Elevating Carbon Management: A Policy Decision-Making Framework and Rubric for the 21st Century

JULY 2025

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Kleinman Center for Energy Policy

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Introduction

In this digest, we specifically address policies supporting carbon capture, utilization, and storage (CCUS) technologies, including overlapping carbon dioxide removal (CDR) methods such as direct air capture (DAC) and bioenergy with carbon capture and storage (BECCS). While broader categories of CDR exist—including marine CDR, nature-based, or agricultural solutions—we focus here on technological approaches with significant policy intersections with CCUS, aligning clearly with industrial decarbonization pathways.

Carbon management has emerged as a vital yet often contentious strategy for addressing climate change. While some see carbon management as essential for tackling hard-to-abate industries and removing legacy emissions, others fear it may prolong reliance on fossil fuels. At the same time, many national and subnational governments remain divided on how aggressively to pursue carbon management—especially when political priorities shift.

Considering Carbon Management Policies

When are policies supporting carbon management appropriate? This guiding question reflects a growing need to determine where, when, and how carbon management can best complement the broader clean energy transition. Achieving reliable, affordable clean energy systems—while also meeting long-term climate goals—will likely require a portfolio of solutions, including carbon management in specific contexts.

The Intergovernmental Panel on Climate Change (IPCC) consistently states that robust, well-regulated carbon management is unavoidable to achieve net-zero scenarios, although the specific implementation depends heavily on effective policy design. But the exact role carbon management should play remains contested and depends heavily on policy design.

The Need for a Broader Lens

Given the complexity and interdependencies involved, carbon management must not simply focus on capturing and removing CO_2 but also strategically align with broader societal and environmental goals.

1. Real and permanent emissions reductions at scale through transitioning fully from unabated fossil fuel use.
2. Protection of communities and the environment, providing tangible local economic and social benefits.
3. Equitable economic development that includes cost and affordability considerations

This digest outlines a **decision-making framework—referred to here as a "rubric"—to evaluate the effectiveness of carbon management policies** in meeting these goals. We then examine the U.S. policy landscape at the start of 2025 to illustrate how applying this framework can highlight each policy's strengths and weaknesses, reveal gaps, and clarify whether a **basket** of policies can collectively

address core concerns. Notably, **no single policy** will fulfill every dimension; understanding how multiple measures fit together is key.

A Note on the Current Political Landscape

While recent shifts suggest a less supportive federal environment for carbon management, best-practice design principles remain crucial for states, companies, and future federal administrations. Even if carbon management slows under certain administrations, spelling out "what good looks like" ensures that policymakers, advocates, and investors have a roadmap for when and how to revive or expand carbon management initiatives responsibly. This framework explicitly considers policy feasibility, including dynamic aspects such as evolving technology costs, market maturity, and political viability.

The Decision-Making Framework (Rubric) for "Effective Carbon Management"

Below is a **ten-point** framework that forms the backbone of this policy review. The ten-point framework was developed based on the authors' extensive experience in government, specifically their direct involvement in implementing major U.S. climate and energy policies, including the Inflation Reduction Act (IRA), the Bipartisan Infrastructure Law (BIL), and the Department of Energy's Carbon Negative Shot initiative.

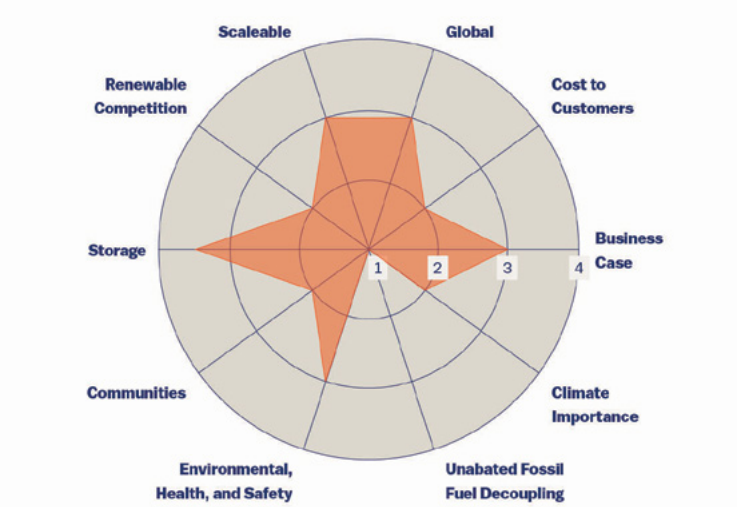
Each of the ten criteria supports one or more of the broader aims outlined above: transitioning fully from unabated fossil fuels, providing tangible community benefits, and promoting equitable economic development. While there is overlap (e.g., environmental, health, and safety can affect community acceptance), separating them helps ensure each dimension gets due consideration.

