
| RESEARCH ARTICLE

The Role of International Environmental Law in Regulating Global Carbon Emissions: A US-Centric Analysis of Treaty Effectiveness and Policy Implementation

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| ABSTRACT

International environmental law has evolved significantly over the past three decades, with carbon emission regulation emerging as one of the most critical challenges facing the global community. This article examines the effectiveness of international treaties, particularly the Paris Agreement, in regulating carbon emissions and combating climate change from a United States perspective. Through comprehensive analysis of treaty mechanisms, implementation challenges, and policy outcomes, this study evaluates how international legal frameworks have shaped US energy policies and influenced carbon footprint reduction across various industries. The research reveals that while international environmental law provides essential frameworks for global cooperation, significant gaps remain between treaty commitments and actual emission reductions, particularly in the United States' approach to international climate obligations.

| KEYWORDS

International environmental law, carbon emissions, Paris Agreement, climate policy, United States, treaty effectiveness.

| ARTICLE INFORMATION

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1. Introduction

The regulation of global carbon emissions through international environmental law represents one of the most complex challenges in contemporary international relations. As the world's second-largest carbon emitter, the United States plays a pivotal role in the success or failure of international climate agreements. The evolution from the Kyoto Protocol to the Paris Agreement reflects a fundamental shift in how the international community approaches climate governance, moving from top-down mandatory targets to bottom-up nationally determined contributions.

The effectiveness of international environmental law in regulating carbon emissions depends on multiple interconnected factors including legal enforceability, domestic implementation mechanisms, economic incentives, and political will. For the United States, these treaties have created both opportunities and constraints, shaping domestic energy policy while navigating complex federal-state jurisdictional issues and economic competitiveness concerns.

2. Historical Development of International Climate Law

2.1 From Rio to Paris: Evolution of Climate Governance

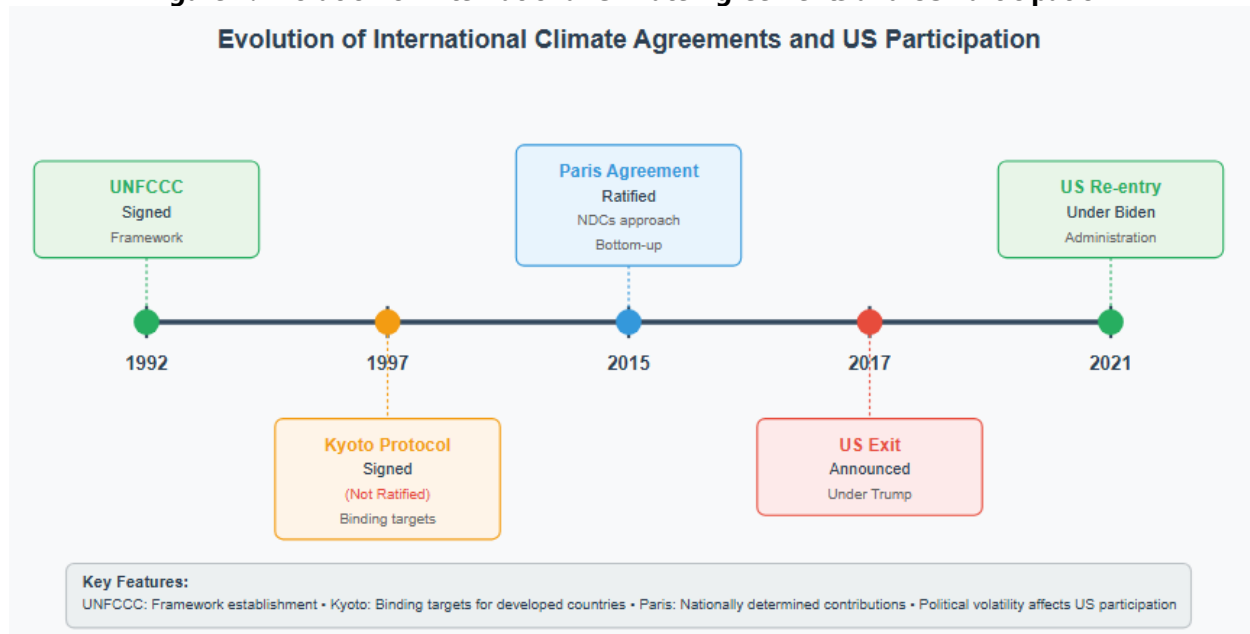
The development of international climate law began earnestly with the 1992 United Nations Framework Convention on Climate Change (UNFCCC), which established the foundational principle of "common but differentiated responsibilities." This principle acknowledged that while all nations share responsibility for addressing climate change, developed countries like the United States bear greater historical responsibility and should take the lead in emission reductions.

