The Inflation Reduction Act

SOCIAL CAPITAL_

How to Read This Presentation

- This is the second of two presentations covering the global energy transition.
- This presentation provides an overview of global climate policy and a deep dive into the implications of the Inflation Reduction Act, which is a critical piece of U.S. climate policy.
- You should read our 101 presentation on the global energy transition first, since this provides useful context on the origins of the global climate challenge and potential solutions to reach net-zero emissions.
- By the end of this presentation, you should have a good understanding of the Inflation Reduction Act, how it aims to accelerate the U.S energy transition, and its implications for key energy transition sectors.

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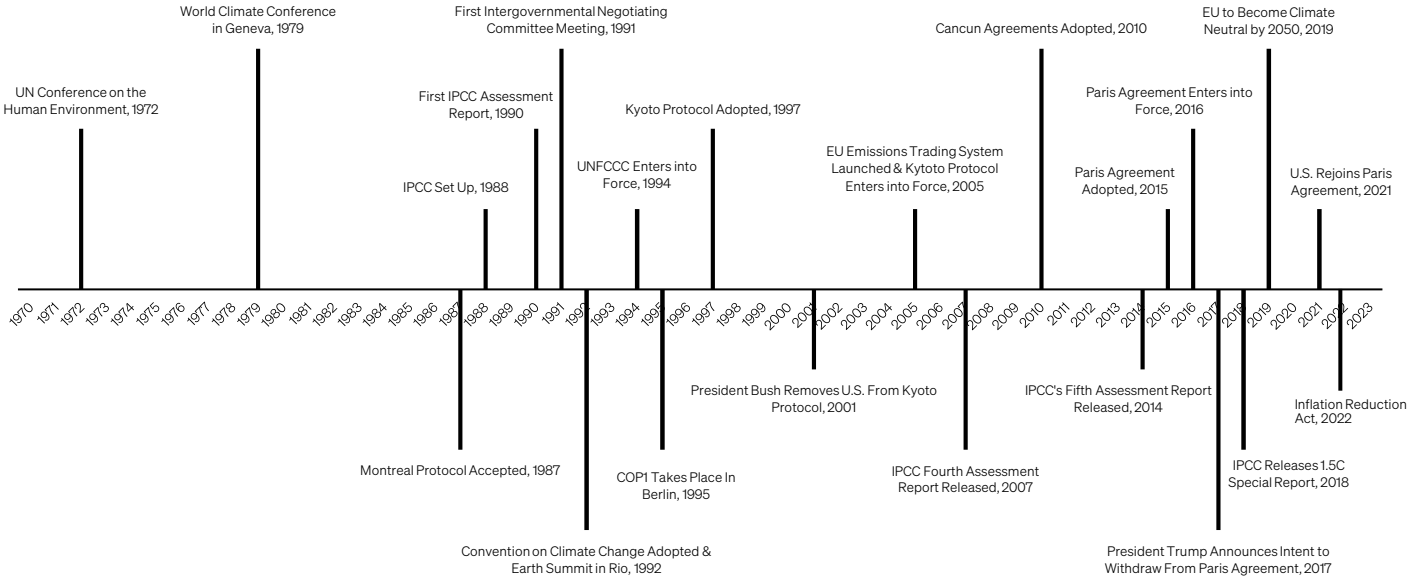
CHAPTER 01

A short history of global climate policy

The World Has Been Discussing Climate Change Since the 1970s

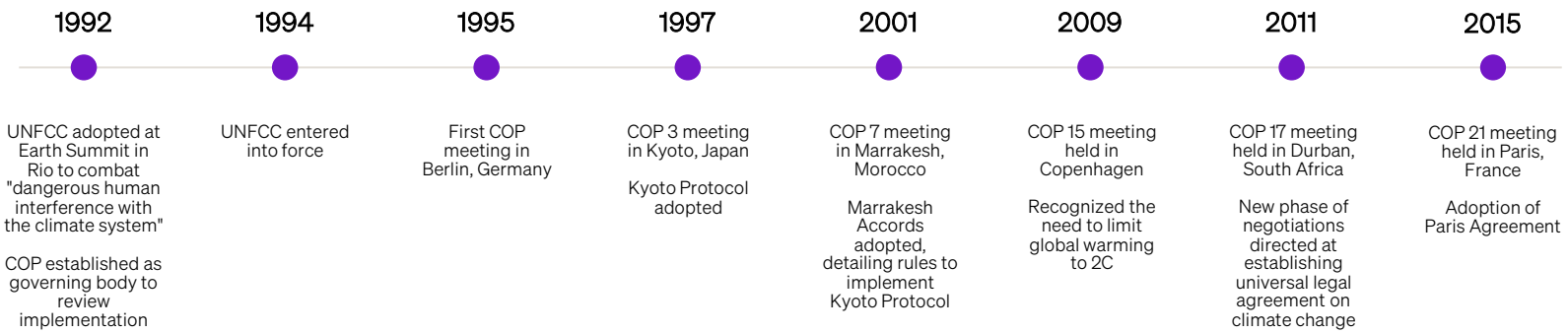
Timeline of Global Climate Action



The United Nations Framework Convention on Climate Change (UNFCC) was established in 1992 to negotiate a global response to climate change

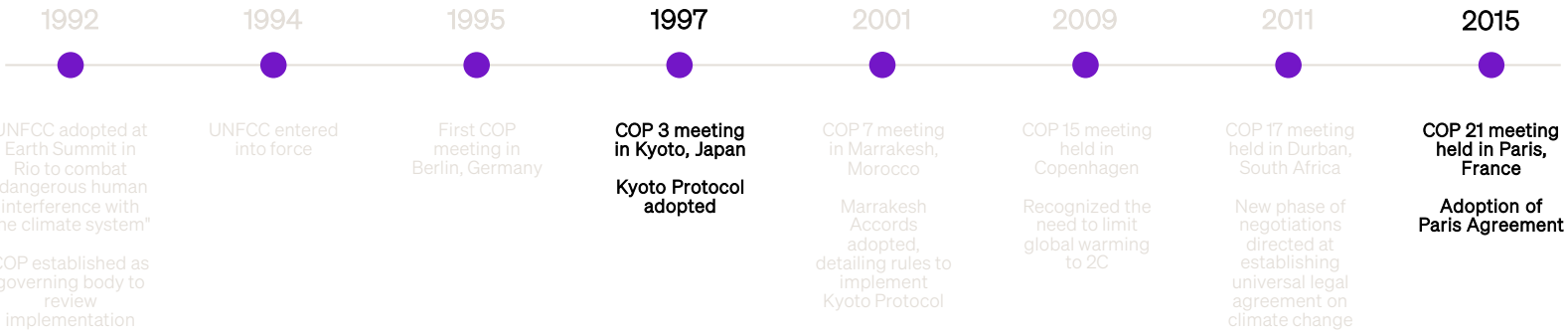
Countries Make Decisions for the UNFCC at the Conference of the Parties (COP)

Timeline of Major COP Milestones



Source: United Nations Framework Convention on Climate Change

Two Significant Climate Actions Emerged From COP Meetings



Source: United Nations Framework Convention on Climate Change

The Kyoto Protocol Set Binding Emissions Reduction Targets For Developed Countries

Key Developments and Provisions of Kyoto Protocol

Created in 1997 at third Conference of the Parties (COP) in Japan

Ratification process 1998-2004, and entered into force in 2005

First commitment period from 2008-2012

Participating countries aimed to reduce emissions by an average of 5% below 1990 levels

Second commitment period launched from 2013-2020

Participating countries committed to reduce GHG emissions by at least 18% below 1990 levels

Source: United Nations Framework Convention on Climate Change, Care About Climate

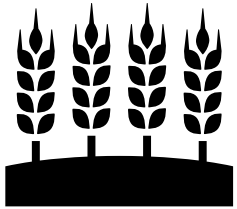
And the Paris Climate Accord Commits Countries to Achieving Net Zero Emissions by 2050

Three Key Provisions of the Paris Agreement

1.

Keeping global temperature increase well below 2°C above pre-industrial levels and aiming for below 1.5°C

2.



Adapting to climate change and reduced greenhouse gases without threatening food production

3.

Making finance flows consistent with a pathway towards low greenhouse gases and climate-resilient development

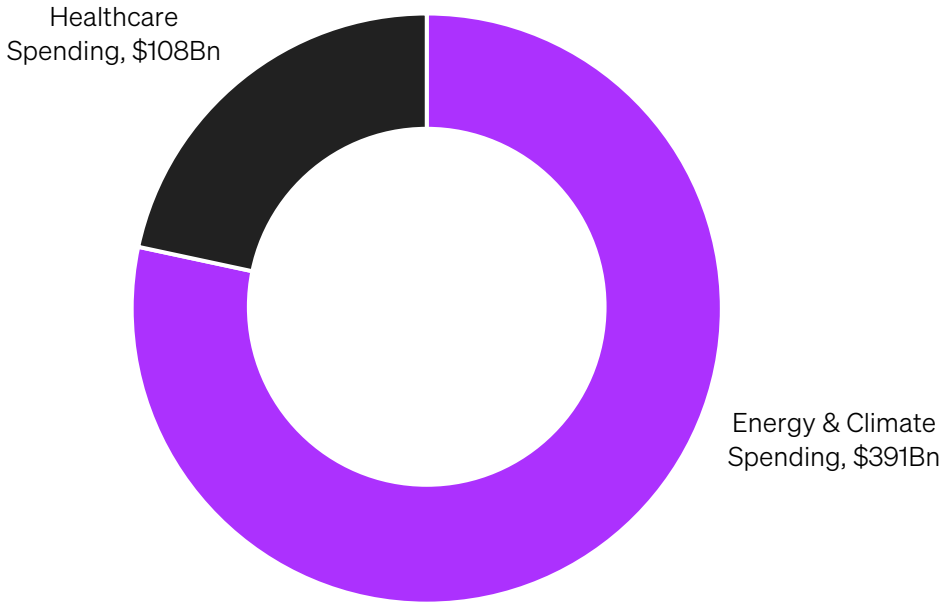
CHAPTER 02

Understanding the Inflation Reduction Act

The U.S. is formally committed to net-zero emissions by 2050

How will the U.S. achieve this?

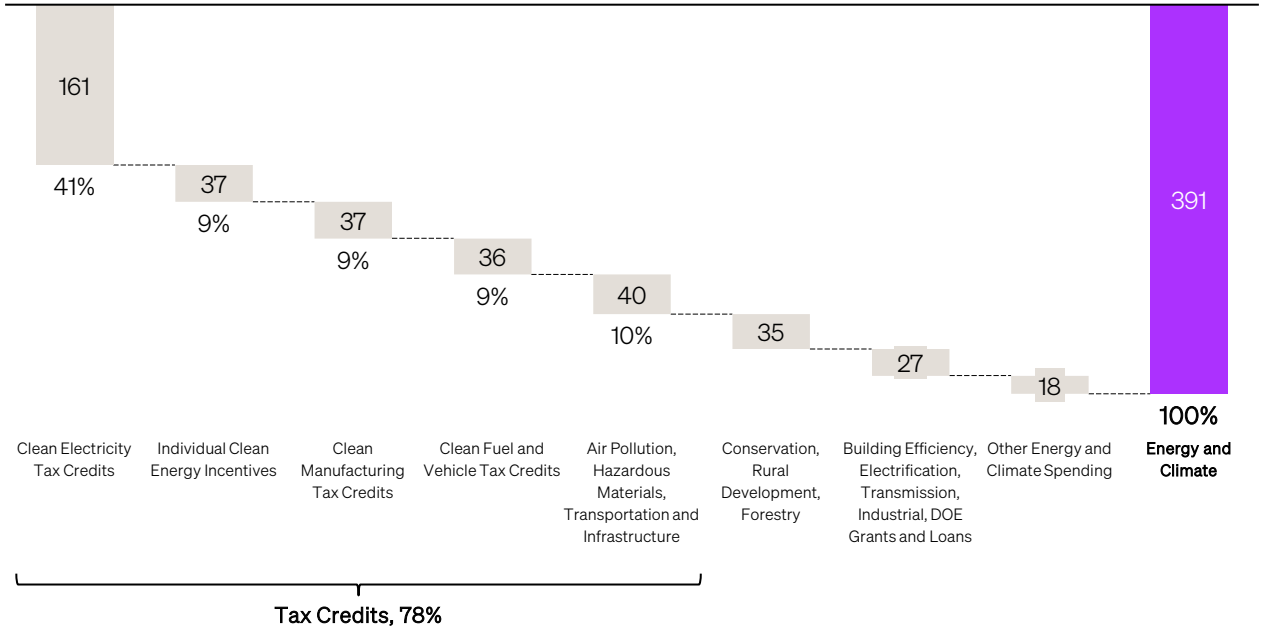
The Inflation Reduction Act Directs $391Bn of Spending Towards Energy and Climate



