

# **NASEO 2023 Annual Meeting**

**Decarbonizing America's Energy System: The Status and  
Outlook for Market-Oriented, Large-Scale Solutions**

**October 17, 2023**

**CLEARPATH**

# CLEARPATH



**Savita**  
**“Savvy”**  
**Bowman**

Sr. Program  
Manager, Carbon  
Management

- Policy, Carbon Dioxide Removal, Carbon Capture Utilization and Storage, Industrial Decarbonization (steel, cement, & concrete), & Agriculture at ClearPath
- Fmr. Tesla Asset Manager for solar and storage
- [bowman@clearpath.org](mailto:bowman@clearpath.org)

## Mission



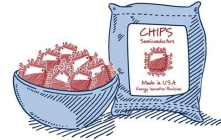
Develop and advance policies that accelerate innovations to reduce and remove global energy emissions

## Vision



Deep global decarbonization by 2050 through an innovation and deployment agenda – driving global uptake of clean technology

# The Past 3 Years Have Been Crazy



## Energy Act 2020

Refocused **DOE RD&D programs** around most pressing climate tech challenges

Authorized **moonshot tech demonstration programs** for storage, adv nuclear, CCUS, CDR, geothermal, and industry.

## IJA

Infusion of \$62 billion to accelerate cleantech innovation:

- Forward funding (5 years) of **Moonshot Tech programs** for, CCUS.
- \$8 billion for **H2 hubs** and \$3.5 billion for **DAC hubs**.
- New \$2.1 billion **CO2 Infrastructure Program**
- Expands **DOE loan program** to invest in aviation, maritime, and manufacturing.

## CHIPS+

Launched first dedicated steel RD&D effort, **the SUPER Act**, to focus DOE efforts on pathways to decarbonize the steel sector.

**Modernizes the DOE Office of Science** to improve federal research facilities and national labs while strengthening public private partnership opportunities.

## IRA

~\$300 billion in **tax incentives** over the next decade for new electric vehicles, clean electricity, hydrogen, carbon capture, and domestic supply chain development

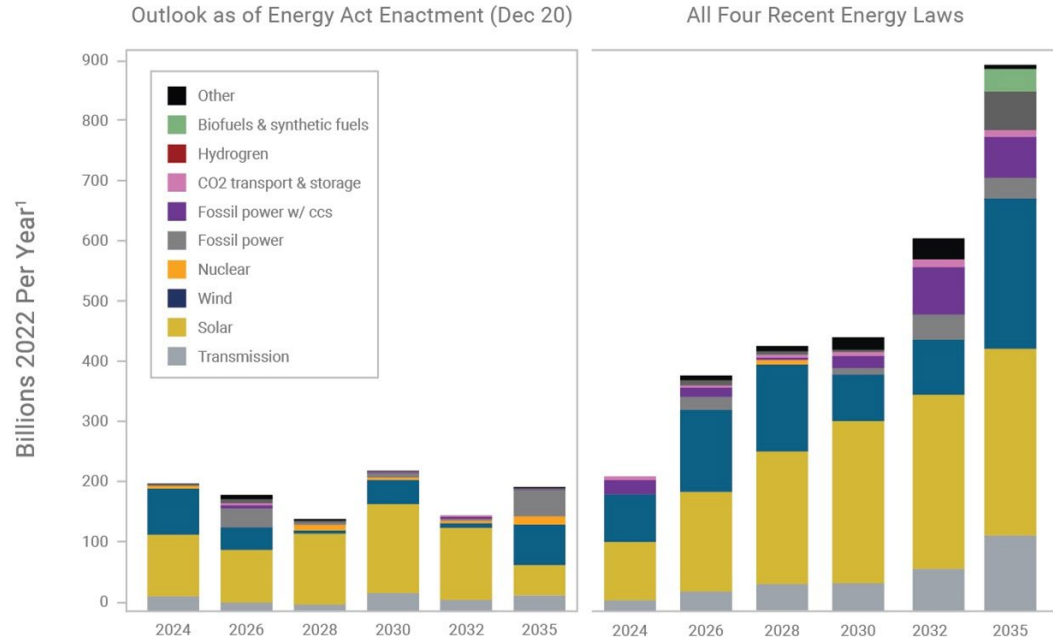
- \$6 billion in **grants to reduce emissions from industrial facilities** like chemicals, steel, & cement.