The Kyoto Protocol of 1997 marked the first attempt at legally binding emission reduction targets for developed countries. The United States signed the protocol but never ratified it, citing concerns about economic competitiveness and the exclusion of major developing country emitters like China and India from binding commitments. This decision had profound implications for the protocol's effectiveness and highlighted the challenges of achieving global cooperation without the participation of major emitters.

2.2 The Paris Agreement: A New Paradigm

The Paris Agreement, adopted in 2015, represented a fundamental shift in international climate governance. Unlike the Kyoto Protocol's top-down approach, the Paris Agreement embraced a bottom-up structure based on nationally determined contributions (NDCs). This approach was specifically designed to accommodate US concerns about sovereignty and flexibility while maintaining global ambition.

Figure 1: Evolution of International Climate Agreements and US Participation



3. Legal Architecture of Carbon Emission Regulation

3.1 Treaty Mechanisms and Enforcement

International environmental law operates through various mechanisms designed to encourage compliance and facilitate cooperation. The Paris Agreement employs several key instruments:

- **Nationally Determined Contributions (NDCs):** Each country submits voluntary emission reduction targets, updated every five years with increased ambition
- **Transparency Framework:** Requires regular reporting on emissions and progress toward targets
- **Global Stocktake:** Periodic assessment of collective progress every five years

- **Climate Finance Mechanisms:** Developed countries committed to mobilizing \$100 billion annually by 2020 for developing country mitigation and adaptation.

The legal enforceability of these mechanisms remains limited, relying primarily on peer pressure, reputational concerns, and domestic political processes rather than traditional international law enforcement mechanisms.

Table 1: Comparison of Kyoto Protocol and Paris Agreement Mechanisms

Aspect	Kyoto Protocol	Paris Agreement
Legal Nature	Binding targets for Annex I countries	Voluntary NDCs with binding procedural obligations
Coverage	~15% of global emissions (without US)	~97% of global emissions
Differentiation	Strict developed/developing divide	Self-differentiation through NDCs
Compliance	Formal compliance mechanism	Facilitative compliance committee
Flexibility	Limited flexibility mechanisms	High flexibility in target setting
US Participation	Signed but not ratified	Ratified 2016, withdrew 2020, rejoined

3.2 Domestic Implementation Challenges

The implementation of international climate commitments in the United States faces unique constitutional and political challenges. The federal system creates complex interactions between national commitments and state-level policies, while the separation of powers requires congressional approval for certain treaty obligations.

The Clean Power Plan, introduced during the Obama administration, represented the primary mechanism for achieving US commitments under the Paris Agreement. However, its replacement with the Affordable Clean Energy Rule under the Trump administration demonstrated the vulnerability of climate policies to political transitions.

4. Effectiveness Analysis: Emission Trends and Policy Outcomes

4.1 Global Emission Trends Under International Agreements

Despite decades of international climate agreements, global carbon emissions have continued to rise, though the rate of increase has slowed in recent years. The effectiveness of international environmental law must be evaluated against this backdrop of continued emission growth.

