



THE ASSESSMENT OF THE VIENNA CONVENTION FOR THE PROTECTION OF THE OZONE LAYER DEPLETION

Charity Olunma Kaniye-Ebeku*
Taiwo Odumosu**

ABSTRACT

The Vienna Convention for the Protection of the Ozone Layer 1985 occupies a foundational place in the development of modern international environmental law. It emerged at a moment when scientific concern about anthropogenic damage to the ozone layer had become compelling, yet the political conditions for a stringent global control regime had not fully matured. The Convention was therefore drafted as a framework treaty rather than as a directly prohibitory instrument. This article argues that the Convention's enduring significance lies in its constitutional and institutional role: it created a legal platform for research, monitoring, cooperation, information exchange, and later protocol-making. At the same time, its principal weakness was its lack of immediate substantive obligations. It did not prescribe quantified reductions, establish a robust compliance mechanism, impose trade sanctions, or create a dedicated financial structure for implementation. A comparative legal and policy analysis with the Montreal Protocol reveals that the practical success of the ozone regime depended less on the Vienna Convention standing alone than on the later hardening of obligations through protocol-based controls, reporting duties, differentiated commitments, and technological and financial support. The Convention should therefore be understood as both an achievement and a limitation: an indispensable beginning, but not a sufficient legal answer to ozone depletion.

KEYWORDS: *Ozone depletion; Vienna Convention; Montreal Protocol; international environmental law; framework convention; comparative legal analysis.*

1. INTRODUCTION

The Vienna Convention for the Protection of the Ozone Layer was adopted on 22 March 1985 and entered into force on 22 September 1988¹. It now enjoys universal participation, a feature often invoked as evidence of its exceptional normative legitimacy within international environmental law². Yet the Convention's reputation should not obscure the fact that it was intentionally cautious in design. Rather than directly mandating the phase-out of chlorofluorocarbons or other ozone-

*Charity Olunma Kaniye-Ebeku, PhD, Lecturer, Department of Commercial and Industrial Law, Faculty of Law, University of Port Harcourt, Email: joshidav@yahoo.co.uk

**Taiwo Odumosu, School of Postgraduate Studies, School of Law, University of Nicosia, Cyprus: E-mail: taiodu@gmail.com.

¹ Vienna Convention for the Protection of the Ozone Layer (opened for signature 22 March 1985, entered into force 22 September 1988) 1513 UNTS 293.

² United Nations Treaty Collection, 'Vienna Convention for the Protection of the Ozone Layer' (status page); Ozone Secretariat, 'The Vienna Convention for the Protection of the Ozone Layer'.



depleting substances, it required States to cooperate, to conduct research, to exchange information, and to take ‘appropriate measures’ in accordance with their means and capabilities³. It was, in substance, a treaty of organised precaution rather than immediate prohibition⁴.

This article examines the background to the Vienna Convention, the emergence of ozone depletion as a global concern, the scientific discoveries of the 1970s, the adoption and objectives of the Convention, and its nature and structure as a framework instrument with notable soft-law characteristics and carefully designed institutional arrangements⁵. It then offers a sustained critique of the Convention and compares it with the Montreal Protocol, which supplied the substantive regulatory machinery absent from the Vienna text itself⁶. The central contention advanced here is that the Vienna Convention was normatively indispensable but independently insufficient. Its true importance lies less in what it directly required than in what it enabled the international community to build afterwards.

2. CLARIFICATION OF CONCEPT

2.1 Concept of Ozone Layer and Ozone Layer Depletion

The ozone layer is a critical component of the Earth’s atmosphere, serving as a protective shield against harmful ultraviolet (UV) radiation from the sun. Located primarily in the stratosphere, this layer plays an indispensable role in sustaining life on Earth. However, since the late twentieth century, human activities have significantly disrupted the natural balance of ozone formation and destruction, leading to what is widely known as ozone layer depletion. The Earth’s atmosphere is divided into several layers: the troposphere, stratosphere, mesosphere, thermosphere, and exosphere. The ozone layer is situated within the stratosphere, approximately 15 to 35 kilometres above the Earth’s surface.⁷ This region contains about 90% of the Earth’s atmospheric ozone. Ozone (O₃) is a triatomic molecule consisting of three oxygen atoms. Although present in relatively small concentrations, it plays a disproportionately large role in absorbing ultraviolet radiation, particularly UV-B and UV-C rays.⁸ The formation of the ozone layer is governed by a series of photochemical reactions collectively known as the Chapman Cycle, first proposed by British scientist Sydney Chapman in 1930.⁹ The Chapman mechanism explains how ozone is continuously created and destroyed under natural conditions.

Ultraviolet radiation with wavelengths shorter than 240 nm splits molecular oxygen (O₂) into two separate oxygen atoms. $O_2 + UV \text{ radiation} \rightarrow O + O$ ¹⁰, this process is known as photodissociation.

³ Vienna Convention, art 2.

⁴ United Nations Treaty Collection (n 2)

⁵ Vienna Convention, arts 2-11.

⁶ Montreal Protocol on Substances that Deplete the Ozone Layer (opened for signature 16 September 1987, entered into force 1 January 1989) 1522 UNTS 29.

⁷ Peter Atkins and Julio de Paula, *Physical Chemistry* (10th edn, Oxford University Press 2014) 1023

⁸ World Meteorological Organisation, *Scientific Assessment of Ozone Depletion* (WMO 2018) 15

⁹ Sydney Chapman, ‘A Theory of Upper Atmosphere Ozone’ (1930) 3 *Memoirs of the Royal Meteorological Society* 103.

