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

Source: BCG analysis
Carbon Capture, Utilization, & Storage | Executive Summary

Significant funding from the IRA and IIJA is expected to kickstart the US CCUS industry, driven by ~$3B in direct funding for early commercial projects\(^1\) and an expanded $60-85/tCO₂e 45Q tax credit, creating a first mover advantage for the US when competing in export markets.

Expanded tax credits will bring many CCUS applications into the money for the first time, with most industrial applications projected to cost less than the $85/tCO₂e max credit value, improving project economics and incentivizing further investment and deployment.

Pairing these tax credits with ~$12B in funding for commercial projects & transport/storage infrastructure will make the US a global leader in CCUS with 85-170 Mtpa deployed by 2030, up from ~20 Mtpa today and 50-55 deployed by 2030 pre-legislation.

This market acceleration will allow the US to build domestic manufacturing hubs and expertise developing CCUS projects, increasing annual export potential and creating ~10k new jobs by 2030.

Exports and jobs will primarily be from equipment manufacturing, project development, and EPC\(^2\) driven by US first mover advantage and relevant expertise in the domestic oil and gas industry.

To further support US competitiveness, future policies should focus on commercialization of R&D by US OEMs to drive down costs & capture global market share, along with streamlined permitting and long-term monetization schemes to allow project developers & EPCs to develop best practices and lead international projects early on (especially in the EU and Middle East).

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1. Appropriations for an Energy Act of 2020 program
2. Engineering, procurement, and construction
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:
- DOE
- IEA
- BCG Analysis

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Recent US policies have resulted in significant increases in projected size of domestic market, exports, and jobs within CCUS

Impact of recent US policies (incl. IRA, IIJA) on cumulative market & job creation through 2030

**US domestic market**
- US cumulative domestic market increased from ~$50B to ~$70B through 2030 after IRA/IIJA due to increased domestic deployments

**US exports**
- US cumulative exports through 2030 increased from $1.5B to $3.0B after IRA/IIJA due to expanded domestic manufacturing base and first mover advantage

**US job creation**
- New job creation in US CCUS industry through 2030 increased from ~6k to ~15k after IRA/IIJA due primarily to increased domestic deployments

Note: All numbers based on IEA STEPS scenario based on change over timeframe from 2020-2030
Source: BCG analysis
Expanded incentives | Expanded 45Q tax credits from the IRA and ~$12B in funding from the IIJA are the key drivers of this market expansion

45Q tax credits significantly decrease costs of CCUS across use cases with some becoming net profitable

- Prior 45Q credit of $35-50/tCO2e increased to $60-85/tCO2e, making the addition of CCUS net profitable for certain use cases.
- ~50% of CCUS applications are now profitable (up from <10%).

- $12B in funding from IIJA supports early commercial deployments and lays groundwork for future growth.

1. IIJA appropriated funds for an existing program created by Energy Act of 2020
2. Category includes several sources such as ammonia production and natural gas processing.

Source: IIJA; IEA; BCG Analysis
Legislation impacts | US policies will catalyze investment in CCUS, growing projected capacity, driving down costs, and accelerating new jobs and exports

New policies accelerate CCUS capacity deployment...

... decreasing technology costs an incremental 5-15%....

Incremental % change of capital cost in 2030 relative to 2022

<table>
<thead>
<tr>
<th>Business as usual²</th>
<th>IRA capacity &amp; learning rate effect³,⁴</th>
<th>Total cost decline</th>
</tr>
</thead>
<tbody>
<tr>
<td>-25-30%</td>
<td>-5 -15%</td>
<td>-30 - 45%</td>
</tr>
</tbody>
</table>

Million tons CO2 per year

<table>
<thead>
<tr>
<th>2020 volume</th>
<th>2030 volume (pre-incentives)</th>
<th>2030 volume (post-incentives)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>50-55</td>
<td>85-170</td>
</tr>
</tbody>
</table>