Table 2: Global CO2 Emissions by Major Emitters (2005-2020)

Country/Region	2005 (GtCO2)	2010 (GtCO2)	2015 (GtCO2)	2020 (GtCO2)	Change 2005-2020 (%)
China	5.3	8.0	9.3	10.7	+102%
United States	6.0	5.6	5.3	4.7	-22%
European Union	4.2	3.8	3.5	3.1	-26%
India	1.2	1.6	2.1	2.4	+100%
Russia	1.6	1.7	1.6	1.6	0%
Global Total	29.3	33.5	35.3	34.9	+19%

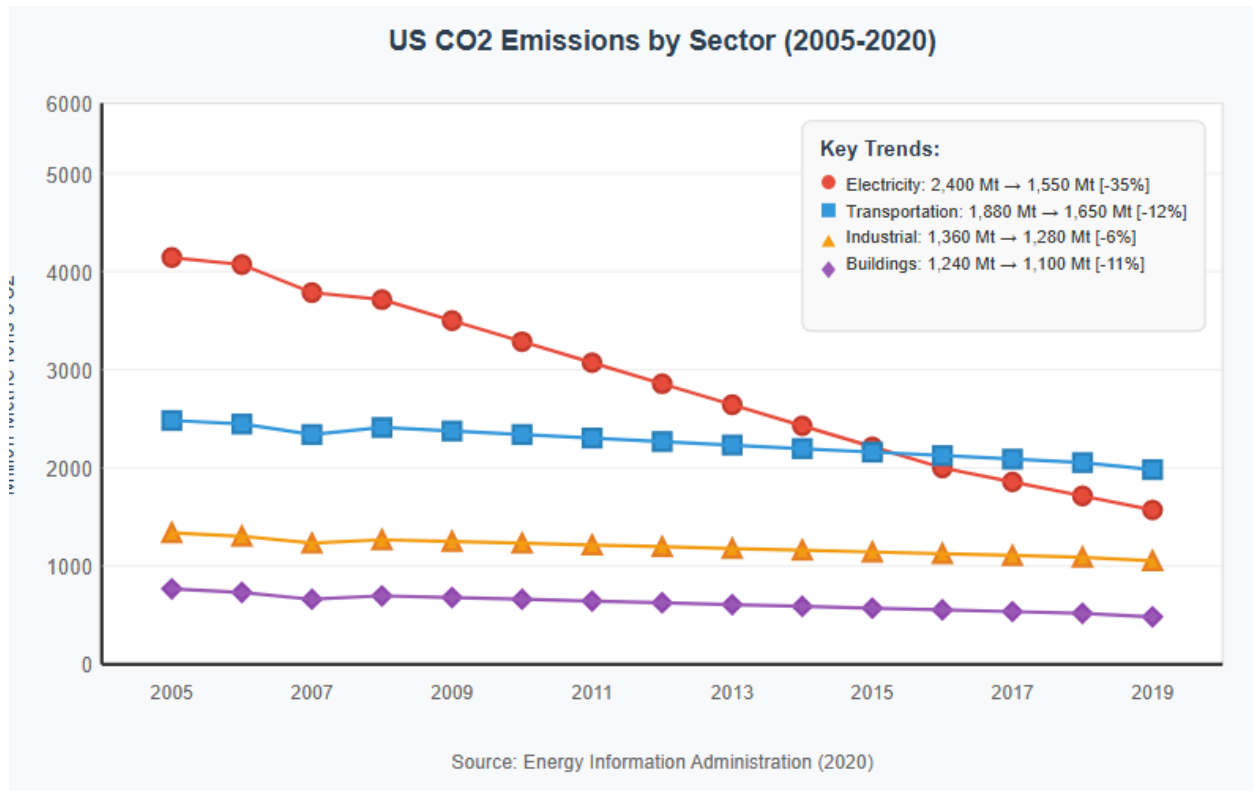
Sources: Global Carbon Atlas (2020), IEA Statistics (2020)

The data reveals a complex picture: while some developed countries, including the United States, have achieved significant emission reductions, these have been offset by rapid growth in developing countries, particularly China and India.

4.2 US Sectoral Emission Trends

The United States has achieved notable emission reductions across several sectors, driven by a combination of federal policies, state initiatives, market forces, and technological innovation.

Figure 2: US CO2 Emissions by Sector (2005-2020)



4.3 Policy Driver Analysis

The emission reductions achieved by the United States result from multiple policy drivers operating at federal, state, and local levels. While international agreements provide important frameworks, domestic policies have been the primary drivers of actual emission reductions.

