BCG

Executive Perspectives

US Inflation Reduction Act: Global Implications

December 2022

Introduction to this document

While the US Inflation Reduction Act (IRA) aims to turbocharge domestic decarbonization, its impact will be felt around the world. With $369B earmarked for climate and energy investments, the IRA catalyzes opportunities for climate action, presenting both benefits and challenges for countries and companies. The IRA lowers costs of emerging clean tech (e.g., hydrogen, carbon capture, grid scale battery storage) and expands supply of critical raw materials and components. At the same time, emerging trade tension with key US trading partners like the EU, Japan, and South Korea creates a more complex geopolitical environment for companies to navigate.

This document, the fourth in our series on the IRA, explores the bill's global implications. It identifies direct and indirect benefits to non-US players, addresses potential changes to global supply chains, and highlights initial reactions from private and public stakeholders.

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**
- **Part 3 | US Inflation Reduction Act: Clean Tech Growth Opportunities and Value Pools**

How can COUNTRIES benefit?

1 IRA provides global benefits by lowering cost and expanding supply chains

- **Accelerated cost declines:** IRA expected to drive down cost for clean tech globally through added capacity deployment and higher learning rates; incremental cost reductions of 1-25% by 2030, with greatest gains for CCUS, DAC, and hydrogen electrolyzers
- **Case for optimism:** Historical cost declines (e.g., solar, wind) have far outpaced projections—progress on clean tech should not be underestimated; US investments expected to drive down costs of emerging tech as did German subsidies for solar PV while catalyzing action abroad
- **Supply diversity:** IRA will incentivize demand for EV critical minerals from free trade partners (20 countries worldwide) and components manufactured in Canada and Mexico, diversifying supply chains in the long-term
- **Green sourcing:** IRA's requirements amplify supply chain transparency trends, facilitating sustainable procurement for other nations and providing opportunities for those who offer solutions

What challenges will they face?

2 Brittle supply chains coupled with US subsidies may disrupt global trade in short term

- **Supply chains:** Despite long-term benefits, high geographic concentration of production and increasing demand will stress brittle supply chains in the short term since majority of solar and EV supply chains are concentrated in China today
- **Market dynamics:** IRA subsidies will give US advantage in green steel exports (i.e., US up to ~40% cheaper than representative German green steel producer) among others, putting other potential exporters at disadvantage
- **Trade implications:** EU, UK, Japan, Korea are concerned about the impact of US subsidies and may respond with countermeasures; though some signals in December 2022 suggest a more constructive way forward ('race to the top')

How can COMPANIES benefit?

3 Opportunities to invest in, sell to, and buy from US; further upside with tax credits

- **Investment opportunities:** US becomes attractive green market for non-US players with an incremental $1.3T of public and private investment in climate action and energy transition as a result of the IRA
- **Export opportunity:** Companies can supply clean tech components to US market boosted by IRA incentives without origin requirements, e.g., electrolyzers, electric commercial vehicles, heat pumps, smart grid components and software
- **Buying green from US:** Clean tech incentives position US as a low-cost exporter (e.g., green and blue hydrogen)
- **Tax credits:** Transferability creates large new market with tax saving opportunities for US taxpayers in any sector
- **Early momentum:** International businesses such as BMW, Panasonic, and Enel are already responding to IRA by entering the US market and expanding their footprint; first movers include EV and solar industries

What challenges will they face?

4 New competitive fault lines due to raw material scarcity and race to new strategies

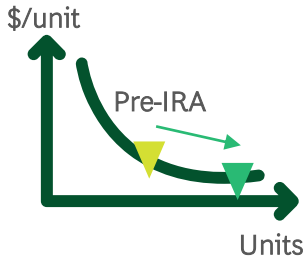
- **Raw material scarcity:** Increased EV demand paired with FTA requirements exacerbate near-term critical mineral supply scarcity (e.g., lithium, cobalt, manganese, and nickel)
- **Strategic response:** Claiming IRA advantages will require comprehensive view of the value chain and ecosystem

Implications for COUNTRIES

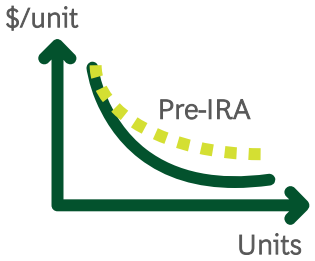
1
Country benefit

Accelerated cost declines | IRA expected to drive down cost for clean tech globally through added capacity deployment and higher learning rates

Capacity growth and innovation will accelerate technology cost decline



Additional global capacity pushes technology cost down experience curve



Innovation changes pace of cost decline (i.e., steepness of the curve)

Key drivers include incremental US capacity, additional global deployment, and improvements in learning rates

Base case (post-IRA): accelerated US deployment in response to IRA; global capacity forecast at pre-IRA levels

Faster global deployment: expected cost declines catalyze faster deployment around the world

Improved learning rate: scenario in which early investments in R&D, pilots, and demonstrations coupled with subsidies de-risks deployment, increasing learning rates across mature and emerging technologies for equipment costs and total installation costs

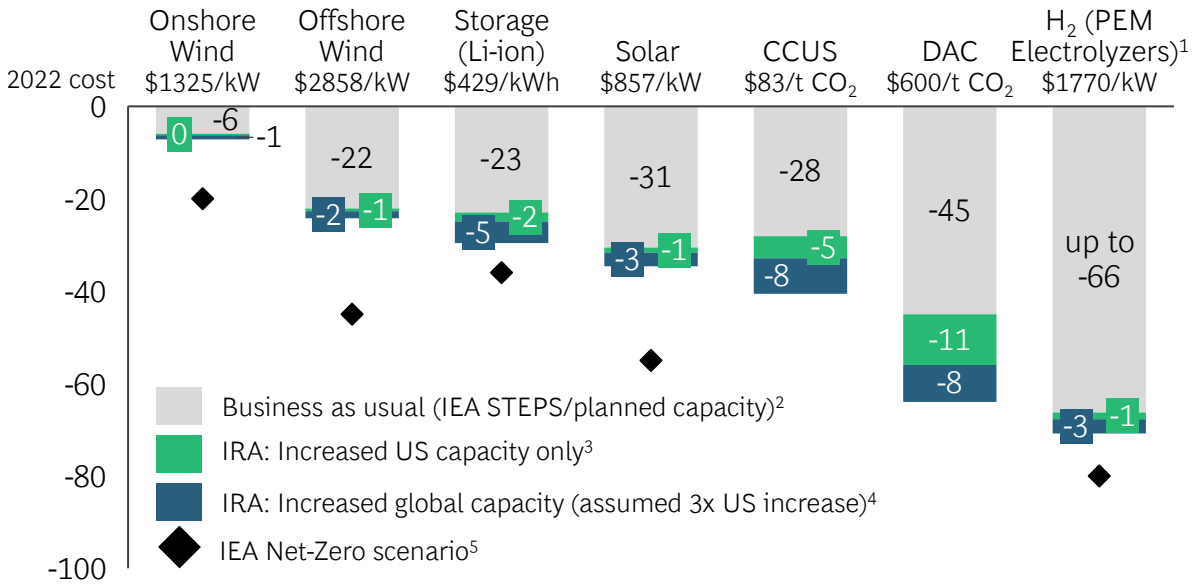
1 Country benefit

Projected impact | Incremental global cost reductions due to IRA range from 1-25% by 2030, with greatest gains for CCUS, DAC, and H_2 electrolyzers