Scoring (1–4)

- **1 = Does not effectively address the criterion**
- **2 = Somewhat addresses the criterion**
- **3 = Addresses the criterion to a significant degree**
- **4 = Addresses the criterion to a high degree**

(A "4" is intentionally stringent, indicating the policy nearly fully meets best-practice standards. Policies that score lower on certain criteria may still be valuable but need targeted improvements.)

Figure 1: Radar (Spider) Chart of the 10-Point Policy Rubric for Carbon Management



Each spoke corresponds to one of the rubric's ten criteria (business case; climate importance; unabated fossil fuel decoupling; environmental, health, and safety; communities; storage; renewables competition; scalability; global linkages; and cost to consumers). The distance from the center (scores 1–4) indicates how effectively the U.S. policy landscape addresses each dimension, revealing both strengths (e.g., secure storage, scalable deployment) and gaps (e.g., lack of unabated fossil fuel phaseout, limited consumer cost protections).

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Table 1: Ten-Point Framework that Forms the Backbone of this Policy Review

Criterion	Key Question	Importance	Examples
1. Business Case	Does the policy provide sufficiently robust economic incentives to drive CCUS and/or carbon removal at the scale needed to meet climate goals? "Business case" specifically assesses economic incentives and financial viability, while "Scalability" focuses on policy support for technological maturity and commercial deployment pathways.	Most carbon capture projects hinge on strong financial signals—tax credits, grants, carbon pricing, or market pull via low-carbon standards.	A robust tax credit (e.g., U.S. 45Q) can make or break a CCUS project's economics.
2. Climate Importance	Does the policy prioritize carbon capture in the hardest-to-abate sectors where other low-carbon alternatives (e.g., electrification) are less feasible (the *"CCS Ladder"* concept)?	Capturing CO_2 in heavy industry or cement can yield outsized climate benefits compared to capturing it from sources that are more easily replaced by clean electricity. Coupling CDR to CCS in supply-chain decarbonization may lead to carbon-negative industry supply chains, potentially targeting reductions in scope 3 emissions.	A policy might award bonus incentives for capturing CO_2 at cement kilns or steel furnaces.
3. Unabated Fossil Fuel Decoupling	Does the policy operate within a broader regulatory framework that pushes a transition away from unabated fossil fuels, preventing CCUS from merely extending the life of polluting assets?	Without a phaseout of unabated fossil fuels or an emissions cap, CCUS can inadvertently lock in fossil infrastructure.	A state might require new gas plants to capture a high percentage of their CO_2 or to retire unabated coal plants by a certain date.
4. Environmental, Health, and Safety	Do safeguards ensure that carbon management activities do not harm local ecosystems, drinking water sources, or community health, and that long-term CO_2 storage is monitored and maintained? Robust safeguards are necessary, including explicit, stringent monitoring, reporting, and verification (MRV) frameworks to ensure transparency and accountability in long-term CO_2 storage.	CCS can pose risks to groundwater or cause CO_2 leakage without proper oversight.	The U.S. Class VI rules require stringent site characterization and monitoring.
5. Communities	Are local communities involved in project siting decisions, and do they share in economic benefits such as jobs or revenue?	Public acceptance is critical; poorly sited or community-imposed projects face resistance that can stall climate action.	A policy might require thorough consultation sessions and local workforce training to ensure equitable benefits.
6. Storage	Do policy mechanisms ensure that captured $CO_{22}$is reliably stored for decades to centuries? Policies must guarantee the reliable and permanent geological storage of captured CO_2, ensuring stability over centuries to millennia.	Permanent sequestration is essential to climate impact; leakage undermines net-zero goals.	A rigorous permitting regime may require 20+ years of post-injection monitoring, frequent site inspections, and robust liability measures.
7. Renewables Competition	Does the policy guard against redirecting renewable energy resources from more impactful uses (e.g., decarbonizing the grid) to energy-intensive CCS or DAC projects?	If limited renewable energy is used primarily for CCUS or DAC, overall emissions reductions could be smaller.	A policy might require "additional" clean power to supply DAC, preventing a zero-sum scenario where renewables otherwise used to displace coal are diverted.
8. Scalability	Does the policy support demonstration, pilot programs, and scale-up so carbon management can become a mature industry?	Carbon capture is capital intensive; technology often needs public R&D and demonstration support before private capital invests at scale.	DOE's "Carbon Negative Shot" program supports pilot projects that may scale to commercial levels, lowering costs over time.
9. Global Linkages	Does the policy encourage sharing technology and financing with emerging economies, enabling global emissions reductions?	Climate change is a global challenge; unilateral decarbonization leaves many regions without tools for CCUS or carbon removal solutions.	A government might include CCUS in development finance programs or collaborate on training overseas regulators and engineers.
10. Cost to Consumers	Does the policy address potential cost burdens on ratepayers and end-users, ensuring that carbon management deployment does not disproportionately drive up energy bills or fuel costs? Policies should manage and minimize economic impacts, specifically ensuring consumer affordability by systematically integrating cost caps, targeted rebates, and comprehensive cost-benefit analyses.	Consumer affordability is often a key political and social concern, and can determine the long-term viability of any low-carbon strategy.	Policies may cap pass-through costs, offer utility bill support for low-income households, or require cost–benefit analyses before approving CCUS projects.

