Impact of IRA, IIJA, CHIPS, and Energy Act of 2020 on Clean Technologies
Objective

Explore impacts of recent legislation on U.S. opportunity and remaining challenges for emerging clean technology deployment

Stakeholders involved

Analysis was commissioned by Breakthrough Energy and Third Way, with input from stakeholders across the public and private sectors

Related publications

- BCG report | How the US Can Win in Six Key Clean Technologies
- BCG report | How the US Can Gain an Edge in Clean Tech
- Third Way publication | When America Leads: Competing for the Future of Clean Energy

1. Legislation assessed here includes Inflation Reduction Act (IRA), Infrastructure Investment and Jobs Act, CHIPS and Science Act, and the Energy Act of 2020

Source: BCG analysis
Electric Vehicles | Executive Summary

IRA provisions provide significant demand and supply side stimulus to encourage expansion of domestic U.S. EV supply chain, supporting both infrastructure and consumer uptake, though global raw material supply chains and domestic power infrastructure bottlenecks may limit domestic deployments.

Strong demand-side incentives accelerate U.S. LDV\(^1\) EV deployment by ~50% by 2030 by bringing EVs to purchase price parity in the immediate term compared to traditional ICE\(^2\) vehicles.

Significant supply-side incentives support expansion of domestic EV manufacturing capacity, battery production, and buildout of EV charging station networks due to manufacturing incentives combined with tax credits tied to domestic content requirements.

“Friend-shoring” of upstream supply chains enhances critical mineral security and is encouraged by IRA tax credit qualifiers for both battery minerals sourced domestically or from free trade agreement partners and battery components sourced from North America.

However, while IRA provisions provide support, global raw material supply chain bottlenecks in critical battery minerals must be addressed by actively facilitating expansion of existing and new mines and refining facilities in trusted partner countries.

Similarly, continued focus on expanding supporting EV infrastructure, such as public charging points and associated grid expansion, will enable the domestic market to rapidly expand, unlocking the potential of the IRA provisions.

1. Light duty vehicle
2. Internal Combustion Engine
3. Total number of positions created through 2050; incremental new jobs calculated as the sum of all non-negative one-year differences in # job-years (e.g., 2021 job-years minus 2020 job-years gives 2021 new jobs); incremental new jobs added to sum from prior period for cumulative calculation.

Note: Numbers on the left are based on IEA’s Announced Pledges (APS) scenario summed up across all value chain segments from 2020-2050.

Source: IEA, BCG Analysis
Recent US policies (e.g., IRA, IIJA) have resulted in significant increases in projected size of domestic market, exports, and jobs within EVs

**US domestic market**
- US cumulative domestic market through 2030 increased from ~$2T to ~$3T after IRA/IIJA due to increased demand-side incentives

**US exports**
- US cumulative exports through 2030 increased from $530B to $640B after IRA/IIJA, a smaller increase as IRA/IIJA mostly affect domestic manufacturing and demand

**US job creation**
- New job creation in US EV industry through 2030 grew from ~455K to ~680K after IRA/IIJA primarily due to domestic manufacturing incentives

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1. Market size and number of jobs increase by 50% post-IRA based on the increase in 2030 EV volume. 2. Given a SOM of 11% for EVs, exports increase by 11% of $1T (difference in market size pre- and post-IRA) to reflect increased demand for domestic production. Note: Pre-IRA numbers based on phase 1 EV model over timeframe from 2020-2030; Source: BCG analysis
Demand-side incentives | IRA & IIJA support of electric vehicles expected to increase domestic uptake ~50% by accelerating the path to cost parity

Demand-side incentives for EVs from the IRA include:

1. **$12B for personal and commercial clean vehicles**, up to $7,500 for personal and up to 30% for commercial

2. **$3B for USPS** to acquire EVs and support infrastructure

3. **$11B to transition school buses, transit buses, and passenger ferries** to low or zero-emission vehicles

Incentives will reduce EV costs by accelerating cost parity ...