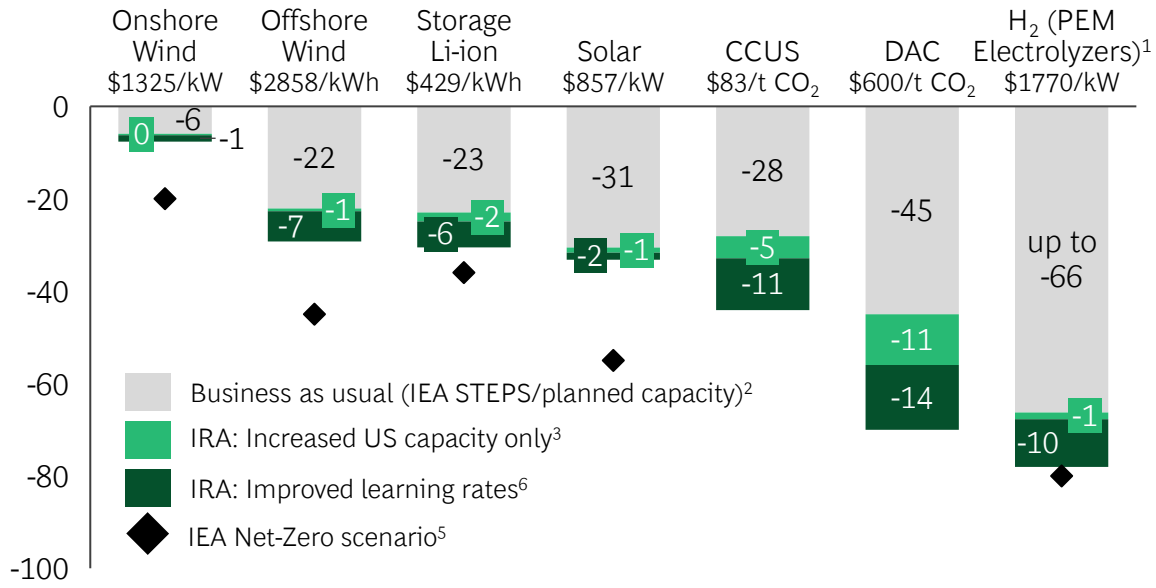
Incremental percent change of unit cost in 2030 relative to 2022

See pg. 13 for US added capacity

Capacity effect of IRA: Incremental technology cost reduction due to added US capacity (base case) and additional global deployment



Learning rate effect of IRA: Incremental cost reduction due to de-risked commercialization (US moving early) and innovation



Methodology

Capacity change + **Learning rate** → **Wright's law** (cost decreases by learning rate for every doubling of capacity) → **Cost decrease**

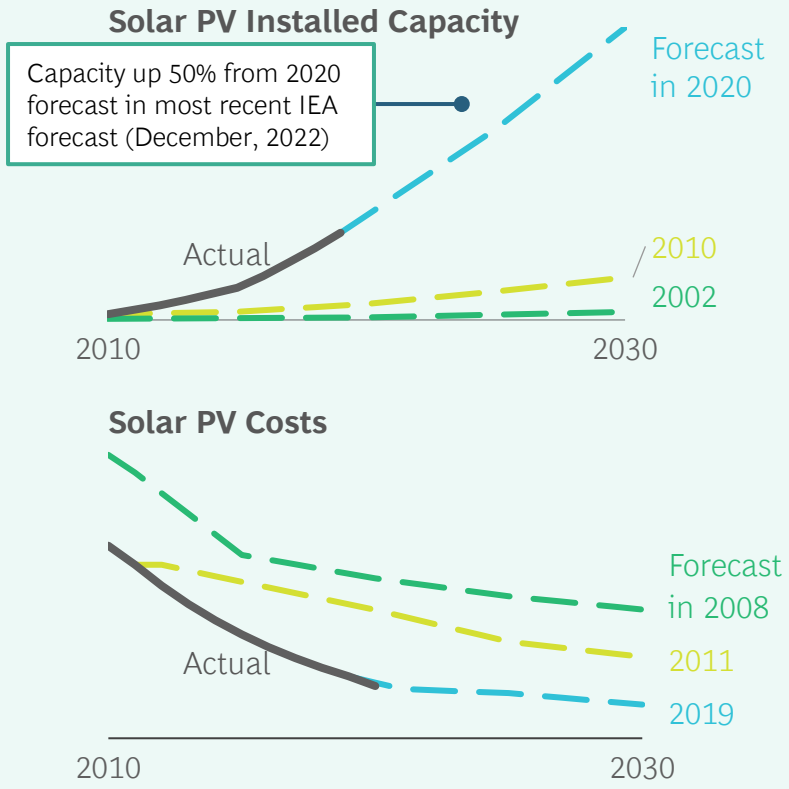
Note: 2030 cost projections do not account for inflation or subsidies. 1. Results are based solely on PEM electrolyzers; learning from other electrolyzer types could influence final cost decline 2. Business as usual: 2030 capacity projections pre-IRA based on IEA stated policy (STEPS) scenario (solar, wind) and planned capacity (all others); DAC capacity is based on 'advanced development' projects 3. US incremental capacity (post-IRA): BCG model of 2030 capacity for a 'deep green' scenario (see page 13) with added US capacity due to IRA 4. Global incremental capacity (post-IRA): Increase the global incremental capacity by 3x US incremental capacity from the prior scenario 5. Net-zero: IEA NZE 2050 scenario values for capacity needed by 2030 and respective upper values for cost decline range; values not available for CCUS and DAC 6. Median learning rate from REFLEX report (see Sources) plus reported error ranges; installed capacity accounts for US incremental deployment post-IRA; Source: IEA (projected capacities and NZE cost decline); historical learning rate values (median: ~6-18%; high: +1-5%) from "Technological learning in energy modelling–experience curves: Policy brief for the REFLEX project" except for CCUS and DAC (based on BCG experts); BCG analysis

1
Country benefit

Case for optimism | Historical cost declines (e.g., solar, wind) have outpaced projections—progress on clean tech should not be underestimated

Solar PV Example

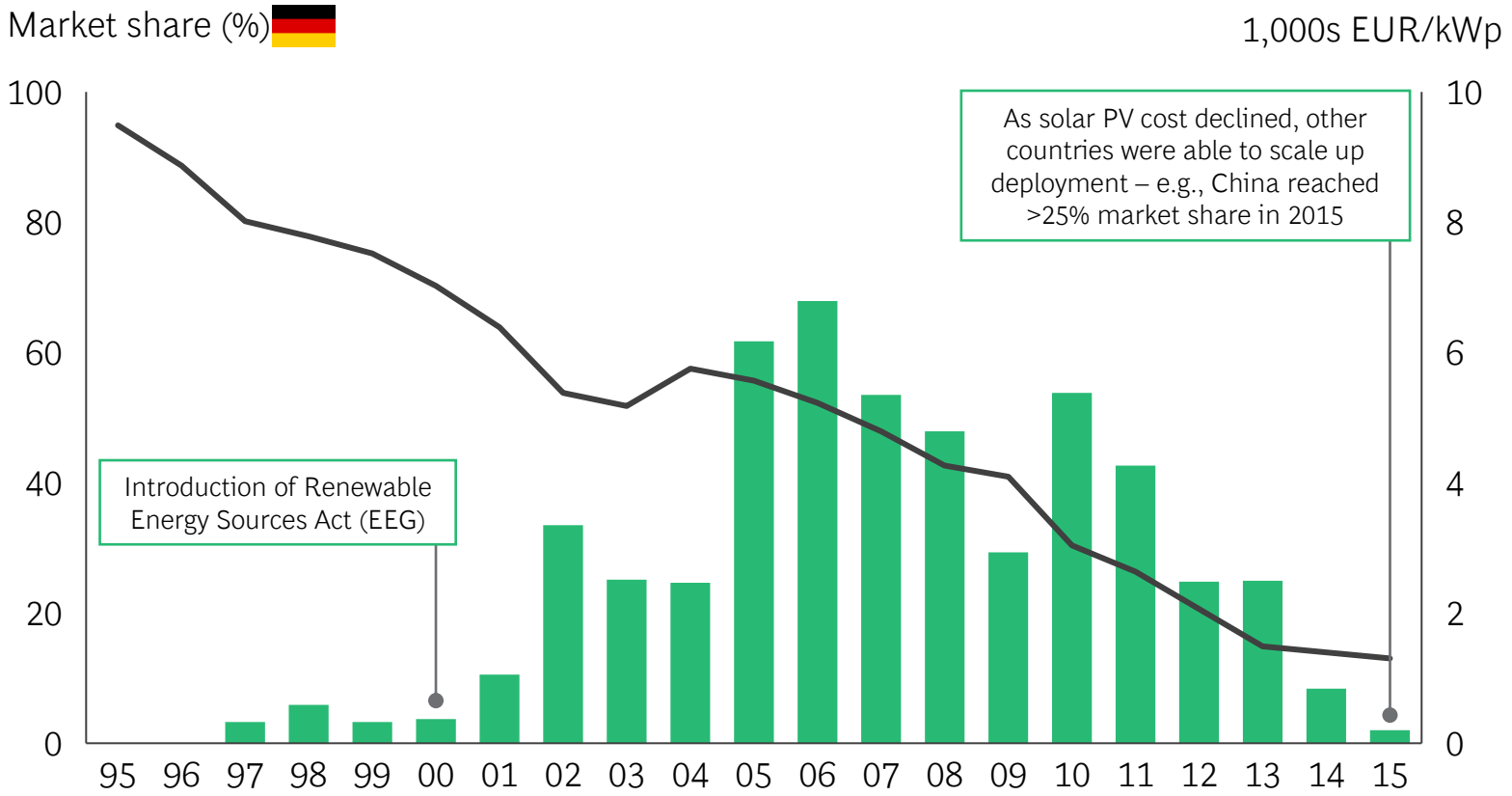
Cost drops likely underestimated as evidenced by trajectory for solar