Why a "Framework" or "Rubric"?

Acknowledging the crucial concept of policy mixes that allow for different stakeholders to prioritize different elements of carbon management:

- **Financiers** focus on economic feasibility (Criterion 1).
- **Communities** want local engagement and tangible benefits (Criterion 5).
- **Consumers** worry about potential bill increases (Criterion 10).
- **Climate advocates** emphasize secure storage (Criterion 6) and fossil fuel phaseout (Criterion 3).

By evaluating a **basket** of policies against these ten criteria—using a 1–4 scale—policymakers and stakeholders can see where the collective policy landscape is succeeding or falling short. Not every single policy will address all ten points, but a strong overall policy mix can ensure that carbon management aligns with 21st-century climate and equity goals.

Case Study: U.S.—Overview of Key Policies

With this framework in hand, we turn to the U.S. policy landscape. While federal tax credits, infrastructure funding, and various state-level initiatives have evolved considerably, they still form a patchwork rather than a coherent, holistic approach. Below is a snapshot of major U.S. policies as of the beginning of 2025, followed by an analysis of how well they address each framework criterion as a collective.

Important Note on the "Unit of Analysis"

The policies below are often intended to work together—no single measure covers all aspects. The framework thus helps us see how the broader landscape stacks up, rather than judging any one program in isolation.

Table 2: U.S. Federal Policy Overview

Policy	Type	Agency	Description
45Q Tax Credit	Subsidy	Treasury	First enacted in 2008, Section 45Q of the U.S. Internal Revenue Code offers per-ton tax credits for CO_2 securely stored or used. The Inflation Reduction Act (IRA) increased these credit levels (currently up to $85/ton for point-source CCS and $180/ton for DAC).
Research, Development, and Demonstration	Subsidy	DOE, USGS, NOAA	The Bipartisan Infrastructure Law (BIL) provides billions for clean energy and climate projects, including CCS demonstrations and DAC hubs. DOE's Loan Programs Office (LPO) also offers loan guarantees at pilot and demonstration scale. The Carbon Negative Shot sets high-level R&D goals for carbon removal.
Geologic Storage	Regulation	EPA, Interior	The Class VI well program (EPA) imposes rigorous site characterization, construction, and monitoring requirements for CO_2 injection. Some states have or seek "primacy" to implement these rules. Offshore storage is regulated by BSEE and BOEM.
CO_2 Emissions Limits	Regulation	EPA	Under the Clean Air Act, Section 111(d) could mandate performance standards for existing power plants. If stringent enough, it may drive CCS or retirements, but its scope is under continual legal and political debate.
CO_2 Pipeline Safety	Regulation	Transportation	PHMSA sets pipeline safety guidelines, while FERC can approve conversion of natural gas pipelines to CO_2 pipelines under certain circumstances.

