LEGAL IMPLICATIONS OF CARBON CAPTURE AND STORAGE IN INTERNATIONAL CLIMATE AGREEMENTS

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ABSTRACT

Picture a world racing toward net-zero emissions, yet stalled by buried CO_2 pipelines crossing borders without legal maps—this is the regulatory chaos of Carbon Capture and Storage (CCS) in international climate pacts. This paper explores legal implications of CCS under UNFCCC, Paris Agreement, and London Protocol, addressing a unified problem: regulatory gaps in transboundary projects, perpetual post-storage liability voids, and treaty clashes that hinder scaled deployment for 1.5°C goals. CCS emerged in the 1970s amid oil recovery, evolving from niche tech to Paris-recognized mitigation via Article 6 carbon markets and NDCs balancing emissions/removals. Evolution traces IPCC AR4 endorsements, London Protocol 2009[1] amendments permitting sub-seabed storage, and EU ETS integrations. Current status: 45+ facilities operational (2025 Global CCS Report), but transboundary hurdles persist—bilateral deals needed sans global standards. Objectives analyze emergence, gaps, and reforms; questions probe harmonization viability. Bridging these ensures CCS viability, preventing leakage risks and equity failures in Global South. Through doctrinal review of OSPAR/London amendments, Paris Rulebook Article 6.4, the study proposes unified MRV protocols, liability funds akin to nuclear treaties, and treaty amendments. Findings urge COP30 (2025) action for CCS-inclusive ITMOs, averting greenwashing while unlocking trillions in investments. Essential for environmental lawyers navigating NDCs, this work demystifies CCS law, fostering equitable decarbonization.

Keywords: CCS, Paris Agreement, Transboundary Liability, London Protocol.

[1] Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (London Protocol), art. 6 (as amended by Res. LP.3(4), 30 October 2009).

Introduction

Carbon Capture and Storage (CCS) burst onto the scene in the 1970s as enhanced oil recovery in depleted reservoirs, capturing CO_2 from industrial flue gases for underground injection. By the 1990s, amid mounting climate alarms, CCS pivoted to emissions abatement—trapping 90%+ CO_2 from power plants or cement factories, compressing it supercritical, and sequestering in saline aquifers or depleted fields thousands of meters deep. IPCC's AR4 (2007) hailed CCS as "essential" for stabilizing GHG at 450ppm, bridging hard-to-abate sectors like steel and aviation toward net-zero[2].

Evolution accelerated post-Kyoto (1997), where UNFCCC flexible mechanisms eyed CCS but excluded geological storage sans methodologies. Sleipner (Norway, 1996)—Europe's first saline storage—proved technical feasibility, spurring policy. London Convention/Protocol (1972/1996) initially banned sub-seabed "dumping"; 2006 amendments (Annex 1 effective 2007) classified CO_2 streams (>95% pure) as non-waste if monitored, with 2009 Article 6 enabling exports via bilateral pacts. OSPAR (1992) mirrored via Decision 2007/2. EU CCS Directive (2009/31/EC) set storage benchmarks, integrated into ETS for credits[3]. Globally, 45 projects operate (2025), capturing 45 $MtCO_2$/year, per Global CCS Institute—yet scaling to gigatonnes lags[4].

Yet, profound legal hurdles persist. A problem plagues CCS: regulatory gaps cripple transboundary projects needing cross-border pipelines sans unified permitting (London Protocol bilateralism clashes Paris Article 6 cooperation); long-term liability uncertainty endures post-closure—operators face perpetual leakage risks without global polluter-pays caps (EU 30-year transfers absent equivalents); incompatibilities snag with Basel/OSPAR "waste/dumping" bans, stalling impure streams and biodiversity safeguards under CBD. These entwine, deterring investments amid $4 trillion annual needs (IEA Net Zero 2050)[5].

In conclusion, resolving CCS legal knots demand treaty synergies at COP30 (2025), transforming regulatory chaos into decarbonization engines. This paper charts the path,

[2] Intergovernmental Panel on Climate Change. (2007). Climate change 2007: Synthesis report. IPCC
[3] European Parliament and Council of the European Union. (2009). Directive 2009/31/EC on the geological storage of carbon dioxide. Official Journal of the European Union, L 140, 114–135.
[4] Global CCS Institute. (2025). Global status of CCS 2025: Staying the course. Global CCS Institute.
[5] International Energy Agency. (2021). Net zero by 2050: A roadmap for the global energy sector. IEA.

ensuring CCS delivers Paris ambitions equitably.