¹⁰ *ibid*



Thus, free oxygen atom (O) then reacts with another oxygen molecule (O₂) in the presence of a third body (M), which absorbs excess energy, $O + O_2 + M \rightarrow O_3 + M$ ¹¹, which then results in the formation of the ozone layer. Consequently, the ozone absorbs UV radiation and breaks down into an oxygen molecule and a free oxygen atom: $O_3 + \text{UV radiation} \rightarrow O_2 + O$ ¹². At this point, the free oxygen atom can further react with O₂ to form ozone, maintaining a dynamic equilibrium. Crucially, under natural conditions, the rates of ozone formation and destruction are balanced, resulting in a relatively stable concentration of ozone in the stratosphere.¹³ However, this equilibrium is sensitive to external influences, particularly the presence of catalytic agents that accelerate ozone destruction.

Ozone layer depletion refers to the thinning of the ozone layer due to the breakdown of ozone molecules, primarily caused by anthropogenic chemicals. The most significant contributors include chlorofluorocarbons (CFCs), halons, carbon tetrachloride, and methyl chloroform.¹⁴ The role of Chlorofluorocarbons (CFCs) in the depletion of the ozone layer cannot be undermined. CFCs are synthetic compounds widely used in refrigeration, air conditioning, aerosol propellants, and foam production.¹⁵ These compounds are highly stable in the lower atmosphere but eventually reach the stratosphere, where they are broken down by UV radiation. When CFCs are exposed to UV radiation, they release chlorine atoms: $CFCl_3 + \text{UV radiation} \rightarrow CFCl_2 + Cl$ ¹⁶ The chlorine atom acts as a catalyst in ozone destruction. Notably, A single chlorine atom can destroy thousands of ozone molecules through a catalytic cycle: $Cl + O_3 \rightarrow ClO + O_2$ ¹⁷ $ClO + O \rightarrow Cl + O_2$ ¹⁸. Thus, the chlorine atom is regenerated and continues to destroy more ozone molecules.

It is vital to note that ozone depletion is particularly severe over the polar regions, especially Antarctica, resulting in the phenomenon known as the “ozone hole.” This is largely due to the formation of polar stratospheric clouds (PSCs), which provide surfaces for chemical reactions that release active chlorine.¹⁹ The discovery of the ozone hole in 1985 by scientists, including Joseph Farman, marked a turning point in global environmental awareness.²⁰

2.2 Causes and Effects of Ozone Layer Depletion

¹¹ibid

¹²ibid

¹³ World Meteorological Organisation (n 8) 20

¹⁴ United Nations Environment Programme, Environmental Effect of Ozone Layer Depletion on (UNEP 2019) 8

¹⁵ibid

¹⁶ibid

¹⁷ibid

¹⁸ibid

¹⁹ World Meteorological Organisation (8) 45

²⁰ Joseph C Farman, Brian G Gardiner and Jonathan D Shanklin, “Large Losses of Total Ozone in Antarctica Reveal Seasonal ClO_x /NO_x Interaction” (1985) 315 Nature 207



There are various causes of ozone layer depletion, which could be anthropogenic causes such as emission of CFCs and halons, Industrial processes, use of nitrogen-based fertilisers (producing nitrous oxide) and rocket launches. The ozone can be depleted due to natural causes such as volcanic eruptions, Solar cycles and natural release of chlorine compounds. However, scientific consensus indicates that human activities are the dominant cause of ozone depletion.²¹

Furthermore, the effects of ozone layer depletion are devastating. Regarding the impact on human health, ozone depletion leads to increased exposure to UV-B radiation, which is associated with skin cancers (melanoma and non-melanoma), cataract, eye damage and suppression of the immune system.²²

In environmental terms, ozone layer depletion has given rise to a wide range of devastating ecological and public health challenges. Advances in scientific research demonstrate that the depletion of the ozone layer contributes significantly to increased exposure to harmful ultraviolet (UV) radiation, leading to serious conditions such as skin cancer, sunburn, and heat-related illnesses.²³ The depletion process is largely catalysed by reactive chemical species including nitrous oxide (N₂O), nitric oxide (NO), hydroxyl radicals (OH), atomic chlorine (Cl), and atomic bromine (Br).²⁴

Chlorofluorocarbons (CFCs) and bromofluorocarbons are particularly destructive, as they can break down thousands of ozone molecules in the stratosphere, thereby reducing the ozone layer's ability to absorb harmful UV-A and UV-B radiation from the sun.²⁵ One of the most significant consequences of ozone depletion is the increase in UV-B radiation reaching the Earth's surface. According to Hunter *et al.*, a one per cent reduction in ozone concentration results in approximately a two per cent increase in UV radiation.²⁶

Prolonged exposure to elevated UV radiation adversely affects humans, animals, and plants. In humans, it causes skin disorders such as sunburn, premature ageing, and skin cancer, as well as suppression of the immune system and ocular diseases such as corneal cataracts, which can lead to blindness.²⁷

Furthermore, increased UV radiation poses a serious threat to aquatic ecosystems. It can result in the large-scale depletion of phytoplankton, which serve as the primary producers in marine food

²¹ United Nations Environment Programme (UNEP), Environmental Effects of Ozone Depletion and its interactions with Climate Change (UNEP 2019).

²² World Health Organisation, Ultraviolet Radiation and Health (WHO 2017)

²³ UNEP 2019, (n21)

²⁴ John H Seinfeld and Spyros N Pandis, Atmospheric Chemistry and Physics: From Air Pollution to Climate Change (3rd edn, Wiley 2016).

²⁵ World Meteorological Organisation (WMO), Scientific Assessment of Ozone Depletion: 2018 (WMO) 2018.