# Recent Laws Dramatically Change Clean Energy Capital Trajectory

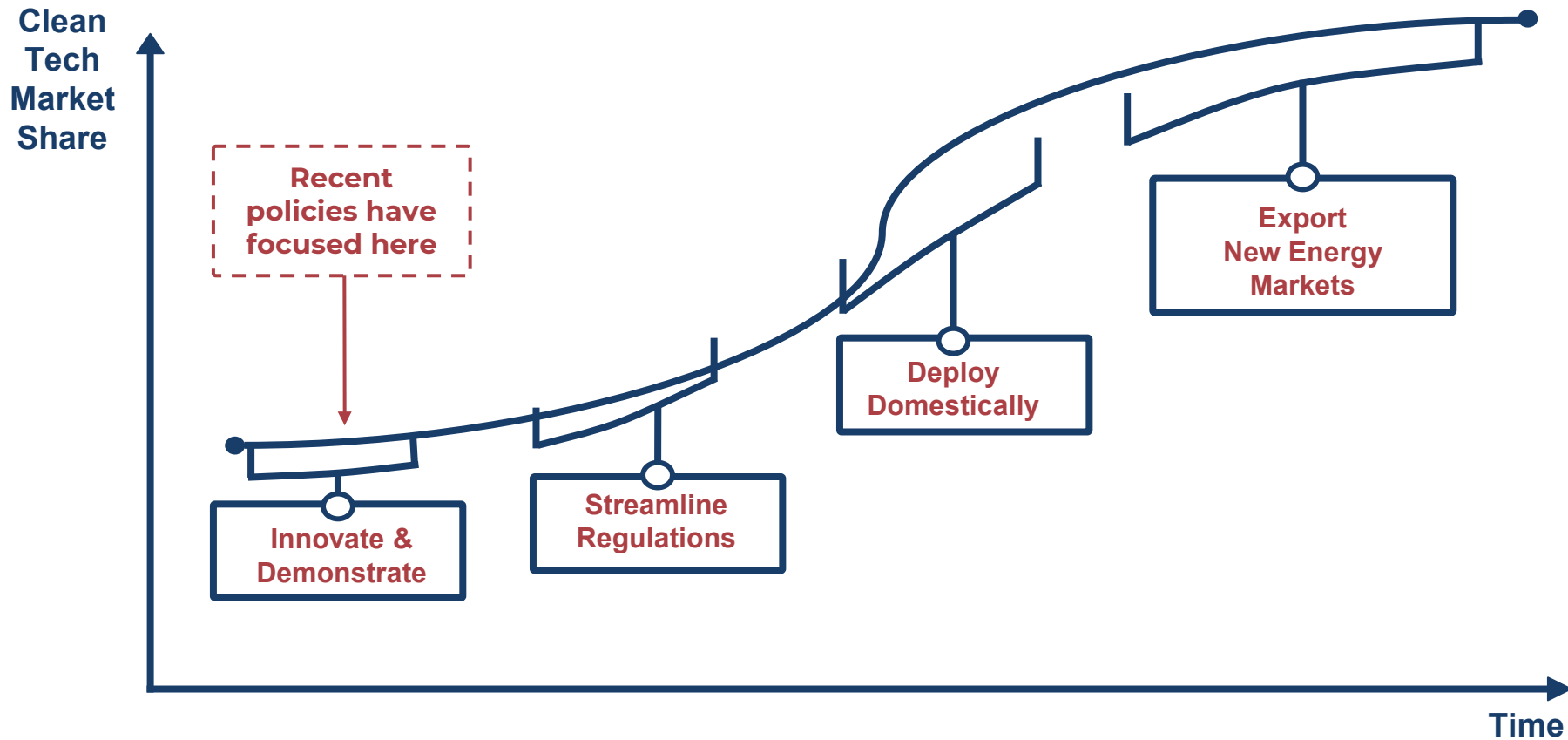
## Financing no longer is the primary barrier

- New clean energy projects are likely to quadruple by 2035 as a result of the Big 4 energy bills compared to the outlook from December 2020.
- These laws have created a tremendous **financial incentive** to build, but success will now depend on the ability to manufacture, permit, site and interconnect projects.

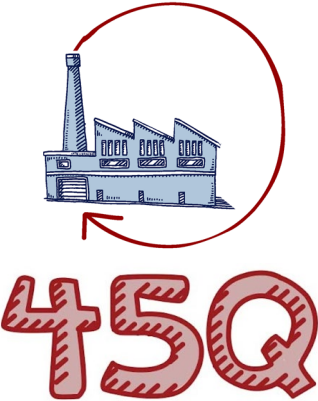
## Annual Capital Investment in Energy Supply Related Infrastructure Billion 2022 USD Per Year<sup>1</sup>



# Policy should push energy technology up the “S-curve”



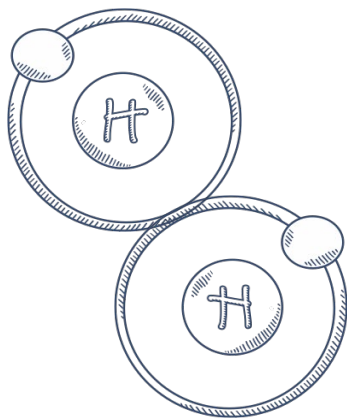
# Recent Legislation Dramatically Boosted the 45Q Tax Credit



- Extension** — Projects must commence construction by Jan 1, 2033 to be eligible
- Credit Level** — Power Plants and Industrial Facilities: \$85 per ton for geologic Storage \$60 per ton for enhanced oil recovery (EOR)\*\*\*  
DAC: \$180 per ton for storage, \$130 per ton for EOR\*\*\*
- Threshold** — DAC Facilities: 1,000 metric tons (MTs) minimum  
Power Plant: 18,750 MTs min, 75% unit capture requirement  
Industrial Facilities: 12,500 MTs minimum
- Direct Pay** — Nonprofits may elect for direct pay for the full 12-years credit  
For-profit entities may elect for direct pay for the first 5 years

\*\*\* Contingent on prevailing wage and apprenticeship requirements

# 45V Hydrogen Production and Investment Tax Credits



Emissions intensity kgCO <sub>2</sub> e/kgH <sub>2</sub>	% of Max Credit	PTC Full Bonus Rate	ITC Full Bonus Rate
2.5 to 4	20 %	\$ 0.60	6%
1.5 to 2.5	25 %	\$ 0.75	7.5%
0.45 to 1.5	34 %	\$ 1.00	10%
0.45 and below	100 %	\$ 3.00	30%