Source: Congressional Budget Office Score as of September 7th 2022

$311Bn of IRA Energy and Climate Spending Will Be Directed Towards Tax Credits

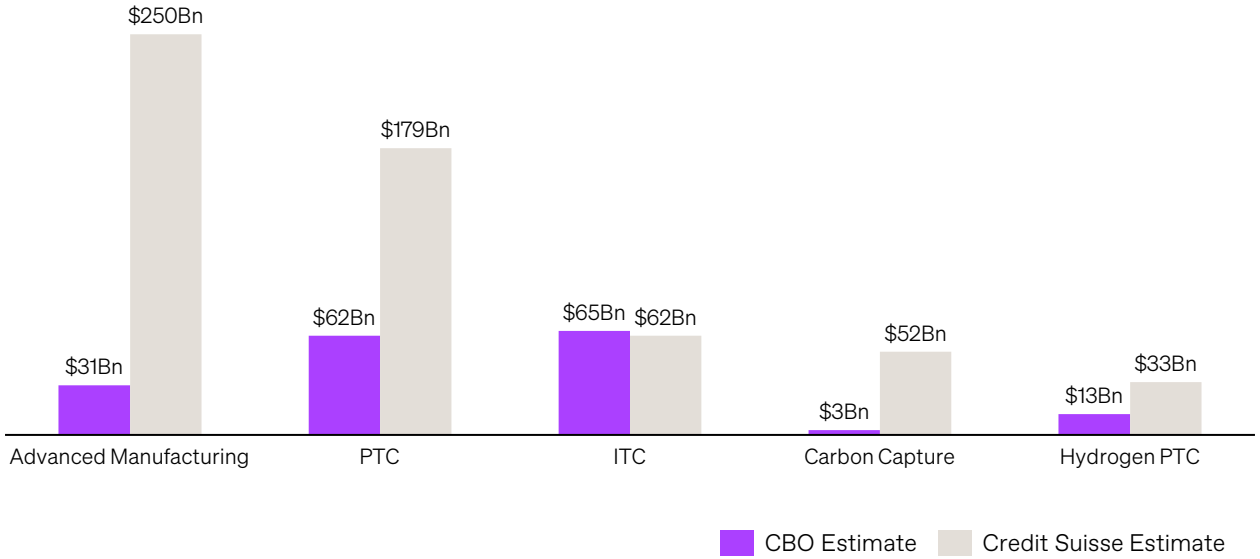
Inflation Reduction Act Summary ($Bn)



Source: Congressional Budget Office Score as of September 7th 2022

But Since Many Credits Are Uncapped, Actual Spending Could be 3x the CBO Estimate

2/3 of IRA Spending is Uncapped



Source: CBO, Credit Suisse

The IRA Offers Tax Credits to Both Corporations and Consumers

IRA

Corporations

- Production Tax Credit (PTC)
- Investment Tax Credit (ITC)
- Industry-Specific Credits for Wind, Solar, Energy Storage, Hydrogen, CCS, Nuclear

Consumers

- Residential Clean Energy Subsidies (e.g. home solar generation & storage)
- Energy Efficiency Home Improvement Subsidies (e.g. appliances)
- Clean Vehicle Subsidies (up to $7,500 per vehicle)

Source: The White House, McKinsey

Corporations Can Apply For Either Production or Investment Tax Credits

IRA Tax Credit Section

		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Production Tax Credits	Renewable Electricity	45	45	45Y	45Y	45Y	45Y	45Y	45Y	45Y	45Y
	Advanced Coal	45A	45A	45A	45A	45A	45A	45A	45A	45A	45A
	Carbon Capture	45Q	45Q	45Q	45Q	45Q	45Q	45Q	45Q	45Q	45Q
	Zero Emissions Nuclear	45J/U	45J/U	45U	45U	45U	45U	45U	45U	45U	45U
	Clean Hydrogen	45V	45V	45V	45V	45V	45V	45V	45V	45V	45V
	Commercial Clean Ventures	45W	45W	45W	45W	45W	45W	45W	45W	45W	45W
	Advanced Manufacturing	45X	45X	45X	45X	45X	45X	45X	45X	45X	45X
	Sustainable Aviation Fuel	40B	40B	45Z	45Z						
Investment Tax Credits	Renewable Electricity	48	48	48E	48E	48E	48E	48E	48E	48E	48E
	Alternative Fuel Refueling Property	30C	30C	30C	30C	30C	30C	30C	30C	30C	30C
	Advanced Energy Project	48C	48C	48C	48C	48C	48C	48C	48C	48C	48C
	Energy Efficient Commercial Building	179D	179D	179D	179D	179D	179D	179D	179D	179D	179D
For Consumers	Energy Efficient Home Improvement	25C	25C	25C	25C	25C	25C	25C	25C	25C	25C
	Residential Clean Energy	25D	25D	25D	25D	25D	25D	25D	25D	25D	25D
	Clean Vehicle	30D	30D	30D	30D	30D	30D	30D	30D	30D	30D

Source: The White House, Various News Sources

And Have Two Alternatives to Monetize Tax Credits

Monetization Scheme	Description
Direct Pay Credits Income-tax exempt entities can claim the tax credit as a direct payment from the IRS 	▪ Available to **tax-exempt entities**, state or local governments (or their political subdivisions), the Tennessee Valley Authority, any Indian tribal government, or any Alaska Native Corporation ▪ **Other taxpayers** may only elect direct pay for: 1. 45V (clean hydrogen) 2. 45Q (carbon capture & sequestration) 3. 45X (advanced manufacturing)
Transfers Credit owners can sell credits to other taxpayers who have tax liabilities to offset 	▪ Available to **any taxpayer other than those entitled to direct payments** ▪ Taxpayers may make an annual election to transfer all (or any portion) of an eligible credit to an unrelated taxpayer, provided the transfer is: 1. Paid in cash 2. Not included in the transferor's gross income 3. Not deductible by the transferee ▪ This provision may not eliminate traditional tax equity structures, as it does not address the monetization of tax depreciation benefits

Source: The White House, Various News Sources

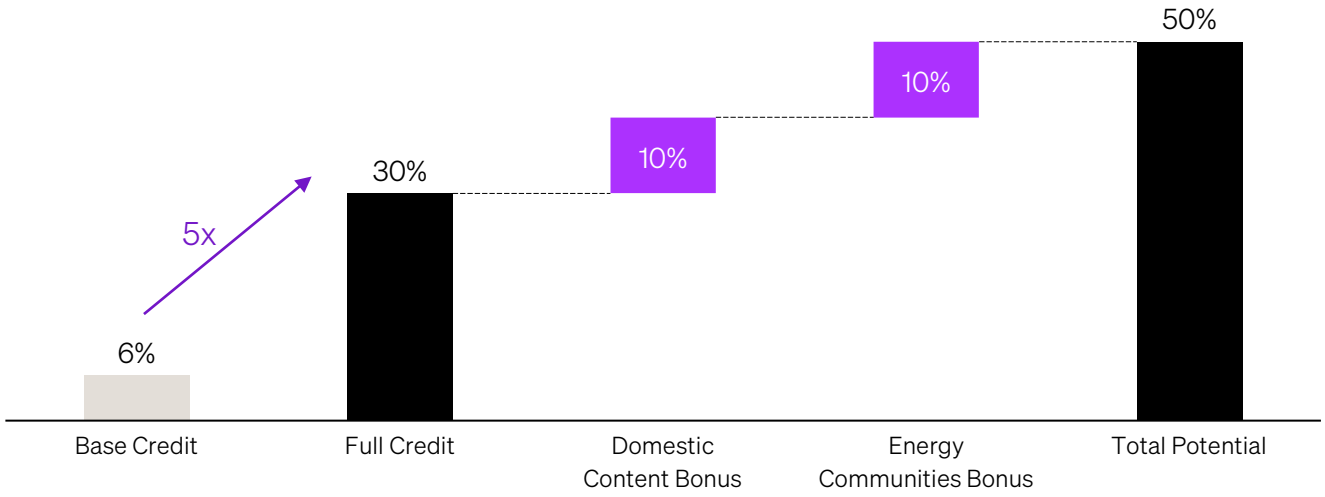
‘Multipliers’ Can Increase the Value of Tax Credits By Up To 5x

Type of Multiplier	Description
Wage & Apprenticeship 	▪ Wage requirement: laborers and mechanics employed must be paid wages at not less than prevailing rates ▪ Apprenticeship requirement: 1. Minimum hours (10-15%) performed by qualified apprentices 2. For contractors with more than 4 employees, 1 in every 4 must be engaged in qualified apprenticeship ▪ Failure to satisfy the wage and apprenticeship requirements may be cured through additional payments to workers and the government
Domestic Content 	▪ Steel, iron produced in the U.S. ▪ Manufactured components produced in the US 1. 40% of costs attributed to components mined, produced or manufactured in the U.S. 2. 20% threshold in the case of offshore wind facilities
Location Requirements 	▪ Brownfield sites ▪ Areas with significant employment (post-1999) related to extraction, processing, transport, or storage of coal, oil or natural gas ▪ Any census tract (or adjoining tract) that had either a coal mine close after 1999 or coal-fired electric generating unit retire after 2009

Source: The White House, IRS, McGuireWoods

Meaning That ~30-50% of the Upfront Capex for Eligible Projects Could be Subsidized by IRA Credits

Illustrative Build-Up of Investment Tax Credit



Source: The White House, McGuire Woods

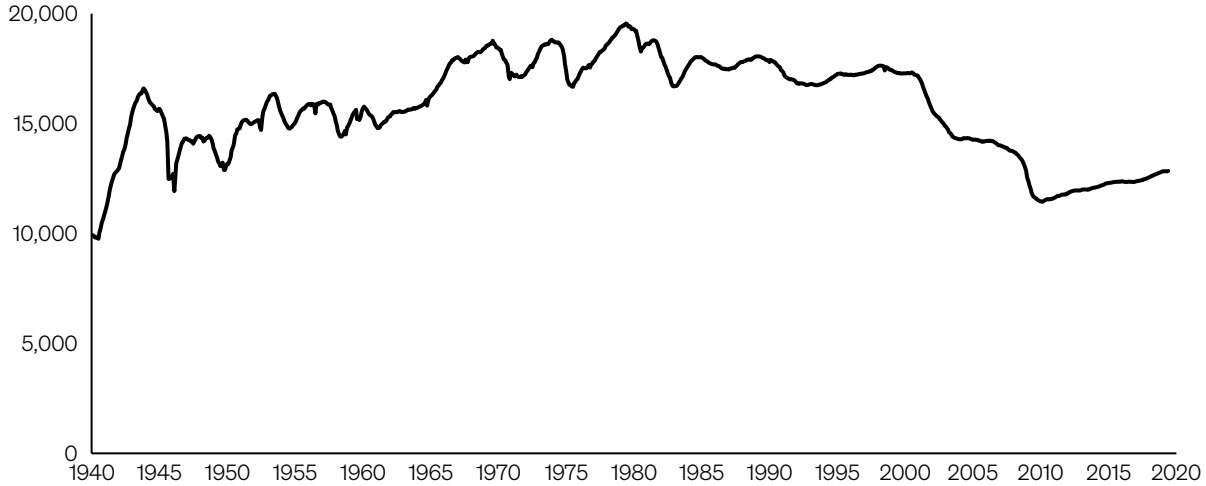
CHAPTER 03

Implications for U.S. manufacturing

Reshoring of U.S. manufacturing will be a critical theme over the next decade

U.S. Domestic Manufacturing Has Been in Decline For Decades

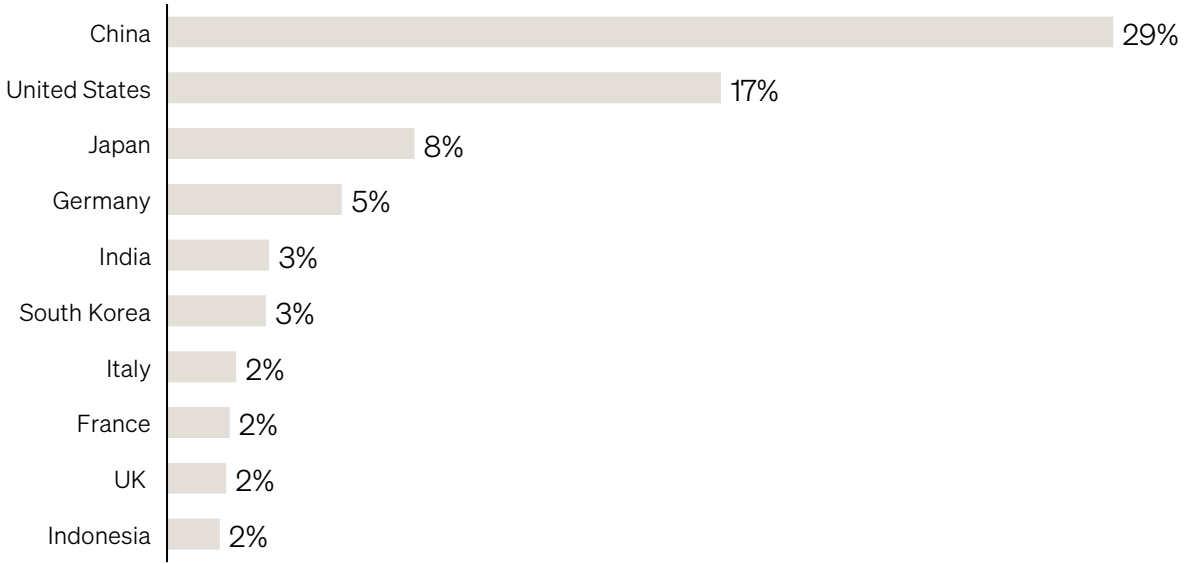
Workers Employed in Manufacturing Sector (Thousands)



