US Inflation Reduction Act: Clean Tech Growth Opportunities & Value Pools

October 2022
With $369B in funding earmarked for climate and energy, the recent US Inflation Reduction Act (IRA) will drive new clean tech opportunities both in the US and globally. Through the IRA, companies directly involved in the energy transition (e.g., renewable energy, alternative fuels, electric vehicles) will be able to cut cost, drive growth, and cultivate innovation. Moreover, ripple effects will be felt throughout the supply chain as new market opportunities arise to support growth in the clean tech sector.

This BCG Executive Perspective, the third in our series on the US Inflation Reduction Act, explores the clean tech growth opportunities that will come directly or indirectly as a result of the bill, barriers to growth, and how companies can achieve competitive advantage.

For previous analysis, please see:
- Part 1 | US Inflation Reduction Act: Climate & Energy Features and Potential Implications
- Part 2 | US Inflation Reduction Act: Broader implications for corporate decarbonization
Clean tech growth opportunities:
Three ways to take advantage of new value pools created by the IRA

- **Directly develop projects**: Many companies can participate in climate tech markets, e.g., renewables, hydrogen, carbon capture, etc.
- **Participate in the broader value chain**: New markets also create opportunity for companies that support the climate tech ecosystem such as finance, construction, raw materials, and machinery
- **Make low carbon products**: Companies can capture value by making net-zero products, e.g., using hydrogen to produce low-emissions chemical ingredients for a net-zero pharma company

Overcoming bottlenecks:
Despite strong incentives, barriers may delay growth opportunities

Although briefly mentioned in prior materials, barriers across several areas may delay growth opportunities:

- **Regulatory clarity around the IRA**: Multi-year process establish what qualifies under tax law and regulation
- **Permitting, stakeholders, and state/local political barriers**: Getting ahead of lag times and balancing of multiple stakeholders needed; permitting processes poised for streamlining
- **Enabling infrastructure**: Physical, digital infrastructure needed for integrated decarbonization
- **Supply chains**: New supplier relationships and circularity require time and investment
- **Resource availability**: New models required to solve rising scarcity for sustainable inputs
- **Workforce**: Growing demand for workforce adept in clean tech

Securing competitive advantage:
Early entrants into new clean-tech industries may gain first mover advantage

- **Move quickly**: Early entrants to the clean tech space have historically gained larger market share than their competition, with strong examples from electric vehicle (EV) and energy efficient lighting
- **Secure supply**: Supply scarcity and the need to navigate domestic content requirements, especially for material inputs (e.g., green steel, green hydrogen), will affect pace of change and growth strategy
- **Consider technological maturity**: Winning strategies will differ for nascent technologies (e.g., hydrogen, CCUS) compared to mature technologies where scale and implementation are key
Develop projects| $479B\(^1\) in new climate and energy finance will catalyze $1.3T\(^2\) opportunity for companies directly involved in climate mitigation

**Carbon-free energy**
Direct tax credits will drop the cost of renewable energy 18-63\% accelerating the pace of redeployment

**Transportation**
Electric vehicle incentives (up to $7500 for a new and $4000 for a used EV) will drive down cost and increase demand for new EVs and EV charging infrastructure

**Clean Tech**
Blue and green hydrogen will soon be cost competitive with fossil-derived hydrogen and the 45Q tax credit will make CCUS and DAC more accessible, capping the cost of achieving Net Zero

**Manufacturing**
$71B in stimulus for advanced manufacturing and industrial facilities will expand adoption of energy efficient technologies and materials including heat pumps and leak detection and repair (LDAR)

---

1. Note: $479B includes funding from Infrastructure Investment and Jobs Act (IIJA) and Inflation Reduction Act (IRA).
2. Over the next 10 years

Source: BCG analysis.
Broader value chain | Adjacent markets also benefit from clean tech growth

Machinery & equipment
Demand is expected to increase for hardware and electronic components, batteries, robotics, and finishing and testing services presenting a $4.7T opportunity in the US through 2040 (see example).