**% of Max Credit Level** - based on emissions intensity of upstream and production

**Bonus Rate** - credit is increased by 5x if wage and apprenticeship requirements are met

**Facility Eligibility** - Commence construction before January 1st, 2033

**Duration** - 10-years after placed-in-service date

**Credit Stacking** - 45V can be taken with 45U (Large LWR nuclear), Section 45 (Renewable energy) or 45Y (tech inclusive clean electricity production credit that takes effect in 2025)

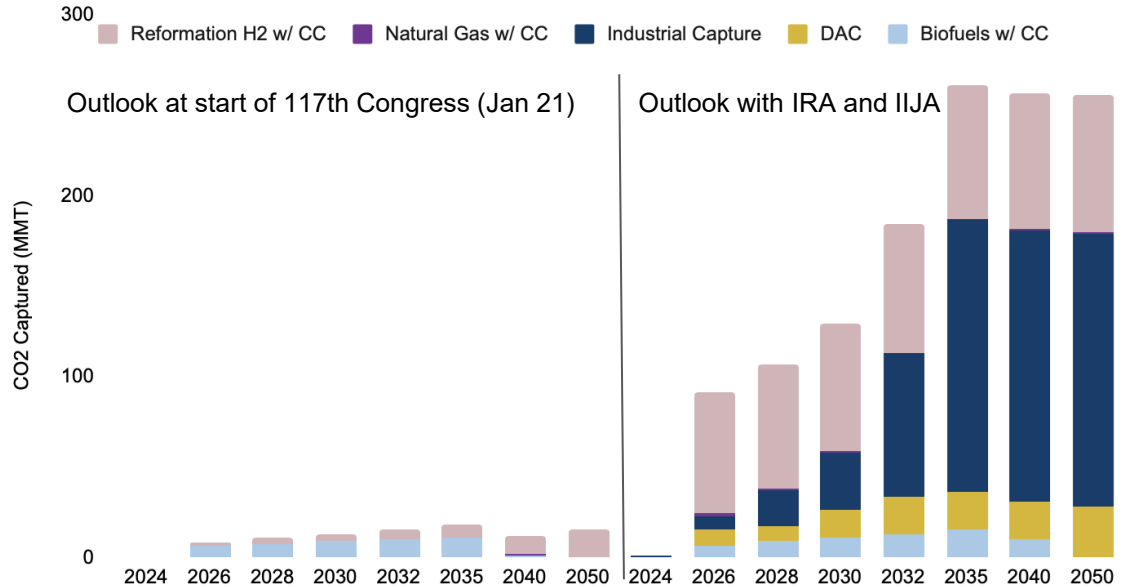
**Stacking Exclusion** - 45V cannot be taken with 45J (Advanced nuclear) or 45Q (Carbon capture credit)

# Legislative Impact on Carbon Capture Technologies

## Recent legislation has tremendously accelerated carbon capture technologies

- Policy support from the IRA and IIJA project **nearly 130 MMT of captured CO2 by 2030 and 255 MMT by 2050 (a near 1,500% increase compared to baseline)**
- Industrial capture benefits the most with an increase from 0 to 150 MMT of captured CO2 by 2035

Annual CO2 Captured By Technology Type  
Million Metric Tons Per Year





# DAC Hubs | 2 Out of 4 Hubs Selected

## Regional DAC Hubs

- Capture carbon directly from the **atmosphere**
- Capacity to capture and sequester and/or utilize **one million** metric tons of CO<sub>2</sub>/year
- Can be developed into a **national carbon network** for sequestration or utilization

### Timeline

Dec  
2022

Funding  
Opportunity  
Announced

Mar  
2023

Applications  
Submitted

Aug  
2023

Award  
Selections



### Selection

**NOI** deviated from legislative direction but recent private sector engagement focused on fix.

**No later than 3 years** after deadline, the Secretary shall select **4 regional DAC hubs**

### Criteria

- Each hub located in a region with **carbon intensive fuel production or industrial capacity**, or such capacity that has retired or closed in the preceding 10 years
- **Geographic** diversity
- Carbon **potential** for sequestration or utilization
- 2 hubs in **economically distressed communities** with high levels of coal or shale gas resources
- **Employment opportunities** for greatest number of residents

### Funding

- Secretary may provide **grants or agreements** to commercialize and demonstrate capture, processing, delivery, storage, and end-use of CO<sub>2</sub>.
- In addition to amounts otherwise made available, **\$3.5 billion** is appropriated from **FY 2022 - FY 2026**

# Two Demonstration Hubs Led by Office of Clean Energy Demonstrations

## South Texas DAC Hub

**Location:** Kleberg County, TX

**Owner:** 1PointFive

**Tech Provider:** Carbon Engineering

**CO2 Removal:** 1MMT CO2 Annually

**CO2 Storage:** Saline geologic CO2 storage site

**CBP Highlights:** Creation of ~2,500 jobs in construction, operations, and maintenance with existing agreements for local hiring-including a target quota for local construction and operations; creation of a Citizen Advisory Board to ensure meaningful community engagement