Source: Bureau of Labor Statistics

China Has Overtaken the U.S. as the World's Manufacturing Leader

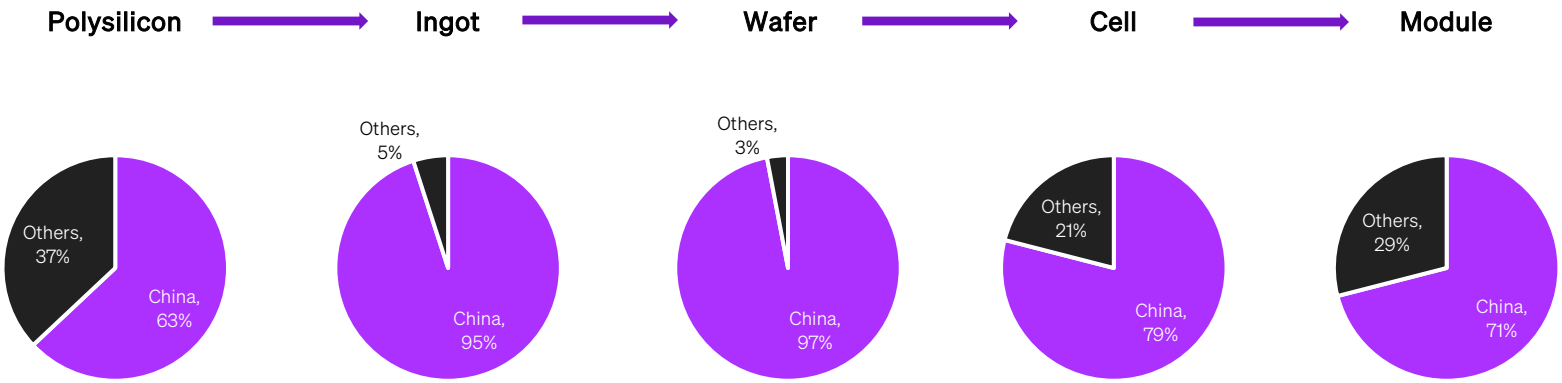
Top 10 Countries by Share of Global Manufacturing Output in 2019



Source: Statista

And Now Dominates Manufacturing of Many Energy Transition Technologies

China Share of Production Volumes Across Solar Value Chain, 2019



Source: Bernreuter Research

Production Tax Credit	45X

The IRA Offers $ / Unit Subsidies for Many Key Inputs to Energy Transition Technologies

Advanced Manufacturing Credit Pay Rates

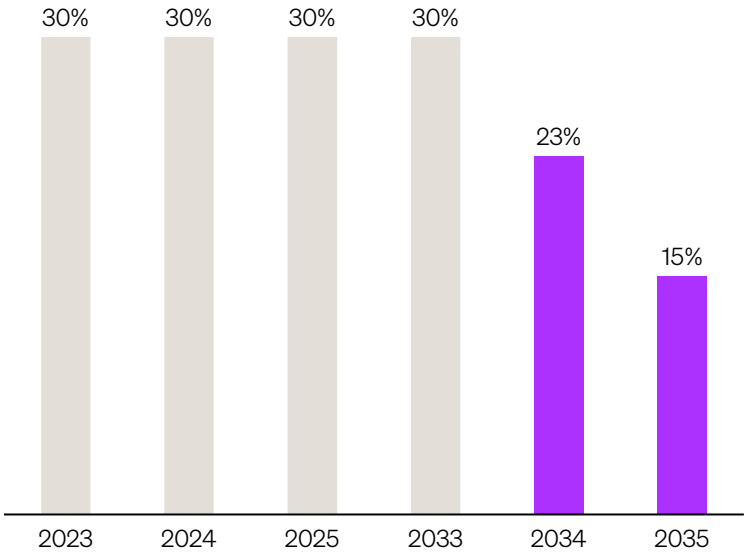
- For Wind, Solar, and Energy Storage, credits are set on a $/unit
- For Critical Minerals projects, credit is set at 10% of "costs incurred by taxpayer with respect to production of such mineral“
- Requires meeting wage & apprenticeship requirements; +10% bonus available for projects meeting domestic wage requirements
- Eligible for Direct Payments (i.e. companies can capture full credit value, even if it exceeds the federal income taxes they owe)

Eligible Components	Definition	Credit Amount
PV Module & Subcomponents		
Solar-Grade Polysilicon	Highly purified silicon suitable for photovoltaic manufacturing	$3/kg
PV Wafer	Thin slice of semiconductor material used to manufacture PV cells	$12/m2
PV Cell	Smallest element of solar module that converts light into electricity	4c/Wdc
Polymeric Backsheet	Sheet on the back of solar module that acts as insulator	40c/m2
PV Module	Connection and lamination of PV cells into final assembly	7c/Wdc
PV Inverter		
Central Inverter	Converts DC into AC electricity, suitable for large utility-scale systems	0.25c/Wac
Utility Inverter	Inverter suitable for commercial or utility scale systems	1.5c/Wac
Commercial Inverter	Inverter suitable for commercial or utility scale systems	2.0c/Wac
Residential Inverter	Inverter suitable for residence	6.5c/Wac
Microinverter	Inverter suitable to connect with a single solar module	11c/Wac
PV Tracking Systems		
Torque Tube	Structural support element part of a solar tracker	87c/kg
Structural Fasteners	Connects system components of solar tracker to foundation	$2.28/kg
Batteries		
Electrode Active Materials	Cathode & anode materials, anode foils, and other active materials	0.1
Battery Cells	Battery cell with 1 or more positive and negative electrodes	$35/kWh
Battery Module	2 or more battery cells configured electrically	$10
Battery Module	Module that doesn't use cells	$45/kWh
Critical Materials	Mining of materials primarily related to the Solar PV chain	10%
Wind		
Wind Blade	Wind turbine blade	2.0c/W
Wind Nacelle	Cover housing generating components within a wind turbine	5.0c/W
Wind Tower	Tubular structure supporting the turbine	3.0c/W
Offshore Foundation (Fixed)	Tower base fixed to sea floor	2.0c/W
Offshore Foundation (Floating)	Tower base attached to sea floor using cables	4.0c/W
Offshore Wind Vessel	Rigs equipped with large cranes for offshore turbine installation	10%

Source: The White House, Department of Energy, Bricker & Eckler

And Investment Tax Credits For Eligible Energy Projects

ITC Option: Advanced Energy Project Credit (48C)

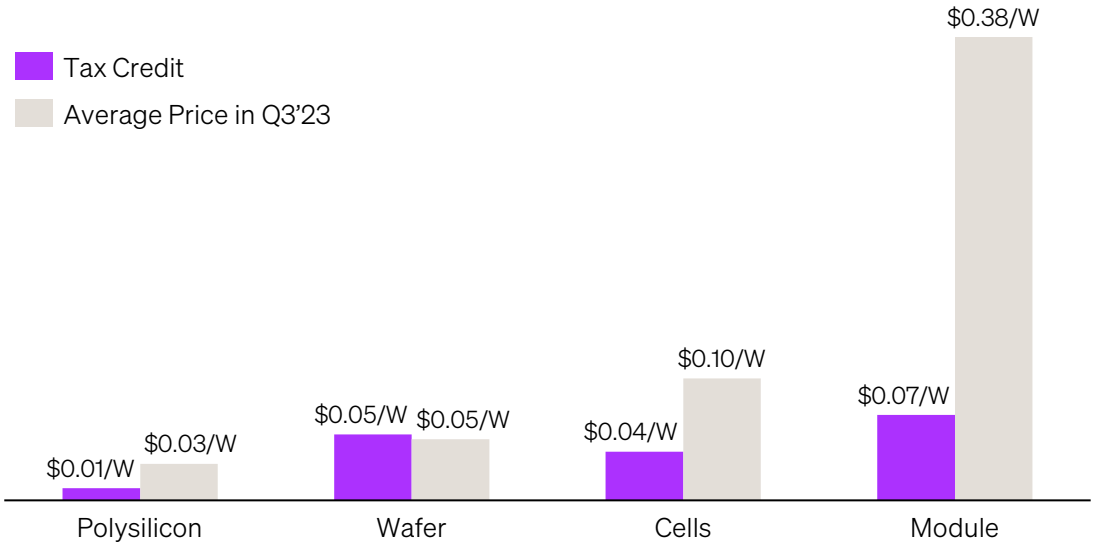


- ITC Full Credit of 30% (5x Base Credit of 6%)
- Eligible for property used in a “qualifying advanced energy project” that is certified by the U.S. DOE
- $10B total allocation (of which $4Bn must be allocated to projects located in energy communities)
- Requires meeting wage & apprenticeship requirements; 10% bonus available for projects meeting domestic content requirements
- **Eligible companies must be involved in the production or recycling of energy storage systems, grid modernization systems, CO2 sequestration, energy conservation, EVs and charging infrastructure, industrial GHG emission reduction, and critical materials**

Source: The White House, Holland & Knight

This Makes Domestic Production of Energy Transition Inputs Much More Competitive

IRA Solar Manufacturing Tax Credits vs Average Component Prices ($/W)

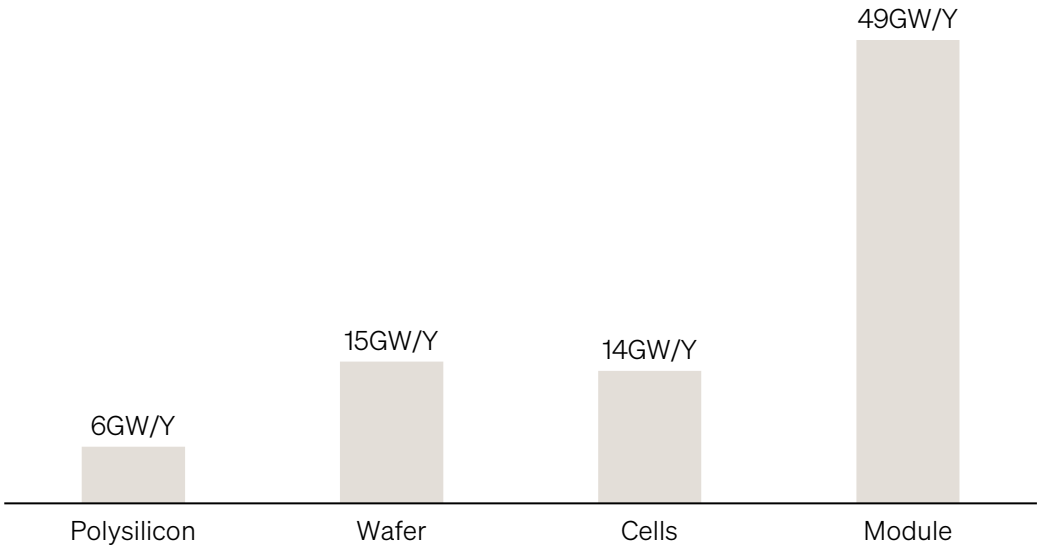


Note: Conversion factor of .6g/W used for polysilicon. Assumes a conversion factor for wafers of 7.69 piece per watt based on PERC cell efficiency of 23.3%