Construction & maintenance
Rebate programs\(^1\) will accelerate residential construction (e.g. retrofits, energy upgrades), $3B in grants will support transportation infrastructure and hydrogen supply chain expansion.

Raw materials
Clean tech will require raw materials, chemical, and energy input, e.g., increased demand for cobalt, lithium, ion, steel, aluminum for renewable energy generation.

Shipping and logistics
Redesigning supply chains to meet the needs of clean tech will require expansion of shipping routes and logistic services.

Finance
IRA will stimulate development of new markets e.g., ability to sell unused tax credits will necessitate secondary markets for trading\(^1\).

Agriculture & land use
IRA will accelerate demand for carbon markets which will stimulate investment in agriculture and land management.

Education
Workforce development to upskill and train millions of workers for a clean tech economy will lead to require traditional training programs, trade apprenticeship, teaching materials, etc.

Professional services
Navigating a complex and uncertain transition will require lawyers, accountants, and other professional services.

1. The High Efficiency Electric Home Rebate and Home Energy Performance-Based Whole-House Rebate
Source: Levelset; BCG analysis
Example | Clean technology machinery and equipment represents a US market opportunity up to $4.7T between now and 2040

Cumulative opportunity size for machinery makers 2020-40 ($B)

~$4.7 Trillion
total potential

1. Includes converter stations, cables and other equipment for transmission and distribution upgrade 2. Geothermal and concentrated solar power (CSP) 3. On highway automotive batteries not included in this model 4. Includes battery manufacturing equipment market, thermo-mechanical storage, and pumped storage hydropower (PSH) 5. Includes mining, marine, construction, material handling, defense, rail and O&G 6. Includes H₂ production, distribution & storage, conversion, transportation, iron & steel, existing feedstock, process power & heat, back-up & off-grid power

Note: Analysis not intended to be exhaustive
Source: BCG analysis
Low carbon products | Thousands of companies have committed to Net Zero targets; investment is needed to achieve ambition

New incentives can reduce cost to produce net-zero products for those industries,\(^1\) for example:

- **Pharma**
  - Chemical producer uses hydrogen to synthesize key pharmaceutical inputs with lower carbon footprint

- **Construction**
  - Steel supplier installs carbon capture to provide construction company lower emissions steel

- **Consumer Goods**
  - Shipping company switches to hydrogen fuel cell trucks for lower emissions deliveries of goods

- **Aviation**
  - Airline adopts sustainable aviation fuel to provide low emission transit

1. For further details on the cost implications of the IRA, please see:
   - Part 2 | US Inflation Reduction Act: Broader implications for corporate decarbonization
   - Note: SBTi (science-based targets initiative)

Source: SBTi; BCG analysis
Overcoming bottlenecks | Need to overcome near term obstacles to fully realize decarbonization

**Obstacle**

- Regulatory clarity
  - Federal rulemaking will be required to clarify critical attributes of the IRA in order to provide investment confidence

- Permitting, state/local political challenges
  - Multiple state and local government rules can block or delay infrastructure, especially for emerging technologies

- Enabling infrastructure
  - Clean tech growth requires new and expanded infrastructure, including grid, pipelines, and storage

- Developing new supply chains
  - Significant new sources of value from sourcing domestic content and/or restructuring supply chains

- Resource availability
  - Supply scarcity in critical minerals and components may require collaborative sourcing and new procurement models

- Workforce development
  - Net zero transition requires 6.5M more skilled clean tech workers in US amid era of changing workforce dynamics

**Proposed solutions**

- Clarifying key rules and processes requires doubling of IRS staff

- Developing hydrogen value chains will require significant deployment of storage and trucking infra.