Federal-Level Policies:

- Renewable Fuel Standard (RFS) promoting biofuel use in transportation
- Corporate Average Fuel Economy (CAFE) standards improving vehicle efficiency
- Investment and production tax credits for renewable energy
- Methane emission standards for oil and gas operations

State-Level Initiatives:

- Regional Greenhouse Gas Initiative (RGGI) in northeastern states
- California's cap-and-trade program and low carbon fuel standard
- Renewable portfolio standards in 30 states and Washington D.C.
- State clean energy targets and carbon neutrality commitments

Market Forces:

- Declining costs of renewable energy technologies
- Natural gas displacing coal in electricity generation
- Corporate sustainability commitments and renewable energy procurement
- Carbon pricing in voluntary markets

5. Industry-Specific Impacts and Carbon Footprint Reduction

5.1 Electricity Sector Transformation

The electricity sector has experienced the most dramatic transformation in carbon intensity, driven by both policy incentives and market dynamics. The transition from coal to natural gas and renewable energy has been the primary driver of overall US emission reductions.

Table 3: US Electricity Generation by Source (2010-2020)

Energy Source	2010 Share (%)	2020 Share (%)	Change (percentage points)
Coal	44.9	19.3	-25.6
Natural Gas	24.1	40.3	+16.2
Nuclear	19.6	20.6	+1.0
Hydroelectric	6.0	7.3	+1.3
Wind	2.3	8.4	+6.1
Solar	0.0	3.3	+3.3
Other Renewables	3.1	0.8	-2.3

Source: Energy Information Administration (2020)

This transformation has been facilitated by renewable energy tax credits, state renewable portfolio standards, and increasingly competitive costs of wind and solar technologies. International climate agreements have provided important policy momentum, even without direct regulatory mandates.

5.2 Transportation Sector Challenges

The transportation sector presents greater challenges for decarbonization, with emission reductions primarily achieved through improved fuel efficiency rather than fuel switching. The sector remains heavily dependent on petroleum-based fuels, though electric vehicle adoption has begun to accelerate.

Key policy interventions include the Corporate Average Fuel Economy standards, which require automakers to achieve fleet-wide fuel efficiency improvements, and the Renewable Fuel Standard, which mandates blending of biofuels with gasoline. State-level initiatives, particularly California's Zero Emission Vehicle program, have also driven innovation and market development for electric vehicles.

5.3 Industrial Sector Adaptation

Industrial emission reductions have been more modest, reflecting the sector's diverse mix of activities and the challenges of decarbonizing energy-intensive processes. Some subsectors have achieved significant improvements through energy efficiency measures and fuel switching, while others face technological barriers to deep decarbonization.

The chemicals, steel, and cement industries represent particular challenges due to their reliance on high-temperature processes and the role of carbon as both an energy source and chemical feedstock. International trade considerations also complicate unilateral emission reduction efforts, raising concerns about carbon leakage and industrial competitiveness.

6. Legal and Policy Gaps in International Climate Governance

6.1 Enforcement and Compliance Mechanisms

One of the fundamental limitations of international environmental law is the absence of effective enforcement mechanisms. Unlike domestic legal systems, international law relies primarily on voluntary compliance and peer pressure rather than coercive enforcement.