Source: BNEF

Companies Are Responding by Announcing New Domestic Factories

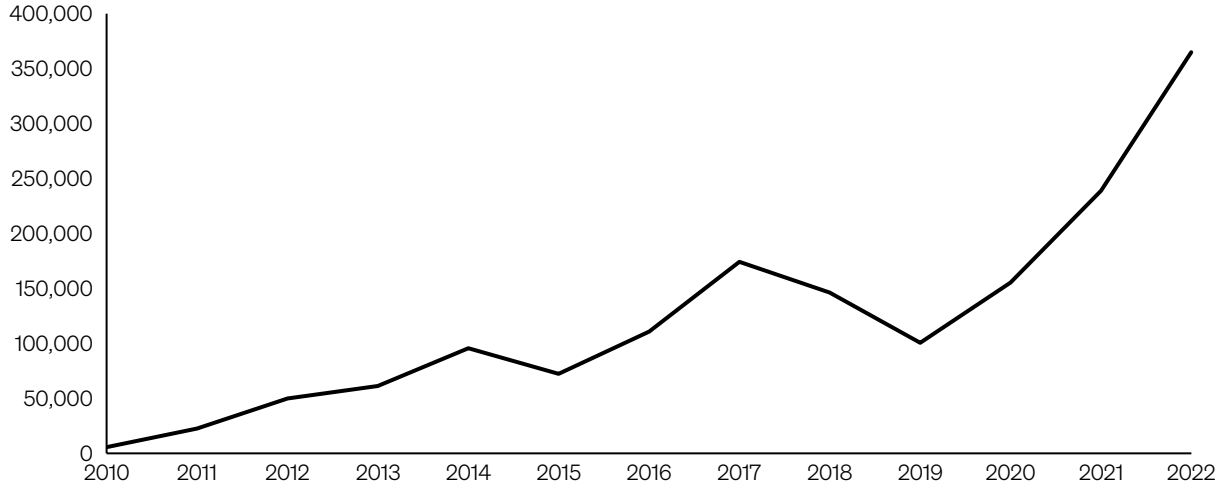
Announced U.S. Solar Capacity (GW/Year)



Note: As of July 24, 2023

And New Domestic Manufacturing Jobs

Manufacturing Job Announcements, Reshoring + Foreign Direct Investment



Source: Reshoring Initiative Library Data

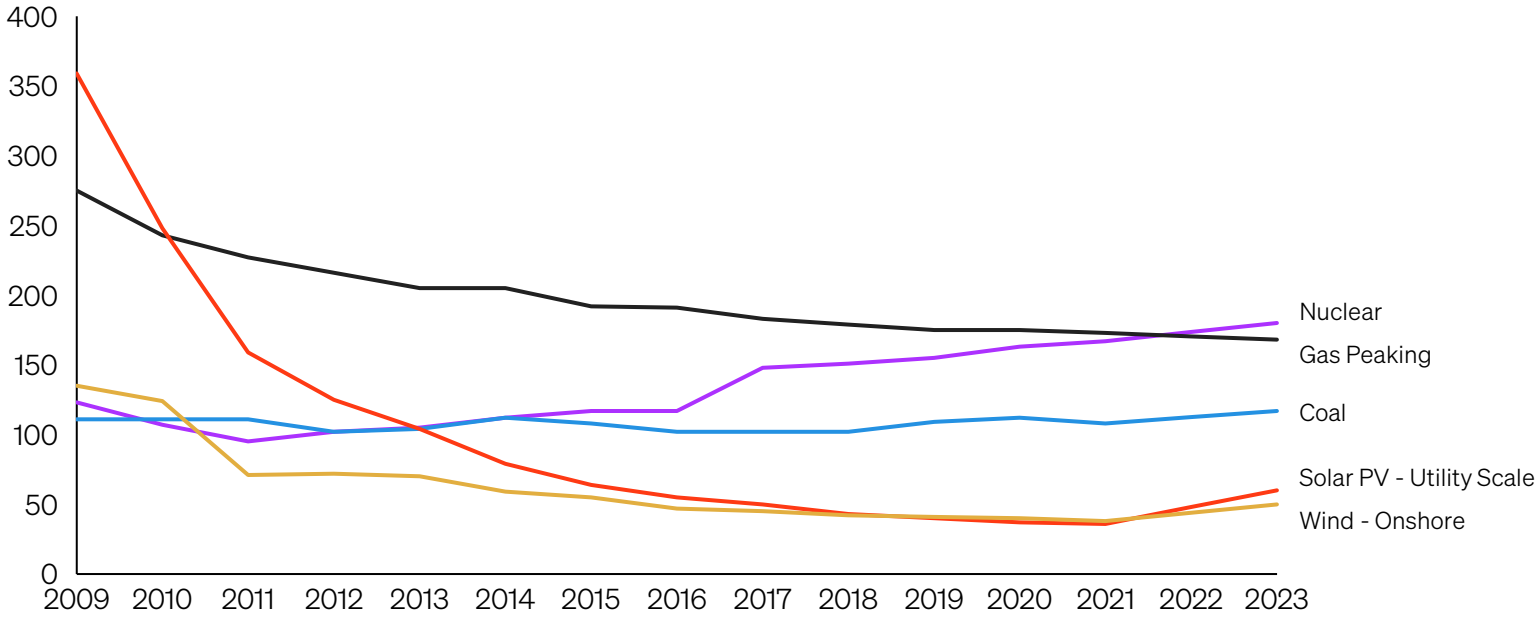
CHAPTER 04

Implications for clean energy

Solar is positioned to be the dominant form of new electricity generation capacity

Wind and Solar Already Offer the Lowest Levelized Cost of Electricity Production

Levelized Cost of Energy ($ / MWh)



Source: Lazard

The IRA Offers Both Production and Investment Tax Credits For Solar Generation Capacity

Production Tax Credit (45Y)

- PTC is 0.3c/kWh Base Credit up to 1.5c/kWh Full credit, for up to 10-years from the start of production
- Full credit requires meeting wage & apprenticeship requirements
- Generally eligible for bonus credits for domestic content and project location (e.g. Energy Communities)
- To be phased out over 3 years

Investment Tax Credit (48E)

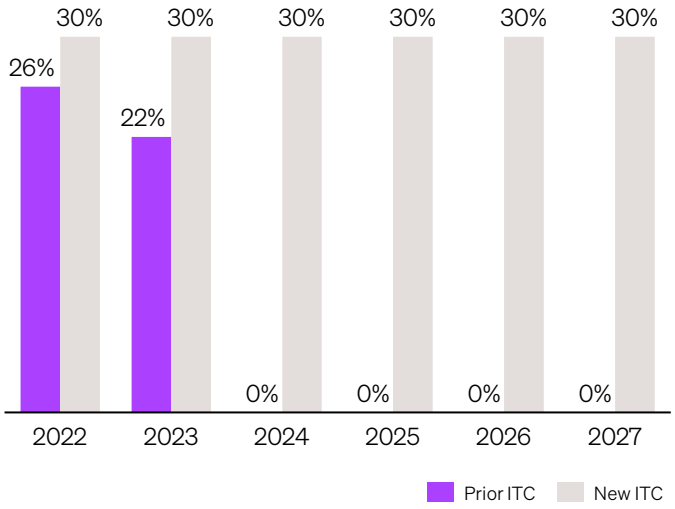
- 6% Base Credit up to 30% Full credit
- Full credit requires meeting wage & apprenticeship requirements
- Generally eligible for bonus credits for domestic content and project location (e.g. Energy Communities)
- To be phased out over 3 years, starting at the earlier of i) 2032, or ii) when the Secretary of Energy determines that annual GHG emissions from the production of electricity have been reduced by >75% vs. 2022 levels
- Subject to recapture if a facility's actual CO2 equivalent emissions are greater than 10g of CO2e per kWh

Source: The White House, Bipartisan Policy Center

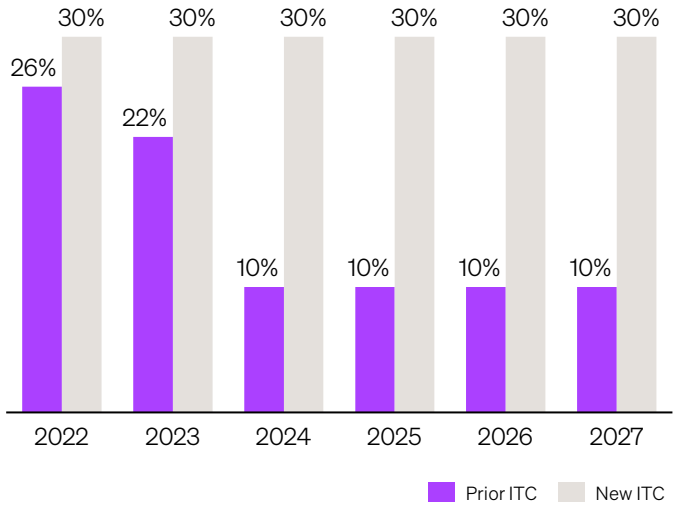
The Investment Tax Credit Boosts and Extends Existing Subsidies for Solar

New vs. Prior Rates for Solar ITC

Residential Solar



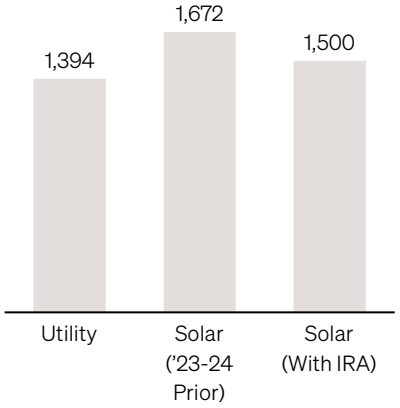
Commercial & Utility Solar



Source: The White House, McGuire Woods

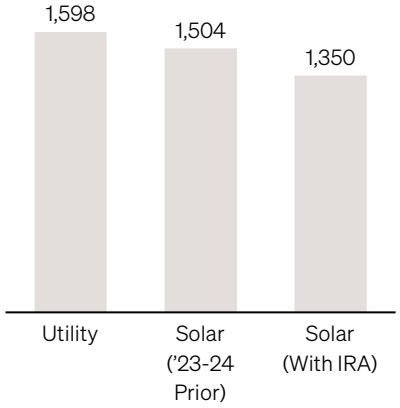
Making the Upfront Cost of Solar Much More Competitive

1st Year Cost



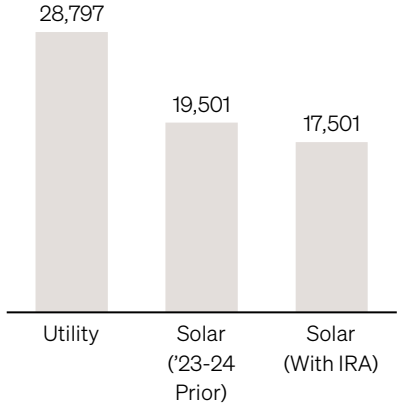
Now, under the IRA, first year solar cost is only ~$100 more than utility power, vs. prior ~$300 premium

10-Year Avg. Cost (Annualized)



… while solar now becomes much cheaper over the first 10-year average…

25-Year NPV @ 5%



… and retains its significant advantage over the life of a system…

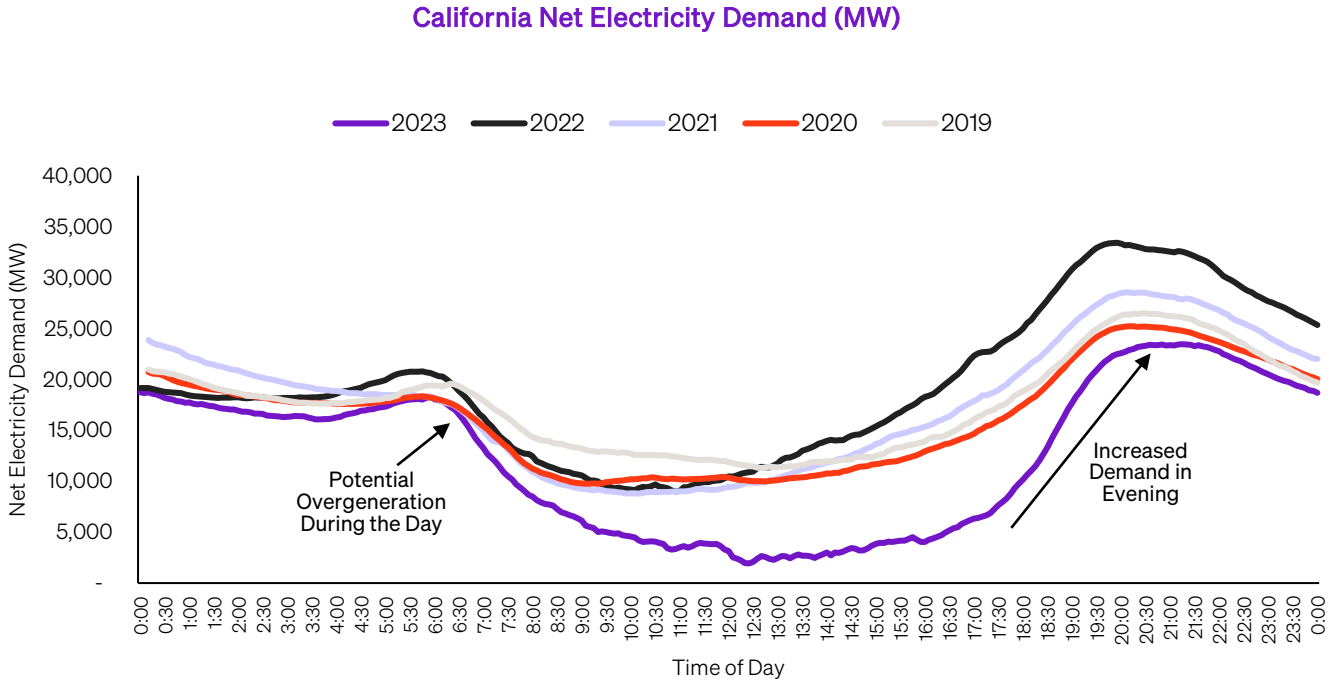
Source: Electrek, EnergyStar, Social Capital Calculation