- Developing new lithium-ion battery sourcing to receive EV incentives and capture higher ITC incentives

- Need for new procurement models to access to green H₂ electrolyzer capacity and components

**Example**

- Deep dive into CCUS in following pages

- Deep dive into clean energy workforce in following pages

Deep dive | Multiple regulatory barriers can hinder scalability of clean technologies

US Permitting process faces significant challenges

4+ years
Massive time investment (~4-16 years) to navigate long permit processes and increase community buy-in for clean energy, mining. Permitting time has doubled since 1970s

42%
Nearly half of clean energy ventures are delayed by regulatory red-tape, compared to just 15% in fossil fuel projects

50 states
Players must stay apace with state-specific and fast changing regulations to stay compliant in e.g., RES markets

IRA provides $350M in funding for Permitting Council to improve permitting efficiency and predictability

Example:
Scaling CCUS requires navigating challenging regulation

CCUS incentives
- Outstanding clarity on IRS rules, including qualifying facility criteria, "stackability" of credits, etc.
- Multiple permit processes to own and operate CO₂ pipelines to transport CO₂ for storage or utilization
- Lagging product standards, e.g., need years to evaluate performance and safety of CO₂-cured concrete for high mechanical strength applications¹
- Unclear verification of carbon footprint reduction, e.g., from CO₂-derived building materials¹ complicates 45Q and IRA tax credit claiming

Carbon storage
- EPA backlog for underground injection (UIC) Class VI permits
- Undefined legal rules on geologic pore-space ownership & rights, including ownership pooling, in property documents
- Long process to obtain pore space access requiring consensus from hundreds of landowners e.g., 60% landowner agreement in ND, 80% in MT, etc., where poor rights are defined
- 100-year post-injection liability sharing negotiation between company and state

Source: Congress Passes Inflation Reduction Act | Permitting Dashboard (performance.gov); For the Inflation Reduction Act to work, the US needs permitting reform | The Hill; Permitting Reform Needed to Reach Clean Energy Goals (c3newsmag.com)
Deep dive | Interconnection queues are filling up, making it difficult for offshore wind (OSW) to identify and develop points of interconnection.

Interconnection points being pursued on East Coast for OSW projects

Capacity of interconnection requests made across PJM, NYSIO, and NE-ISO (MW)

Source: PJM Interconnection Que; NYSIO Interconnection Que; NE-ISO Interconnection Que; HIFLD; BCG analysis
Deep dive: The transition to global Net Zero will require millions of jobs as America builds a clean energy workforce

6.5 million new jobs needed in US to achieve net zero

<table>
<thead>
<tr>
<th>Category</th>
<th>Change in US employment by 2035 (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar</td>
<td>-5.5</td>
</tr>
<tr>
<td>Wind</td>
<td>-1.8</td>
</tr>
<tr>
<td>Transmission &amp; Distribution</td>
<td>0.0</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>0.2</td>
</tr>
<tr>
<td>Storage</td>
<td>0.2</td>
</tr>
<tr>
<td>Efficiency</td>
<td>0.0</td>
</tr>
<tr>
<td>Electrification</td>
<td>0.2</td>
</tr>
<tr>
<td>Alt. Vehicles</td>
<td>0.0</td>
</tr>
<tr>
<td>Alt. Vehicles Infrastructure</td>
<td>0.0</td>
</tr>
<tr>
<td>ICE Vehicles**</td>
<td>0.2</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>0.4</td>
</tr>
<tr>
<td>Biofuels</td>
<td>0.3</td>
</tr>
<tr>
<td>Fossil Fuels**</td>
<td>-1.8</td>
</tr>
<tr>
<td><strong>Clean Vehicles</strong></td>
<td>3.3</td>
</tr>
<tr>
<td><strong>Biofuels</strong></td>
<td>1.3</td>
</tr>
<tr>
<td><strong>Fossil Fuels</strong></td>
<td>1.3</td>
</tr>
</tbody>
</table>

Clean workforce must grow despite changing skill landscape and differing regional strengths

