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Legal and Policy Frameworks for Climate and Air Protection in Saudi Arabia: A Review of Progress

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Abstract

This research paper analytically examines Saudi Arabia's climate protection strategies, focusing on studying the pivotal role of environmental regulations, programs, and initiatives in the Kingdom of Saudi Arabia in improving air quality and mitigating climate change. The study also analyzes the role of Saudi policy in addressing climate change, considering the nation's unique environmental context and economic structure. The study also concludes with some recommendations aimed at enhancing the efficiency of current regulatory frameworks.

Keywords: *Air, Quality, Climate, Change, Protection, Regulations, Projects, and Initiatives.*

Introduction

The growing threat of environmental destruction is now a major concern at both the global and national levels (Albakjaji, El Baroudy, 2024; Albakjaji, 2022). Among the key challenges linked to environmental degradation are air pollution and the accelerating impacts of climate change (Alsamara & Ghazi, 2024).

The international community faces difficulties in formulating cohesive strategies that tackle the environmental challenges (Albakjaji, 2025). Governments are making efforts through legal measures, regulatory actions, and developmental projects to limit the effects of environmental destruction (Albakjaji et al, 2025).

Saudi Arabia, known for its vast oil reserves, faces significant environmental challenges, including arid climate conditions, water scarcity, and reliance on fossil fuels. Recognizing the need for sustainable development, the Kingdom has initiated various policies and programs aimed at environmental conservation and climate protection.

Environmental protection has emerged as a strategic priority for the Kingdom of Saudi Arabia, driven by mounting environmental pressures associated with rapid industrial expansion and accelerated urban development. In response to these challenges, and under the framework of **Vision 2030**, the Kingdom has intensified efforts to develop and implement robust environmental legislation, strategies, initiatives and programs aimed at promoting sustainable development. Key policy initiatives include the air quality, climate change, conservation of water resources, the protection of biodiversity, the regulation of waste management, and the promotion of recycling practices (Albati et al, 2024).

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Air quality management has emerged as a key policy area globally, especially with the growing urgency of climate change and its impact on human health and the environment. Regulatory frameworks are central to this effort, providing the legal, institutional, and operational foundation for pollution control and environmental protection (OECD, 2021). In the context of Saudi Arabia, the Kingdom has taken significant steps to establish a comprehensive legal infrastructure in line with Vision 2030, particularly through the 2020 Environmental Law and the Executive Regulations for Air Quality.

Despite these reforms, Saudi Arabia continues to confront significant environmental challenges, including acute water scarcity and escalating air pollution. Addressing these complex issues necessitates the enactment of comprehensive environmental laws that not only regulate anthropogenic activities but also foster public engagement, promote innovation, and leverage advanced environmental governance and technologies.

This research aims:

- To analyze the effectiveness of Saudi Arabia's climate protection policies and initiatives.
- To assess the progress made in renewable energy adoption and environmental conservation.
- To identify challenges hindering the implementation of climate protection strategies, and policies.

To achieve its objectives, the study will seek to explore the following questions:

1. What is the key climate protection, regulations, and policies implemented by Saudi Arabia?
2. How effective have these policies been in achieving their intended goals?
3. What challenges does Saudi Arabia face in implementing climate protection measures?

Research Methodology

Regarding the research methodology, this study employs a qualitative research methodology, analyzing policy documents, statistical data, academic literature, and reports from reputable organizations. Primary data will be used where the researchers will use the relevant legal texts when analyzing the effectiveness of such rules and polices. Also, secondary data such as reports from professional departments and bodies will be used as well.

Legal Framework for Environmental Protection in general and the Air Protection, and Climate Change in Particular in Saudi Arabia

Environmental protection in Saudi Arabia is primarily governed by the Saudi Environmental Law, issued under Royal Decree No. M/165 of 2020, and enforced by the Environmental Regulations, also under Royal Decree No. M/165 dated 19 Dhu al-Qi'dah 1441 AH (corresponding to July 10, 2020), officially came into effect on January 13, 2021, replacing the previous 2011 regulations. Moreover, a significant institutional restructuring occurred in 2019, leading to the establishment of five specialized environmental centers to replace the former Presidency.

These five specialized centers operate under the supervision of the Ministry of Environment, Water, and Agriculture. These include:

- the National Center for Environmental Compliance,
- the National Center for Wildlife,
- the National Center for Waste Management,
- the National Center for Meteorology, and
- the National Center for Vegetation Cover Development and Combating Desertification.

The Environment Law is supported by approximately 17 executive regulations, which are primarily implemented through three key centers: the National Center for Environmental Compliance, the National Center for Wildlife, and the National Center for Vegetation Cover Development and Combating Desertification.

In addition, the Meteorology Law and its executive regulations are in effect, under the mandate of the National Center for Meteorology, which was established specifically for this purpose.

With regard to waste management, the Waste Law and its executive regulations are enforced through the National Center for Waste Management, which oversees the implementation and monitoring of relevant policies.

The updated environmental regulations prohibit numerous activities that lead to pollution of water, air, and land. Furthermore, any project with a potential environmental impact is required to comply with Saudi Arabia's environmental standards and principles. A key regulatory mechanism is the mandatory Environmental Impact Assessment (EIA), which obliges project developers to evaluate the environmental consequences of their proposals prior to receiving approval.