CHAPTER 05

Implications for energy storage

Energy storage will become a must-have component for onshore renewables

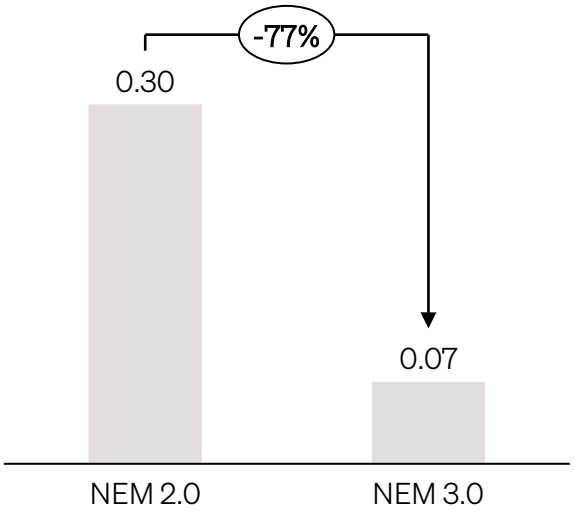
Adding Renewable Energy Sources Risks Oversupplying the Grid During the Day When Energy Demand is Lower, Resulting in Wasted Power Generation



Source: California ISO

States Are Responding By Changing Net Metering Rules to Incentivize Battery Storage

PG&E California Export Rate ($/kWh)



- 'Net Energy Metering' allows consumers to earn a rebate for excess electricity they generate and export to the grid, offsetting their electricity bill
- NEM 3.0 reduces the rate at which consumers can export electricity to the grid by +75%
- Battery storage allows consumers to store electricity during periods of surplus and either use or export it during peak demand
- At new export rates, batter storage materially improves the payback period for a new solar system
- Incentivizing battery storage reduces the risk of oversupplying the grid during periods of peak generation and minimal demand

Source: SunRun, PG&E, Various News Sources

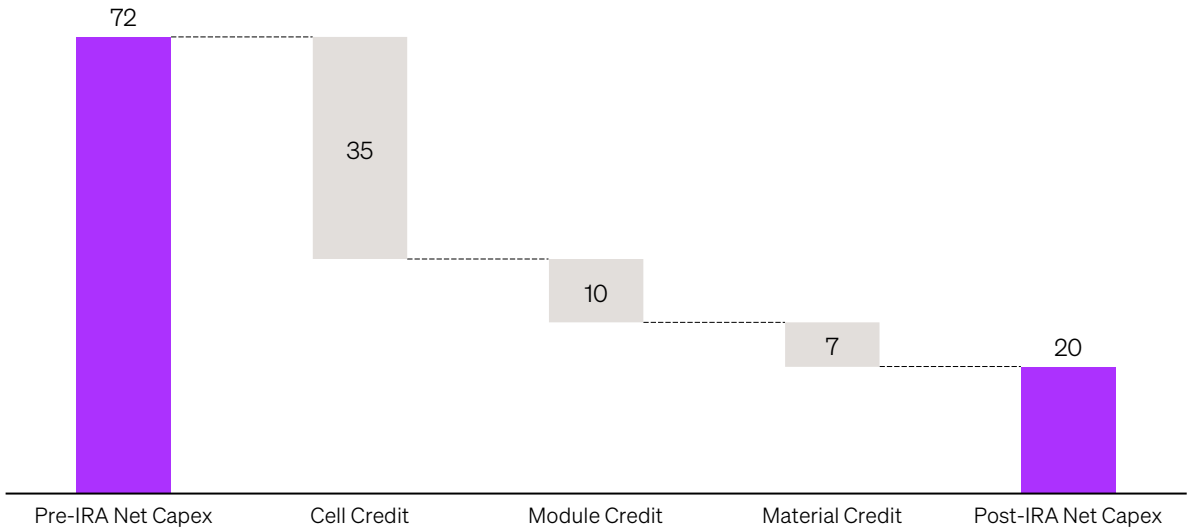
The IRA Offers Credits to Incentivize Battery Production and Attach Rates

	48E (ITC)	25D (ITC)	45X (PTC)
Summary	▪ Technology-neutral clean electricity credit ▪ Max value of 30% through 2022 ▪ Storage capacity must be at least 5kwh	▪ 30% on battery storage technology expenditures made on U.S. residences ▪ Max credit must be placed in service by 2023 ▪ Step down credits are eligible through 2034 ▪ Second homes qualify ▪ Storage capacity must be at least 3kwh	▪ For battery producers ▪ $35/kwh of capacity for cells ▪ $10/kwh of capacity for modules ▪ +10% bonus of total production cost if critical mineral requirement is met
Primary Beneficiaries	▪ Project Developers ▪ IPPs ▪ Utilities ▪ C&U Customers	▪ Individual Taxpayers	▪ Battery Manufacturers

Source: The White House, Energy.gov

This is Expected to Materially Improve the Economics of Domestic Battery Production

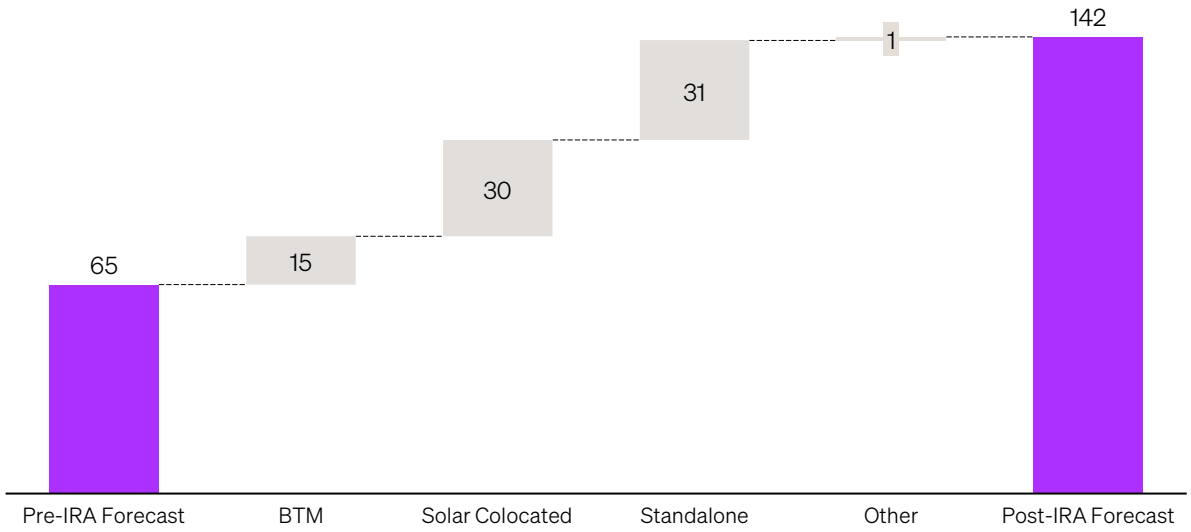
Capital Requirements for U.S. Battery Production ($ / kWh)



Source: Goldman Sachs

And Double the Rate of Battery Storage Capacity in the U.S.

U.S. Energy Storage Additions Through 2030 (kW)



Source: S&P Global Commodity Insights, Fluence Energy

CHAPTER 06

Implications for electric vehicles

EVs are cost competitive with gasoline and diesel cars

IRA Awards Up To $7,500 EV Tax Credit Split Into Two Sourcing Criteria

1. Sourcing of Critical Minerals
$3,750

- % of value of critical minerals mined or processed in the U.S. or FTA countries, or recycled in North America: 40% in 2024 to 80% in 2027 and beyond *(gradually increased)*
- No critical minerals sourced from Foreign Entity of Concern as of 2024

2. Manufacture of Battery Components
$3,750

- % of value of battery components manufactured or assembled in North America: 50% in 2024 to 100% in 2029 (gradually increased)
- No battery components sourced from Foreign Entity of Concern as of 2025

Maximum Suggested RRP

SUVs, Vans & Pickup Trucks	$80k
Other Vehicles	$55k

Income Cap

Filing Jointly	$300k
Head of Household	$225k
Single	$150k

Source: The White House, IRS

And Up To $4,000 For the Purchase of Used EVs

Credit is lesser of 30% of sales price or $4,000

Vehicle Price
- Less than $25,000

Vehicle Age
- Greater than 2 years old

Vehicle Weight
- Less than 14,000 lbs

Vehicle Engine
- Propelled to a significant extent by electric motor + battery combo
- Capacity >7 kWh
- Capable of being recharged from external source of electricity

Income Bracket

Filing Jointly	$150k
Head of Household	$112.5k
Single	$75k

Source: The White House, IRS

Commercial EVs Are Eligible For Tax Credits For First Time Ever

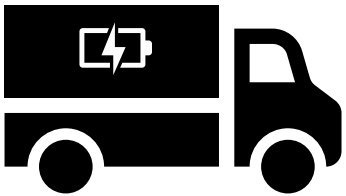
Credit is lesser of 30% of sales price or difference between the purchase price of the EV and a comparable internal combustion engine vehicle

Vehicle Weight & Cost

- Up to $7,500 for vehicles weighing less than 14,000 lbs
- Up to $40,000 for vehicles weighing more than 14,000 lbs

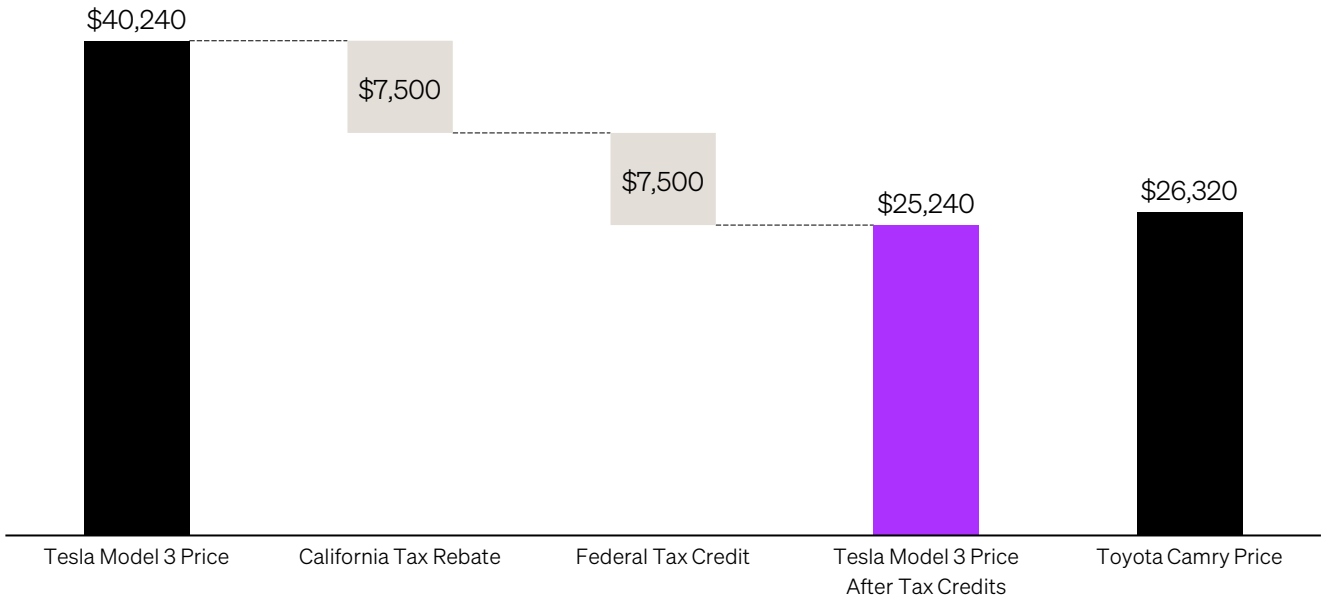
Vehicle Purpose

- Vehicle must be used for business purposes



Source: The White House, IRS

New Consumer EVs are Now Cost Competitive With Gasoline and Diesel Cars



Source: Reuters

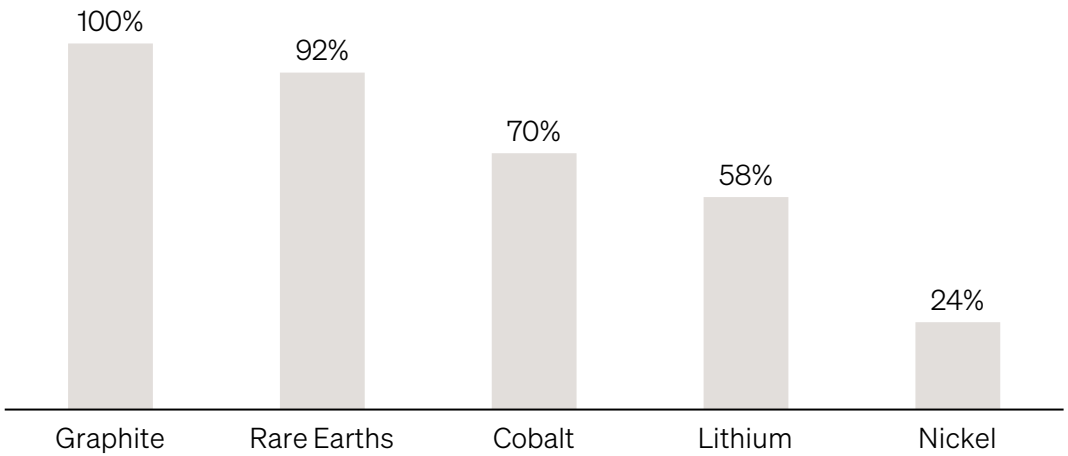
CHAPTER 07

Implications for critical materials

Global critical material flows will shift away from China and other ‘countries of concern’

