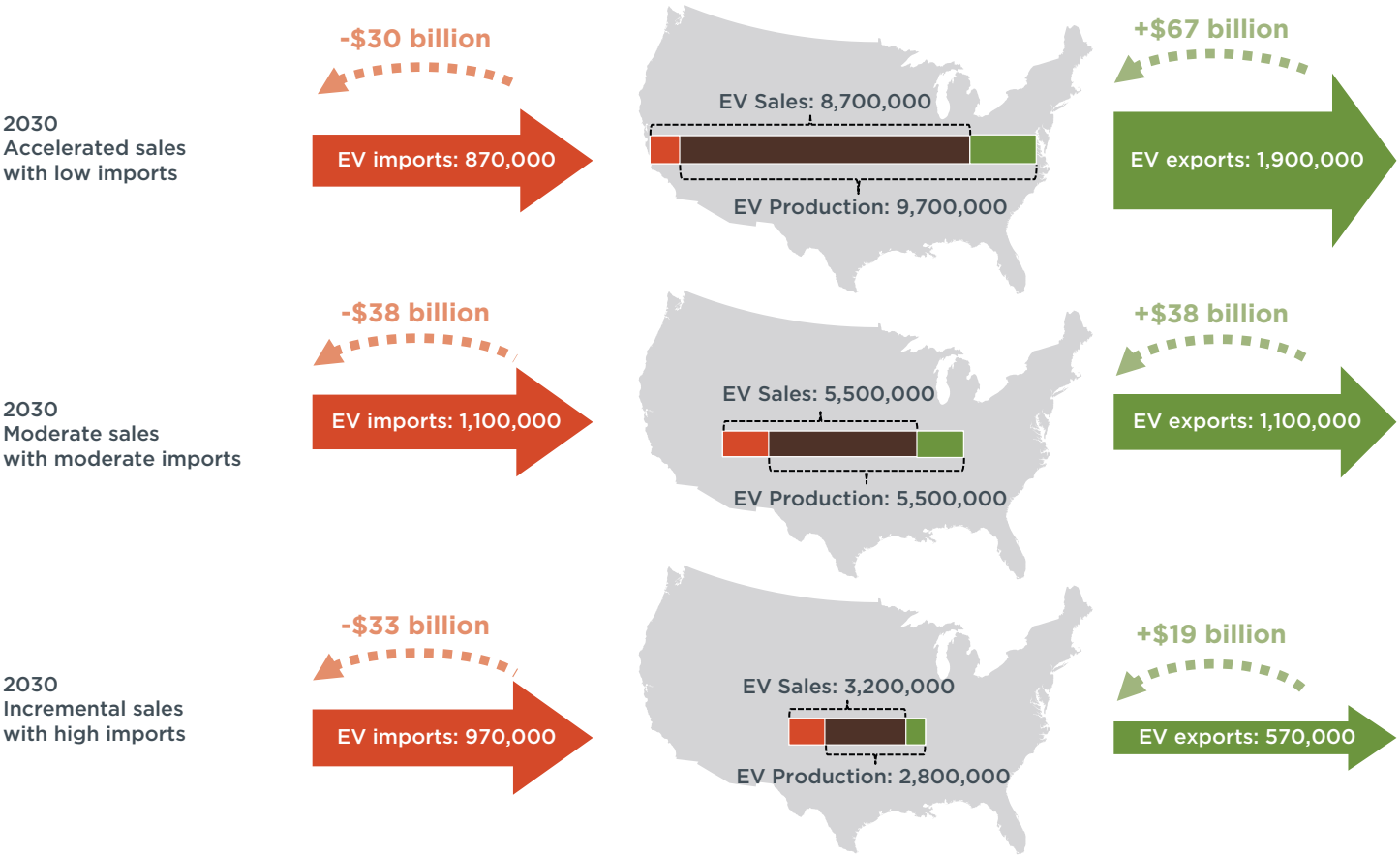

Figure 6. U.S. electric vehicle market metric volumes and trade revenue, three scenarios, 2030

The long-term economic opportunities extend beyond annual revenue as the United States capture greater global market share. Table 2 summarizes the trade balance for the United States between 2021 and 2030 for the nine scenarios. Positive numbers in the table show surplus—export revenues are generally higher than import revenue—while negative numbers show a deficit, all in billion dollars. The best-case scenario, highlighted in green, is still the accelerated sales and low import with the highest trade revenue and a $188 billion surplus. About $37 billion or one-fifth of this surplus comes from 2030 trade revenue, as shown in Figure 6. Highlighted in red text is the worst-case scenario, accelerated sales and high imports, representing the highest deficit.