Historical cost projections have often underestimated **deployment** and **cost declines** of clean tech

Sources: "Winning the Race to Net-Zero" (WEF & BCG); "Renewables 2022" (IEA)

Case study: Impact of PV subsidies for PV solar in the early 2000s in Germany with subsequent uptake of technology across the world



Source: BNEF; Energy Transition: The Global Energiewende

1
Country benefit

Supply diversity | IRA will incentivize demand for EV critical minerals from free trade partners and components manufactured in Canada and Mexico

Free-trade partners, including several emerging economies, benefit from content requirements for EV critical minerals and battery components…[1]

IRA eligibility criteria specifically for EV incentives[1]

Critical minerals

40%
sourced from or processed in **US** or **country with free trade agreement[2]**

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

Battery components

50%
of **battery components** manufactured in **US, Mexico, and Canada [2,3]**

Content requirement increases by 10ppts up to 100%

Countries that benefit

Australia, Bahrain, Canada, Chile
Colombia, Costa Rica, Dominican Republic, El Salvador
Guatemala, Honduras, Israel, Jordan
S. Korea, Mexico, Morocco, Nicaragua
Oman, Panama, Peru, Singapore

Mexico, Canada

…and incentives have been welcomed by key trade partners

> *The Inflation Reduction Act (IRA) envisages an enormous investment in clean technology. Australia has an opportunity through green hydrogen, through other innovations working to gain jobs and economic opportunity.*
>
> - Anthony Albanese, Australian PM

> *We cannot do that without affordable, cost-competitive renewables… From that perspective, I very much welcome the Inflation Reduction Act. For us, it's very much a signal to the world, to our friends in Europe indeed and to ourselves.*
>
> - Leila Benali,
> Morocco's Minster of Energy Transition
> and Sustainable Development

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 with free trade agreements from sourcing from these foreign entities 3. Included recycling done in North America
Source: IEA, H.R.5376 – 117th Congress (2021-2022): Inflation Reduction Act of 2022

1
Country benefit

Green sourcing | IRA's requirements amplify global trends around supply chain transparency and ethical procurement

Four key themes along clean tech supply chains

1 Mineral tracing

- US mineral tracing will expand with the IRA EV battery minerals requirement
- Opportunities to streamline processes (e.g., trade compliance) and expand software solutions

2 Labor due diligence

- IRA and new US forced labor law[1] has increased visibility for labor and human rights
- US expectations, alongside other countries, will drive industry standards that extend throughout supply chains

3 Emissions reporting

- US tax credits linked to emissions intensity (e.g., 45Q for hydrogen, SAF), alongside new SEC requirements, will further expand the emissions reporting market beyond EU's Carbon Border Adjustment Mechanism

4 Early procurement

- Role of procurement must broaden focus from cost-only to strategic sourcing to ensure access to scarce resources
- In near-term, limited supply of key inputs or decarbonized commodities creates advantage for early movers
- New contracting approaches may be necessary to spur investment in incremental green production (e.g., advanced offtake agreements)
- Skills will need to evolve as role shifts towards strategic engagement with suppliers on technically complex topics

1. Uyghur Forced Labor Prevention Act | US Customs and Border Protection (cbp.gov)

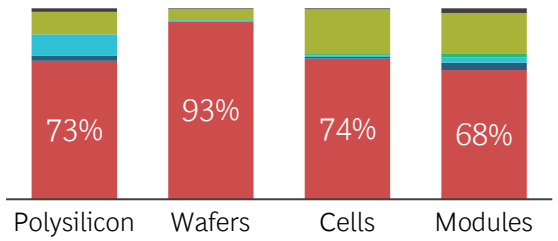
Source: BCG analysis

2
Country challenge

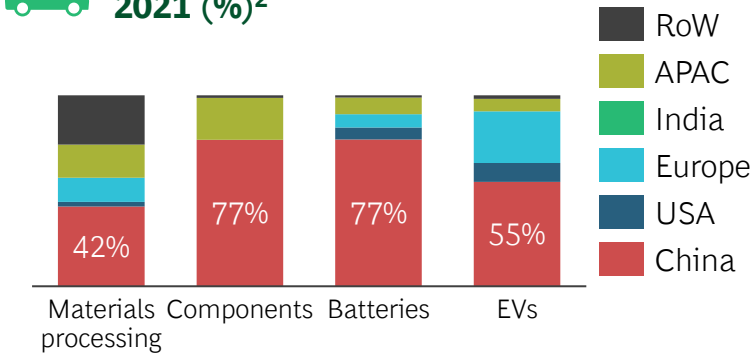
Supply chains | High geographic concentration of production and increasing demand will stress brittle supply chains in the short term

Solar and EV supply chains are highly concentrated in China

Annual solar supply chain, 2021 (%)[1]

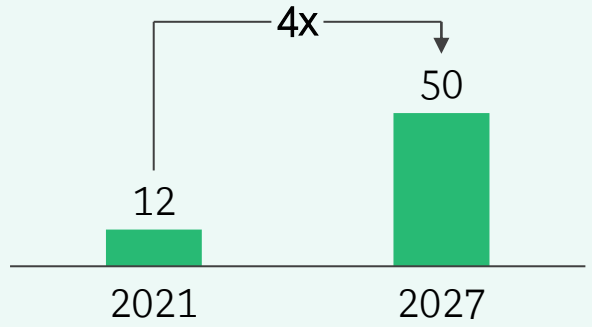


Annual EV supply chain, 2021 (%)[2]

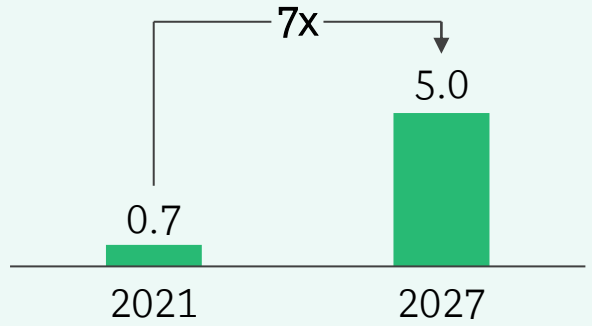


Increasing demand will place stress on supply chains facing numerous challenges

US solar PV demand (GW)[3]



US EV demand (M vehicles)[4]