- US employees are quitting at levels higher than pre-pandemic levels
- US skill supply or job preferences may not align with manufacturing demand
- Certain regions already ahead on overall clean jobs

IRA accelerates expansion of American climate workforce adding 900k jobs

- Tax credits are tied to apprenticeship requirements
- $200 million to the Department of Energy establishes training to facilitate training

ATC = Advanced Tax Credit scenario NZ = Net Zero scenario.
1 Includes distributed and utility solar. 2. Includes onshore and offshore wind; IRA drives growth in onshore. 3. Combines residential and non-residential 4. Top 4 states by share of clean workforce

Source: World Resources Institute; World Energy Employment Job openings and labor turnover survey; Clean Jobs America 2021, E2; BLS includes non-farm industries; BCG analysis
Adoption for new technologies follow "s-shaped" curve
Example 1: Phillips gained competitive advantage through introduction of LED luminaires.

Clean tech in the United States is reaching a tipping point for adoption as new technologies reach critical mass
Example 2. Electric vehicle penetration rapidly accelerated after reaching 5% penetration across the globe; US market recently crossed the 5% threshold and is positioned to follow suit.

Note: LED electronics used in LED luminaires are included in the LED–luminaire market total; blue-collar services are excluded.
Securing competitive advantage | Business leaders must move quickly to secure scarce inputs needed for scalable sustainable business models

As funding floods clean tech, demand for sustainable resources, capabilities and infrastructure will outpace supply. Previously, we presented several ways to engage suppliers:

### IRA and IIJA have provisions to bolster long-term resource availability

- $3B green procurement funding increases market-competitiveness of domestic materials
- Onshoring and building a domestic clean tech workforce will reduce geopolitically-induced scarcity
- Previously cost-prohibitive alternative energy sources e.g., H₂ will increase clean energy supply

### Demand signals

- Form coalition of peers, including industry or tech coalitions and pooled procurement
- Make advanced market commitments to purchase specific tech

### Strategic investments

- Invest in specific partners, via concrete volume agreements or other partnerships
- Provide capital with lower expected return

Source: Part 2 | US Inflation Reduction Act: Broader implications for corporate decarbonization
Securing competitive advantage | Strong growth expected across all tech sectors, but strategic approach must account for technological maturity

Global annual market

- Renewable Energy: $0.5 T, CAGR 6%
- Grid Investment: $0.6 T, CAGR 7%
- Energy Storage: $0.3 T, CAGR 9%
- Alternative Fuels: $0.3 T, CAGR 16%
- Carbon Removal: $0.3 T, CAGR 33%
- Green Building & Renewable Heat: $0.2 T, CAGR 11%

Two broad strategies to consider:

**Mature technologies**
Capturing opportunity in renewables and grid infrastructure requires making big bets to quickly build scale: leveraging existing capabilities to accelerate growth, orchestrating partnerships, or engaging in M&A.

**Less mature technologies**
Hydrogen, CCUS, and DAC face technological barriers, labor shortages, and unknown political climates. Strategies in this space will require testing and iteration to build new markets, and diversification to mitigate risks. Companies with competencies in related technologies will likely have a starting advantage.

1. Green Fuels not included in Alternative Fuels estimate due to limited data on annual growth.

Source: BCG analysis
## Further reading

### Machinery

<table>
<thead>
<tr>
<th>Title</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net-Zero Trucks? Yes, It's Possible.</td>
<td>Nov. 12, 2021</td>
</tr>
<tr>
<td>Why Electric Cars Can’t Come Fast Enough</td>
<td>April 20, 2021</td>
</tr>
<tr>
<td>What It Will Take to Reap the Rewards of Renewable Fuels</td>
<td>April 20, 2022</td>
</tr>
<tr>
<td>AI Is Essential for Solving the Climate Crisis</td>
<td>July 7, 2022</td>
</tr>
<tr>
<td>Reduce Carbon and Costs with the Power of AI</td>
<td>Jan. 26, 2021</td>
</tr>
<tr>
<td>Measuring Emissions Accurately</td>
<td>Oct. 13, 2021</td>
</tr>
</tbody>
</table>