Table 2. U.S. total trade balance 2021-2030 (billion $) from electric vehicle trade in nine sales and import scenarios

	Low imports	Medium imports	High imports
Accelerated sales	**$188**	$70	**-$40**
Moderate sales	$139	$57	-$19
Incremental sales	$100	$46	-$5

Table 2 further reveals the balances between export and import volumes. The positive trade balance in the accelerated sales and low imports scenario (green text), is close to 3.3 times higher than the moderate sales and medium imports scenario. In the accelerated sales and high import scenario, by 2030, the electric vehicle exports (1.5 million) reflect roughly 20% of total U.S. electric vehicle sales (8.7 million), compared

to the 30% represented by the imports (2.6 million). The trade deficit is approximately $40 billion. In this scenario, even though the United States has a relatively high domestic production volume, the country overall imports more vehicles than it exports between 2021 and 2030.

POLICY CONTEXT

Supply- and demand-side policies are both crucial to expansion of the electric vehicle industry. Automakers and battery manufacturers typically look for markets with the best business and political environments, access to skilled labor, proximity to customers, and raw material suppliers. Both China and Europe have shown further advancement in electric vehicle development than the United States due to comprehensive government policies and investments that facilitate stronger foundations for the electric vehicle market.

Several examples point to the role of policy in the growth of the electric vehicle market in China and Europe. Tightened CO_2 standards and additional electric vehicle fiscal incentives to alleviate the 2020 COVID-19 economic downturn likely contributed to the European Union's three-fold increase in electric vehicle adoption relative to 2019. China strengthened targets for new energy vehicle sales from 2021 onwards and continued strong non-fiscal policy incentives, leading to high and stable sales levels in 2020. These markets have also established strong support for the domestic supply chain for electric vehicles, including development of batteries—the most expensive component in electric vehicle manufacturing.[17] For example, Germany announced $1.1 billion to fund European Union battery production, and France invested $800 million to support planning for the battery value chain.[18] China has been the leader in battery production since 2017 and is likely to continue dominating this market. It is also the only country with a dedicated new energy vehicle battery recycling policy and guidelines to help secure recycled raw materials.[19]

To catch up in the long run, it may be necessary for the U.S. federal and state governments to make direct, non-financial support along with financial investments in both battery and vehicle manufacturing capacity, similar to those made in the EU and China. More stringent regulations and expansion of fuel economy standards and ZEV requirements in more U.S. states could play a complementary role in supporting domestic ZEV sales and accelerating the development of the emerging domestic electric vehicle manufacturing industry.

Direct financial investment, which could take the form of grants, loan guarantees, or subsidies reserved for domestic manufacturing, would help develop this early market toward a strong domestic electric vehicle industry. For reference, in 2019 alone, U.S. light-duty vehicle trade deficit was more than $138 billion.[20] This paper analyzes the trade impacts of domestically produced electric vehicles that make up, at most, 45% of U.S. light-duty vehicle sales by 2030 (as shown in the accelerated sales and low imports scenario). To further offet the light-duty vehicle deficit and maintain

17 Nic Lutsey and Michael Nicholas, *Update on electric vehicle costs in the United States through 2030*.

18 Transport & Environment, *Electric surge: Carmakers' electric car plans across Europe 2019-2025 (2021),* https://www.transportenvironment.org/wp-content/uploads/2021/07/2019_07_TE_electric_cars_report_final.pdf.

19 Lingzhi Jin, Hui He, Hongyang Cui, Nic Lutsey, Chuqi Wu, and Yidan Chu, *Driving a green future: A retrospective review of China's electric vehicle development and outlook for the future,* (ICCT: Washington, DC, 2021) https://theicct.org/publications/china-green-future-ev-jan2021.

20 International Trade Administration, New vehicle trade data visualization.

the pace of the electric vehicle transition, the government can deploy investment strategies to minimize imports, such as building or expanding manufacturing plants to produce high-value electric vehicles for domestic sales and exports. As a policy example, expanding and attaching electric vehicle requirements to the Advanced Technology Vehicles Manufacturing Loan Program can nudge the automobile industry to domestically produce electric vehicles in greater volumes.[21] Support could also come from state governments in the form of funding for projects to increase in-state manufacturing of electric vehicles, components and batteries, and charging infrastructure, similar to California's Zero-Emission Vehicle (ZEV) transportation manufacturing grants.[22]

Robust industry development in key supply areas has the potential to create jobs upstream in the supply chain and manufacturing, and downstream in other logistics and recycling areas. Several studies point to the job creation benefits of the transition. The automotive sector is one of the largest industries in the United States based on employment, with more than 4 million jobs tied to manufacturing and retail trade of motor vehicles and parts.[23] While the bulk of automotive jobs are still in ICE vehicle production, the share of jobs in electric vehicle technology is growing. At automaker plants across the United States, close to 60,000 employees will be working on electric vehicles by 2025.[24]

It is estimated that close to 150,000 assembly and auto-part jobs could be created by 2030 in a scenario in which battery electric vehicles make up 50% of light-duty vehicle sales, the United States assembles 60% of its light-duty vehicles sales, and domestic electric vehicle powertrain production accounts for 75% of total powertrain use in U.S. electric vehicle manufacturing.[25] To put this into perspective, under the best-case scenario in our analysis where the U.S. experiences accelerated electric vehicle sales and low imports, electric vehicles make up 50% of U.S. light-duty vehicle sales with 90% assembled domestically. This suggests that achieving the best-case scenario defined in this briefing would be associated with job creation that would exceed 150,000 by 2030.