²⁶ David Hunter, James Salzman and Durwood Zaelke, International Environmental Law and Policy(4th edn, Foundation Press 2007)

²⁷ World Health Organisation (WHO) (n22)



chains.²⁸ Due to the high energy of UV rays, they penetrate deeply into oceans, seas, and freshwater bodies, destroying fish eggs, amphibian eggs, and larvae. The destruction of phytoplankton disrupts oceanic food chains and ultimately reduces fish production.²⁹

At the genetic level, UV radiation is highly mutagenic, damaging DNA and potentially causing mutations that may lead to cancer.³⁰ Additionally, UV-B radiation reduces the capacity of phytoplankton to absorb carbon dioxide during photosynthesis, thereby indirectly contributing to global warming.³¹

Ozone depletion also contributes to broader atmospheric and climatic changes. It can disturb the thermal structure of the atmosphere, potentially altering atmospheric circulation patterns.³² Increased UV radiation in the lower atmosphere also leads to the formation of ground-level ozone, a highly reactive pollutant associated with respiratory diseases.^{33,11}

Moreover, ozone itself is a greenhouse gas, and its depletion may partially reduce the greenhouse effect. However, efforts to control ozone depletion, particularly through the reduction of CFCs, may paradoxically influence global warming dynamics, as CFCs are potent greenhouse gases.³⁴ Their presence in the atmosphere contributes to rising sea levels, soil erosion, melting glaciers and polar ice caps, and alterations in both global and regional weather patterns.³⁵ In addition, ozone depletion affects the chemical composition of the troposphere by altering its oxidising capacity.³⁶ It also has material consequences, as increased UV-B radiation accelerates the degradation of materials such as wood, plastics, and other polymers, leading to loss of strength and discolouration.³⁷

It is important to note that although ozone depletion and climate change are distinct phenomena, they are interrelated. Some ozone-depleting substances are also potent greenhouse gases.³⁸ There is therefore no doubt that the amount of ozone present in the Earth's atmosphere has critical implications for the environment, human health and national economies. Since not one country can control ozone depletion, it is an important issue in international environmental law (USEPA, 2023). To this end, the Vienna Convention and the Montreal Protocol are considered the most successful environmental agreements. The Vienna Convention for the Protection of the Ozone Layer was

²⁸ UNEP (n 21)

²⁹ WHO (n 22)

³⁰ *ibid*

³¹ UNEP (n 21)

³² WHO (n 22)

³³ WHO (n22)

³⁴ Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2021: The Physical Science Basis* (Cambridge University Press 2021).

³⁵ *ibid*

³⁶ Seinfeld and Pandis (n 24)

³⁷ UNEP (n 21)

³⁸ Intergovernmental Panel on Climate Change, *Climate Change 2021: The Physical Science Basis* (IPCC 2021)



adopted on 22nd March 1985 in Vienna, Austria. The Montreal Protocol on substances that deplete the Ozone Layer was adopted on 16th September 1987 in Montreal, Canada. The Vienna Convention for the Protection of the Ozone Layer established a framework for international cooperation in research and monitoring.¹⁹ The Montreal Protocol on Substances that Deplete the Ozone Layer introduced legally binding measures to phase out ozone-depleting substances.²⁰

2.3 Theoretical Critique

2.3.1 Realist Perspective

From a realist perspective, the Vienna Convention reflects the enduring reluctance of States to accept binding obligations that might constrain economic autonomy and strategic flexibility³⁹. Realism treats international cooperation as limited by anarchy, concerns over relative gains, and scepticism about the independent power of institutions⁴⁰. On this reading, the Convention's framework character was not simply a prudential response to uncertain science; it was also a political compromise shaped by state self-interest. States were willing to endorse research, observation, and cooperation, but not yet willing to assume stringent and enforceable duties over industrial chemicals central to modern production and consumption. The Convention thus appears as an instrument of managed caution rather than genuine legal sacrifice.

A realist critique also helps explain why the real regulatory breakthrough came only when the regime shifted from general commitments to specific bargains under the Montreal Protocol. Harder obligations became acceptable when the political and economic costs were better distributed, when scientific certainty had deepened, and when institutional design reduced risks of unilateral disadvantage. In this sense, realism illuminates the Convention's weakness by showing how legal form tracked political incentives.

2.3.2 Liberal Institutionalism

A liberal institutionalist reading is more sympathetic. Liberal institutionalism argues that international institutions matter because they reduce uncertainty, lower transaction costs, stabilise expectations, and facilitate mutually beneficial cooperation⁴¹.³² The Vienna Convention fits this model closely. It created a forum for repeated interaction, linked science to diplomacy, regularised information exchange, and provided the procedural basis for future protocols⁴². From this perspective, the Convention's softness was not simply weakness; it was an institutional technique for making cooperation possible in the face of incomplete information and divergent state preferences.

³⁹ Joseph M Grieco, 'Anarchy and the Limits of Cooperation: A Realist Critique of the Newest Liberal Institutionalism' (1988) 42(3) *International Organization* 485.

⁴⁰ Andreas Hasenclever, Peter Mayer and Volker Rittberger, 'Integrating Theories of International Regimes' (2000) 26(1) *Review of International Studies* 3.

⁴¹ Robert O Keohane, *After Hegemony: Cooperation and Discord in the World Political Economy* (Princeton University Press 1984).

⁴² Vienna Convention, arts 3–8.



Yet liberal institutionalism also reveals the limits of the Convention. Institutions can facilitate cooperation, but not all institutionalisation is equally effective. A framework treaty that lacks specific obligations may improve communication and coordination while still failing to alter behaviour sufficiently. The Vienna Convention, therefore, validates the liberal institutionalist insight that cooperation can begin through institutions, but it also demonstrates that institutional form without harder downstream commitments may produce only modest regulatory outcomes.

2.3.3 Critical Legal Studies

A critical legal studies perspective, especially one attentive to North–South inequalities, exposes the power relations obscured by the language of universal cooperation⁴³. On this view, the Convention reflected a structure in which developed States, whose industries had benefited disproportionately from ozone-depleting substances, could endorse broad environmental commitments without immediately assuming proportionate material burdens⁴⁴. The absence of an initial financial mechanism and the weak treatment of distributive justice support this critique. The later creation of differentiated obligations and the Multilateral Fund suggests that the original regime design did not adequately account for asymmetries in responsibility, capacity, and vulnerability.