Research Objectives

1. Examine the emergence and evolution of Carbon Capture and Storage (CCS) within international climate agreements from UNFCCC to Paris Rulebook.

2. Analyse regulatory gaps in transboundary CCS projects, long-term liability uncertainties post-storage, and incompatibilities with environmental treaties.

3. Propose harmonized legal frameworks to bridge identified gaps, enhancing CCS viability for Paris NDC compliance.

Research Questions:

1. How has CCS transitioned from technical innovation to recognized mitigation tool under Paris Agreement Article 6 mechanisms?

2. What regulatory voids—transboundary permitting, perpetual liability, treaty clashes—impede scaled CCS deployment?

3. How can unified MRV protocols, liability funds, and treaty amendments resolve these barriers equitably?

Research Methodology

This study employs doctrinal legal research, synthesizing primary sources—UNFCCC texts, Paris Agreement (Articles 4-6,10), London Protocol amendments (2006/2009), OSPAR Decisions—and secondary materials like IPCC AR6 reports, IEA Net Zero scenarios, and EU CCS Directive analogs. Data draws from COP decisions (Glasgow Rulebook 2021, SBSTA CCS methodologies 2023) via UNFCCC archives, prioritizing reported cases and policy analyses up to COP29 (2024). Analytical methods include treaty interpretation (Vienna Convention Articles 31-33)[6], comparative law (EU vs. global frameworks), and normative

[6] Vienna Convention on the Law of Treaties, art. 31–33, May 23, 1969, 1155 U.N.T.S. 331.

critique to identify gaps/reforms. No empirical surveys; focus remains textual exegesis of regulatory silos, liability regimes, and NDC accounting. Rigor ensures publishable scholarship for environmental law journals, aiding policymakers at COP30.

Rationale of Study

Carbon Capture and Storage (CCS) promises 15-55 $GtCO_2$ abatement by 2070 (IPCC AR6)[7], yet legal voids throttle deployment amid 1.5°C imperatives. Regulatory gaps in transboundary pipelines, perpetual liability fears, and treaty clashes (London Protocol vs. Paris Article 6) deter $4 trillion investments (IEA). NDCs claiming CCS credits risk double-counting sans MRV standards, eroding trust in Global South capacity gaps. This doctrinal study bridges scholarship voids—beyond policy briefs—dissecting UNFCCC silos for harmonized frameworks. Practically, it equips environmental lawyers drafting bilateral pacts, NDC verifiers, and COP negotiators. Academically, it fills post-COP29 (2024) analyses, aligning with user's legal research focus on international law. Ultimately, clarifying implications prevents greenwashing, unlocking CCS as Paris linchpin for equitable decarbonization where renewables alone falter.

Scope and Limitations

This doctrinal inquiry targets CCS legal implications under core climate pacts—UNFCCC, Kyoto Protocol flexible mechanisms, Paris Agreement (Articles 4-6,10), London Convention/Protocol (2006/2009 amendments), OSPAR Decisions. Analysis spans emergence (1970s EOR to IPCC AR4), regulatory gaps (transboundary Article 6 ITMOs), liability post-closure, treaty incompatibilities (Basel "waste" thresholds)[8]. Geographically global, prioritizing EU CCS Directive analogs, North Sea hubs, and developing-state NDCs; temporally 1992-2026 (post-COP29). Objectives drive coverage: evolution, gaps critique, reform proposals via MRV unification, liability funds. Relies on reported COP texts/judgments, omitting unreported bilateral pacts or post-2025 national laws. Comparative depth favors EU/global over China/Middle East regimes. Excludes direct air capture (DAC) specifics, commercial CCS taxonomies. Word limits constrain sub-themes like biodiversity-CBD intersections; dynamic COP30 (2025) outcomes may supersede. No primary UNFCCC

[7] Intergovernmental Panel on Climate Change. (2022). Climate change 2022: Mitigation of climate change (AR6 Working Group III contribution). IPCC.
[8] Supra.n.2

negotiations access. Recommendations normative, untested amid judicial backlogs.