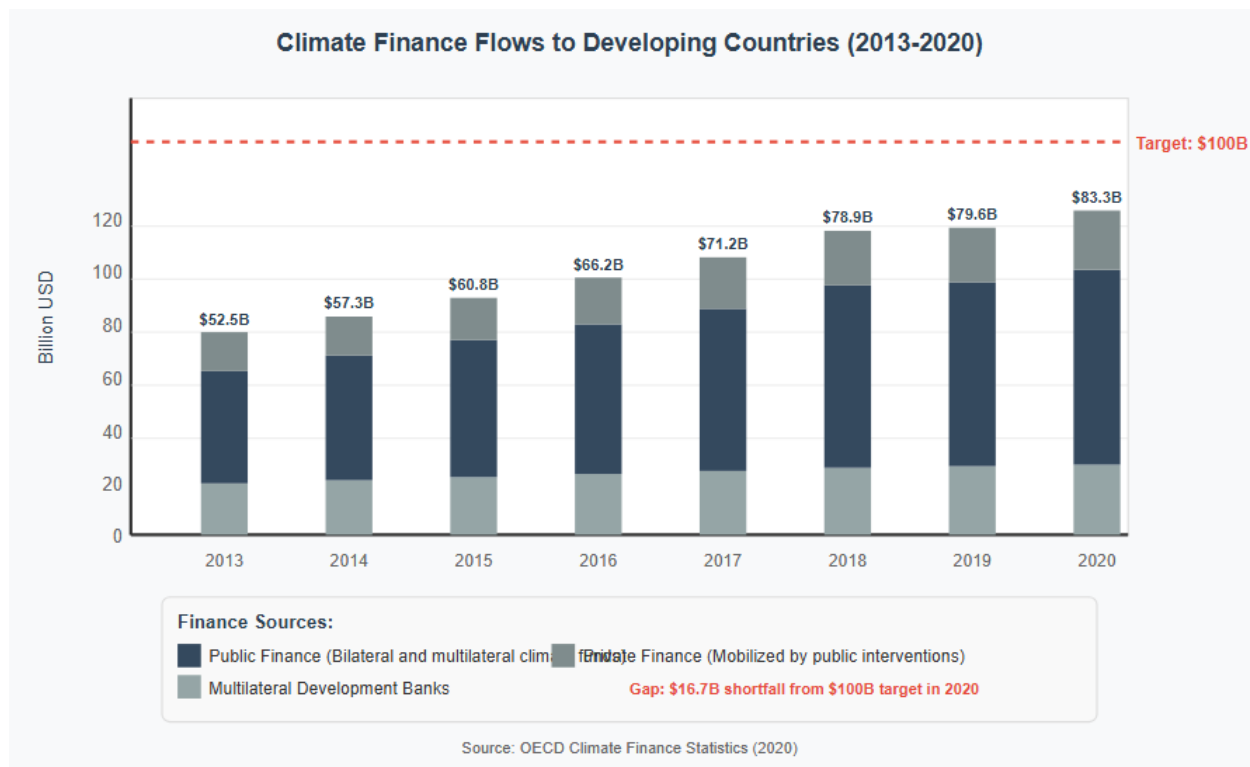
The Paris Agreement's compliance mechanism is explicitly non-punitive, designed to facilitate rather than enforce compliance. While this approach accommodated US concerns about sovereignty, it also limits the agreement's effectiveness in ensuring that countries meet their commitments.

Key enforcement challenges include: • Lack of binding emission reduction targets • Absence of financial penalties for non-compliance • Limited mechanisms for addressing free-rider problems • Difficulty in measuring and verifying emission reductions • Political volatility affecting long-term commitments

6.2 Climate Finance and Technology Transfer

The commitment by developed countries to mobilize \$100 billion annually in climate finance by 2020 has fallen short of targets, with actual mobilization reaching approximately \$80 billion according to OECD estimates. This shortfall undermines trust between developed and developing countries and limits the global effectiveness of climate action.

Figure 3: Climate Finance Flows to Developing Countries (2013-2020)



For the United States, climate finance obligations create both opportunities and constraints. While US contributions to multilateral climate funds have been limited, American private sector investment and technology development play crucial roles in global clean energy deployment.

6.3 Technology Transfer and Intellectual Property

International climate agreements emphasize the importance of technology transfer from developed to developing countries, but implementation has been limited by intellectual property concerns and market dynamics. US companies hold significant patents in clean energy technologies, creating tension between commercial interests and climate cooperation objectives.

The Technology Mechanism established under the UNFCCC includes the Technology Executive Committee and Climate Technology Centre and Network, but these institutions have limited resources and authority to facilitate large-scale technology transfer.

7. The Role of Non-State Actors and Subnational Governance

7.1 City and State Climate Initiatives

In the United States, subnational actors have played increasingly important roles in climate governance, particularly during periods when federal policy has been less supportive of international climate cooperation. The "We Are Still In" coalition, formed after the Trump administration's withdrawal from the Paris Agreement, demonstrated the continued commitment of states, cities, and businesses to climate action.