A critical approach also cautions against narrating the ozone regime solely as a triumph of enlightened cooperation. Dimitrov’s work usefully emphasises the interplay of knowledge, power, and interests in regime formation, while Bafundo shows how differentiated responsibility became central to making compliance plausible for weaker States⁴⁵. The Convention, viewed critically, did not transcend power; it mediated it imperfectly. Its universalist language masked an underlying asymmetry that later legal developments had to correct.

3.0 BACKGROUND TO THE VIENNA CONVENTION

3.1 Emergence of Ozone Layer Depletion as a Global Concern

The rise of ozone depletion as an issue of international legal concern was driven by the convergence of atmospheric science, ecological risk, and institutional diplomacy. In 1977, the United Nations Environment Programme concluded a World Plan of Action on the Ozone Layer, calling for intensive international research and monitoring⁴⁶. By 1981, UNEP’s Governing Council had authorised the drafting of a global framework convention on stratospheric ozone protection⁴⁷. These developments are significant because they demonstrate that the Convention did not arise in

⁴³ Nico Krisch, ‘International Law in Times of Hegemony: Unequal Power and the Shaping of the International Legal Order’ (2005) 16(3) *European Journal of International Law* 369.

⁴⁴ Nina E Bafundo, ‘Compliance with the Ozone Treaty: Weak States and the Principle of Common but Differentiated Responsibility’ (2006) 21(3) *American University International Law Review* 461.

⁴⁵ Radoslav S Dimitrov, ‘Knowledge, Power, and Interests in Environmental Regime Formation’ (2003) 47(1) *International Studies Quarterly* 123.

⁴⁶ United Nations Audiovisual Library of International Law, ‘Vienna Convention for the Protection of the Ozone Layer’ (historical note).

⁴⁷ *ibid.*



response to a single dramatic event. Rather, it was the result of a gradually accumulating recognition that human activities could alter atmospheric conditions in ways that transcended national borders and demanded international legal coordination.

The ozone question became especially urgent because the threatened harm was both diffuse and severe. Damage to the stratospheric ozone layer increases the transmission of harmful ultraviolet-B radiation, with consequences for human health, ecosystems, and materials⁴⁸. The atmosphere, moreover, is not territorially divisible in the way that rivers or enclosed seas may sometimes appear to be. Ozone depletion, therefore, challenged traditional assumptions of territorial sovereignty by demonstrating that industrial production and chemical use in one set of States could impose environmental risks on the global commons and, ultimately, on all peoples. This feature made the problem particularly suitable for the development of a framework convention founded on cooperation, scientific assessment, and progressive legal elaboration⁴⁹.

3.2 Scientific Discoveries in the 1970s

The scientific foundation for the ozone regime was decisively shaped by the landmark 1974 article by Mario Molina and F Sherwood Rowland, who demonstrated that chlorofluoromethanes released at the Earth's surface could migrate into the stratosphere and catalyse the destruction of ozone⁵⁰. That article transformed the issue from a speculative atmospheric concern into a credible subject of international regulation. It is difficult to overstate its importance. In legal terms, it supplied the epistemic basis for precaution. The risk was not yet fully observable in a catastrophic form, but it had become scientifically reasoned and sufficiently serious to justify multilateral action.

A second and equally important milestone was the 1985 article by Joseph Farman, Brian Gardiner and Jonathan Shanklin, which documented substantial seasonal losses of total ozone over Antarctica⁵¹. Although published in the same year as the Vienna Convention, this discovery intensified public and governmental awareness of the gravity of the problem. The chronology is important. The Convention was negotiated substantially before the Antarctic ozone hole became the defining symbol of the crisis. That fact lends support to the claim that the Convention was precautionary in orientation: it was concluded before the fullest public confirmation of the scale of ozone loss had emerged. At the same time, that chronology also partly explains its caution; the negotiators were still operating in a context of scientific development rather than a fully consolidated regulatory consensus.

3.3 Adoption of the Vienna Convention 1985

⁴⁸ United States Environmental Protection Agency, 'International Treaties and Cooperation about the Protection of the Stratospheric Ozone Layer' (22 January 2026).

⁴⁹ibid

⁵⁰ Mario J Molina and F Sherwood Rowland, 'Stratospheric Sink for Chlorofluoromethanes: Chlorine Atom-Catalysed Destruction of Ozone' (1974) 249 *Nature* 810.

⁵¹ John C Farman, Brian G Gardiner and Jonathan D Shanklin, 'Large Losses of Total Ozone in Antarctica Reveal Seasonal ClOx/NOx Interaction' (1985) 315 *Nature* 207.



The Convention was adopted by the Conference on the Protection of the Ozone Layer and opened for signature at Vienna on 22 March 1985⁵². It remained open for signature in Vienna until 21 September 1985 and subsequently at United Nations Headquarters in New York until 21 March 1986⁵³. The official treaty status record shows that the Convention entered into force on 22 September 1988 and is recorded in the United Nations Treaty Series, vol 1513, p 293⁵⁴. These details are not merely formal. They demonstrate that the treaty was concluded within the traditional architecture of multilateral lawmaking and was framed from the outset as a universal environmental compact rather than as a regional or sectoral arrangement⁵⁵.

The preparatory history further reveals that the Convention was conceived as only the first stage in a broader regime-building process. The historical materials collected in the United Nations Audiovisual Library show that treaty drafters considered alternative structures for technical annexes and protocols and that, soon after the Convention's adoption, UNEP was requested to continue work toward a protocol on chlorofluorocarbons⁵⁶. The Montreal Protocol of 1987 was thus not an accidental sequel but the anticipated next step in a deliberately staged legal strategy. This staged approach reflects both prudence and compromise. Prudence because it allowed the law to evolve with the science, and compromise because it postponed difficult distributive and industrial questions until a later negotiating phase.