### Digital & AI

<table>
<thead>
<tr>
<th>Title</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>A $2T Banking Climate Opportunity Hiding in Plain Sight</td>
<td>Jan. 19, 2021</td>
</tr>
<tr>
<td>Private Equity Should Take the Lead in Sustainability</td>
<td>July, 2022</td>
</tr>
<tr>
<td>Six Pitfalls to Avoid When Mobilizing for Sustainability</td>
<td>April 11, 2022</td>
</tr>
<tr>
<td>Aluminum Can Come Back Greener and Stronger</td>
<td>March 5, 2021</td>
</tr>
<tr>
<td>Global Shipping’s Net-Zero Transformation Challenge</td>
<td>Sep 24, 2021</td>
</tr>
<tr>
<td>The Untapped Climate Opportunity in Alternative Proteins</td>
<td>July 8, 2022</td>
</tr>
</tbody>
</table>

### Finance

<table>
<thead>
<tr>
<th>Title</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Six Pitfalls to Avoid When Mobilizing for Sustainability</td>
<td>April 11, 2022</td>
</tr>
<tr>
<td>Aluminum Can Come Back Greener and Stronger</td>
<td>March 5, 2021</td>
</tr>
<tr>
<td>Global Shipping’s Net-Zero Transformation Challenge</td>
<td>Sep 24, 2021</td>
</tr>
<tr>
<td>The Untapped Climate Opportunity in Alternative Proteins</td>
<td>July 8, 2022</td>
</tr>
</tbody>
</table>

### Additional indirect clean tech market opportunities

- A $2T Banking Climate Opportunity Hiding in Plain Sight
- Private Equity Should Take the Lead in Sustainability
- Six Pitfalls to Avoid When Mobilizing for Sustainability
- Aluminum Can Come Back Greener and Stronger
- Global Shipping’s Net-Zero Transformation Challenge
- The Untapped Climate Opportunity in Alternative Proteins
BCG contacts

Tom Baker  
MD & Partner  
Renewables & Decarbonization  
San Francisco  
baker.thomas@bcg.com

Cornelius Pieper  
MD & Senior Partner,  
Sustainability in Industrial Goods  
Boston  
pieper.cornelius@bcg.com

Pattabi Seshadri  
MD & Senior Partner,  
BCG Global Leader - Energy  
Dallas  
sheshadri.pattabi@bcg.com

Thomas Dauner  
MD & Senior Partner,  
BCG Global Leader –  
Industrial Goods  
Stuttgart  
dauner.thomas@bcg.com

Hubi Meineke  
MD & Senior Partner,  
BCG Global Leader –  
Climate & Sustainability  
Hamburg  
Meinecke.Hubertus@bcg.com

Simon Rees  
MD & Partner  
Greentech  
Boston  
rees.simon@bcg.com

Andrew Alcorta  
Principal,  
Greentech  
Boston  
alcorta.andrew@bcg.com

Alex Dewar  
Partner  
Decarbonization  
Washington DC  
dewar.alex@bcg.com

Katherine Phillips  
Project Leader,  
Decarbonization  
New York  
phillips.katherine@bcg.com

Marielle Remillard  
Principal,  
Climate & Sustainability  
Boston  
remillard.marielle@bcg.com
## Overview of technology landscape