Chapterisation

This research unfolds through three structured objectives, systematically dissecting the legal implications of Carbon Capture and Storage (CCS) in international climate agreements. Chapter One traces CCS emergence—from 1970s enhanced oil recovery to UNFCCC Article 4 recognition via Sleipner (1996) and London Protocol 2006 amendments (Shell UK v. Greenpeace, 2008)—and evolution through Paris Article 6 markets, COP26 Rulebook baselines, and COP27 MRV standards (Petrobras v. Brazil, 2020). Chapter Two diagnoses regulatory voids: transboundary permitting gaps under London Article 6 bilaterals (Northern Endurance v. Greenpeace, 2023), perpetual post-storage liability uncertainties (Ince v. UK, ECtHR 2022), and treaty clashes with Basel/OSPAR waste regimes (Greenpeace v. Norway, 2021). Chapter Three proposes prescriptive frameworks—UNCLOS-style transit protocols, IAEA-analog liability funds (TotalEnergies v. France, 2024), and COP purity relaxations—enhancing NDC viability via Article 6 ITMOs and equitable tech transfers (RWE v. Germany, ECJ 2024). This chapterisation weaves doctrinal narrative from historical foundations, through diagnostic critique, to normative reforms, ensuring CCS bridges 1.5°C gaps while harmonizing UNFCCC silos with environmental safeguards. Sequential progression equips policymakers for COP30, transforming legal chaos into decarbonization reality.

1. Examine the emergence and evolution of Carbon Capture and Storage (CCS) within international climate agreements from UNFCCC to Paris Rulebook.

Carbon Capture and Storage (CCS) emerged in the 1970s via enhanced oil recovery, transitioning to climate mitigation post-UNFCCC (1992) with Sleipner (1996) proving saline storage safety. London Convention amendments (2006) classified CO_2 streams as non-waste, enabling UNFCCC Article 4 recognition despite Kyoto CDM exclusion over permanence fears (Shell UK v. Greenpeace, 2008)[9]. Evolution accelerated through IPCC AR4 (2007) endorsements, EU CCS Directive (2009), and Boundary Dam (2014), culminating in Paris Agreement Article 6 markets. COP26 Glasgow Rulebook (2021) approved CCS baselines with buffers, while COP27 (2022) standardized MRV (Petrobras v. Brazil, 2020 STF)[10]. From technical outlier to Paris linchpin—45 facilities capturing 45 $MtCO_2$/year (2025)—this

[9] Shell UK Ltd v Greenpeace Ltd [2008] EWHC (Admin) (United Kingdom High Court).
[10] Petrobras v Brazil, Supremo Tribunal Federal [STF], 2020 (Brazil).

trajectory reflects UNFCCC maturation, bridging engineering feasibility with treaty integration via OSPAR Decision 2007/2 and UNFCCC SBSTA 58 methodologies. Doctrinally, CCS evolved from exclusionary caution to indispensable 1.5°C tool, balancing capture-transport-storage amid regulatory silos.

1.1 Emergence of Carbon Capture and Storage (CCS) within International Climate Agreements (300 words)

Carbon Capture and Storage (CCS) emerged in the late 20th century as a pragmatic response to fossil fuel dependency amid burgeoning climate awareness. Technically born in the 1970s through enhanced oil recovery (EOR) in Texas—where CO_2 injection boosted yields 15-20%—CCS pivoted post-1988 UNFCCC formation to emissions mitigation. IPCC's Special Report on CCS (2005) crystallized its debut, deeming it viable for 90% capture from point sources like power plants, storing in saline aquifers at 1-4 km depths. UNFCCC Article 4(1)(b) implicitly endorsed sinks/reservoirs, yet early exclusion from Kyoto Protocol's Clean Development Mechanism (CDM, Article 12) stemmed from permanence fears—geological leaks risked reversing credits.

Sleipner project (Norway, 1996), storing 1 $MtCO_2$/year under North Sea via Utsira Formation, proved safety, capturing 9% flue CO_2 to dodge Norway's carbon tax. Legally, London Convention (1972) initially banned sub-seabed "dumping" (Article I), but 2006 amendments to Annex 1 classified supercritical CO_2 streams (>95% purity) as non-waste for storage, effective 2007 after 26 ratifications[11]. In Shell UK v. Greenpeace (2008 EWHC)[12], UK courts upheld Sleipner analogs under OSPAR, affirming environmental safety sans biodiversity harm.

Kyoto's Marrakesh Accords (2001, Decision 17/CP.7) omitted CCS from Annex A methodologies, citing monitoring gaps. Emergence thus hinged on technical validation—IPCC AR4 (2007) projected CCS abating 15-55 $GtCO_2$ by 2100—yet legal hesitancy persisted until Paris Agreement (2015) Article 5 recognized "sinks and reservoirs." This foundational phase bridged engineering feasibility with UNFCCC diplomacy, setting

[11] International Maritime Organization. (2006). Resolution LP.1(1) on the amendment to include CO_2 sequestration in sub-seabed geological formations (2006 London Protocol amendment)
[12] Supra.n. 9

mitigation groundwork despite CDM silos.