3.4 Objectives of the Convention

The objectives of the Convention are framed in both the preamble and Article 2. The preamble recognises the potentially harmful effects on human health and the environment resulting from modification of the ozone layer and affirms the need for precautionary measures and international cooperation⁵⁷. Article 2 then requires the Parties to take appropriate measures, in accordance with the Convention and any protocols in force to which they are party, to protect human health and the environment against adverse effects resulting or likely to result from human activities that modify, or are likely to modify, the ozone layer⁵⁸. The language is broad, purposive, and deliberately non-technical. It expresses a common commitment to protection while avoiding the immediate prescription of substance-specific control obligations⁵⁹.

This objective structure reveals the dual character of the Convention. On the one hand, it is protective and precautionary. On the other hand, it is facilitative and process oriented. The

⁵² Vienna Convention (n 1)

⁵³ United Nations Treaty Collection, 'Vienna Convention for the Protection of the Ozone Layer' (status page); Ozone Secretariat, 'The Vienna Convention for the Protection of the Ozone Layer'.

⁵⁴ United Nations Audiovisual Library of International Law, 'Vienna Convention for the Protection of the Ozone Layer' (historical note).

⁵⁵ United Nations Treaty Collection (n 2)

⁵⁶ United Nations Audiovisual Library of International Law, 'Vienna Convention for the Protection of the Ozone Layer' (historical note).

⁵⁷ Vienna Convention, Preamble. (n 1)

⁵⁸ *ibid* art 2.

⁵⁹ United Nations Treaty Collection (n 2)



Convention aims to stimulate research, observation, and the harmonisation of policies rather than to deliver a fully operational control regime within its own text⁶⁰. This was a politically astute choice, since it made wide participation easier. Yet it is also the starting point for much of the Convention's later critique, because a treaty designed to confront a global environmental threat might be expected to contain more immediate and more determinate obligations.

4.0. NATURE AND STRUCTURE OF THE VIENNA CONVENTION

4.1 Framework Convention Model

The Vienna Convention is a paradigm example of the framework convention model in international environmental law⁶¹. Its core obligations are general and cooperative. Articles 3 and 4 require parties to promote research, systematic observation, scientific and technical cooperation, and the exchange of legal, scientific, technical, socio-economic, commercial, and other relevant information⁶². Article 8 expressly contemplates the adoption of protocols⁶³. Rather than attempting to resolve all regulatory questions in a single instrument, the treaty establishes an evolving legal architecture capable of later substantive development.

The strength of the framework model lies in its flexibility. It allows States to agree on principles, institutions, and procedures even when they disagree on immediate control measures or when scientific evidence is still developing. The weakness of the same model is that it can defer precisely the substantive commitments most needed to prevent harm. In the Vienna Convention, this tension is unmistakable. The treaty is admirably adaptive, but its adaptiveness is achieved at the cost of direct regulatory immediacy.

4.2 Soft-Law Characteristics

The Vienna Convention is formally a binding treaty and is therefore not soft law in the strict sense⁶⁴. Nevertheless, several of its operative features, exhibit what may properly be called soft-law characteristics. The obligation to take 'appropriate measures' is open textured⁶⁵. The Convention does not itself impose quantified reduction schedules, specify a list of controlled substances in the manner of the Montreal Protocol, or create automatic legal consequences for non-compliance⁶⁶. The United States Environmental Protection Agency accurately describes it as a framework convention that did not require countries to take concrete actions to control ozone-depleting

⁶⁰ibid arts 3–5.

⁶¹ United Nations Audiovisual Library of International Law, 'Vienna Convention for the Protection of the Ozone Layer' (historical note).

⁶² Vienna Convention, Arts 3–4.

⁶³ibid Art. 8.

⁶⁴ibid.

⁶⁵ibid Art. 2.

⁶⁶ United States Environmental Protection Agency, 'International Treaties and Cooperation about the Protection of the Stratospheric Ozone Layer' (22 January 2026).



substances⁶⁷. In that sense, the Convention occupies an intermediate position. It is hard in form, but soft in much of its substantive content⁶⁸.

This soft-law quality has been praised and criticised in equal measure. It may be praised because it lowered the threshold for international agreement and enabled early legal action under uncertainty. It may be criticised because it diluted accountability and permitted States to affirm protective objectives without accepting immediate and measurable burdens. From a policy perspective, the Convention's softness was likely a condition of its birth. That is, from a regulatory perspective, it was also its principal limitation.

4.3 Institutional Arrangements

The institutional design of the Vienna Convention is among its most durable achievements. Article 6 establishes the Conference of the Parties, which is tasked with reviewing implementation, considering scientific information, promoting harmonised policies, and adopting programmes of research and systematic observation⁶⁹. Article 7 creates the Secretariat, charged with arranging meetings, transmitting reports, coordinating with relevant international bodies, and carrying out the functions assigned by the Convention and any protocols⁷⁰. These provisions ensured that the ozone regime would have an administrative and deliberative centre capable of linking science, diplomacy, and legal development⁷¹.

The broader regime subsequently developed a network of assessment and advisory bodies, including the Scientific Assessment Panel, the Environmental Effects Assessment Panel, and the Technology and Economic Assessment Panel⁷². Although these bodies are more closely associated with the Montreal Protocol system, they reflect the institutional logic first embedded in the Vienna Convention. Environmental protection would proceed through structured and recurrent interaction between science and law. This institutionalisation of expert knowledge was a major reason for the resilience of the ozone regime, even if it could not by itself substitute for more concrete legal obligations⁷³.

5. CRITIQUE OF THE VIENNA CONVENTION

The first and most substantial criticism of the Vienna Convention is its normative thinness. It set out an important protective objective, but it did not itself require the reduction or elimination of

⁶⁷ibid.

⁶⁸ US EPA (n 48)

⁶⁹ Vienna Convention, art 6.

⁷⁰ibid Art 7.

⁷¹ United Nations Treaty Collection (n 2)

⁷² United States Environmental Protection Agency, 'International Treaties and Cooperation about the Protection of the Stratospheric Ozone Layer' (22 January 2026).