Table 3: U.S. State and Local Policy Overview

Policy	Type	State	Description
Low Carbon Fuel Standards (LCFS)	Regulation	California. Oregon, Washington	Sets declining carbon intensity targets for transportation fuels; generates market credits to incentivize reductions.
Cap & Trade, Clean Electricity	Regulation	California	Includes potential for CCS crediting, though finalized protocols remain pending.
Carbon Corridors and Hubs	Permitting	Wyoming	Streamlines permitting and infrastructure development for CO_2 pipelines and storage.
California Climate Crisis Act (AB 1279)	Regulation	California	Accelerates decarbonization, crucial for decoupling from unabated fossil fuels and strengthening economic incentives for carbon management.
Clean Energy Grid Act (S.2967)	Regulation	Massachusetts	Advances clean energy grid integration, equity, and ratepayer protection, effectively addressing consumer affordability and economic fairness.

Applying the Framework: Grading the U.S. Carbon Management Policy Landscape

Overall, the U.S. policy landscape scores around 2.6 (on a 1–4 scale, 4 highest), reflecting significant strengths in certain areas (e.g., storage, scale-up) but notable gaps in others (e.g., fossil fuel decoupling, community input, and addressing consumer costs).

Table 4 shows a summarized scoring table, followed by detail on each criterion.

Opportunities for Improvement

Below are recommended ways to bolster U.S. carbon management policy for each criterion, with an eye toward **both** near-term feasibility and long-term best practices. These recommendations remain relevant regardless of the current federal stance; states, companies, and future administrations can adopt or adapt them.

1. Business Case for Investment

- **Extend and Expand 45Q:** Provide a guaranteed multi-year extension with direct pay options (beyond the current five-year limit) and index credit values to inflation or cost of capital. Policy improvements must explicitly broaden beyond CCS, integrating diverse carbon removal technologies such as DAC, enhanced rock weathering, biochar, and others to comprehensively address climate goals.
- **Leverage the Loan Programs Office:** Streamline application processes and prioritize projects in truly hard-to-abate sectors (e.g., cement, steel).
- **Enhance Predictability:** Offer stable policy signals through 2030 and beyond, allowing developers and financiers to plan confidently.

2. Align with the "CCS Ladder"

- **Target Harder-to-Abate Sectors:** Provide **bonus 45Q** or similar incentives for industrial emitters and cement/steel plants.
- **Refine BIL/IRA Funding Criteria:** Condition grants/loans on capturing CO_2 from difficult processes rather than chasing "low-hanging fruit" with minimal additional climate benefit.
- **Account for Lifecycles:** Develop standards that reward net GHG reductions, factoring in energy inputs, supply-chain emissions, and potential co-benefits.