A Significant Proportion of Battery Metals Processing is Completed in China

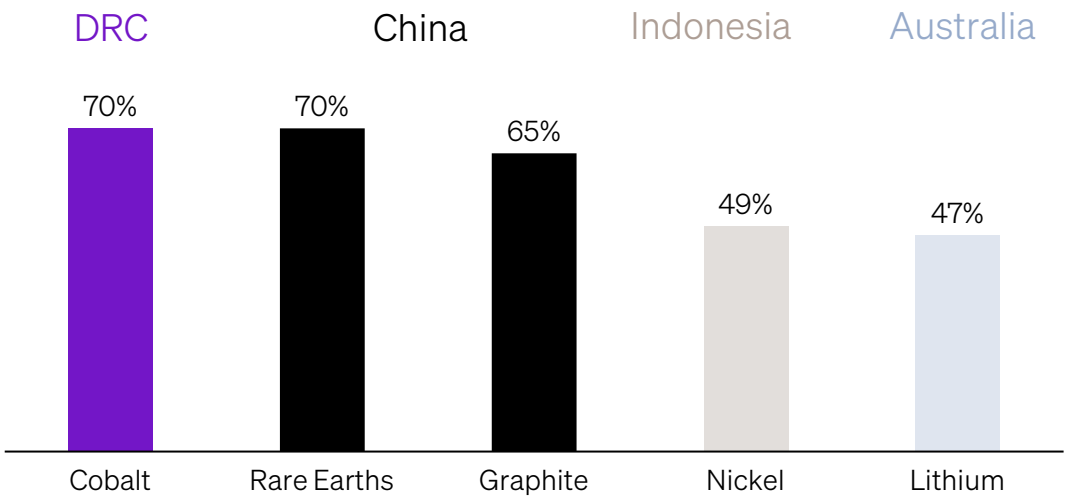
% of Critical Materials Processed in China



Source: IRENA, Politico

And China Dominates Rare Earths and Graphite Mining

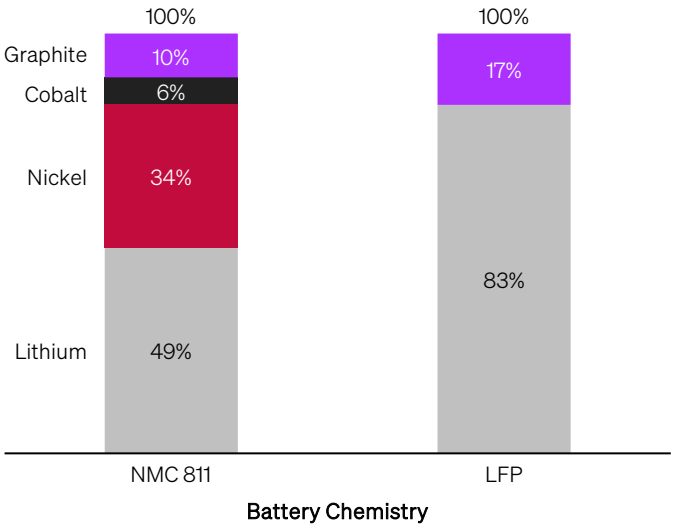
% of Critical Material Mined in Each Country



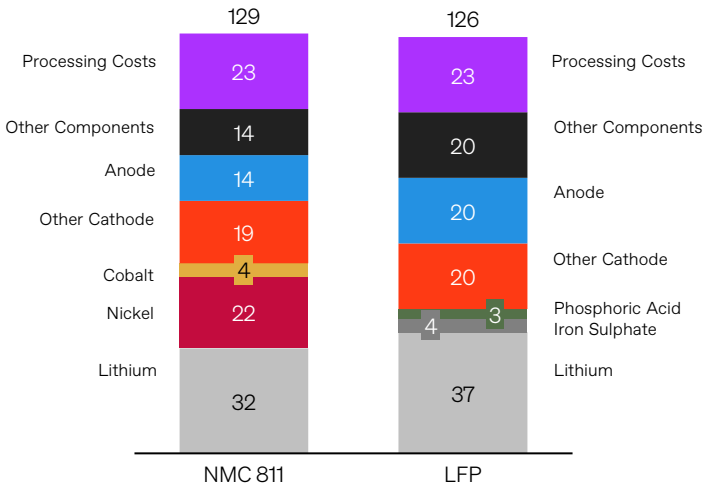
Source: IRENA, Politico

Lithium, Nickel and Graphite Are Key Input Materials for Battery Manufacturers

% of Critical Minerals in EV Batteries



EV Battery Cell Cost Breakdown ($ / kWh)



Source: Benchmark Mineral Intelligence

Investment Tax Credit	30D
Production Tax Credit	45X

EV Tax Credit and Upstream Critical Materials Producer Incentive Will Strongly Incentivize U.S. OEMs to Source Locally

1.

EV OEM / Consumer Incentive EV Tax Credit

- Auto & battery contents ($3,750 each) must meet growing requirements for sourcing from U.S. FTA countries and/or North America
- Autos are disqualified from both credits if *any* critical minerals in the battery are sourced from a 'foreign entity of concern' (e.g., China, Russia)

2.

Upstream Critical Materials Producer Incentive

- 10% Production Tax Credit (PTC) available to producers (e.g., US-based lithium mines)
- Measured against the 'costs incurred by the taxpayer' for the relevant critical minerals

U.S. FTA Countries:

- Resource-Rich: Canada, Australia, Chile, Peru
- Advanced Industry: Korea, Mexico, Israel, Singapore
- Others: Bahrain, Colombia, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Jordan, Morocco, Nicaragua, Oman, Panama

U.S. List of Critical Materials:

- Battery Metals: Lithium, Nickel, Manganese, Cobalt, Graphite
- Other Metals: Aluminium, Zinc, Titanium, Magnesium, PGMs, Tin, Tungsten, Vanadium
- Rare Earths

U.S. List of 'Countries of Concern'

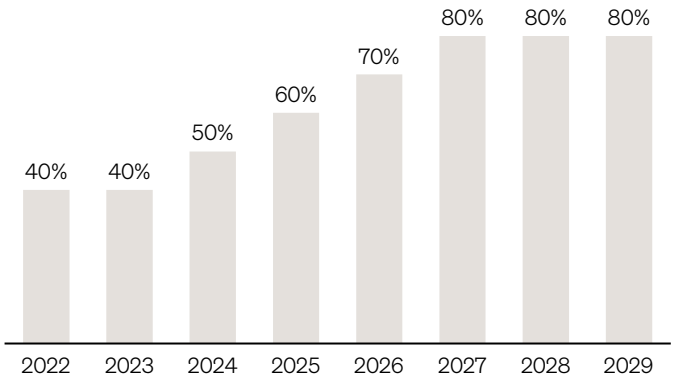
- Burma, China, Eritrea, Iran, North Korea, Pakistan, Russia, Saudi Arabia, Tajikistan, Turkmenistan

Source: The White House, Various News Sources

To Be Eligible for the $7,500 EV Tax Credit, OEMs Must Meet Growing Requirements To Source From U.S. FTA Countries and/or North America

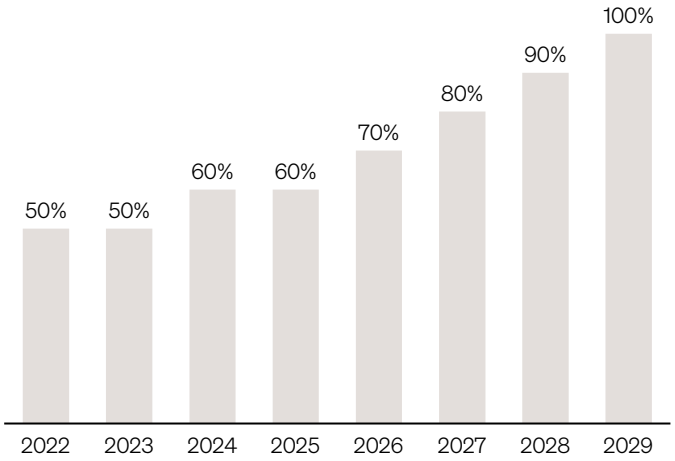
Critical Minerals Requirement, % of *Value*

Vehicle: $3,750 Tax Credit
Required Mining or Processing in the U.S. or FTA countries or recycled in North America



Battery Manufacturing/Assembly Requirement, % of *Value*

Battery: $3,750 Tax Credit
Required Manufactured or Assembled in North America



Source: The White House, Various News Sources

Avoiding ‘Countries of Concern’ in the EV Battery Supply Chain Will Be Difficult

Lithium	→	Australia will need to find locations ex-China to process its lithium supply
Graphite	→	Will drive an enormous call on North American graphite supply growth
Cobalt	→	Price premium likely to open for North American and LatAm sources of Cobalt
Rare Earths	→	U.S., Canada and India can all become sources of ‘untarnished’ supply

U.S. FTA Countries:

- Resource-Rich: Canada, Australia, Chile, Peru
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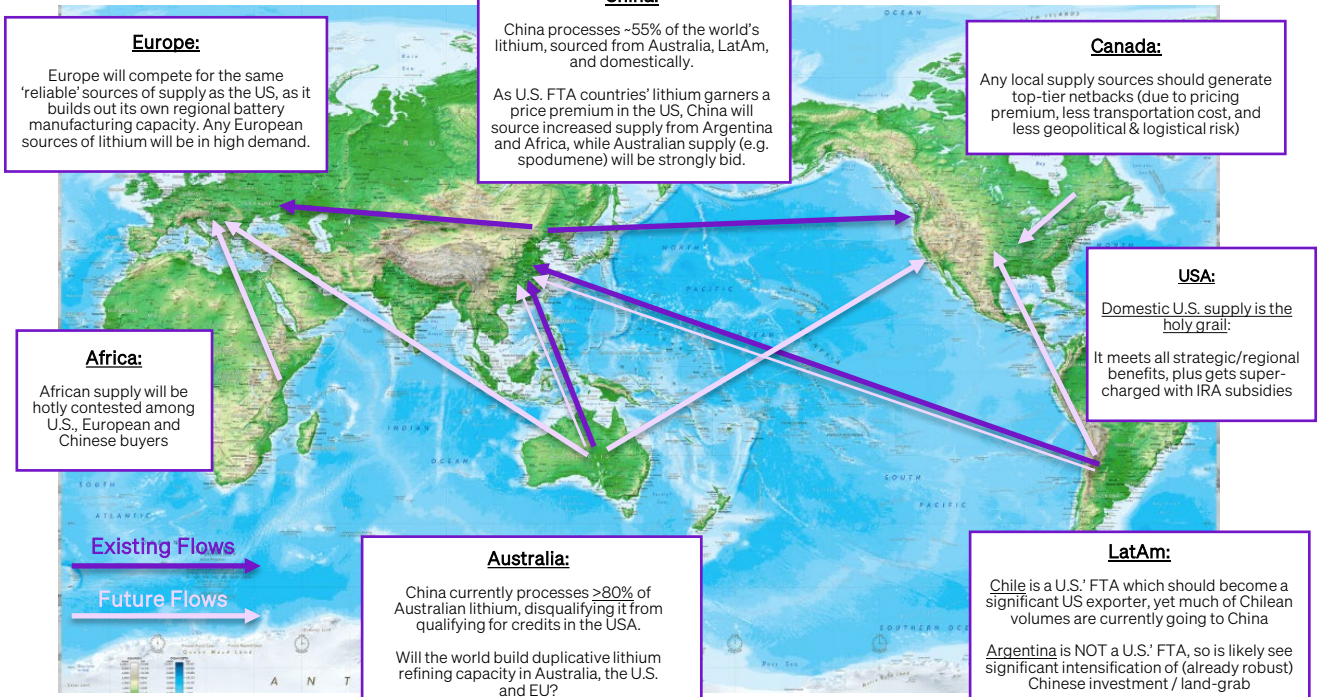
- Burma, China, Eritrea, Iran, North Korea, Pakistan, Russia, Saudi Arabia, Tajikistan, Turkmenistan

Source: The White House, Various News Sources, Social Capital

Meeting IRA Sourcing Requirements Will Drive Re-Plumbing of Global Metal Flows



Europe:

Europe will compete for the same 'reliable' sources of supply as the US, as it builds out its own regional battery manufacturing capacity. Any European sources of lithium will be in high demand.