## Project Cypress

**Location:** Calcasieu Parish, LA

**DAC Hub Owner:** Battelle

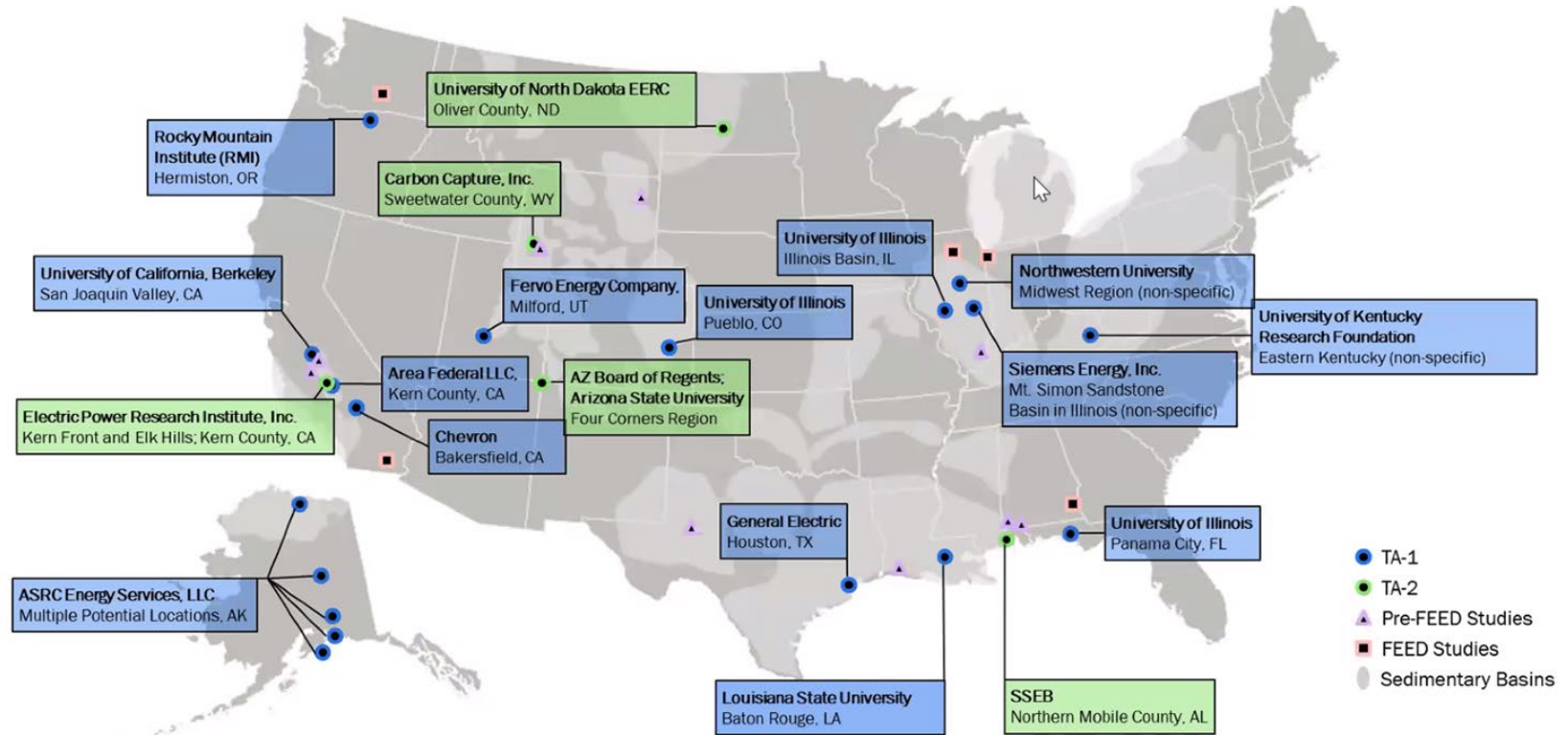
**Tech Providers:** Climeworks & Heirloom

**CO2 Removal:** 1MMT CO2 Annually

**CO2 Storage:** Deep saline aquifer, through an offtake agreement with Gulf Coast Sequestration

**CBP Highlights:** Creation of ~2,300 jobs, with a goal to hire workers formerly employed by the fossil fuel industry for 10% of the overall workforce; robust two-way community engagement towards developing a Community Benefits Plan

# Direct Air Capture Map: TA1 Concept Studies & TA2 FEED Studies



# IIJA Carbon Capture Demo Program | FOAs have Been Released

## Carbon Capture Demos

- Funds carbon capture demonstration and FEED studies from the **point source capture** projects to significantly improve the **efficiency, effectiveness, costs, emissions reductions, and environmental performance** of coal and natural gas use

### Timeline



### Selection

**FOA 1** will fund up to \$189 million for up to 20 integrated front-end engineering design studies (FEED)

**FOA 2** authorizes **\$1.7B** to select 2 electrical generating facilities powered by coal, 2 by natural gas and 2 non-electric generating industrial facilities

### Criteria

- A detailed **Community Benefits Plan** is expected to be provided by all projects looking to receive funding. This plan will include Administration's Justice 40 initiative

### Insights

- \$2.537 billion** available for the Demonstration Program
- Questions remain why the two FOAs do not equal the amount funded (~\$0.2B+\$1.7B ≠ \$2.5B)
- Expect a FOA 3 to be issued for the remaining funds
- Projects under this FOA 2 will have a minimum 50% cost share requirement