Challenges to developing supply chains sufficient to match demand

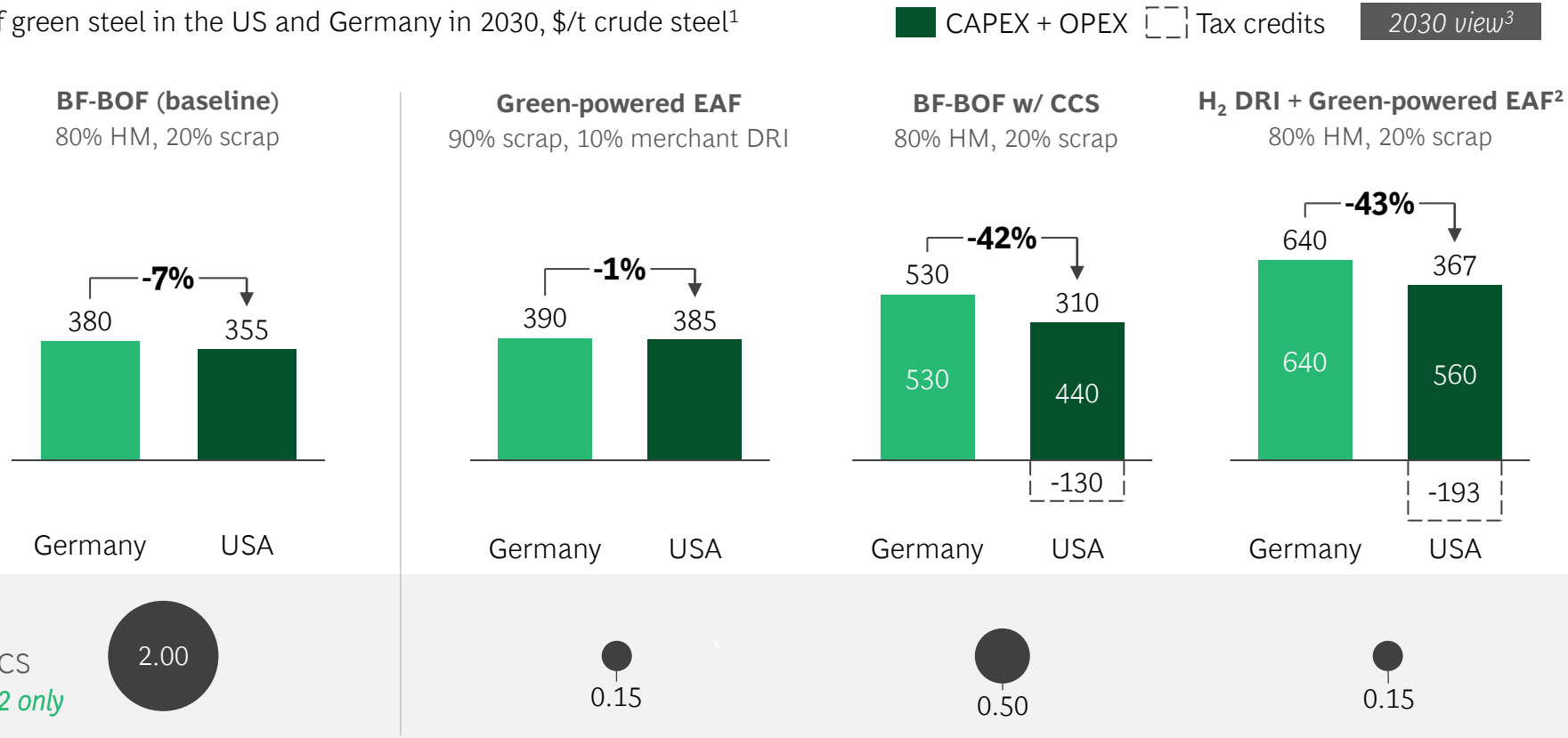
1. **Regulations** that reward domestic content and will restrict products from countries of concern
2. **Long lead times** to initial production, especially for EV batteries and materials
3. **Industrial policy** that further consolidates supply chains
4. **Structural advantages** from human and knowledge capital in legacy regions

1. 4-year average 2017-2021. International Energy Agency, Special Report on Solar PV Global Supply Chains. APAC refers to Asia Pacific region excluding India and China; Rest of World (RoW) refers to all countries not listed 2. 2021 values. International Energy Agency, Global Supply Chains of EV Batteries. Materials processing average of Li, Ni, Co, Gr processing percentages. Components average of cathode and anode production percentages 3. SEIA, Solar Market Insight Report 2022 Q3
4. Bloomberg New Energy Finance, Electric Vehicle Outlook 2022

Market dynamics | IRA subsidies will give US advantage in green steel exports among others, putting other potential exporters at disadvantage

For example, tax credits for US green steel could provide up to ~40% savings compared to Germany in the international market…

Cost of green steel in the US and Germany in 2030, $/t crude steel[1]



… but a few factors may change the economics

1. **Policy response:** anti-subsidy action may lessen effects of US tax credits in certain markets, especially EU
2. **Durability of incentives:** current IRA credits have a tenure of 10 years compared to steel industry capex lock-in of 20-25 years
3. **Availability of inputs:** supply constraints for scrap, DR-grade iron ore, DRI plan-t makers, and transport & storage of Hydrogen
4. **CCS deployment:** large scale adoption, feasibility and cost competitiveness of CCS

Note: EAF = Electric Arc Furnace, BF-BOF = blast furnace - basic oxygen furnace, CCS = carbon capture storage DRI = direct reduced iron, DR-grade = direct reduction grade
1. Cost assumptions do not represent current 2022 market prices (e.g., per unit costs of scrap = $225, DR pellets = $119, coking coal = $100-120, etc.) 2. Onsite H_2 production with renewables, no storage cost, and $3/kg credit 3. Costs may vary based on transport distance and location, availability of key inputs, etc.
Source: GCCSI 2021 Technology Readiness and Costs for CSS; IEA; BCG analysis

2
Country challenge

Trade implications | EU, UK, Japan, and South Korea are concerned about the impact of US subsidies and may respond with countermeasures

As of 9 December 2022

Despite shared climate goals, trade partners are concerned that IRA diverts jobs, investment to US

- Localized supply chains cut out competition, especially for passenger battery electric vehicles
- Incentives shift OEM manufacturing to US; subsidized products enter market
- Cheap alternative fuels (H_2, SAF) undermine growth of global industry

Japan, South Korea, UK, and EU have raised concerns about "discriminatory" trade implications of IRA; France estimates **€8B** hit to economy from IRA as it stands

Countries are considering counter-measures

Regulation	Industry interest groups, such as the EU's largest hydrogen lobby (Hydrogen Europe) have pushed for changes in local regulation in response to IRA
Trade status	EU, Japan, and South Korea are in discussions with the US seeking preferential trading status for EVs and batteries on par with Canada and Mexico[1]
On-shoring	EU is considering regulation that would require that all airlines serving EU airports buy sustainable aviation fuel in the EU
Subsidies	Nova Scotia has lobbied the Canadian government to match US incentives, and Canada has expanded some incentives on CCS
WTO action	Countries may raise a dispute at the World Trade Organization as a last resort if unable to find resolution

"We need to strengthen our own competitiveness in response… by creating really excellent conditions for investment in Europe."
– German finance minister Christian Lindner, *Financial Times* 2022

1. As of 1-Dec-22 Biden and Macron discussed widening the IRA beneficiaries to include allies in addition to free trade agreement countries Source: Reuters; Forbes; Financial Times; BCG analysis

2 Country challenge

Trade implications | However, some positive signals may also suggest that IRA catalyzes action for countries to "race to the top"

As of 9 December 2022

Not exhaustive

Direct policy response to IRA

Canadian IRA response package[1]
Nov 3, 2022 | Canada
A comprehensive suite of policy and financial instruments—including $15B (CAD) Canada Growth Fund—for clean tech, decarbonization, manufacturing, critical minerals, scaling companies, improving supply chains, & more.
New investment tax credits (ITC) up to 30% for clean tech (net-zero and low-carbon) and battery storage and up to 40% for clean H_2.

EU coordinated response[2]
Dec 5, 2022 | European Union
EU is working on a "structural answer" in response to IRA, with a focus on adapting state-aid rules to encourage local clean tech investment, utilizing existing funds, increasing financial support to maintain a competitive advantage, and considering local content requirements.