Table 4: U.S. Federal Policy Overview

Criterion	Score	Strengths	Weaknesses
1. Business Case	3	• IRA boosts 45Q (up to $85/ton for point-source CCS, $180/ton for DAC). • BIL provides billions for large-scale pilots, transport infrastructure, and industrial decarbonization. • DOE's Loan Programs Office de-risks early projects.	• Long-term policy uncertainty (e.g., tax-equity financing, shifting politics). • Harder capture conditions remain marginally economic. • State/local incentives are limited outside CA LCFS.
2. Climate Importance	2	• Growing emphasis on industrial and heavy-sector decarbonization (CarbonSAFE, BIL). • Harder-to-abate sources receive attention in some programs. • LCFS crediting for industrial CCS in CA.	• Many initial projects still focus on high-purity CO_2 (e.g., ethanol) or EOR. • No federal requirement to prioritize toughest sectors (steel, cement) over cheaper alternatives.
3. Unabated Fossil Fuel Decoupling	1	• Proposed EPA 111(d) rule could push CCS or retirements for coal and some gas plants. • Some states have zero-emission power mandates indirectly limiting new unabated fossil.	• Limited direct regulation requiring new unabated fossil plants to include CCS or to retire unabated assets. • Market signals remain weak for a robust phaseout of unabated fossil infrastructure.
4. Environmental, Health, and Safety	3	• Class VI well regulations are globally stringent. • NEPA reviews can address environmental impacts for federally funded/permitted projects. • Pipeline safety oversight (PHMSA).	• Permitting bottlenecks and limited agency capacity. • Resource constraints can hamper robust enforcement. • Environmental justice concerns not always integrated into Class VI or NEPA reviews at scale.
5. Communities	2	• Recent legislation emphasized allocating significant benefits to disadvantaged communities; however, shifting political priorities have weakened direct federal commitments such as Justice40, underscoring the need for robust state-level and local frameworks ensuring community benefits and engagement remain integral to carbon management policies. • NEPA public comment processes can provide input pathways. • Some state-level rules mandate local consultation for siting/permitting.	• No uniform federal requirement for local consent or structured benefit-sharing. • Pace of deployment can outstrip smaller communities' capacity to engage. • EJ provisions often too broad, not CCS-specific; no standard revenue-sharing for localities hosting CO_2 storage.
6. Storage	3.5	• Class VI wells offer rigorous oversight and permanence requirements. • DOE's CarbonSAFE and related programs fund site characterization. • Monitoring and liability rules, though evolving, are relatively strong by global standards.	• Permitting time can be lengthy. • Uncertainty about ultra-long-term liability persists (50+ years). • Basin-scale approaches still under development.
7. Renewables Competition	2	• IRA extends broader clean energy tax credits, supporting renewable growth. • Many states have RPS or clean energy standards that expand renewables.	• No clear "additionality" requirement for CCS or DAC to avoid redirecting renewables from the grid. • Risk that CCS or DAC relying on grids with significant fossil generation undermines net climate benefits.
8. Scalability	3	• BIL funds large-scale DAC Hubs and CCS demos. • Loan Programs Office has significant capacity. • Carbon Negative Shot signals high-level commitment to innovation and scale-up.	• High capital costs still pose hurdles. • Interest rate and tax policy changes could slow project financing. • Long-term durability of policy support remains uncertain.
9. Global Linkages	3	• U.S. participates in bilateral and multilateral efforts (Clean Energy Ministerial, Mission Innovation). • While private-sector initiatives significantly complement these efforts, this analysis focuses explicitly on public policy instruments. Some private-sector "carbon removal purchase" initiatives (e.g., Frontier) could expand internationally.	• Most U.S. CCS/DAC policies are domestically focused. • Limited direct support for CCS technology transfer or deployment in developing countries beyond broad climate finance.
10. Cost to Consumers	2	• Some states require utility commissions to assess rate impacts of new infrastructure. • BIL/IRA includes broad consumer-facing programs (e.g., efficiency rebates) that might help offset possible upstream costs.	• Few federal or state policies directly cap pass-through CCS costs to energy consumers. • Limited data on how new CCS or DAC power demands might translate into higher bills. • Consumer affordability is not systematically integrated into federal CCS decision-making.

3. Couple with Mandates and Regulations to End Unabated Fossils

- **Strengthen EPA's 111(d):** Impose more stringent CO_2 performance standards for coal and gas plants, prompting higher capture rates or retirements on unabated units.
- **Regulate Industrial Emitters:** Classify high-percentage CCS as a "best available control technology" for large stationary sources in steel, cement, refining, etc.
- **Create Complementary Phaseouts:** Gradually phase out CCS subsidies while ramping up zero-emission mandates, ensuring CCS is a bridge—not a crutch—on the path to a future without unabated fossil fuels.

4. Environmental, Health, and Safety

- **Expand Class VI Permitting Capacity:** Increase agency staffing and resources to handle anticipated applications.
- **Address Cumulative Impacts:** Integrate stronger environmental justice guidelines into Class VI and NEPA reviews, ensuring that multiple CCS or DAC projects in one region don't unduly burden local residents.
- **Enhance Pipeline Safety:** Update PHMSA regulations on CO_2 pipelines and include community right-to-know provisions.

5. Community Input and Socioeconomic Benefits

- **Standardize Engagement:** Make robust community consultations a requirement for federally funded CCS projects, with clear timelines and accessible technical assistance.
- **Build Local Benefits:** Incentivize local hiring and consider **revenue-sharing** mechanisms so communities hosting infrastructure directly benefit.
- **Site with Consent:** Strengthen or pilot "consent-based siting" processes.
- **Increase Transparency:** Ensure standard environmental impact assessments and data sharing.