Number of EVs (Million)

- **2020 Capacity**
- **2030 Pre-IRA volume**
- **2030 Post-IRA volume (base growth)**
- **2030 Post-IRA volume (optimistic growth)**

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Source: BCG analysis
Supply-side incentives | IRA, IIJA, and the CHIPS Act provide significant funding to build an end-to-end domestic supply chain given growing demand for EVs

Legend:
- Innovation
- Production
- Manufacturing grants
- Supportive infrastructure

1. PTC = production tax credit, 2. BEV = battery electric vehicle
Source: BCG analysis
Raw materials security | IRA encourages friend-shoring for critical inputs to decrease dependence on highly concentrated supply sources

EV batteries’ raw materials dominated by China today, with limited capacity in US

IRA mandates sourcing requirements that benefit free-trade partners

IRA eligibility criteria ¹

Countries that benefit

Critical minerals
40% sourced from or processed in US or country with free trade agreement ²

Content requirement increases by 10 ppts per year up to 80%

Battery components
50% of battery components manufactured in US, Mexico, and Canada ², ³

Content requirement increases by 10 ppts per year up to 100%

1. Does not apply to commercial vehicle tax credit of $40,000 2. IRA excludes minerals (raw, processed) and components sourced from foreign entities of concern (i.e., China, Russia, North Korea, Iran), preventing countries from free trade agreements from sourcing from these foreign entities 3. Including recycling done in North America

Note: All dates refer to when construction must start by or safe harbor achieved by. Source: H.R.5376 - 117th Congress (2021-2022): Inflation Reduction Act of 2022, BCG Analysis
Raw materials security | However, global supply chains must ramp up quickly to qualify for the incentives, limiting IRA benefit realization

**Lithium**: Global supply shortage projected to become acute by 2030 as planned production capacity may fail to meet demand

**Cobalt**: Supply chain risk due to geopolitical issues and reliance on single country (DRC) which houses 70% of global supply

**Nickel**: Risk of becoming dependent on Indonesia in the long-term; Ni bottlenecks expected in the medium-term

**Manganese**: US and Europe to localize supply given likely concentration risks in high-grade ore and processing

Note: FTA = Free trade agreement countries; LCE = Lithium carbonate equivalents; DRC = Democratic Republic of Congo; Units in kilo- or megatons (kt, mt)

Source: S&P Capital IQ; USGS Minerals Commodity Summaries; BCG analysis
EV infrastructure | Additional ~$24B public charging infrastructure funding is needed beyond the $7.5B from the IRA

IRA provisions to drive a ~10% increase in public EV charging points ...

Number of EV charging points (k)

- 2020 actual: 115
- Pre-IRA 2030 forecast: 1,030
- Post-IRA 2030 forecast: 1,085 +10%

High power charging points show the largest increase of ~12% due to IRA provisions

... but additional investment is needed to expand charging infrastructure

EV charging station investment required through 2030 ($B)

- Investment needed to deploy EV charging points: 31.0
- Funding provided in IRA: 7.5
- Additional investment needed: 23.5

Additional ~$24B gap must be closed to meet post-IRA public charging point demand by 2030

Source: BCG EV forecast (2021), BCG Analysis
Pre-legislation challenges | To support EV deployment, several challenges needed to be addressed across the value chain

Value chain segments

- Raw materials mining
- Minerals refining and processing
- Battery manufacturing
- EV car manufacturing
- EV charging infrastructure
- EV deployment

Primary activities

- Mine site selection and permitting
- Sourcing raw minerals
- Battery design and development
- Source, manufacture, and assemble EVs
- Site selection, grid connection, and financing

Timeline

1. Mine site selection and permitting
2. Sourcing raw minerals
   - Financing to build processing facilities
3. Battery design and development
   - Battery manufacturing and assembly
   - Design and development
4. Source, manufacture, and assemble EVs
5. Site selection, grid connection, and financing
   - Equipment supply, installation, and operation
   - Sale through wholesale, dealership or D2C channels