# Hydrogen at the State Level

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## Colorado

- Enacted a tax credit for end-users of low-carbon hydrogen (i.e., ammonia, steel, long-distance trucking, etc.)
- \$1 for Hydrogen made with 0.45 CO<sub>2</sub>e/kgH<sub>2</sub> in addition to the federal tax credit

## Washington

- Enacted a law to streamline siting and permitting for clean energy projects, including the production of hydrogen via electrolysis

## North Dakota

- Legislators appropriated \$11.3M for state-led research into hydrogen and fossil fuel storage in two underground salt caverns

## DOE H2Hub Awardees

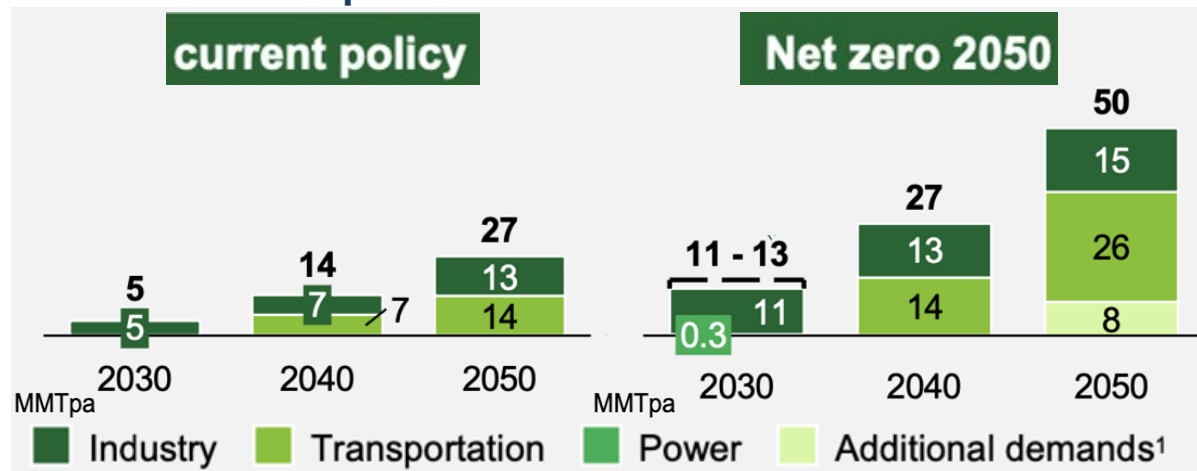
- Seven hubs were selected across 16 states to receive up to \$7 billion in federal funding and catalyzing about \$40 billion in private sector investment
- The hubs will create over 330,000 direct jobs in local communities

# Hydrogen at Scale

## Investments by 2050

- To reach the net zero by 2050 goal, DOE estimates midstream infrastructure be ~15% of total hydrogen investments through 2030
- Beyond 2030, DOE estimates over 30% of total investments to be in midstream infrastructure
- By 2050, \$300-\$400B would be spent on midstream infrastructure