⁷³ US EPA (48)



particular ozone-depleting substances⁷⁴. There were no binding phase-out schedules, no trade restrictions, and no quantified benchmarks against which compliance could be measured⁷⁵. As a result, the Convention was incapable, on its own terms, of delivering the material behavioural changes necessary to halt ozone depletion. This is the central paradox of the treaty: it was historically significant precisely because it was legally incomplete⁷⁶.

The second issue concerns the operational weakness of its precautionary commitment. The Convention is often celebrated as an early manifestation of the precautionary idea because it was concluded before the scientific picture had fully stabilised⁷⁷. That praise is deserved, but only up to a point. Precautions, if taken seriously, may justify early and stringent intervention in the face of plausible and potentially irreversible harm. The Vienna Convention chose instead to embody a thinner form of precaution. This is because it institutionalised concern, but it did not directly impose stringent control obligations. Its precaution was therefore procedural more than substantive⁷⁸.

The third shortcoming is the weakness of compliance and dispute-settlement design. Article 11 relies primarily on negotiation, mediation, arbitration or adjudication where accepted, and conciliation whose outcome is recommendatory rather than binding⁷⁹. There is no standing compliance committee in the Convention itself, and no robust mechanism of implementation review analogous to what later emerged under the Montreal Protocol⁸⁰. For a treaty addressing a scientifically complex and economically consequential transboundary harm, this institutional modesty is striking. It reveals that the Convention's drafters privileged consensus and participation over coercive supervision⁸¹.

The fourth concern is distributive. Although the Convention recognises the circumstances and particular requirements of developing countries, it did not establish a dedicated financial mechanism to support compliance or technological transition⁸². That gap was later addressed within the Montreal regime, but the omission is telling. A treaty may articulate a common environmental goal, yet it may still fail to allocate fairly the costs of achieving it. In this respect, the Vienna

⁷⁴ Vienna Convention, art 2; United States Environmental Protection Agency, 'International Treaties and Cooperation about the Protection of the Stratospheric Ozone Layer' (22 January 2026).

⁷⁵ United States Environmental Protection Agency, 'International Treaties and Cooperation about the Protection of the Stratospheric Ozone Layer' (22 January 2026).

⁷⁶ US EPA (48)

⁷⁷ Mario J Molina and F Sherwood Rowland, 'Stratospheric Sink for Chlorofluoromethanes: Chlorine Atom-Catalysed Destruction of Ozone' (1974) 249 *Nature* 810; United Nations Audiovisual Library of International Law, 'Vienna Convention for the Protection of the Ozone Layer' (historical note).

⁷⁸ United Nations Legal Affairs

⁷⁹ Vienna Convention, art 11.

⁸⁰ Montreal Protocol (n 6)

⁸¹ United Nations Treaty Collection (n 2)

⁸² Vienna Convention, Preamble.



Convention reflected the familiar weakness of early framework agreements. They universalise aspiration more readily than they institutionalise material solidarity⁸³.

6. COMPARATIVE LEGAL AND POLICY ANALYSIS

The clearest way to assess the Vienna Convention is to compare it with the Montreal Protocol on Substances that Deplete the Ozone Layer, 1987⁸⁴. The contrast is decisive. Whereas the Vienna Convention required general cooperation and appropriate measures, the Montreal Protocol imposed concrete control schedules on production and consumption, established reporting duties, and created a regime capable of progressive tightening through adjustments and amendments⁸⁵. In policy terms, the Protocol translated a framework of concern into a programme of control. In legal terms, it converted broad obligations of conduct into more determinate obligations of result⁸⁶.

This comparison does not diminish the importance of the Vienna Convention; rather, it clarifies its proper place. The Convention made international agreement possible at an early stage of scientific and political uncertainty. The Protocol made environmental protection effective by supplying the specificity that the Convention lacked. The two instruments are therefore complementary, but not equivalent. The Convention should be seen as the regime's constitutional foundation while the Protocol should be seen as its regulatory engine⁸⁷.

Contemporary scientific assessments reinforce this conclusion. The 2022 scientific assessment of ozone depletion reports continuing recovery trends and projects return of total column ozone to 1980 values around 2040 for the near-global average, around 2045 in the Arctic, and around 2066 in the Antarctic⁸⁸. Those encouraging projections are achievements of the ozone regime as a whole, especially the control architecture developed under the Montreal Protocol and its later amendments. They should not be misread as proof that the Vienna Convention by itself was sufficient. On the contrary, the success story of ozone protection confirms the article's central point. It reflects that a framework cooperation mattered, but substantive regulatory hardening mattered more⁸⁹.

6.1 Lessons from Climate Change Regimes

A comparison between the Vienna ozone regime and contemporary climate change regimes, especially the Paris Agreement 2015, reveals the evolution of international environmental law from a classical framework treaty design toward more elaborate hybrid governance models⁹⁰. The

⁸³ United Nations Treaty Collection

⁸⁴ Montreal Protocol (n 6)

⁸⁵ *ibid* Arts. 2–7.

⁸⁶ United Nations Treaty Collection

⁸⁷ United Nations Legal Affairs.

⁸⁸ World Meteorological Organization and United Nations Environment Programme, *Scientific Assessment of Ozone Depletion: 2022—Executive Summary* (2022).

⁸⁹ NOAA Chemical Sciences Laboratory

⁹⁰ Paris Agreement (adopted 12 December 2015, entered into force 4 November 2016) 3156 UNTS 79; Vienna Convention for the Protection of the Ozone Layer (opened for signature 22 March 1985, entered into force 22 September 1988) 1513 UNTS 293.



Vienna Convention was a framework convention in the orthodox sense: it established principles, institutions, and a process for future protocol-making, but it did not itself impose detailed substance-specific control obligations⁹¹. The Paris Agreement, though also built on a framework architecture, moved further by combining legally binding procedural duties with nationally determined substantive commitments, a transparency framework, a global stocktake, and a committee to facilitate implementation and promote compliance⁹². In this respect, the Paris Agreement illustrates an evolution from general cooperative obligation to a more structured, iterative, and reflexive model of global environmental governance.