China:

China processes ~55% of the world's lithium, sourced from Australia, LatAm, and domestically.

As U.S. FTA countries' lithium garners a price premium in the US, China will source increased supply from Argentina and Africa, while Australian supply (e.g. spodumene) will be strongly bid.

Canada:

Any local supply sources should generate top-tier netbacks (due to pricing premium, less transportation cost, and less geopolitical & logistical risk)

USA:

Domestic U.S. supply is the holy grail:

It meets all strategic/regional benefits, plus gets super-charged with IRA subsidies

Africa:

African supply will be hotly contested among U.S., European and Chinese buyers

Australia:

China currently processes >80% of Australian lithium, disqualifying it from qualifying for credits in the USA.

Will the world build duplicative lithium refining capacity in Australia, the U.S. and EU?

LatAm:

Chile is a U.S.' FTA which should become a significant US exporter, yet much of Chilean volumes are currently going to China

Argentina is NOT a U.S.' FTA, so is likely see significant intensification of (already robust) Chinese investment / land-grab

Source: The White House, Various News Sources, Social Capital

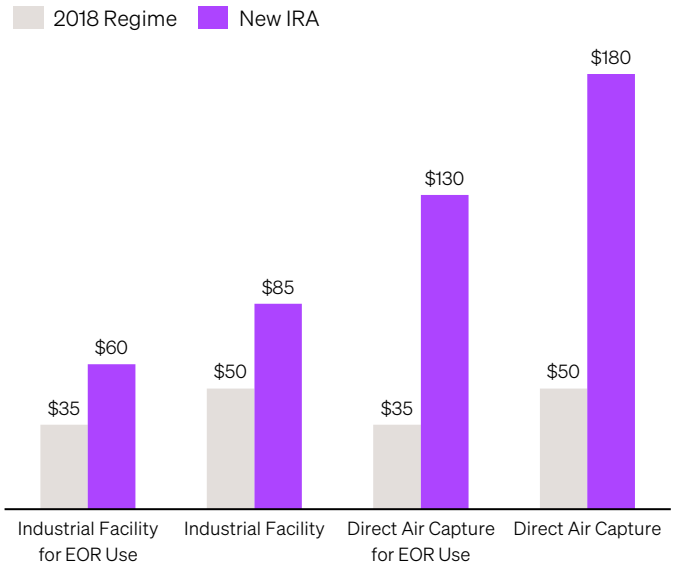
CHAPTER 08

Implications for carbon capture

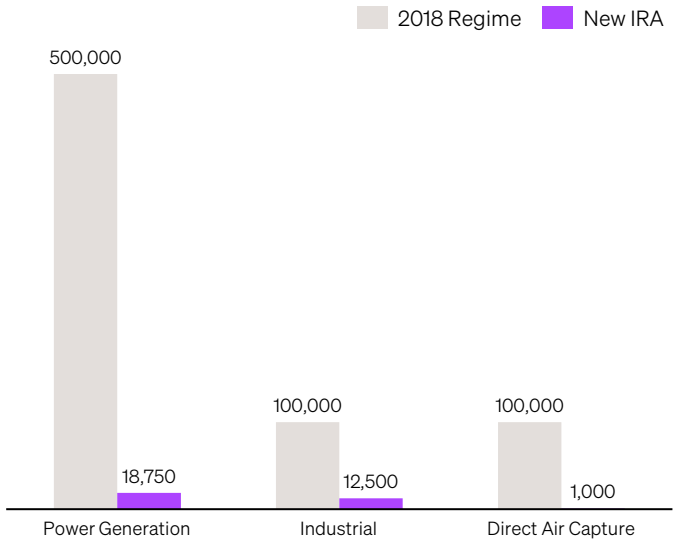
Capturing carbon is now economically viable across a wide range of sectors

The IRA Significantly Expands the Prior Carbon Capture Credit System

45Q Credit Value ($ / ton)



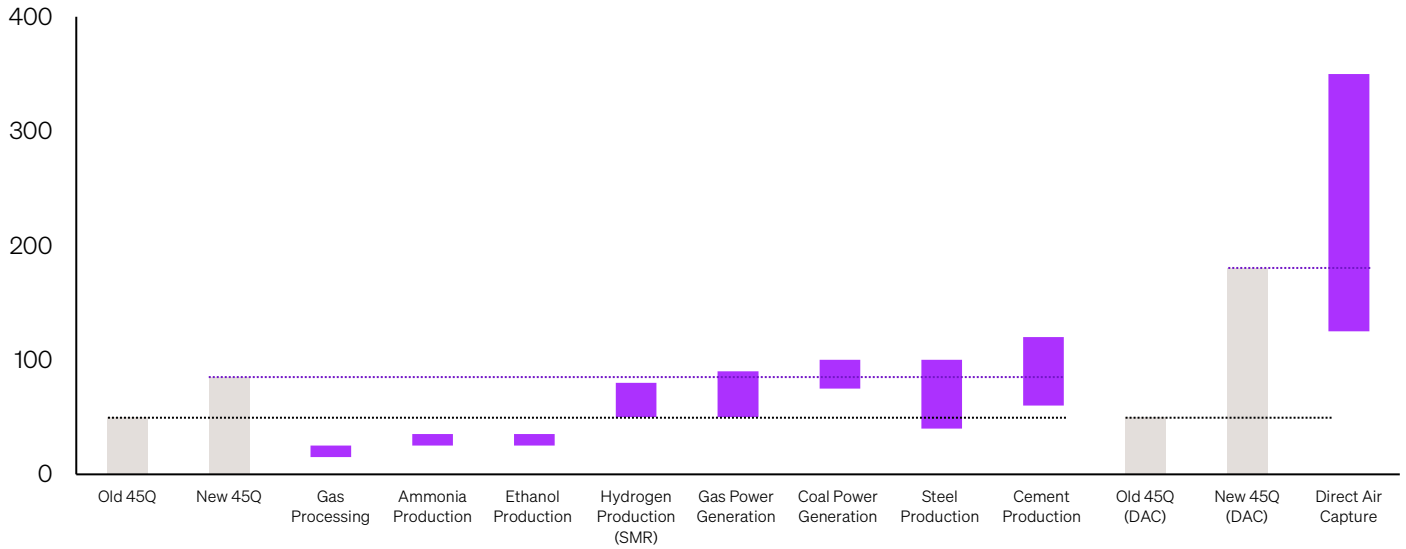
Capture Threshold (CO2 Tons / Year)



Source: The White House, Carbon Capture Coalition

Which Makes it Cheaper to Decarbonize Many Previously Hard to Abate Sectors

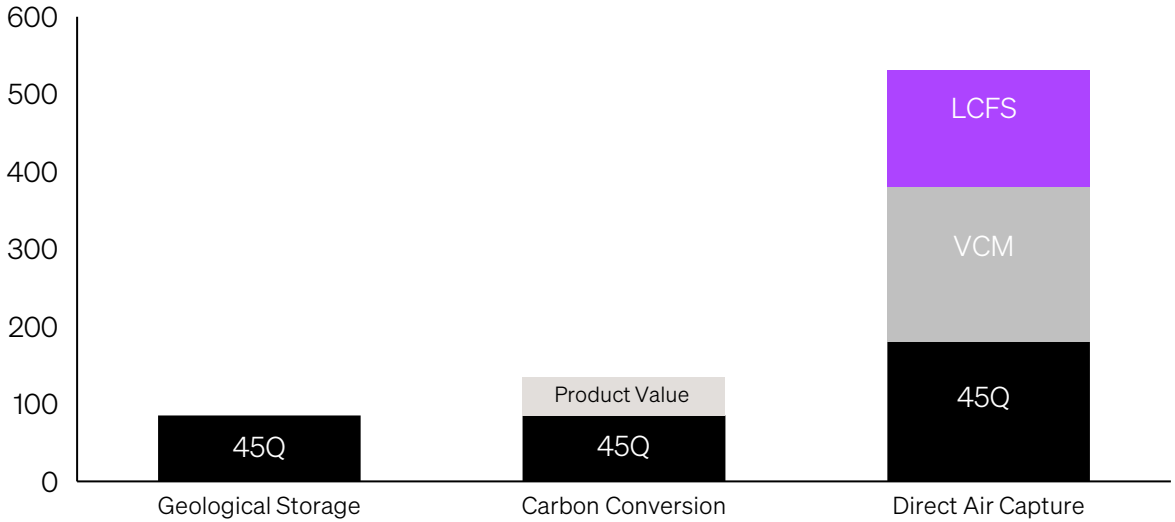
Levelized Cost of Capture Range vs. Credit Value



Source: Great Plains Institute, Bloomberg

45Q Credits Can Be Combined With Non-Federal Credits Like Low Carbon Fuel Standard (LCFS) and Voluntary Carbon Market (VCM) Credits

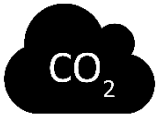
Illustrative Revenue Stacks for Carbon Capture ($ / ton)



Source: The White House, Various News Sources

Credits Can Become a Key Revenue Stream For Companies That Use Carbon to Produce and Sell Real World Products

Feedstock = 'Waste'



- CO2 Input (e.g. Flue Gas, DAC)
- Mineral Feedstock Input
- Typically, Calcium- or Magnesium-based)
- E.g. Steel Slag, Fly Ash, Mine Tailings, Cement Waste, HCL

Industrial Plant

Chemical reaction of CO2 with calcium or magnesium binder

Revenue Sources

- 'Real world product' often based on calcium carbonate
- 45Q credit ($60/ton for utilization)

1. Calcium carbonate → limestone (cement), wallboard, pigments
2. Magnesium carbonate → fire retardant, plasterboard, food additives

Source: Department of Energy, Various News Sources

CHAPTER 09

Implications for clean hydrogen

Blue and green hydrogen will become competitive with grey hydrogen

There are Four Main Types of Hydrogen

Brown	Grey	Blue	Green
▪ Derived from black coal or lignite ▪ Releases carbon dioxide and carbon monoxide into the atmosphere ▪ Least environmentally friendly	▪ Derived from natural gas using steam methane reformation ▪ Releases carbon dioxide into the atmosphere ▪ Better than coal but still highly-emissive	▪ Derived from natural gas using same chemical process as grey ▪ Use of carbon capture and storage to capture CO2 by-product ▪ Better than grey but still produces GHGs	▪ Derived by splitting water into hydrogen and oxygen using electrolysis ▪ Powered by clean electricity from renewable energy sources ▪ Most environmentally friendly
			

Source: National Grid Group

U.S. Department of Energy Makes Clean Hydrogen Production a Strategic Priority

Goal to produce 50 Mt of clean hydrogen annually by 2050

1.

High-Impact H2 Uses
September 2022

- Decarbonizing segments such as in industry and heavy-duty transportation that are difficult to electrify

2.

The 'Hydrogen Shot'
June 2021

- Reducing the cost of clean hydrogen to $1 for 1kg within a decade
- Interim goal of $2/kg by 2026, by reducing:
  1. The cost of electrolyzers
  2. The cost of CO2 transport and storage

3.