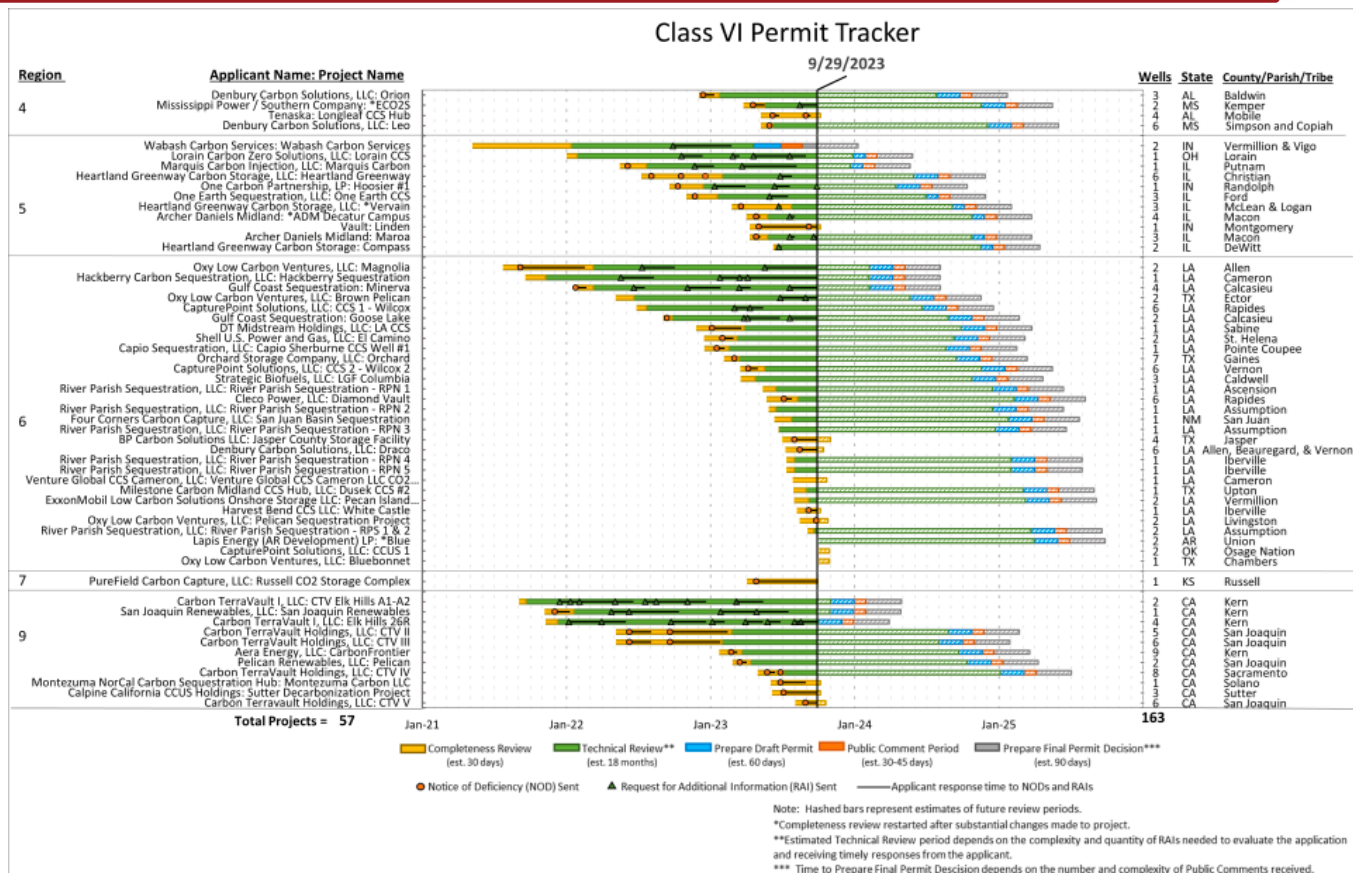
## End user Consumption 2050



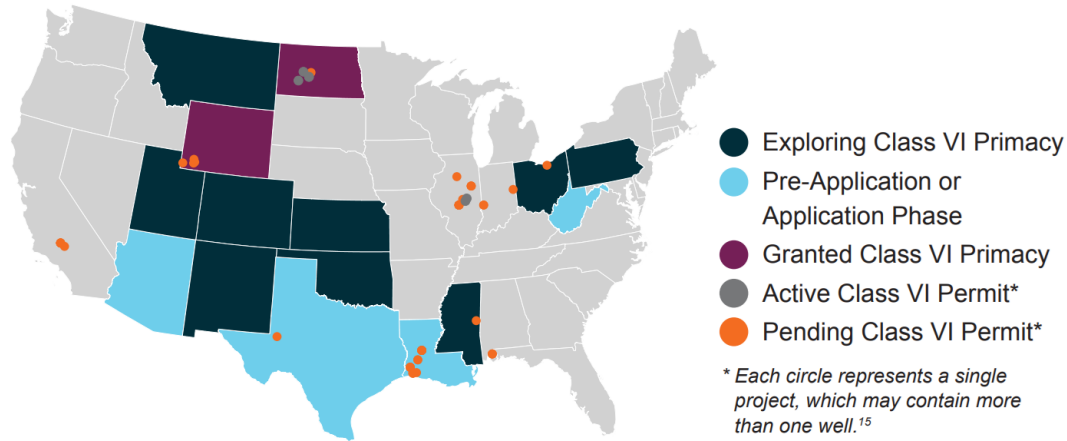
Source: [DOE Pathways to Commercial Liftoff: Clean Hydrogen](#)

# EPA Has a backlog of 150+ Class VI wells and climbing

- EPA oversees the Underground Injection Control program which oversees Class VI geologic sequestration wells
- EPA has only permitted 2 wells; both are located in Illinois
- Reviewing applications from 57 projects totaling 163 unique Class VI wells, each estimated to have, at best, a two-year timeline



# Status of Class VI and Primacy



- Most states hold primacy for at least one well class; in many cases they have for 40+ years.
- Class VI was established as a new well class in 2011
- So far just 2 states hold Class VI Primacy: ND and WY
- Proposed rule for Louisiana released in April 2023, final determination coming soon
- TX, AZ, and WV, are all formally in the process of acquiring Primacy.
- IIJA provided \$50M for states to build out their Class VI Primacy capabilities



# Future Outlook

## Implement DOE Programs

- Engaging with DOE to ensure there is well-organized coordination among offices as programs are rolled out
- Ensuring that programs prioritize technologies with high impact, the ability to commercialize, and competitive cost
- Supporting DOE exploration into measurement rubrics such as MRV in CDR

## Streamline Permitting

- Ensuring that permitting addresses unnecessary duplication, provides clear timelines throughout the process that enhance predictability, and a limit to superfluous legal action — for example EPA UIC Class VI

## Advance Enabling Legislation

- Parallel to financial resources, a focus on *bipartisan* authorizing language to enable RD&D of emerging clean tech
- In the case of CDR, the CREST Act

## Provide Regulatory Clarity

- EPA engagement to develop relationships and request regulatory for application requirements & process + jurisdiction clarity
- Requesting regulatory clarity from EPA through approps direction



**Savvy Bowman**

[bowman@clearpath.org](mailto:bowman@clearpath.org)