Key pre-IRA gaps to be addressed

1. Supply shortage of EV critical minerals and complex, long mining permitting processes
2. High investment risk in setup of domestic processing plants and lack of guaranteed supply of raw materials from IRA incentivized countries
3. Further battery innovation and commercialization at scale is critical
4. High investment risk for small-scale EV companies to commercialize and lack of trained EV workforce
5. Build out of public EV charging infrastructure rapidly and equitably

Source: BCG Analysis
Remaining challenges | While recent legislation has addressed many priority issues for EVs, additional policy could further boost U.S. competitiveness

<table>
<thead>
<tr>
<th>Pre-legislation priority challenges</th>
<th>Changes from recent legislation (IRA, IIJA, CHIPS, and EA 2020)</th>
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<tbody>
<tr>
<td>Raw materials mining</td>
<td>$400M grant to support innovation in advance critical minerals production</td>
</tr>
<tr>
<td>Minerals refining and processing</td>
<td>Manufacturing PTC covers 10% of the cost of production</td>
</tr>
<tr>
<td>Battery manufacturing</td>
<td>$3B Battery Material Processing Grant</td>
</tr>
<tr>
<td>EV car manufacturing</td>
<td>Manufacturing PTC covers 10% of the cost of production</td>
</tr>
<tr>
<td>EV charging infrastructure</td>
<td>$3B Battery Manufacturing &amp; Recycling grant</td>
</tr>
<tr>
<td>EV deployment</td>
<td>45X Manufacturing PTC of $35/kWh for battery cell and $10/kWh for battery module</td>
</tr>
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</table>

Priority areas

1. Supply shortage of EV critical minerals and complex, long mining permitting processes
2. High investment risk in setup of domestic processing plants and lack of guaranteed supply of raw material from IRA incentivized countries
3. Further battery innovation and commercialization at scale is critical
4. High investment risk for small-scale EV companies to commercialize and lack of trained EV workforce
5. Build out of public EV charging infrastructure rapidly and equitably

Remaining areas to target with future policies

- Invest in foreign mineral extraction and streamline permitting processes for domestic new extraction site
- De-risk investment through loan guarantees and cost-sharing programs for mineral processing plants and develop favorable foreign trade agreements for mineral supply
- Continue investment in battery chemistry research and commercialization of innovations through grants and loan guarantees
- Provide loan guarantees to small-scale EV companies to support commercialization
- Create workforce training and upskilling programs to bolster domestic talent pool
- Provide additional grants and incentivize private investment through loan guarantees to build out the EV charging network equitably

Source: IRA, IIJA, DOE, IEA, BCG Analysis
Summary actions | IRA provides significant support to accelerate EV adoption, but further action needs to be taken to boost U.S. competitiveness

Key levers that will enable the US to win the EV market

- **Permitting reform for mining EV minerals**
  Permitting reform for mining of critical EV minerals is needed to boost the build up of sufficient capacity of minerals domestically for manufacturers to take advantage of IRA incentives

- **Increase battery mineral production**
  Increased financing and licensing support to setup critical minerals mining and processing domestically and in FTA countries

- **Charging infrastructure expansion**
  Additional funding support to further expand charging infrastructure to enable and support the growing EV adoption

- **Grid upgrade and expansion**
  Additional support for transmission grid development to successfully connect EV charging infrastructure to existing grid network

Source: BCG Analysis
## New legislation provides incentives for facilities and production of EVs (I/II)