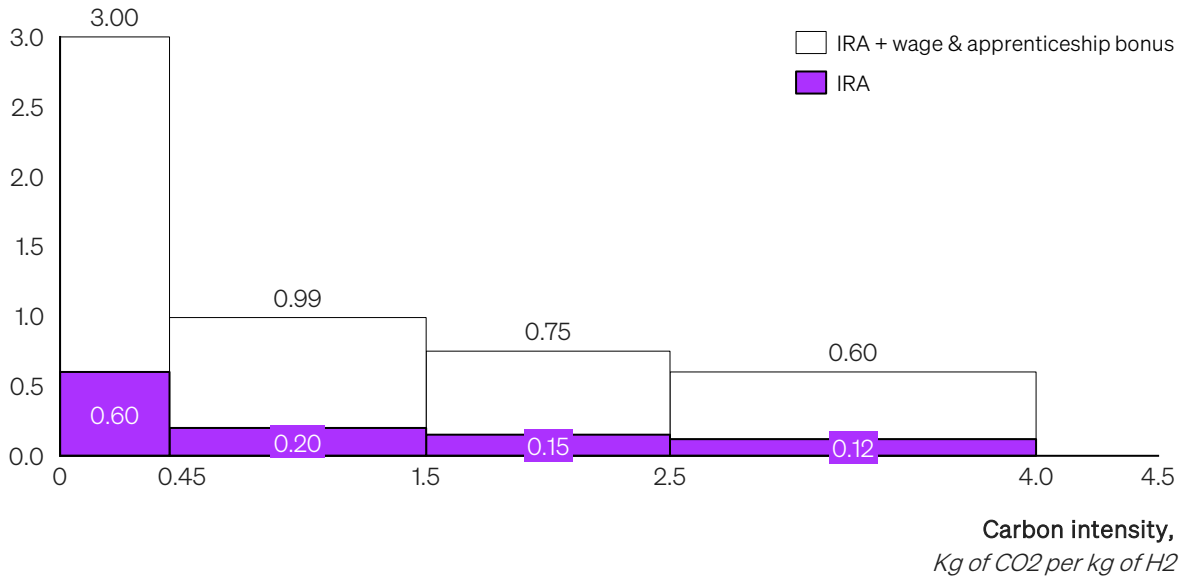
Four Regional 'H2 Hubs'
BIL – November 2021

- Creating at least 4 regional hubs to produce clean hydrogen, with at least one hub proposal from each of three production routes
  1. Fossil fuels
  2. Renewables
  3. Nuclear energy
- Each of the hubs should aim for different uses for clean hydrogen
  1. Power generation
  2. Industrial manufacturing
  3. Residential & commercial heating
  4. Transport

Source: Department of Energy

IRA Directly Subsidizes Clean Hydrogen Production Based Upon Carbon Intensity

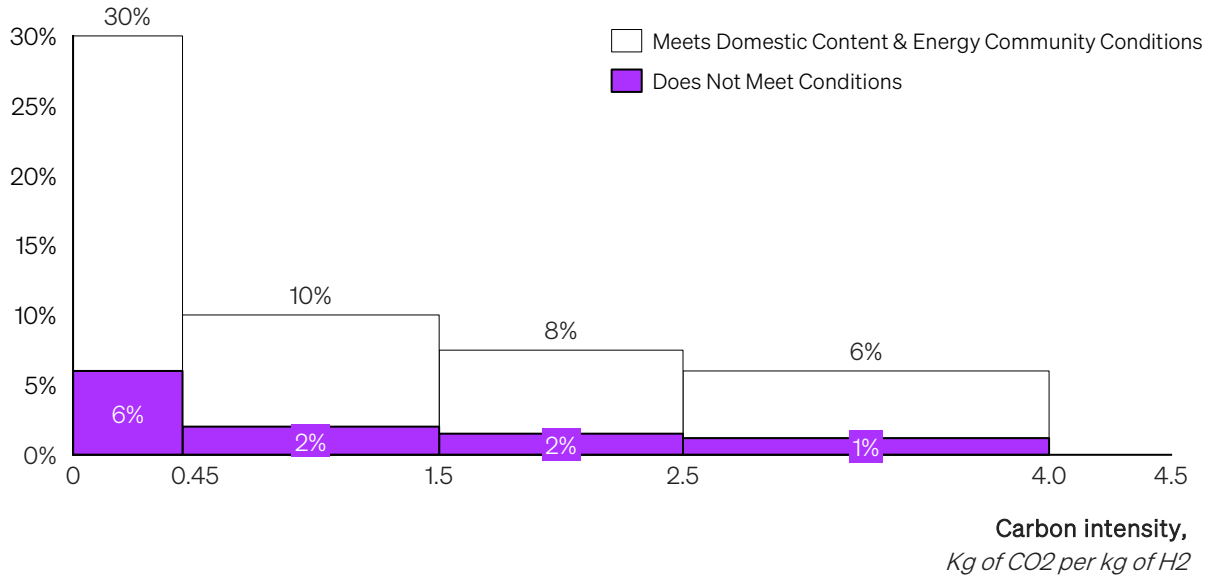
Amount of Production Credit Granted ($ / kg)



Source: The White House, U.S. Code

And Offers Investment Tax Credits For Domestic Clean H2 Production & Storage Facilities

% of Qualified Investment Costs



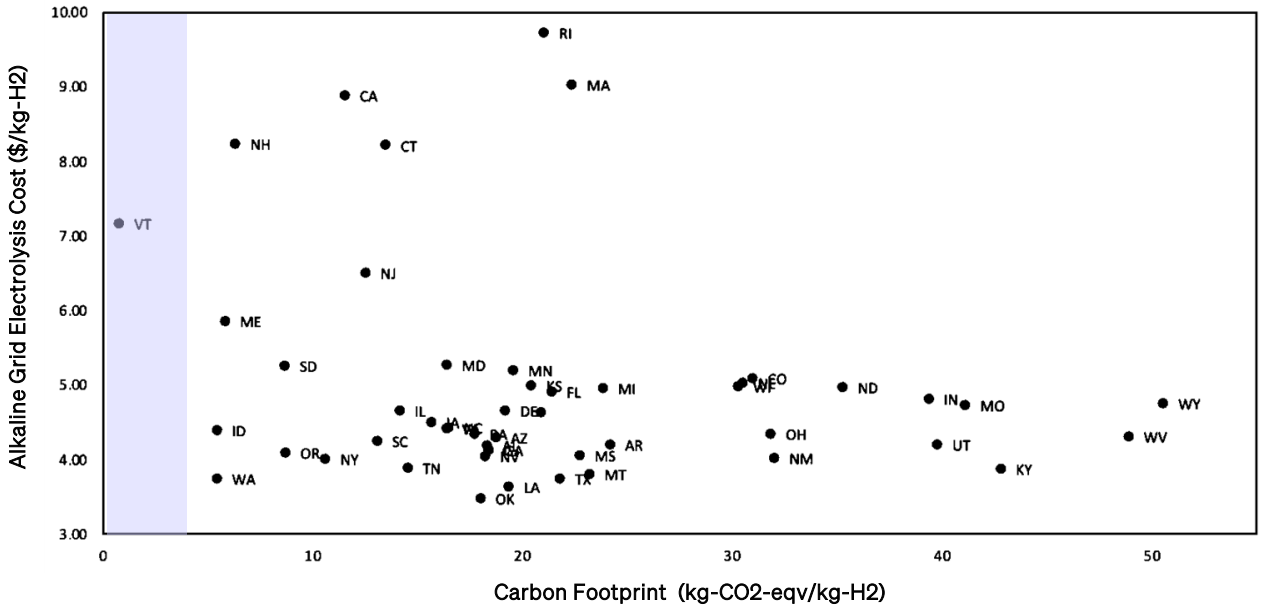
Source: The White House, Department of Energy

Clean Hydrogen Can Help to Decarbonize Hard to Abate Emissions Across Sectors

Industry	Transportation	Energy
Hydrogen can replace coal as the reducing agent in steel production 	Hydrogen fuel cells can provide range and fast refueling for heavy duty vehicles 	Hydrogen can be produced and to store energy during periods of excess energy generation 
Hydrogen is a key feedstock for producing ammonia which is used in fertilizer 	Hydrogen and derived fuels can help to decarbonize shipping and aviation 	Hydrogen can replace or be blended with natural gas for heating 

But Cheaper Renewables Will Be Required to Enable Competitive Green Hydrogen

Only Vermont at >$7/kg H2 would be eligible for IRA Hydrogen Credits



Source: Analysis of Hydrogen Production Costs across the United States and over the next 30 years, Cornell (2022)

CHAPTER 10

Implications for consumer homes

Consumers are strongly incentivized to improve home energy efficiency

The IRA Offers Thousands of Dollars of Credits to Consumers For Home Upgrades

Investment Tax Credit	25C
Investment Tax Credit	25D
Investment Tax Credit	30D

30% Resi-Solar
Installation costs for solar + storage or standalone battery storage

$1,200 Insulation & Air Sealing Materials

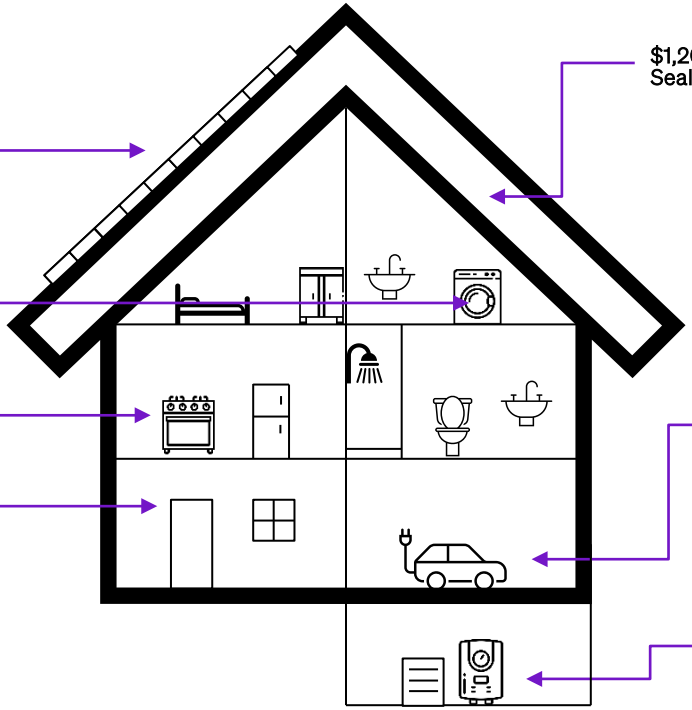
$840 Appliance Upgrades
Electric stove, cooktop, oven, or heat pump clothes dryer

$7,500 New EVs, $4,500 Used EVs

$1,100 Weatherized Windows & Doors

$1,200 Air & Water Cooling / Heating Equipment

$2,000 Air or Water Heating Pumps



Source: The White House

CHAPTER 11

Wrapping up

8 Key Takeaways of the Inflation Reduction Act

1. Reshoring of U.S. manufacturing will be a critical theme over the next decade
2. Solar is positioned to be the dominant form of new electricity generation capacity
3. Energy storage will become a must-have component for onshore renewables
4. EVs are cost-competitive with gasoline and diesel cars
5. Global critical material flows will shift away from China and other ‘countries of concern’
6. Capturing carbon is now economically viable across a wide range of sectors
7. Blue and green hydrogen will become competitive with grey hydrogen
8. Consumers are strongly incentivized to improve home efficiency

Future Deep Dives

Month	Theme	Deep-Dive	Summary
Dec	**Energy Transition**	**The Global Energy Transition**	**What is climate change and why is it happening? Where are global carbon emissions coming from? What are the key pieces of legislation we have implemented to solve this?**
Jan	Deep Tech	A Primer on Artificial Intelligence	What is Artificial Intelligence and what are the different types? How do the various models work? How is value created? What are the risks?
Feb	Life Sciences	The Business Model of Healthcare	What are the incentives that drive the behavior and outcomes of drug companies, insurers and hospitals? What new disruptions are at hand?
Mar	Economic Analysis	'Go Woke, Go Broke'?	Which companies have 'gone woke' and why? Where has this business strategy succeeded and failed? Do companies that 'go woke' underperform their peers?
Apr	Energy Transition	Residential Solar and the Future of Energy	Outline of the solar value chain, industry trends, and how residential solar could disrupt traditional utilities.
May	Deep Tech	The Future of Space	What are the legacy and emerging business models built around space? How do we get to space today? What will space look like tomorrow?
Jun	Life Sciences	The Economics of Drug Development	How do the economics of drug companies work? Why have biotech sector returns been so poor over the past decade?
Jul	Socio-Political Trends	Is India the Next Economic Giant?	Where is India's economy today and where might it be tomorrow? What are the key demographic and social factors that are driving the country's development?
Aug	Energy Transition	Replacing Animal Meats	What are global trends driving protein demand? Do we need plant-based meat? What are the challenges to production and adoption?
Sep	Deep Tech	Moore's Law and Next Steps for Silicon	What is Moore's Law and has it broken down? What are the different types of semiconductors? Why are companies moving towards more custom-designed silicon?
Oct	Economic Analysis	When Companies Go 'Ex-Growth'	What does it mean for a company to go 'ex-growth'? Why does it happen? What are the implications for valuation? How can companies respond?
Nov	Socio-Political Trends	A Demographic and Social Breakdown of America	Where is America today? A visual representation of our democracy, demography, economy, quality of life, progress and more.

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