Oct 10, 2022 | Indonesia[3]
Upcoming disruptive EV subsidies in 2023

Nov 24, 2022 | Philippines[4]
Dropped import duties on EVs for 5 years

EV subsidies try to keep pace with IRA
Nov 29, 2022 | Germany
Germany plans to award 15-year subsidy contracts to energy-intensive industries for decarbonization

Oct 27, 2022 | France & Germany
EU to promote and protect national auto industries via extension of subsidies for EVs and plug-in hybrids; while a US-EU task force works to settle concerns of IRA requirements

International cooperation for decarbonization

Partnership for Accelerating CleanEnergy[5]
Nov 2022 | UAE & US
$100B in financing and support to deploy 100 GW of clean energy by 2035 in emerging economies around the world

Just Energy Transition Partnership[6]
Nov 2022 | Japan, US, & International Partners Group (IGP)
$20B in public and private financing over 3-5 years to retire coal and accelerate decarbonization of Indonesia

Indo-Pacific Economic Framework
Nov 2022 | India, Australia, Japan, Republic of Korea, Indonesia, Canada, & others
Expanded cooperation on shared economic issues and a boost to trade and climate finance

1. Canada Fall Economic Statement 2022, announced but not yet funded; further responses planned for 2023 budget 2. Politico 3. Bloomberg 4. Reuters 5. White House 6. White House; IGP is co-led by US and Japan and includes Canada, Denmark, EU, France, Germany, Italy, Norway, and UK.

Implications for COMPANIES

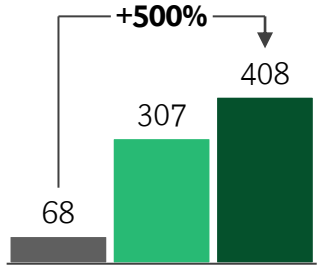
3 Company benefit

Investment opportunities | US becomes attractive green market for non-US players with ~$1.3T deployed in next 10 years from private and public sources

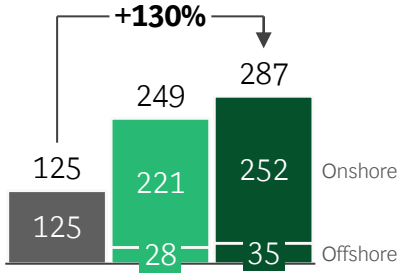
Not exhaustive

IRA accelerates deployment of decarbonization technologies…

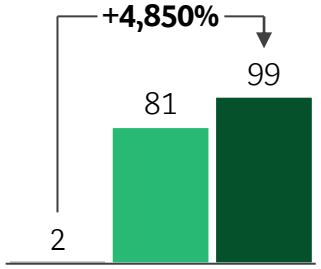
Utility-scale solar
Installed Capacity (GW)



On/Offshore Wind
Installed Capacity (GW)

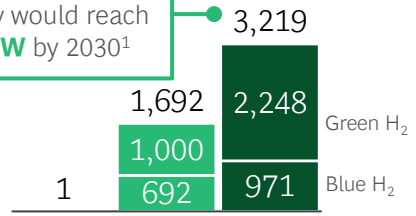


Non-residential Storage
Installed Capacity (GWh)

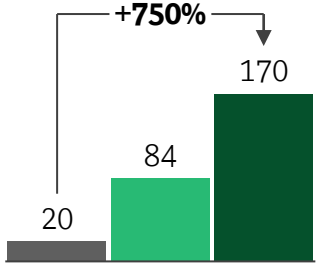


Hydrogen (H_2)
Thousand tons H_2 per year

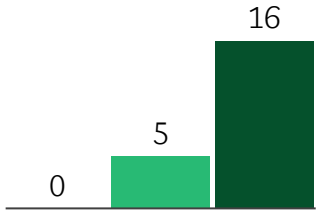
Electrolyzer installed capacity would reach **10-20 GW** by 2030[1]



Carbon capture
Million tons CO_2 per year[2]



Direct Air Capture (DAC)
Million tons CO_2 per year



2020 volume | 2030 volume, base case[3] | 2030 volume, optimistic

…and catalyzes significant capital

$1.3T in total investment[5]

- Expected total investment by federal funding, including $1.2T from technology-specific funding and $165B from non-technology specific funding

Over 8 years

- Estimates assume investment occurs between enactment and 2030

Incremental $170B annually

- Combined annual rate of private investment ($129B) generated by federal funding

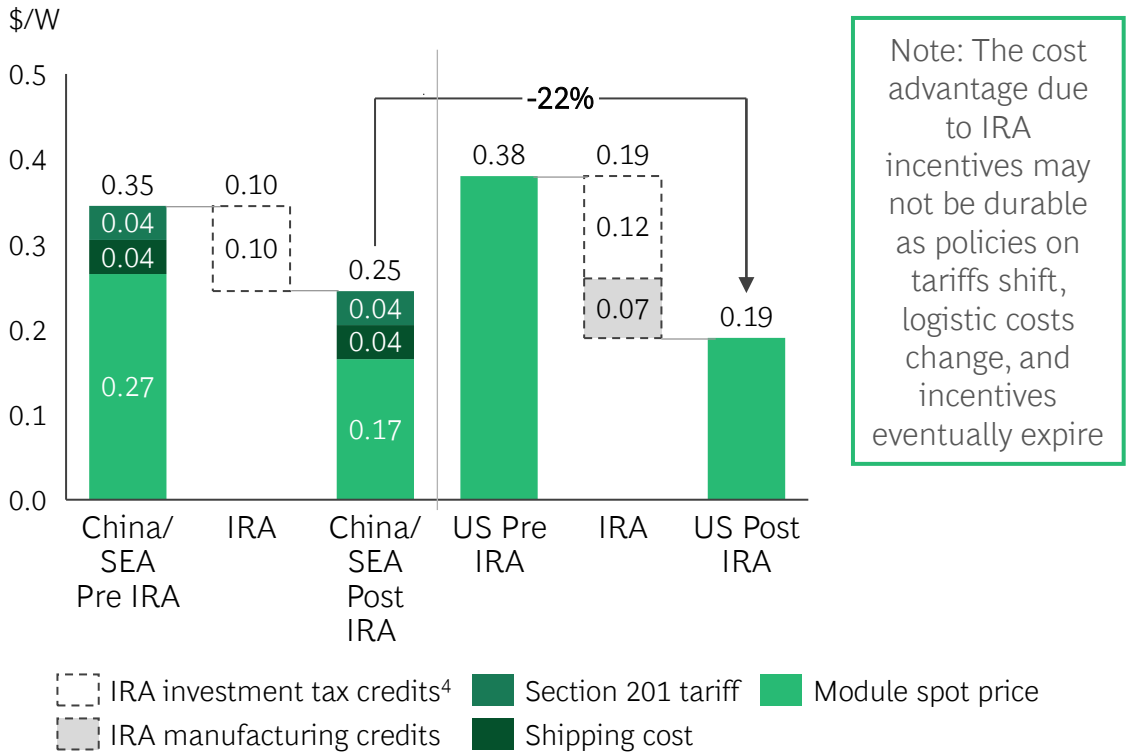
Annualized rate of investment to exceed recent annual spending by U.S. utility (~$133B) or O&G (~$60B) industries

1. Assuming a 1 Mtpa Green H_2 to 10 GW ratio 2. Does not include direct air capture (DAC) 3. BCG scenarios with varying assumptions on growth, rates of qualification for incentives, nuclear penetration, and energy efficiency 4. Including nuclear, transmission, energy efficiency, EVs and EV infrastructure, and SAF/biofuels in addition to listed examples 5. Includes IIJA funds and indirect effects, see previous editions of Executive Perspectives on IRA. Source: BCG analysis