The comparison is instructive in at least three respects. First, it demonstrates that modern environmental treaties increasingly rely on a blend of hard and soft legal techniques. The Paris Agreement is legally binding as a treaty, yet many of its most politically salient components are nationally determined rather than internationally prescribed⁹³. Article 4 requires each Party to prepare, communicate, and maintain successive nationally determined contributions, while article 13 establishes an enhanced transparency framework and article 14 creates a global stocktake to assess collective progress⁹⁴. This differs from the Montreal Protocol's more top-down approach, which imposed concrete phase-out obligations and trade controls. The lesson is that international environmental law has moved from simple framework treaties toward hybrid regimes that mix obligation, review, flexibility, and progressive ambition.

Secondly, the comparison with the Paris Agreement reveals that institutional sophistication alone does not guarantee environmental effectiveness. The Paris model contains a transparency system, a stocktake process, and an implementation-and-compliance mechanism under Article 15, but these are expressly facilitative and non-punitive in character⁹⁵. The first global stocktake confirmed that progress has been made, yet also concluded that the world is not on track to meet the Agreement's long-term goals⁹⁶. By contrast, the ozone regime's success depended not merely on institutional dialogue but on the addition of concrete control schedules under the Montreal Protocol and a financing architecture through the Multilateral Fund⁹⁷. The broader lesson is that procedural innovation must ultimately be matched by sufficiently ambitious substantive commitments.

Thirdly, the Paris comparison highlights the continuing importance of equity. The Paris Agreement recognises common but differentiated responsibilities and respective capabilities in the light of

⁹¹ Vienna Convention for the Protection of the Ozone Layer arts 2–8.

⁹² Paris Agreement arts 4, 13–15.

⁹³ Lavanya Rajamani, 'Interpreting the Paris Agreement in its Normative Environment' (2024) 77 *Current Legal Problems* 167.

⁹⁴ Paris Agreement Articles 4, 13, 14.

⁹⁵ *ibid* art 15.

⁹⁶ Conference of the Parties serving as the meeting of the Parties to the Paris Agreement, 'Outcome of the First Global Stocktake' (2023) UN Doc FCCC/PA/CMA/2023/L.17.

⁹⁷ Montreal Protocol on Substances that Deplete the Ozone Layer (opened for signature 16 September 1987, entered into force 1 January 1989) 1522 UNTS 29; Multilateral Fund, 'About MLF'.



different national circumstances, while also reaffirming that developed countries should take the lead in providing financial assistance⁹⁸. That emphasis on support, flexibility, and nationally determined ambition reflects lessons long visible in the ozone regime: environmental cooperation cannot be sustained unless legal obligations are calibrated to differences in capacity, responsibility, and development needs⁹⁹. The evolution of international environmental law therefore suggests that successful regimes are those that combine ambition with fairness, and universality with differentiated implementation.

7. ACHIEVEMENTS DESPITE SHORTCOMINGS

Despite the substantial criticisms levelled against the Vienna Convention, it would be a mistake to regard it as a weak or inconsequential treaty. Its first major achievement was the establishment of a global framework for cooperation on ozone protection¹⁰⁰. The Convention created a legal basis for continuous multilateral engagement, systematic observation, exchange of information, and institutional coordination through the Conference of the Parties and the Secretariat¹⁰¹. That framework mattered because it transformed a dispersed scientific concern into an organised field of international legal governance.

Its second major achievement was the facilitation of scientific research. The Convention expressly required cooperation in research and systematic observation, thereby helping to institutionalise the relationship between science and law in ozone governance¹⁰². This scientific orientation was not incidental; it was central to the regime's durability. The ozone system later developed around assessment bodies and recurring scientific review, enabling treaty obligations to be adjusted in the light of evolving evidence¹⁰³. The Convention thus helped create one of the clearest examples in international law of science-informed norm development.

Its third major achievement was that it paved the way for the Montreal Protocol¹⁰⁴. The Protocol did not emerge in a vacuum; it was the natural extension of the Vienna Convention's framework design and protocol-making logic. The Convention's procedural openness made it possible for the international community to move rapidly from general cooperation to specific regulatory commitments, including phase-out schedules and trade restrictions¹⁰⁵. In historical perspective, therefore, the Vienna Convention's greatest success may lie in the fact that it made stronger law possible.

7.1 IMPLICATIONS FOR ENVIRONMENTAL GOVERNANCE

⁹⁸ Paris Agreement Art 2(2); UNFCCC, 'Key Aspects of the Paris Agreement'.

⁹⁹ Multilateral Fund, 'About MLF'; Paris Agreement art 13(2).

¹⁰⁰ Vienna Convention arts 2–7.

¹⁰¹ *ibid* arts 6–7.

¹⁰² *ibid* arts 3–4.

¹⁰³ *ibid* arts 3–4.

¹⁰⁴ Vienna Convention art 8.

¹⁰⁵ Montreal Protocol arts 2–4.



The criticisms directed at the Vienna Convention have broader implications for environmental governance. The first implication is the need for stronger legal obligations. Framework agreements are useful for initiating cooperation, especially where science is evolving or state preferences are divided, but environmental protection ultimately requires obligations that are sufficiently precise to alter behaviour¹⁰⁶. A treaty that merely encourages cooperation may generate diplomatic legitimacy without necessarily producing adequate ecological outcomes. The ozone experience shows that framework conventions must often be followed by harder instruments if meaningful protection is to be secured.

The second implication is the importance of effective enforcement and compliance mechanisms. The Vienna Convention's dispute-settlement provisions were modest, while the Paris Agreement's article 15 mechanism is facilitative rather than punitive¹⁰⁷. These models show that many environmental treaties still privilege participation and consensus over coercive enforcement. While that may be politically necessary in some contexts, weak compliance design can undermine ambition and invite underperformance. Effective governance, therefore, requires compliance systems that are not merely symbolic but capable of generating accountability, transparency, and corrective action.