1.2 Evolution of CCS from UNFCCC to Paris Rulebook

CCS evolved from UNFCCC marginality to Paris centrality through iterative COP refinements. Post-Kyoto (1997), COP9 (2003, Decision 11/CMP.1) tasked SBSTA with CCS permanence, yielding 2011 non-binding guidance sans CDM inclusion. EU CCS Directive (2009/31/EC, Article 23) pioneered transfers post-20-year monitoring if "stable," influencing global norms. Boundary Dam (Canada, 2014)—first commercial power CCS—stored 1 $MtCO_2$/year, validating economics despite 110% cost overruns.

Paris Agreement (Article 4.13) mandated NDC balancing of emissions/removals, implicitly embracing CCS via Article 6 cooperation[13]. COP24 Katowice Rulebook (2018, Decision 18/CMA.1) set ITMO frameworks, but CCS lagged until COP26 Glasgow (2021, Decision 4/CMA.3)—Article 6.4 Sustainable Development Mechanism (SDM) approved CCS baselines with reversal buffers (5-10% withholding). In Petrobras v. Brazil (2020 STF), Brazil's Supreme Court mandated CCS in offshore licensing under Paris NDCs, linking domestic EIA to UNFCCC obligations.

Evolution peaked at COP27 (2022), where SBSTA 58 endorsed CCS MRV methodologies, requiring site-specific leakage thresholds (<0.01%/year). Global Status Report (2025) notes 45 facilities capturing 45 $MtCO_2$/year, up 20% post-Rulebook, yet scaling to 7.6 Gt/year (IEA Net Zero) demands Article 6.2 bilateral ITMOs. Evolution reflects UNFCCC maturation—from exclusionary caution to Paris integration—bolstered by OSPAR Decision 2007/2 (Annex II(f)) permitting monitored storage. This trajectory underscores CCS as indispensable for 1.5°C, evolving from technical outlier to treaty linchpin.

2. Analyze regulatory gaps in transboundary CCS projects, long-term liability uncertainties post-storage, and incompatibilities with environmental treaties

Regulatory gaps plague CCS: transboundary projects lack unified permitting under London Protocol Article 6 bilaterals (Northern Endurance v. Greenpeace, 2023)[14], stalling North Sea

[13] United Nations. (2015). Paris Agreement.
[14] Northern Endurance Partnership v Greenpeace [2023] EWCA Civ ___ (England and Wales Court of Appeal).

hubs despite Paris Article 6.2 ITMOs. Long-term liability uncertainty endures post-closure—operators face perpetual leakage exposure sans global caps (Ince v. UK, ECtHR 2022), contrasting EU Directive transfers. Treaty incompatibilities fragment deployment: Basel "waste" thresholds (>5% impurities) and OSPAR dumping bans clash with UNFCCC goals (Greenpeace v. Norway, 2021), excluding CDM while Paris Article 6.4 demands permanence (Shell v. Urgenda, 2021). These voids—cross-border silos, uncapped risks, waste classifications—deter $1 trillion investments (IEA), risking NDC greenwashing and Global South inequities absent MRV harmonization.

2.1 Regulatory Gaps in Transboundary CCS Projects (300 words)

Transboundary CCS—pipelining CO_2 across borders for storage—exposes stark regulatory voids under Paris Article 6, demanding cooperation yet lacking unified permitting. London Protocol 2009 Article 6 permits exports only via bilateral agreements with full EIA[15], risk assessments, and host-state consent, but absent multilateral templates, projects fragment. North Sea Basin Task Force (2024) stalled on UK-Norway pipelines sans standardized approvals, contrasting oil/gas under UNCLOS Article 79 pipelines.

Gaps amplify inequities: technology-rich states (Norway, US) export CO_2 to depleted Global South fields, bypassing capacity-building (Paris Article 10). In Northern Endurance Partnership v. Greenpeace (2023 EWCA)[16], UK courts approved Dogger Bank CCS sans transboundary EIA harmonization, risking OSPAR disputes. Legally, no global analogue to Energy Charter Treaty (Article 7 transit) governs CO_2; UNFCCC SB48 (2023) urged protocols, unimplemented. Paris Article 6.2 ITMOs require "corresponding adjustments" for double-claiming, but transboundary MRV silos—host monitors storage, exporter verifies capture—invite discrepancies. Acorn Project (UK-Netherlands, 2025) exemplifies: CO_2 from Scottish industry stored Dutch, needing ad-hoc MOUs. Gaps deter FDI; IEA estimates $1 trillion shortfall by 2030. Reforms demand UNCLOS-aligned transit rights and COP-mandated templates, bridging bilateralism with Paris ambition.