3
Company benefit

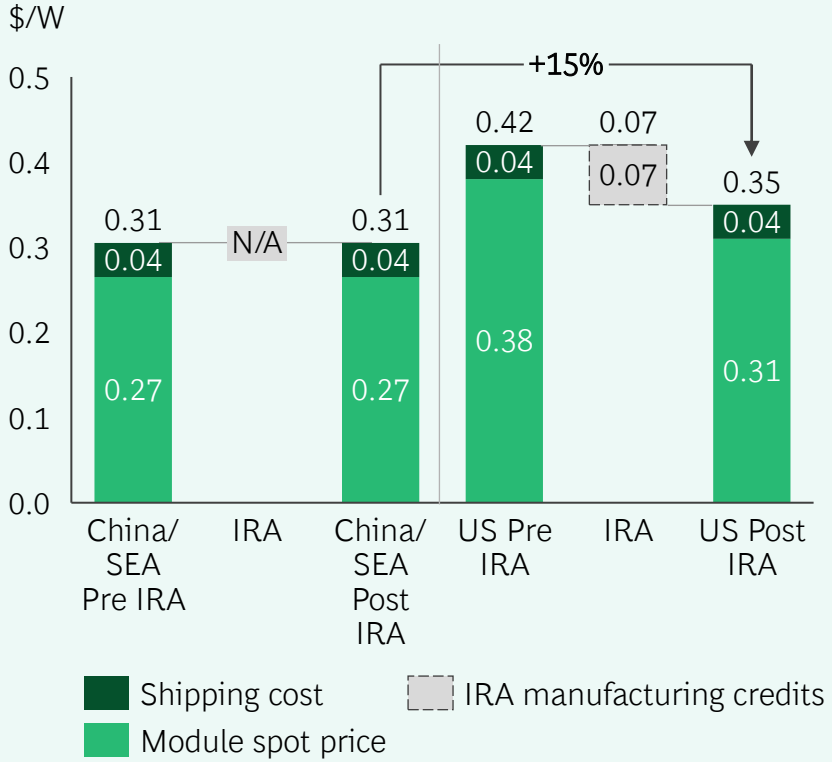
Investment opportunity example | US solar module production newly competitive in domestic market, but unlikely to displace suppliers globally

Made in US for domestic market: with IRA credits, domestic modules ~20% less than delivered price of SEA-modules



Note: The cost advantage due to IRA incentives may not be durable as policies on tariffs shift, logistic costs change, and incentives eventually expire

Made in US for exports: US exports are expected to remain ~15% more expensive than Chinese/SEA products



1. InfoLink spot price 2. 14.75%; tariffs exempted for 24-months from June 2022 on solar modules imported from Cambodia, Malaysia, Thailand, and Vietnam 3. 30%; Investment tax credits (ITC) can range from 6% to 70% depending on bonus incentives – 6% base, 30% if prevailing wages and apprenticeship, additional 10% domestic content bonus, additional 10% energy community bonus, additional 20% low-income bonus 4. 30% ITC + 10% domestic content in US example 5. InfoLink spot price 6. EU currently has no tariffs on module imports 7. Germany used as an illustrative example of a potential export market
8. Assumption of shipping costs is conservative
Source: InfoLink; BCG analysis

3
Company benefit

Export opportunity to US | Companies can supply equipment >$4T[1] US market boosted by IRA incentives without origin requirements

Not exhaustive

U.S. market potential for green components

$ estimates for machinery only (2021-2040)

Carbon-free energy

Example Equipment

- Building and residential equipment
  - Heat pumps
  - Induction stoves
  - Building automation
- Power sector equipment
  - Wind turbines and components
  - Long-duration energy storage systems
  - Smart- and micro-grid components
  - Long-distance transmission

Transportation

- Electric vehicle infrastructure
  - Charging station equipment
  - Meters and charge management systems
- Commercial fleets
  - Urban transit, e.g. buses
  - Long- and short-haul trucks

Clean tech

- Hydrogen equipment
  - Electrolyzers
  - Storage and transportation
- Emerging technology
  - Fuel cells
  - DAC systems
- Digital systems
  - Supply-chain tracking tools
  - Smart grid software
- Small modular nuclear reactors
  - Heat pipes
  - High-temp, corrosion-resistant metals & alloys

Manufacturing

- Heavy industry decarbonization equipment
  - Electric arc furnaces for clean steel
- Advanced chemical production
  - Polysilicon
  - Synthetic graphite

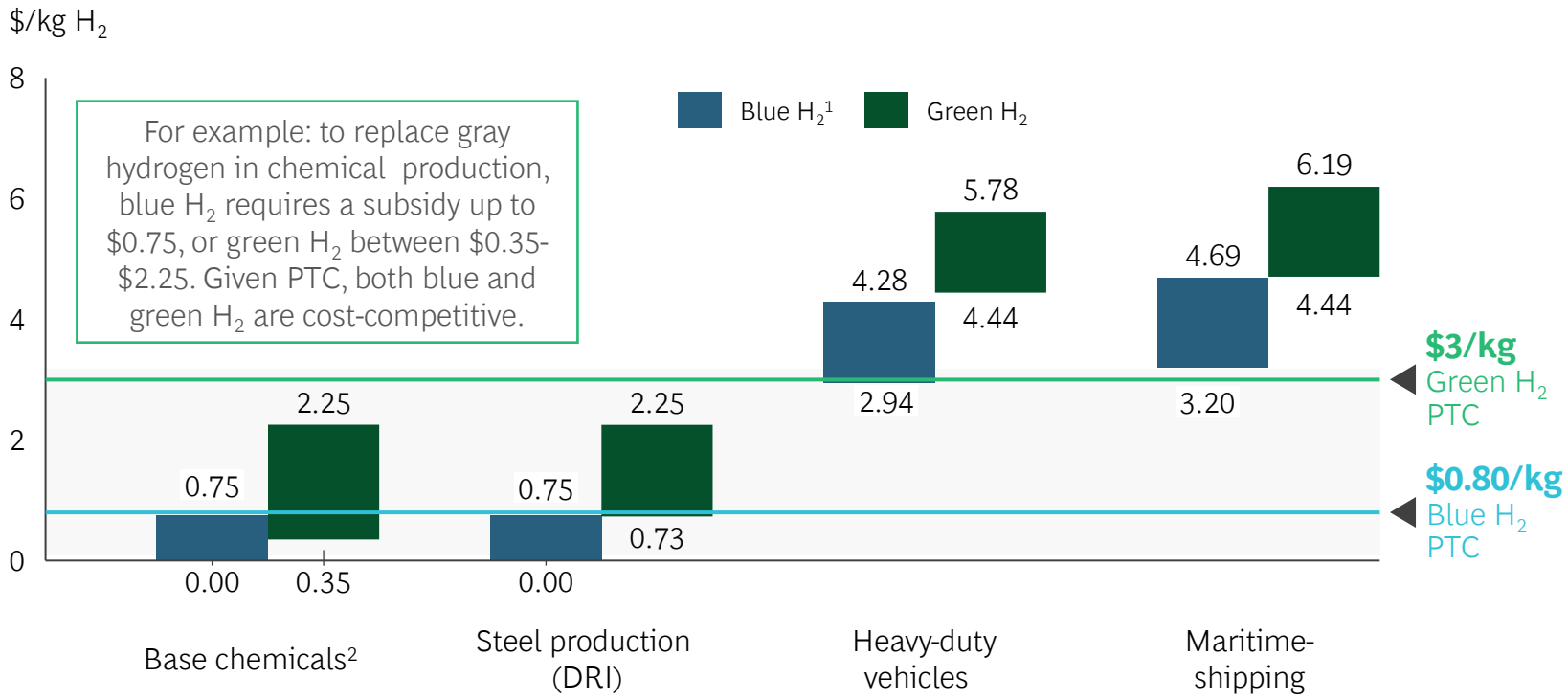
1. Estimated revenue potential for OEMs in US for clean tech machinery 2. Renewable energy, energy storage (stationary batteries), grid investments, green building (building automation, heat pumps) 3. Energy storage (Off-highway electric vehicles, battery manufacturing equipment), EV equipment, biofuels for transport 4. Alternative fuels (except biofuels for transport), hydrogen, fuel cells, carbon removal 5. Renewable heat (heat optimization & recovery, electric arc furnaces)
Source: BCG analysis

3
Company benefit

Buying green from US | Clean tech incentives position US as a low-cost exporter (e.g., green and blue hydrogen)

IRA subsidies expected to make blue and green hydrogen competitive with incumbent technologies for most applications by 2030

2030 view What level of subsidy is needed to compete with fossil-fuel based alternatives?



US role in the market will depend on the following policy decisions

Will subsidy deployment be constrained by bottlenecks?