CONCLUSIONS

As the electric vehicle industry evolves and changes the trade dynamics of light-duty vehicles, a key question emerges for the United States domestic automotive industry. To what extent will the United States drive the transition in its own market and, at the same time, claim a long-term integral position in global electric vehicle trade? We conclude with the following four takeaways related to the U.S. position in the electric vehicle industry and its opportunity to become a leader in the sector.

21 U.S. Loan Program Office, Advanced Technology Manufacturing Loan Program, accessed May 4, 2022, https://www.energy.gov/lpo/products-services/advanced-technology-vehicles-manufacturing-loan-program.

22 California Energy Commission, GFO-21-605- Zero-Emission Transportation Manufacturing, accessed May 4, 2022, https://www.energy.ca.gov/solicitations/2022-03/gfo-21-605-zero-emission-transportation-manufacturing.

23 U.S. Bureau of Labor Statistics, Automotive Industry: Employment, Earnings, and Hours, https://www.bls.gov/iag/tgs/iagauto.htm.

24 Electric vehicle only employee data from Atlas EV Hub, https://www.atlasevhub.com/materials/automakers-dashboard/.

25 Economic Policy Institute, *The stakes for workers in how policy makers manage the coming shift to all-electric vehicles* (2021), https://www.epi.org/publication/ev-policy-workers/ .

The U.S. light-duty and electric vehicle markets are behind China and Europe. Close to 50% of the U.S. light-duty vehicle sales and 30% of electric vehicle sales are imported. In contrast, China and Europe imported 5% and 21%, respectively, of their light-duty vehicle sales. Similarly, China and Europe imported 2% and 24% of their electric vehicle sales. These two electric vehicle markets each had more than four times the electric vehicle sales of the United States, and three times the U.S. production, in 2020. The United States also has less electric vehicle model availability than the other two competing markets. The U.S. market imported close to 80% of the electric models sold in the country in 2020. Of the 15 global top-selling models in 2020, three were produced in the United States, nine were produced in China, and seven were made in Europe.

Markets with well-designed policies and incentives experience electric vehicle growth. Federal regulatory and support policies along with incentives are critical to influence automakers' decisions on new electric vehicle facility construction and facility upgrades to support the transition. The influence of such policies can be seen in major market developments in 2020. Europe experienced a three-fold increase in electric vehicle sales following the introduction of electric vehicle purchase incentives in stimulus packages, direct investment in domestic battery manufacturing capacity, and development of CO_2 emission standards that pushed automakers to introduce more models to the market. China saw a drop in sales in early 2020 due to the decrease in subsidies then reversed the trend in the second half of 2020 by extending the subsidy program and increasing the sales target for new energy vehicles (electric vehicles). Greater government investment will likely be necessary in the U.S. to build a strong battery and electric vehicle manufacturing industry, such as grants for the construction of new manufacturing facilities as well as other fiscal and non-fiscal measures. Our research shows that these early investments will likely have large knock-on benefits for U.S. trade in the longer term.

Establishing a robust domestic electric vehicle manufacturing industry comes with great benefits. In 2020, the United States had the highest export volume of electric vehicles, generating a surplus of $6 billion. Our scenarios demonstrate that if the United States reaches 50% electric vehicle sales and imports just 10% of them, the country would potentially generate a $188 billion trade surplus, accumulated from 2021 to 2030. In contrast, achieving 50% electric vehicle sales by 2030 and doing so primarily via imports results in substantial trade defecits of up to $40 billion through 2030. Therefore, efforts to significantly increase domestic electric vehicle production capacity by at least as much as the pace of increased electric vehicle sales are needed to position the United States as a leader in the global industry.

The United States has the potential to establish more supply chain production capacity to support the domestic electric vehicle industry and job growth. As the country rapidly shifts to production of more electric vehicles, policies to establish an adequate and premium supply chain are crucial to reduce United States reliance on imports from other markets, both in light-duty and ultimately, electric vehicle production. By doing so, the country can vertically integrate more production, offset imports, reduce upfront vehicle costs, and create jobs upstream and downstream within the electric vehicle ecosystem. The "best-case" scenario of accelerated electric vehicle sales and low imports is approximately aligned with those by other studies that estimate associated job creation of up to 150,000 new jobs.

Global competition among countries is moving the electric vehicle transition forward rapidly. Along with investment announcements by major automakers, governments

worldwide are developing policy and market signals to attract more private investment and accelerate deployment. This briefing demonstrates the potential and extent to which the United States can lead or lag behind the global transition. The U.S. opportunity to lead in the electric vehicle industry domestically and internationally lies in its ability to transform its manufacturing industry to electrification. Understanding the risks of accruing negative trade balances and failing in job creation should prompt U.S. government policies to spur the domestic supply chain for electric vehicles, especially regarding the development and supply of batteries.