1. 2030 cost projections do not account for inflation or subsidies 2. Business as usual: 2030 capacity projection pre-IRA based on IEA stated policy (STEPS) scenario 3. Capacity effect: incremental cost reduction due to added US capacity and additional global deployment (assumed 3x US increase) 4. Learning rate effect: incremental cost reduction due to de-risked commercialization (US moving early) and innovation (improved learning rates)

Source: IEA; historical learning rate values from REFLEX; IIJA; BCG analysis

... and adding an additional ~10k jobs and ~$0.5B in exports

- Incremental US market growth catalyzed by IRA/IIJA incentives: $40B
- Incremental CCUS jobs catalyzed by IRA/IIJA incentives: ~10K
- Incremental CCUS exports catalyzed by IRA/IIJA incentives: $1.5B

2050-55 Million tons CO2 per year

2030 volume (pre-incentives) 2030 volume (post-incentives)

2020 volume 2030 volume (pre-incentives) 2030 volume (post-incentives)
Pre-legislation challenges | CCUS deployment has been limited by both lack of monetization mechanisms and insufficient supporting infrastructure

Illustrative project timeline

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Years 2-3</th>
<th>Years 4-5</th>
<th>Years 6+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-development</td>
<td>Design &amp; development</td>
<td>Construction</td>
<td>Operations</td>
</tr>
</tbody>
</table>

**OEM**
- Tech/site evaluation
- GTM strategy
- Customer, partner & site selection
- FEED study
- Project management

**Financing**
- Financing evaluation & finalization

**EPC**
- Construction prep
- Construction

**O&M**
- Capture ops, maintenance, etc.
- Land & pore access
- Environmental impact & permits
- FEED study
- CO2 injection permitting
- Pipeline & storage monitoring

### Key pre-IRA gaps to be addressed

1. Many CCUS applications either too expensive or impractical for deployment
2. Limited regulations around CO2 emissions today limit widespread deployment of CCUS given lack of policy push
3. Long term monetization mechanisms needed to de-risk project financing
4. Long procurement timelines and difficulty obtaining/retaining talent slowing projects
5. Long permitting timelines and limited clarity on long-term storage and monitoring liability slows down project development
6. Insufficient infrastructure currently built out for source-to-sink matching

*Source: ADB; International CCS Knowledge Center; BCG analysis*
Remaining challenges | While recent legislation addressed some CCUS issues, additional non-cost barriers limit US competitiveness and deployment

- **Pre-legislation priority challenges**
  1. High cost/complexity of CCUS applications
  2. Limited regulations around CO2 emissions
  3. Lack of long-term monetization mechanisms
  4. Long procurement timelines and difficulty obtaining/retaining talent
  5. Long permitting timelines and limited clarity on CO2 storage liability
  6. Insufficient CO2 transport & storage infrastructure

- **Changes from recent legislation (IRA, IIJA, CHIPS, and EA 2020)**
  - RD&D funding for novel & modular techs to drive down costs
  - IIJA funding for commercial-scale projects
  - 48C investment tax credit of up to 30%
  - Expanded $60-85/tCO2e tax credit from 45Q in IRA
  - Direct funding for states to establish well permitting programs in IIJA
  - Financing for both CO2 pipelines & large-scale carbon sequestration projects in IIJA

- **Future Remaining areas to target with future policies**
  - CCUS cost projections remains too high to support widespread deployment (esp. with bespoke model) and limited support for commercialization of US-developed tech
  - Limited demand for developing new CCUS projects and incurring related costs without CO2 emissions mandates or costs (by-sector or economy-wide)
  - Tough to incentivize investment given lack of long-term monetization opportunities to de-risk financing as 45Q credits expire after 12 tax years and construction needs to commence by 2033
  - Insufficient workforce available to enable rapid deployment of CCUS without additional training programs & incentives for O&G workforce
  - Limited clarity on long-term storage & monitoring processes & liabilities at the federal level
  - Need further buildout of CO2 infrastructure to support CCUS hubs which will enable widespread deployment

Source: C2ES; DOE; IIJA; IEA; BCG Analysis
Summary | Actions to further boost US competitiveness

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

1. **Commercialization support**
   - Support for early commercial deployments of next gen technologies and follow-on funding for initial manufacturing hubs