6. Long-Term Storage Security

- **Scale Up CarbonSAFE:** Fund comprehensive geologic site characterization across multiple basins.
- **Improve Monitoring Technologies:** Incorporate continuous measurement (satellites, sensors, etc.) to detect leaks.
- **Clarify Liability:** Ensure no gap exists in long-term stewardship or financial responsibility after site closure; explore private–public insurance models.

7. Avoid Displacing Renewables

- **Institute "Renewables Additionality":** Require CCS and DAC projects to source new, dedicated renewable capacity where feasible, rather than drawing from existing renewable resources that could otherwise directly decarbonize the grid. Robust 'additionality' provisions should explicitly demonstrate net climate benefits, ensuring carbon management complements renewables deployment rather than competes with it.
- **Coordinate Grid Planning:** Encourage grid operators (RTOs/ISOs) to plan for DAC/CCS loads, ensuring renewable capacity expands in tandem.
- **Keep Clean Hydrogen Clean:** If hydrogen is used for CCS power needs, mandate robust lifecycle standards (e.g., no "gray hydrogen" from unabated natural gas).

8. Pathway to Commercial Scale

- **Link BIL/IRA Funding with Offtake:** Pair demonstration funding with guaranteed carbon-removal offtake (e.g., public procurement or private "Frontier" contracts), smoothing the path from pilot to market.
- **Support FEED and Small Pilots:** Maintain robust support for front-end engineering design, especially in emerging capture approaches.
- **Coordinate Across Agencies:** Align timelines among DOE, EPA, and other agencies so demonstration projects reach commercial operation without falling into policy gaps.

9. International Equity and Technology Transfer

- **Provide Development Finance:** Leverage U.S. development finance (DFC, Export–Import Bank) to co-fund CCS in emerging economies where capital costs are prohibitive.
- **Collaborate Mulilaterally:** Expand open-access data and capacity-building (e.g., Class VI-like storage regulations) through forums like the Clean Energy Ministerial.
- **Rework Global Markets:** Allow U.S. carbon-removal purchase agreements to include international projects, fostering technology diffusion and equitable deployment.

10. Cost to Consumers

- **Utility Bill Protections:** Develop regulations that cap or spread out costs for CCS retrofits to prevent rate shock, especially in regulated electricity markets.
- **Transparent Cost–Benefit Analyses:** Require regulators to publish rigorous consumer impact assessments before approving new CCS or DAC projects tied to utility ratepayers.
- **Provide Targeted Relief:** For low- and moderate-income households, expand energy bill assistance or efficiency programs, ensuring that decarbonization efforts do not exacerbate energy poverty.

Conclusion

As assessed at the beginning of 2025, the U.S. carbon management policy landscape demonstrates notable progress—particularly through the Inflation Reduction Act's expanded 45Q credits, the Bipartisan Infrastructure Law's demonstration funding, and ongoing Department of Energy R&D initiatives. However, substantial gaps persist and could widen if not promptly addressed, particularly in ensuring that carbon management:

- Genuinely targets hardest-to-abate emissions,
- Operates alongside a clearly defined phaseout of unabated fossil fuels,
- Incorporates rigorous community engagement and environmental justice considerations,
- Explicitly safeguards consumer affordability.

Political realities often shift the feasibility and momentum behind federal carbon management policies, underscoring the essential role of state, local, and private-sector leadership. Clearly defining and consistently upholding best-practice standards ensures readiness for when federal priorities realign. Even during periods of reduced federal enthusiasm, establishing and maintaining robust frameworks and transparent definitions provide the necessary groundwork for swift, responsible policy action.

Ultimately, well-designed carbon management strategies are not about prolonging fossil fuel dependence. Rather, they responsibly deploy critical tools within a diversified portfolio of climate solutions—solutions aimed squarely at stabilizing our climate, safeguarding communities, and advancing an equitable and resilient low-carbon future.

References and Further Reading

- Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report.
- U.S. Department of Energy, Office of Fossil Energy and Carbon Management—"Carbon Negative Shot."
- Pipeline and Hazardous Materials Safety Administration (PHMSA) updates on CO_2 pipeline safety.
- State-level Low Carbon Fuel Standards (California Air Resources Board, Oregon DEQ, Washington Department of Ecology).

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