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<th>Provision</th>
<th>Summary</th>
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<tr>
<td><strong>IRA Section 13401: Clean Vehicle credit</strong></td>
<td>Extension of Section 30D tax credit; $7,500 credit for purchase of clean vehicles(^1)</td>
<td>Investment Tax Credit (ITC)</td>
<td>$7.54B to 2032</td>
</tr>
<tr>
<td><strong>IRA Section 13402: Credit for previously owned clean vehicles</strong></td>
<td>$4,000 credit (or 30% of sales price) for qualifying used EVs(^3) weighing less than 14kls and costing less than $25k</td>
<td>Investment Tax Credit (ITC)</td>
<td>$1.34B to 2032</td>
</tr>
<tr>
<td><strong>IRA Section 13403: Qualified commercial clean vehicles</strong></td>
<td>Credit is an amount equal to the lesser of 15% of the basis of a taxpayer used vehicle(^4) (30% in the case of a vehicle not powered by ICE), or the incremental cost of such vehicle; maximum credit per vehicle is $7,500 for vehicles with gross vehicle weight ratings (GVWR) of less than 14,000 pounds, or $40,000 for heavier vehicles</td>
<td>Investment Tax Credit (ITC)</td>
<td>$3.58B to 2032</td>
</tr>
<tr>
<td><strong>IRA Section 70002: USPS clean fleet investments</strong></td>
<td>Appropriates $3 billion to the United States Postal Service (USPS) to acquire zero-emission delivery vehicles ($1.29B) and requisite infrastructure at USPS facilities ($1.71B)</td>
<td>Grant</td>
<td>$3.0B</td>
</tr>
<tr>
<td><strong>IRA Section 60101: Zero - Emissions Heavy - Duty Vehicle Investments</strong></td>
<td>Appropriates $1 billion(^5) to the Environmental Protection Agency to implement a grant and rebate program for clean heavy-duty vehicles</td>
<td>Grant</td>
<td>$1.0B</td>
</tr>
</tbody>
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1. Credit eligibility depends on MSRP, income, critical mineral sourcing, battery component, and assembly location requirements. For more detailed click [here](#).
2. Fuel cell vehicles - FCVs or Plug-in electric vehicles | PEVs
3. A qualifying vehicle must also be propelled to a significant extent by an electric motor that draws electricity from a battery, and which has a capacity of not less than 7 kWh, and is capable of being recharged from an external source of electricity; additional eligibility factors includes income, use of other clean vehicle credits and prior credits from the vehicle
4. For use on public streets, roads, and highways, or be mobile machinery
5. Of which $400 million set aside for projects to replace vehicles serving communities located in an air quality nonattainment area for any air pollutant

Source: DOE, IRA, BCG Analysis
### Backup | New legislation provides incentives for facilities and production of EVs (II/II)

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<tr>
<td>IRA Section 13501: 48C Advanced Energy Manufacturing Project Tax Credit</td>
<td>Extension of the advanced energy manufacturing project credit. Base rate of 6% and 30% tax credit if wage and apprentice requirements are satisfied</td>
<td>Manufacturing Tax Credit</td>
<td>$10B</td>
</tr>
<tr>
<td>IRA Section 13502: 45X Advanced Manufacturing Tax Credit</td>
<td>Advanced Manufacturing Tax Credit, is a credit for manufacturers of eligible components produced within the United States. Tax credits include US$45 per KWh of capacity, which consists of (i) US$35 per KWh of battery capacity for battery cells and (ii) US$10 per KWh of capacity for battery modules. 10 percent of the cost to produce “electrode active materials” also qualifies for a Section 45X tax credit</td>
<td>Manufacturing Tax Credit</td>
<td>-</td>
</tr>
<tr>
<td>IIJA section 11115: congestion mitigation and air quality improvement</td>
<td>Allows states to spend up to 10 percent of CMAQ funds on various projects including purchase of medium- or heavy-duty zero emission vehicles and related charging equipment</td>
<td>Investment Tax Credit (ITC)</td>
<td>$2.6B</td>
</tr>
<tr>
<td>CHIPS - Section 10771</td>
<td>Authorizes $1.4 billion for research, development, and demonstration for sustainable transportation (part of a larger $11.2b funding)</td>
<td>Grant</td>
<td>$1.4B</td>
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**IIJA includes legislation tangential to EVs authorizes ~$20 billion for charging stations¹ and Battery investments and EV battery recycling programs²**

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1. Sec. 11401. Grants for charging and fueling infrastructure - $2.5B; Sec. 11403. Carbon reduction program - $7B; IIJA: Title VIII National Electric Vehicle Formula Program - $5b
2. Sec. 40207. Battery processing and manufacturing - $6.13B Sec. 40208. Electric drive vehicle battery recycling and second-life applications program - $2B

Source: DOE, IIJA, BCG Analysis
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