Table 4: Major US Subnational Climate Commitments (as of 2020)

Initiative	Participants	Coverage	Emission Reduction Target
US Climate Alliance	25 states + territories	60% of US economy	26-28% below 2005 by 2025
Climate Mayors	470+ cities	70+ million Americans	Various local targets
RE100 Corporate Initiative	280+ companies	Global operations	100% renewable electricity
Science Based Targets	1,000+ companies	\$20+ trillion market cap	Paris-aligned targets

Sources: *US Climate Alliance (2020), Climate Mayors (2020), RE100 (2020)*

These subnational initiatives demonstrate that international climate agreements can influence domestic action even without strong federal support, though coordination challenges and limited authority constrain their overall impact.

7.2 Corporate Climate Commitments

American corporations have increasingly adopted voluntary climate commitments that align with or exceed international agreement objectives. These commitments reflect various motivations including consumer preferences, investor expectations, supply chain requirements, and regulatory anticipation.

Major corporations such as Microsoft, Amazon, and General Motors have announced carbon neutrality or net-zero commitments with timelines ranging from 2030 to 2050. These commitments often include investments in renewable energy, energy efficiency, electric vehicles, and carbon removal technologies that contribute to broader emission reduction objectives.

8. Future Directions and Recommendations

8.1 Strengthening International Climate Governance

The effectiveness of international environmental law in regulating carbon emissions can be enhanced through several mechanisms:

Enhanced Transparency and Accountability: Strengthening measurement, reporting, and verification systems to provide better data on emission trends and policy effectiveness. The Enhanced Transparency Framework under the Paris Agreement represents progress in this direction but requires adequate financial and technical support for implementation.

Market-Based Mechanisms: Developing international carbon pricing mechanisms and linking existing carbon markets to create stronger economic incentives for emission reductions. Article 6 of the Paris Agreement provides a framework for such cooperation, though implementation details remain under negotiation.

Sectoral Approaches: Focusing on specific high-emission sectors such as international aviation and shipping, which are not adequately covered by national commitments. The International Civil Aviation Organization and International Maritime Organization have begun developing sectoral measures, but progress has been slow.

8.2 Addressing US-Specific Challenges

For the United States, several specific measures could enhance the effectiveness of international climate cooperation:

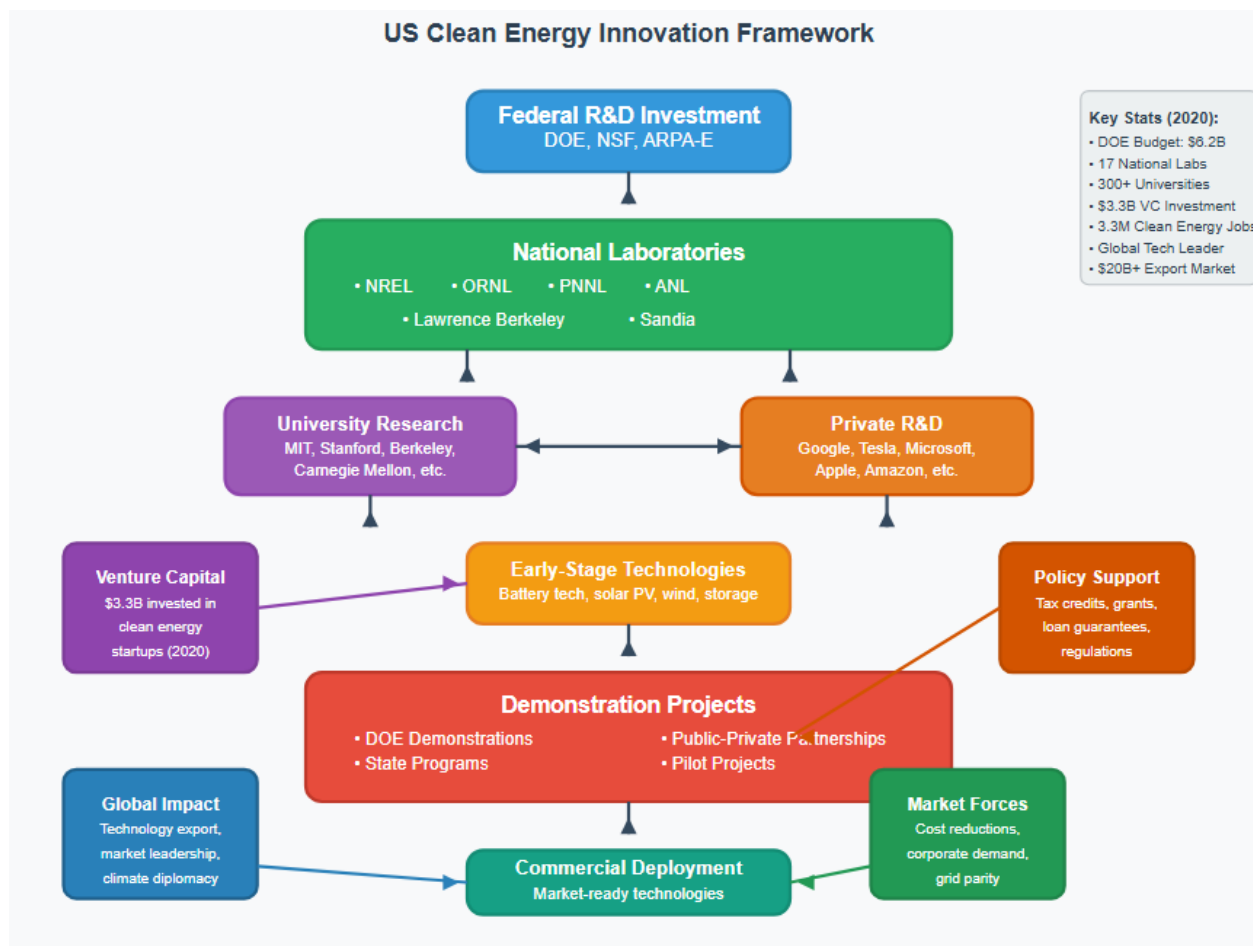
Constitutional and Legal Frameworks: Developing more robust domestic legal frameworks that can survive political transitions and provide certainty for long-term investments. This might include constitutional amendments, federal legislation with bipartisan support, or interstate compacts that create binding commitments.