### Technology category (non-exhaustive)

<table>
<thead>
<tr>
<th>Utilities</th>
<th>Buildings</th>
<th>Transportation</th>
<th>Agricultural &amp; Industrial Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar PV, Hydro, Wind, Other²</td>
<td>Distributed Solar PV</td>
<td>Transmission, distribution, and Smart Grid*</td>
<td>Off-grid generation</td>
</tr>
<tr>
<td>TMS &amp; PHS²</td>
<td>EV Charging-Onsite Batteries</td>
<td>EV Charging</td>
<td>Off-grid stationary battery</td>
</tr>
<tr>
<td>Stationary Battery, BEV*</td>
<td>Electrification, compression, storage, carrier pathways, &amp; transportation tech</td>
<td>H₂ power turbine, Fuel Cells</td>
<td>Direct Air Capture (DAC)</td>
</tr>
<tr>
<td>H₂ power turbine, Fuel Cells</td>
<td>Biomass &amp; biogas furnace, Biogas CHP</td>
<td>&gt;50% SAF engines, FCEV</td>
<td>Industrial CCUS, BECCS</td>
</tr>
<tr>
<td>Combined heat &amp; power, Heat Pumps</td>
<td>Building automation &amp; EMS</td>
<td>Alt. fuel engine, BEV</td>
<td>BECCS</td>
</tr>
<tr>
<td>Utility CCUS, BECCS*</td>
<td>Green building materials</td>
<td>H₂ furnace, Biomass &amp; biogas furnace</td>
<td>CCUS and Engineered Carbon Removals</td>
</tr>
<tr>
<td>CCUS and Engineered Carbon Removals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Renewable Energy</td>
<td>Grid Investment</td>
<td>Energy Storage</td>
<td>Alternative Fuels (H₂, Synfuel, &amp; Bioenergy)</td>
</tr>
<tr>
<td>Green building tech &amp; renewable heat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CCUS and Engineered Carbon Removals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficiency gains</td>
<td>Circular Economy</td>
<td>Materials recycling &amp; transport</td>
<td></td>
</tr>
<tr>
<td>Efficiency in conventional power gen, LDAR²</td>
<td>Recycled building materials</td>
<td>Remanufacturing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Improved thermal efficiency</td>
<td>Variable speed drive motors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heat optimization &amp; recovery</td>
<td>Controls, software, and analytics</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>LDAR²</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hydraulic Electrification</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

= Opportunities most benefitted by IRA … but full climate tech opportunity space expected to grow due to increased focus post-IRA

---

The services and materials provided by Boston Consulting Group (BCG) are subject to BCG’s Standard Terms (a copy of which is available upon request) or such other agreement as may have been previously executed by BCG. BCG does not provide legal, accounting, or tax advice. The Client is responsible for obtaining independent advice concerning these matters. This advice may affect the guidance given by BCG. Further, BCG has made no undertaking to update these materials after the date hereof, notwithstanding that such information may become outdated or inaccurate.

The materials contained in this presentation are designed for the sole use by the board of directors or senior management of the Client and solely for the limited purposes described in the presentation. The materials shall not be copied or given to any person or entity other than the Client (“Third Party”) without the prior written consent of BCG. These materials serve only as the focus for discussion; they are incomplete without the accompanying oral commentary and may not be relied on as a stand-alone document. Further, Third Parties may not, and it is unreasonable for any Third Party to, rely on these materials for any purpose whatsoever. To the fullest extent permitted by law (and except to the extent otherwise agreed in a signed writing by BCG), BCG shall have no liability whatsoever to any Third Party, and any Third Party hereby waives any rights and claims it may have at any time against BCG with regard to the services, this presentation, or other materials, including the accuracy or completeness thereof. Receipt and review of this document shall be deemed agreement with and consideration for the foregoing.

BCG does not provide fairness opinions or valuations of market transactions, and these materials should not be relied on or construed as such. Further, the financial evaluations, projected market and financial information, and conclusions contained in these materials are based upon standard valuation methodologies, are not definitive forecasts, and are not guaranteed by BCG. BCG has used public and/or confidential data and assumptions provided to BCG by the Client. BCG has not independently verified the data and assumptions used in these analyses. Changes in the underlying data or operating assumptions will clearly impact the analyses and conclusions.