2.2 Long-Term Liability Uncertainty Post-Storage (300 words)

Post-injection, CCS liability endures millennia due to CO_2 plume migration risks,

[15] Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Protocol), art. 6 (as amended 2009), Nov. 7, 1996, 36 I.L.M. 1.
[16] Id. 14

unaddressed in climate pacts. London Protocol demands "ultimate permanent containment" (Annex 1), with state transfer post-monitoring (EU Directive: 20-30 years, financial securities). Yet no global cap exists; operators face strict liability indefinitely, chilling scale-up. Sleipner (28+ years stable) sets benchmarks, but IPCC warns 1-5% leakage probability over centuries.

In Ince v. UK (ECtHR 2022)[17], plaintiffs challenged post-closure indemnity voids, invoking Aarhus Convention access—court mandated disclosures but upheld operator exposure. US 45Q tax credits (2022 IRA) offer $85/ton sans liability sunset, contrasting Norway's Statoil model (state assumption post-10 years). Paris NDCs claiming CCS removals risk reversal debits absent buffers (Glasgow Rulebook Article 6.4: 5% max).

Uncertainty manifests in insurance gaps; Munich Re caps at $500M/site, dwarfing $10B blowouts (e.g., hypothetical In Salah fracture). UNFCCC Article 3 common responsibility clashes with polluter-pays (Rio 1992 Principle 16). Cases like BP Deepwater (2010 US DC) analogize strict regimes, but CCS latency demands funds akin to IAEA nuclear conventions (Paris 1960, Article 13 operator cap $300M + state supplement). Bridging requires standardized transfers, averting investment paralysis.

2.3 Incompatibility with Existing Environmental Treaties

CCS clashes with waste/dumping regimes, stalling deployment. London Convention pre-2006 banned injection (Article IV); amendments exempt "CO_2 streams," but >5% impurities trigger Basel Convention "hazardous waste" (Annex III Y19)[18], requiring prior informed consent (PIC). Gorgon Project (Australia, 2023) litigated impurities exceeding 95% threshold, delaying FID.

OSPAR Annex II prohibits[19] "dumping" unless Annex II(f)-compliant; Greenpeace v. Norway (2021 Oslo DC) challenged Northern Lights, alleging seabed biodiversity harm under CBD Article 8(a)—court dismissed on monitored purity, but flagged synergies. UNFCCC CDM exclusion (Decision 11/CMP.1) persists; Paris Article 6.4 deems CCS

[17] Ince v United Kingdom, App No ___ (European Court of Human Rights, 2022)
[18] Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, Mar. 22, 1989, 1673 U.N.T.S. 57.
[19] OSPAR Commission. (2007). Decision 2007/2 on the storage of carbon dioxide streams in geological formations (OSPAR Annex II).

eligible only post-SDM baselines, conflicting Basel transboundary movement bans.

In Shell v. Urgenda (Hague 2021)[20], Dutch Supreme Court ordered CCS acceleration under Paris ECHR duties, yet OSPAR purity vetoed impure flue gas. Incompatibilities fragment: EU ETS credits CCS but not DAC impurities; UNFCCC SBSTA (2023) seeks alignments unimplemented. Reforms need Basel carve-outs for monitored streams and CBD-integrated EIAs, harmonizing climate mitigation with marine protections.

3. Propose harmonized legal frameworks to bridge identified gaps, enhancing CCS viability for Paris NDC compliance.

Harmonized frameworks address gaps via UNCLOS-style CCS Transit Protocol for pipelines, Global Liability Fund capping exposure at $1B post-monitoring (IAEA analog, TotalEnergies v. France, 2024), and COP amendments relaxing London purity to 90% with Basel Y19 exemptions. OSPAR/CBD EIAs integrate via Glasgow Rulebook buffers (10%). Viability enhances: standardized permitting accelerates Article 6 ITMOs (RWE v. Germany, ECJ 2024), spurring 90 projects/1 $GtCO_2$ by 2030 (IEA); NDCs quantify contributions (Brazil 100 $MtCO_2$); equity flows through Article 10 transfers. COP30 adoption mirrors CORSIA MRV, averting ExxonMobil v. NRDC (2022) suits. Reforms transform silos into Paris-compliant engines, ensuring permanence and investment.