Federal-State Coordination: Improving coordination between federal and state climate policies to maximize effectiveness and avoid conflicting requirements. This could include joint federal-state implementation plans and shared funding mechanisms.

Industry Engagement: Enhancing engagement with carbon-intensive industries to develop economically viable pathways for deep decarbonization. This includes support for research and development, demonstration projects, and market development for low-carbon technologies.

8.3 Innovation and Technology Policy

Figure 4: US Clean Energy Innovation Ecosystem



The United States has significant advantages in clean energy innovation, with strong research institutions, venture capital markets, and technology companies. Leveraging these advantages through targeted public investment and

supportive policies could accelerate global clean energy deployment while maintaining American technological leadership.

9. Conclusion

The role of international environmental law in regulating global carbon emissions presents a complex picture of partial success and ongoing challenges. While international agreements have provided important frameworks for cooperation and have influenced domestic policies, their direct impact on emission reductions has been limited by enforcement challenges, political volatility, and the continued dominance of national sovereignty over global governance.

For the United States, international climate agreements have created both opportunities and constraints. The Paris Agreement's flexible structure accommodated US concerns about sovereignty and economic competitiveness while providing a framework for enhanced ambition over time. However, the withdrawal and re-entry of the United States highlights the vulnerability of international cooperation to domestic political changes.

The analysis reveals that the effectiveness of international environmental law depends critically on domestic implementation mechanisms, economic incentives, and technological innovation. While international agreements provide essential coordination functions and political momentum, actual emission reductions result from specific policies and market changes within national jurisdictions.

Looking forward, enhancing the effectiveness of international climate governance will require addressing fundamental challenges of enforcement, finance, and technology transfer while building more resilient domestic institutions that can maintain policy continuity across political transitions. The United States, as a major emitter and technology leader, has both the responsibility and the opportunity to contribute to more effective international climate cooperation.

The path toward effective global carbon emission regulation through international law remains challenging, but the foundation established by existing agreements provides a platform for enhanced cooperation and ambition. Success will depend on the ability of countries like the United States to align international commitments with domestic policies and to maintain long-term commitment to climate action despite short-term political pressures.

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