- Tax equity and credit transferability market will need to remain robust and efficient to enable subsidy deployment at pace with development ambition

How will H_2 carbon intensity be calculated to align with emerging global standards?

- Global green H_2 use will require certification bodies to verify carbon intensity; subsidies will need to track changes to standards
- PTC[3] applies to production with no additional conditions

How will other nations respond?

- As countries angle to be exporters, they may engage in a subsidy-race with US or raise tariff barriers to US imports, buoying global market

Note: Incumbents defined as gray hydrogen (O&G, ammonia, specialty chemicals) and natural gas (methanol, steel), and ICE (heavy duty vehicles, maritime-shipping). Light duty vehicles excluded due to BEV dominance projections.
1. Blue Hydrogen range based on a $1.5/gk differential to green hydrogen costs. 2. Chemicals include methanol, ammonia, and oil and gas refining. 3. PTC = Production Tax Credit
Source: BCG analysis

3
Company benefit

Tax credits | Transferability creates large new market with tax saving opportunities for US taxpayers in any sector

New policy could create a total of $172B in transferable tax credits for businesses with US presence[1]

Interested parties will need to navigate uncertain market creation

Monetize credits

Developers can sell excess credits or fulfill immediate cash needs

Facilitate transfers

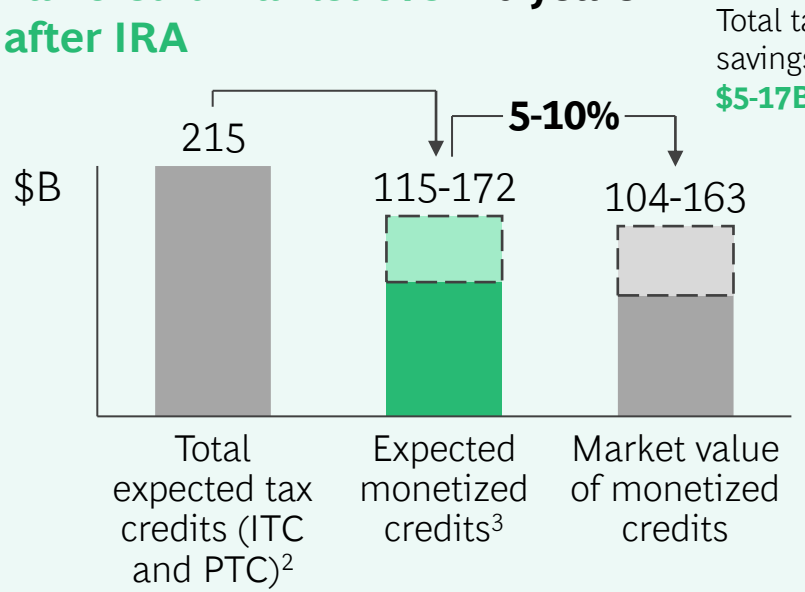
Tax credit brokers and accountants may facilitate sales at a discount in an **emerging marketplace**

Save on US taxes

Institutions purchase credits and save on taxes (e.g., large businesses, banks, insurance companies)

Tax equity is expected to remain a common method of renewable energy financing because of benefits of accelerated depreciation

Tax credit market over 10 years after IRA



Rules

- Investment Tax Credit (ITC) up to 70%, and Production Tax Credit (PTC) with up to 20% boost[4]
- Credits may be sold **once,** with tax-free income and expense

1. Tax-exempt entities excluded 2. Congressional Budget Office, Estimated Budgetary Effects of Public Law 117-169 3. Lower bound calculated as 39% of $180B (CY2020 tax equity market $18B, over 10 years, 39% of solar projects under 20MW) plus 80%*$58B ($46B) in non-clean energy credits; upper bound calculated assuming ~80% of projects will benefit from monetized credits. Source: Norton Rose Fulbright, Tax equity snapshot; BCG Analysis; US EIA Preliminary monthly electric generator inventory 2018 4. Part 1 | IRA Executive Perspective. Transferable PTC and ITC are available to projects producing wind and solar electricity, carbon capture, technology that reduces emissions, clean hydrogen, zero-emissions nuclear power, and clean manufacturing

3
Company benefit

Early momentum | International businesses are already responding to IRA with US expansion; first movers include EV and solar industries

Not exhaustive, as of December 2022

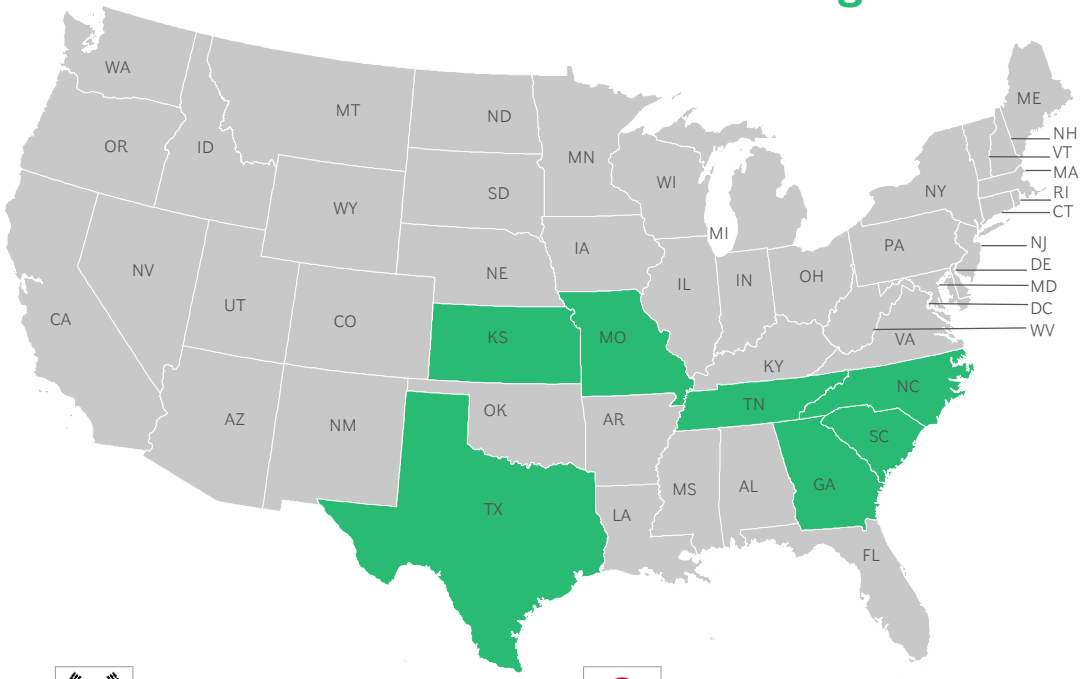
EV
"Audi considers 1st U.S. assembly plant amid new EV tax credits

Oliver Hoffmann of Audi says the Inflation Reduction Act tax incentives have the German brand considering localizing EV production in the U.S."
- October 09, 2022[1]

EV
"EV announcements snowballing post Inflation Reduction Act" [KS, NC, TN]
- September 12, 2022[2]

EV
"BMW plans to invest $1.7 billion in U.S. to produce electric vehicles" [SC]
- October 19, 2022[3]

States with expanded clean tech manufacturing



EV, Batteries
"Hyundai breaks ground on $5.5 bln U.S. EV, battery plant" [GA]
- October 25, 2022[4]

Batteries
"Panasonic to start building Kansas battery plant next month"
- October 31, 2022[5]

Solar
"Mission Solar announces 1 GW made-in-USA solar panel manufacturing expansion

The company plans to add 300 MW of production capacity immediately and targets 1 GW of annual production expansion by 2024." [TX]
- November 1, 2022[6]

Solar
"Enel to build massive solar panel factory in U.S.