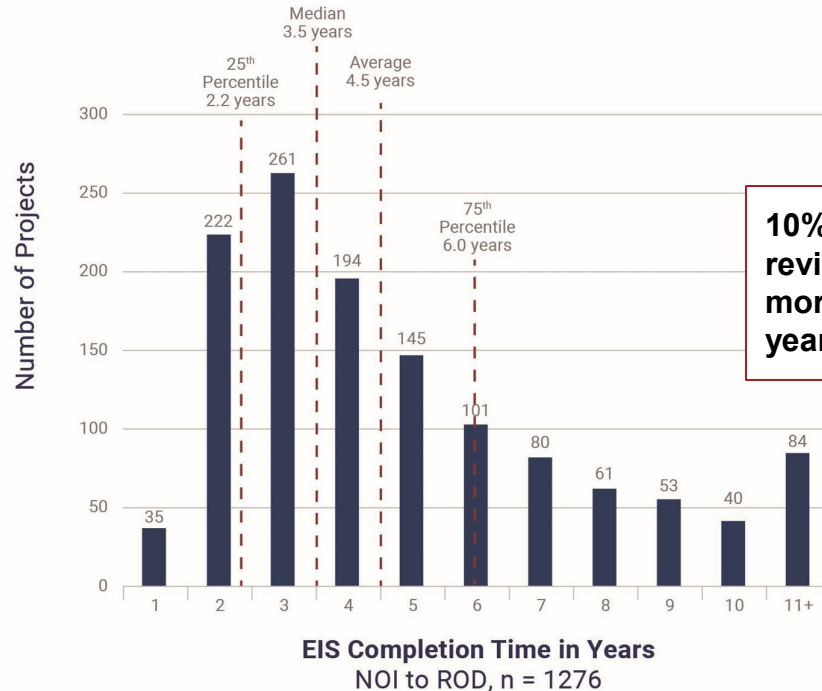
 [@Savvy\\_Bowman](https://twitter.com/Savvy_Bowman)

# Current permitting system is slow and broken, for all types of energy

## Current system is a “none of the above” strategy

- 42% of the DOE’s active NEPA projects are related to clean energy, transmission or conservation.
- CEQ’s 1978 regulations and guidance recommended an EIS normally be less 300 pages even for actions of unusual scope and complexity, and the timeline **should not exceed 1 year.**

Distribution of EIS Completion Time (NOI to ROD)  
All EISs Completed 2010-2018



# CDR Legislation in Congress

## CREST Act

- Senate introduction by Sens. Susan Collins (R-ME), Maria Cantwell (D-WA), Bill Cassidy (R-LA), Angus King Jr. (I-ME), Christopher Coons (D-DE)
- Bipartisan CDR R&D with support for biomass carbon removal such as BECCS and carbon conversion, carbon mineralization, waste mineralization, and ocean carbon removal such as direct ocean capture, macro & micro algae, & ocean alkalinity enhancement.
- Tech-neutral pilot carbon dioxide removal purchase program
- Cost: \$546 million

## Carbon Dioxide Removal Research and Development Act

- House introduction by Rep. Paul Tonko (D-NY)
- Senate introduction by Sen. Brian Schatz (D-HI)
- Launches a 10-year, multi-agency program for carbon dioxide research, development & demonstration.
- Incorporates diverse CDR solutions, including DAC, BiCRS, and ocean CDR.
- Establishes and funds a research program at the NSF.
- Prioritizes holistic social, economic, and environmental considerations.
- Cost: \$12 billion

## CREATE Act

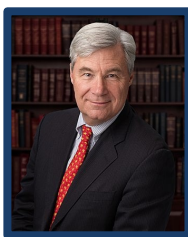
- Senate introduction by Sens. Kyrsten Sinema (I-AZ), Lisa Murkowski (R-AK), Sheldon Whitehouse (D-RI), Shelley Moore Capito (R-WV)
- Establishes the Committee on Large-Scale Carbon Management within the National Science and Technology Council (NSTC) to coordinate and oversee federal efforts on carbon management.
- The group will focus on carbon removal in the oceans, atmosphere, and land using both natural and technological approaches and monitor carbon dioxide levels, environmental impacts and pursue long-term shortage solutions.

# CCUS Legislation in Congress

## CCUS Parity Act (S.542 & H.R.1262)



Sen. Cassidy  
[R-LA]



Sen. Whitehouse  
[D-RI]



Rep. Schweikert  
[R-AZ-1]



Rep. Sewell  
[D-AL-7]



Rep. Wesley  
[R-TX-38]

- Bipartisan bill to establish parity between 45Q carbon tax credits for utilization and sequestration
- Increases the value for DAC utilization to \$180/metric ton; and increase the value for power and industrial sector utilization to \$85/metric ton
- EOR would be at the lower credit value

## Lower Energy Costs Act (H.R.1) Primacy Amendment



Rep. Crenshaw  
[R-TX-2]

- After 180 days if a state has not ruled on a state's Primacy application, then the state would automatically be granted UIC Class VI authority

# Recently Enacted Policies



- **FECM - Study on Blue Hydrogen Technology**
- **NE - Integrated Energy Systems Program Authorization**
- **FECM - CC at steam methane reformation facilities**
- **FECM - Turbine Efficiency program includes H2**
- **AMO - Industrial Emissions Reduction Technology Development Program**
- **LPO - Hydrogen production added to eligible projects**