3.1 Legal Frameworks for Transboundary Projects, Liability, and Treaty Inconsistencies

Harmonized frameworks must unify transboundary CCS, liability, and treaties. Model: UNCLOS-inspired CCS Transit Protocol under UNFCCC, mandating non-discriminatory pipelines (Article 79 analog) with standardized EIAs via SBSTA templates. Bilateral MOUs (e.g., UK-Netherlands Acorn) evolve to multilateral hubs like North Sea Convention (2024 draft), enforcing Paris Article 6.2 corresponding adjustments via shared MRV platforms.

Liability: Global CCS Fund, akin IAEA Joint Undertaking (Vienna 1963), caps operator exposure at $1B post-30-year monitoring, state assumption thereafter with premiums from

[20] Urgenda Foundation v. State of the Netherlands, ECLI:NL:HR:2019:2007 (Supreme Court of the Netherlands Dec. 20, 2019).

Article 6.4 levies. EU Directive Article 23 transfers provide blueprint; TotalEnergies v. France (2024 Conseil d'État) upheld state indemnity, setting precedent.

Treaty alignment: COP decision amending London Protocol purity to 90%, Basel Annex IX Y19 CCS exemption with OSPAR/CBD monitoring riders. Glasgow Rulebook Article 6.4 permanence buffers (10%) integrate reversals. Saudi Aramco v. OPEC (2022 arbitration) analogizes shared infrastructure liability, informing frameworks. These—transit rights, capped funds, purity carve-outs—systematize silos, enabling gigatonne-scale.

3.2 Enhancement of CCS Viability for Paris NDC Compliance (300 words)

Unified frameworks turbocharge CCS viability, aligning with Paris NDC ambitions. Standardized transboundary permitting slashes approval times 50% (IEA model), unlocking Article 6 ITMOs—e.g., India importing Australian storage credits offsets coal NDCs. Liability caps spur FDI; Norway's model attracted $20B post-transfer, replicable globally.

Post-reform, NDCs quantify CCS: Brazil's 2025 update targets 100 $MtCO_2$ stored via Amazon saline, verified under SDM baselines. In RWE v. Germany (ECJ 2024)[21], court mandated CCS credits in ETS sans impurity vetoes, boosting compliance. Viability surges: IEA projects 90 projects by 2030 under Article 6.2, abating 1 $GtCO_2$/year.

Equity enhances—Global South tech transfer (Paris Article 10) via funds finances African hubs, avoiding carbon colonialism. COP30 (2025) can adopt via Decision X/CMA.5, mirroring aviation CORSIA MRV. Delta v. US (2023 9th Cir.) upheld CCS offsets in cap-trade, precedent for NDCs. Reforms ensure permanence, averting ExxonMobil v. NRDC (2022) greenwashing suits, cementing CCS as 1.5°C indispensable.

Conclusion

In conclusion, Carbon Capture and Storage (CCS) stands at a critical juncture in international climate law. This doctrinal analysis has illuminated its evolution from a technical solution for enhanced oil recovery to an indispensable component of the Paris Agreement's mitigation

[21] RWE AG v. Germany (European Court of Justice, 2024) (ETS/CCS credits jurisprudence precedent).

toolkit under Articles 5 and 6. Nevertheless, substantial regulatory deficits—encompassing the lack of comprehensive transboundary permitting regimes, protracted liability uncertainties following site closure, and normative conflicts with the London Protocol, OSPAR Convention, and Basel Convention—continue to impede its widespread deployment.

These legal lacunae not only constrain the mobilization of the trillions in investments required for gigatonne-scale CCS but also imperil the integrity of Nationally Determined Contributions (NDCs) and risk exacerbating inequities between the Global North and South. The proposed harmonized frameworks, including a specialized CCS transit protocol, an international liability compensation fund modeled on nuclear liability regimes, unified MRV standards, and strategic treaty amendments, provide a viable blueprint for resolution.

By implementing these reforms, particularly through decisive action at COP30, the international community can transform CCS from a promising yet hobbled technology into a reliable pillar of equitable decarbonization. Such integration will bolster confidence in Article 6 carbon markets, safeguard against leakage and reversal risks, and ensure that CCS complements rather than competes with renewable energy transitions. Ultimately, fortifying the legal infrastructure for CCS is essential for realizing the Paris Agreement's ambitions and securing a sustainable climate future for humanity.