..Planning a factory that can initially produce 3 GW—and ultimately as much as 6 GW—of solar panels ...The planned factory would also make solar cells, a key part of the supply chain not currently produced in the U.S."
- November 17, 2022[7]

Solar
"Nine gigawatt solar manufacturing facility being scouted for Qcell module manufacturing" [GA, SC, TX]
- August 15, 2022[8]

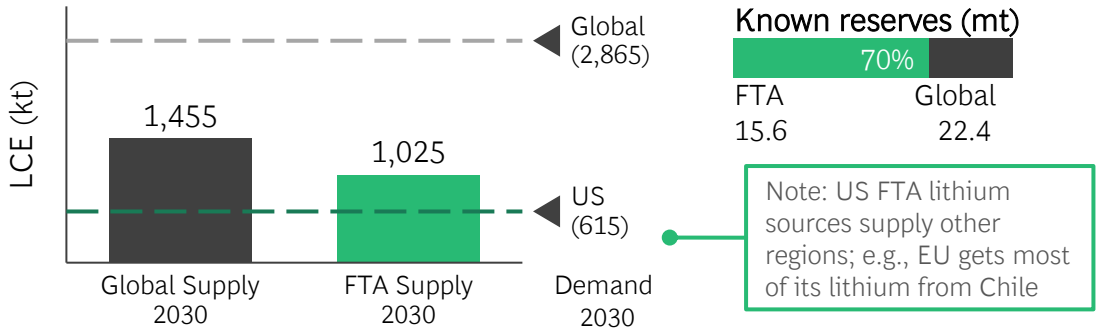
1. Automotive News 2. S&P Global Market Intelligence 3. CNBC 4. Reuters 5. Reuters 6. PV Magazine 7. Wall Street Journal 8. PV Magazine

4
Company challenge

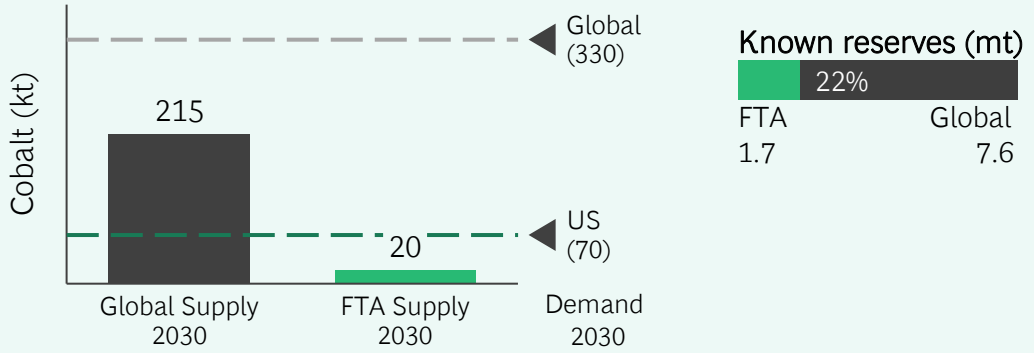
Raw material scarcity | Increased EV demand paired with FTA requirements exacerbate near-term critical mineral supply scarcity

2030 view

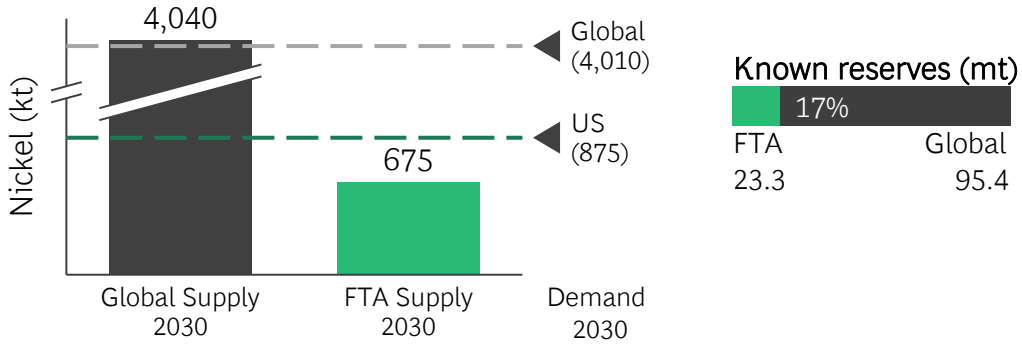
Lithium: FTA reserves growing and diversifying, but short-term tightness expected due to lead time for deposit developments



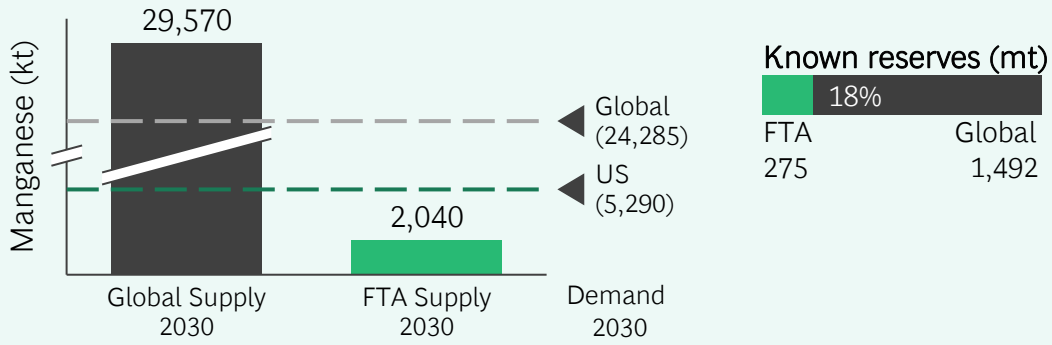
Cobalt: Risk due to high-single country exposure (DRC); recycling and new deposits softening but not solving the concentration risk



Nickel: Evolving long-term dependency risk from Indonesia; class 1 Ni bottlenecks expected in the medium-term



Manganese: Concentration risks for high-grade ore and processing; US & Europe driving to diversify & localize supply



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 Mineral Commodity Summaries; BCG analysis

4
Company challenge

Strategic response to scarcity | Claiming IRA advantages will require comprehensive view of the value chain and ecosystem

Companies need to move quickly due to long lead times for…

Permitting and financing across large, high-CAPEX projects required for land use, resource extraction, material processing, project development, power delivery, labor standards, and construction

Key resource scarcities emerging from multiple fronts, including raw material availability, market access, regulation, production capabilities/labor, infrastructure, and/or production economics, necessitating portfolio response

Eight portfolio responses that companies can consider as part of a comprehensive strategy to address sustainability scarcity

1 **Secure the supply**
Select and contract with suppliers to mitigate a shortage and create a more resilient supply chain

2 **Own the origins**
Acquire suppliers or invest in companies developing alternative resources

3 **Force innovation**
Innovate alternatives to address scarcities or bottlenecks

4 **Extract Value**
Capture value through price premiums, or build new businesses to fill a need

5 **Broaden the market**
Advocate for public policy that enables technology innovation, expands supply, or incentives alternatives

6 **Seed the market**
Invest in early-stage technologies and new companies that address scarcities

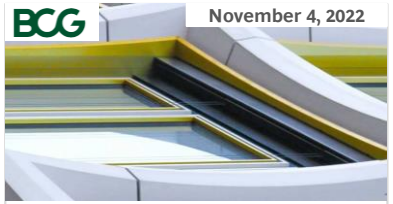
7 **Arbitrage the options**
Create value from different supply and pricing dynamics across geographies

8 **Act collectively**
Participate in industry and cross-sector coalitions to address supply constraints

Source: BCG Henderson Institute article "Solving the Puzzle of Sustainable Resource Scarcity" (2021); BCG analysis

Further reading

Clean tech and renewables



Strategies for Scaling Africa's Green Ventures

Five Ways CEOs Can Take On the Climate Challenge

How the US Can Win in Six Key Clean Technologies

Achieving Energy Security in the EU

EV and batteries

How Governments Can Solve the EV Charging Dilemma

The Lithium Supply Crunch Doesn't Have to Stall Electric Cars

Critical minerals

The Lithium Supply Crunch Doesn't Have to Stall Electric Cars

The Case for a Circular Economy in Electric Vehicle Batteries

Supply chain

Gauging the Risks of Raw-Material Volatility

How Technology Can Tame the EU Carbon Tax on Imports

Investment flows

A Tectonic Shift of Capital Is Just Beginning

The Net-Zero Opportunity in Consumer Lending

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