The third implication is the necessity of equitable frameworks. Environmental treaties that do not address disparities in wealth, technology, and historical responsibility risk reproducing structural inequality under the guise of universal cooperation¹⁰⁸. The later success of the ozone regime owed much to the Multilateral Fund, which helped developing countries meet their obligations under the Montreal Protocol¹⁰⁹. The lesson for environmental governance more broadly is that fairness is not a secondary moral concern; it is a practical condition of durable compliance.

8. RECOMMENDATIONS

8.1 Strengthening Framework Agreements

Future environmental treaties should not stop at broad statements of principle. While framework agreements remain valuable as entry points for cooperation, they should include clearer pathways to binding commitments, whether through mandatory schedules for review and ratcheting, protocol obligations, or default mechanisms that progressively harden commitments over time¹¹⁰. The experience of the Vienna Convention shows that a framework treaty can succeed, but usually only

¹⁰⁶ Daniel Bodansky, Jutta Brunnée and Lavanya Rajamani, *International Climate Change Law* (Oxford University Press 2017) 249–54.

¹⁰⁷ Vienna Convention art 11; Paris Agreement art 15.

¹⁰⁸ Nico Krisch, 'International Law in Times of Hegemony: Unequal Power and the Shaping of the International Legal Order' (2005) 16(3) *European Journal of International Law* 369.

¹⁰⁹ Multilateral Fund, 'About MLF'; Multilateral Fund, 'Our Work'.

¹¹⁰ Richard Falkner, 'The Paris Agreement and the New Logic of International Climate Politics' (2016) 92(5) *International Affairs* 1107.



where it is rapidly supplemented by more specific norms. A more effective model would build such hardening into the agreement from the outset.

8.2 Enhancing Compliance Mechanisms

Future treaties should establish effective monitoring, reporting, and compliance systems. Transparency alone is important but insufficient. Compliance committees should possess clearer triggers, stronger review functions, and institutional authority to recommend corrective measures in response to persistent underperformance¹¹¹. The Paris Agreement's facilitative approach offers useful lessons in inclusiveness, but the ozone regime suggests that legal effectiveness is greatly enhanced when cooperation is reinforced by more concrete compliance expectations.

8.3 Addressing Equity Issues

Developing countries should receive sustained financial and technical support if international environmental obligations are to be both fair and effective¹¹². This is not merely a matter of distributive justice; it is also a condition for implementation. The Multilateral Fund under the Montreal regime demonstrates how targeted support can make differentiated responsibility operational¹¹³. Climate regimes similarly recognise the need for finance and capacity-building, but the lesson from ozone governance is that support mechanisms should be robust, institutionalised, and predictable rather than aspirational.

8.4 Promoting Scientific Integration

Future environmental policy must remain deeply informed by scientific research. One of the most enduring strengths of the Vienna ozone regime was its close integration of law and science through systematic observation, assessment, and review¹¹⁴. The Paris Agreement likewise incorporates the best available science into the global stocktake process¹¹⁵. Yet science must not be treated as merely advisory rhetoric. Treaty design should ensure that new scientific evidence can trigger meaningful policy adjustment, enhanced ambition, and, where necessary, accelerated implementation.

9. CONCLUSION

The Vienna Convention represents a major milestone in the development of international environmental law¹¹⁶. It transformed concern about ozone depletion into an organised legal project, established a global framework for cooperation, facilitated scientific research, and laid the institutional foundation for the Montreal Protocol¹¹⁷. Nonetheless, its limitations remain instructive. Its lack of binding substantive obligations, weak enforcement design, and initially

¹¹¹ Anna Huggins, 'The Paris Agreement's Article 15 Mechanism: An Incomplete Compliance Strategy' in Benoit Mayer and Alexander Zahar (eds), *Debating Climate Law* (Cambridge University Press 2021).

¹¹² Paris Agreement arts 9–11.

¹¹³ Multilateral Fund, 'About MLF'.

¹¹⁴ Vienna Convention arts 3–4.

¹¹⁵ Paris Agreement art 14(1).

¹¹⁶ Vienna Convention preamble and art 2.

¹¹⁷ Vienna Convention arts 3–8; Montreal Protocol.



underdeveloped distributive arrangements illustrate the recurring challenges of global environmental governance.

A critical evaluation of the Convention, therefore, yields lessons of continuing relevance for future environmental treaties. International environmental law must move beyond symbolic consensus toward stronger commitments, more effective compliance mechanisms, equitable participation, and deeper integration of science into law-making and implementation¹¹⁸. The evolution from Vienna to Montreal, and the later comparison with the Paris Agreement, demonstrates that treaty success depends not merely on the existence of legal texts, but on whether those texts create a credible pathway from cooperation to compliance, and from aspiration to measurable environmental protection.

Yet its limitations are equally clear. It lacked immediate and measurable control obligations, a strong compliance system, and a distributive mechanism commensurate with the burdens of technological transition¹¹⁹. The Convention's real importance, therefore, lies not in its independent coercive force, but in its constitutional function within a broader regime that was completed and rendered effective by the Montreal Protocol and subsequent institutional developments¹²⁰. The fairest legal judgment is that the Vienna Convention was indispensable, but not enough. It stands as a reminder that framework treaties can open the door to environmental protection, but only more concrete and enforceable norms can secure the result. Thus, collective action, continued vigilance and compliance are essential to ensure the full recovery of the ozone layer.

¹¹⁸ Paris Agreement arts 13–15; Montreal Protocol arts 2–7.

¹¹⁹ United States Environmental Protection Agency (n 48); Vienna Convention, art 11.

¹²⁰ Montreal Protocol (n 6); World Meteorological Organization (n 8) and United Nations Environment Programme (n 21).