**Scattered inclusion in other DOE programs**

- **Regional Clean Hydrogen Hubs - \$8 billion**
- **Clean Hydrogen Electrolysis Program - \$1 billion**
- **Clean Hydrogen manufacturing and Recycling - \$0.5 billion**
- **DOE R&D Reauthorization**
- **Clean Hydrogen Strategy and Roadmap**
- **Clean Hydrogen Production Standard**

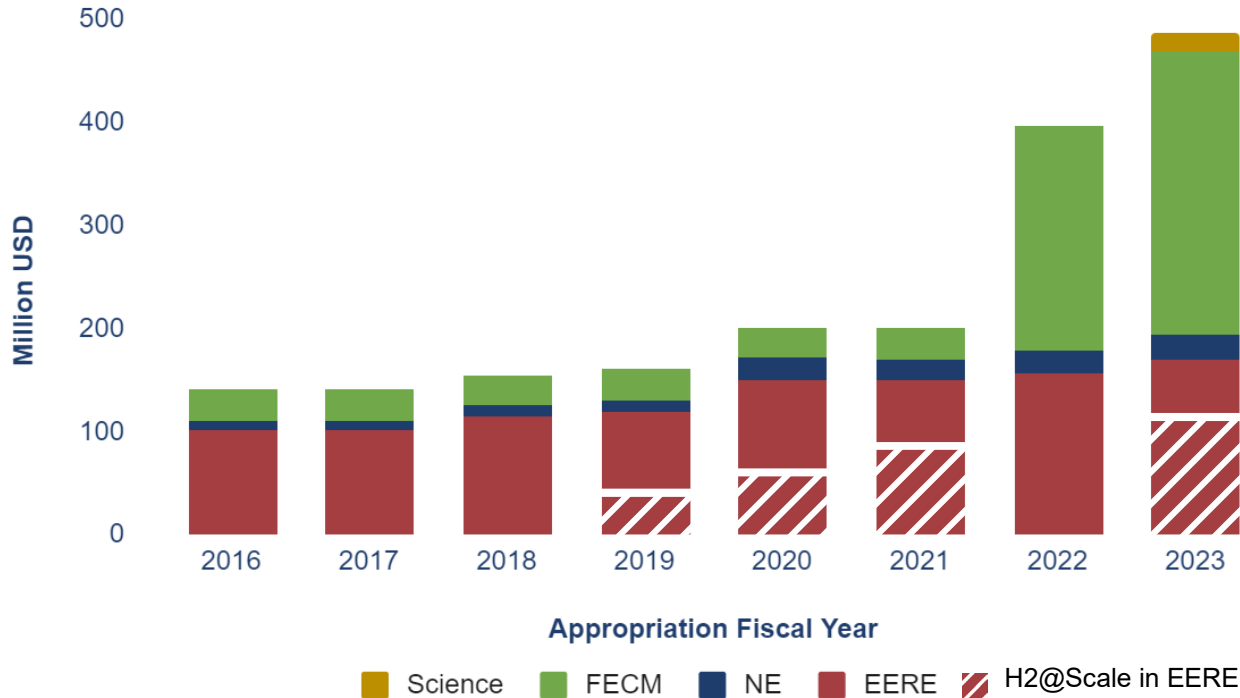
**Program reauth, money, and demos/deployments**

- **45V - Hydrogen PTC credit with ITC option**
- **48 - Energy storage credit**
- **48C - Advanced Energy Projects ITC extension - \$10 billion**
- **45Q - Carbon Oxide Sequestration Credit**
- **LPO: Loan Guarantee expansion - \$80 billion & new loan authority for energy repowering generation - \$250 billion**
- **Advanced Industrial Facilities Deployment program - \$5.8 billion**
- **Grants to Reduce Air Pollution at Ports - \$2.25 billion**

**Large production tax credit & credits/programs for H2 value chain**

# History of Hydrogen R&D and Policy

## Annual Funding for Hydrogen Activities by DOE Office



- DOE → EERE → Sustainable Transportation → Hydrogen Fuel Cell Tech Office (HFTO)
- 2019 – H2@Scale initiative
- 2019 – Integrated energy systems program
- 2021 – H2 EarthShot \$1:1kg by 2030 announced
- 2021 – IIJA passage
- 2022 – Increase in FE solid oxide fuel cell program, and H2+NG technology

# IIJA Regional Clean Hydrogen Hubs | Selection expected in Q4

## Regional Hydrogen Hubs

- Demonstrate the production, processing, delivery, storage and end-use of clean hydrogen
- Create a foundation of a national clean hydrogen network

### Timeline

**Notice of Intent:** June 2022

**First Funding Opportunity Announcement:** October 2022

**Concept Papers due:** November 2022

**Encourage/Discourage Notices:** December 2022

**Final Submission Deadline:** April 2023

### Selection

**FOA 1** will likely select 6-10 hubs for a total of up to \$7 billion in federal funding.

### Criteria

- **Feedstock diversity.** Production in at least one of the hubs must be from fossil fuels, nuclear energy, and renewable energy
- **End-use diversity.** End-use in at least one of the hubs must be for power generation, the industrial sector, heating, and transportation
- **Geographic diversity.** Shall be located in different regions, but at least two hubs must be in regions with natural gas resources

### Funding

- **\$7 billion** in DOE funding for selected applicants
- Projects under this FOA will likely have a **50% cost share** requirement
- **Milestone-based funding** is disbursed in 4 phases