2. **Regulations & long-term monetization opportunities**
   - Permanent monetization opportunities (e.g., LCFS in CA) for CCUS projects to replace 45Q after it expires and/or regulations mandating CO2 reductions

3. **Workforce training**
   - Additional training/incentive programs to accelerate transition of existing O&G workforce to employment on CCUS projects in order to meet labor needs

4. **Processes for long-term storage & monitoring**
   - Federal rules for storage and monitoring (e.g., length of liability) and clear permitting processes

Source: BCG Analysis
Backup | New legislation provides incentives for Carbon Capture, Utilization, and Storage (I/II)

<table>
<thead>
<tr>
<th>Provision</th>
<th>Summary</th>
<th>Type</th>
<th>Total investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRA Section 13104</td>
<td>Increases 45Q tax credit for sequestration and utilization to a maximum of $85/t for sequestration and $60/t for utilization with additional prevailing wage and apprenticeship requirements</td>
<td>Production Tax Credit (PTC)</td>
<td>$3.22B to 2033</td>
</tr>
<tr>
<td>IIJA Sec. 41004/Energy Act</td>
<td>Authorizes $3.5 billion for Carbon Capture large-scale pilot projects authorized by the Energy Act of 2020</td>
<td>Grant Funding</td>
<td>$3.5B to 2026</td>
</tr>
<tr>
<td>IIJA Sec. 40302/Energy Act</td>
<td>State/local government grants to procure products derived from captured carbon. Expands DOE's Carbon Utilization program to include standards &amp; certifications for commercialization of CO₂ products</td>
<td>Grant Funding</td>
<td>$310M to 2026</td>
</tr>
<tr>
<td>IIJA Sec. 40303/Energy Act</td>
<td>Expands DOE's Carbon Capture Technology program to include front-end engineering &amp; design for CO₂ transport infrastructure</td>
<td>Grant Funding</td>
<td>$100M</td>
</tr>
<tr>
<td>IIJA Sec. 40304</td>
<td>Establishes CO₂ Infrastructure Finance and Innovation Act, providing flexible, low-interest loans for CO₂ transport infrastructure projects &amp; grants</td>
<td>Loan Authority/Market Enabler</td>
<td>$2.1B</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>• $600M for 2022-2023</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• $300M for 2024-2026</td>
</tr>
</tbody>
</table>

1. Originally approved in Energy Act of 2020
Source: DOE; IRA; IIJA; BCG Analysis
## Backup | New legislation provides incentives for Carbon Capture, Utilization, and Storage (II/II)

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<tr>
<td><strong>6</strong> IIJA Sec. 40305/Energy Act¹ Carbon Storage Validation &amp; Testing</td>
<td>Expands DOE’s Carbon Storage Validation &amp; Testing program to include large-scale commercialization of new/expanded sequestration projects &amp; transport infrastructure</td>
<td>Grant Funding</td>
<td>$2.5B to 2026</td>
</tr>
<tr>
<td><strong>7</strong> IIJA Sec. 40306 Secure Geologic Storage Permitting</td>
<td>Funding for permitting of wells for geologic sequestration of CO2 &amp; creates grant program for states to establish Class VI permitting programs</td>
<td>Grant Funding</td>
<td>$75M</td>
</tr>
<tr>
<td><strong>8</strong> IIJA Sec. 40307 Geologic Carbon Sequestration</td>
<td>Allows DOI to permit carbon sequestration on outer Continental Shelf</td>
<td>Market Enabler</td>
<td>NA</td>
</tr>
<tr>
<td><strong>9</strong> CHIPS Sec. 10102</td>
<td>Establishes a “Carbon Sequestration Research and Geologic Computational Science Initiative” and at least two carbon storage research and geologic computational science centers</td>
<td>Market Enabler</td>
<td>$250M through 2027</td>
</tr>
<tr>
<td><strong>10</strong> 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>
</tbody>
</table>

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1. Originally approved in Energy Act of 2020

Source: DOE; IRA; IIJA; BCG Analysis
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