On the international stage, Saudi Arabia has ratified several major environmental conventions. These include the International Convention for the Prevention of Pollution of the Sea by Oil (Oilpol, 1954), the International Convention on Civil Liability for Oil Pollution Damage (CLC, 1969), and the Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC).

Notably, environmental considerations have also been integrated into national economic strategies. For example, the National Industrial Strategy, implemented in 2017, incorporates environmental planning within industrial development. This reflects the Kingdom's growing commitment to ensuring that industrial expansion aligns with environmental sustainability (Saudi Ministry of Industry and Mineral Resources, 2020).

Saudi Arabia's environmental legal framework places significant emphasis on the conservation of biodiversity. The Wildlife Protection Law of 2004 plays a central role in safeguarding the Kingdom's unique ecosystems, many of which are home to endemic and vulnerable species. This law establishes protected areas and prohibits practices that endanger wildlife habitats, thereby supporting the conservation of native flora and fauna.

A key initiative that reflects this commitment is the Saudi Green Initiative, launched in 2021. This national strategy seeks to enhance biodiversity, reduce carbon emissions, and restore degraded ecosystems through the planting of billions of trees and the rehabilitation of vast tracts

of land. These goals are reinforced by legal frameworks that safeguard these areas from unsustainable development and environmental degradation (Saudi Green Initiative, 2021).

These regulatory efforts are aligned with the broader objectives of Saudi Vision 2030, which emphasizes the reduction of air pollution and the expansion of renewable energy infrastructure. The National Renewable Energy Program, for example, is a key component of this strategy, aiming to diversify the Kingdom's energy mix and reduce its dependence on fossil fuels—thereby contributing to lower greenhouse gas emissions and improved air quality (Saudi Vision 2030, 2016).

Moreover, Saudi environmental law recognizes the importance of public participation in environmental decision-making. Involving stakeholders and local communities enhances social awareness and fosters a sense of shared responsibility for environmental protection. The Environmental Impact Assessment (EIA) process facilitates this participation by allowing public review and commentary on proposed projects, particularly those with potential environmental impacts. This participatory approach promotes transparency, ensures that community concerns are addressed, and helps maintain a balance between developmental goals and environmental conservation (GAMEP, 2019).

In relation to air and water quality, Saudi Arabia has implemented specific regulations aimed at controlling pollution and promoting sustainable development. The Air Quality Control Regulation and Water Qual ity Regulation, both enacted in 2008, establish limits on emissions and discharges from industrial and commercial activities. These standards are designed to protect public health, preserve natural resources, and ensure the long-term sustainability of the environment.

For air protection and climate change, Saudi Arabia has enacted a set of rules and regulations that establish a comprehensive legal framework aimed at safeguarding the environment, with specific provisions addressing air pollution, air quality protection, and climate change mitigation. This section focuses on the relevant articles and their implications in these areas. In the next section, researchers will discuss an overview of the key rules and regulations governing this area of environmental protection.

Environmental Law (2020)

The Environmental Law issued by Royal Decree No. M/165 in 2020, along with its executive regulations, especially the *Air Quality Executive Regulation*, represent a paradigm shift in environmental protection. These regulations specify emission limits, monitoring protocols, licensing requirements, and penalties for violations, marking a significant legal milestone (MEWA, 2020).

Article 1 defines "Air Quality" as the characteristics of air measured against standards and criteria established by the competent authority. This definition is not merely terminological—it has substantive importance. By tying the meaning of air quality to standards set by environmental and health authorities, the article empowers those authorities with regulatory discretion to determine acceptable pollution thresholds. This allows for scientific and contextual adaptability, ensuring that definitions remain responsive to evolving environmental risks and public health priorities.

From an analytical perspective, this article establishes a reference point for enforcement. Regulatory bodies cannot act arbitrarily—they must operate within the bounds of what qualifies

as acceptable air quality under these defined standards. It also provides a legal foundation for interpreting violations or compliance in later provisions.

Building upon the definitional framework, Article 1 articulates the overarching objective of the legislation: the protection and preservation of the environment through pollution prevention and mitigation. Importantly, it integrates the concept of sustainable development, emphasizing a balance between ecological integrity and socio-economic progress.

This article serves several critical functions. First, it acts as a guiding principle for interpreting all other provisions in the law. Second, it reinforces the obligation of the state and regulated entities to adopt a preventive approach to environmental harm, rather than merely reacting to violations after they occur. Analytically, this reflects a precautionary legal philosophy, aligned with international environmental law principles such as the Rio Declaration's Principle 15.

Moreover, by mandating adherence to environmental standards and criteria, the article links abstract objectives to enforceable benchmarks-making the objectives not just aspirational, but operational.

Regarding the Obligations for Harmful Substances, **Article 9** introduces concrete obligations for individuals and entities engaged in activities involving substances harmful to air quality or the ozone layer. Specifically, it requires them to implement the plans developed by the competent authority aimed at the gradual phase-out of these substances. This provision reflects a command-and-control regulatory model, where the government not only identifies harmful substances but also actively plans and oversees their elimination.

What is analytically significant here is the binding nature of the implementation requirement. Entities are not merely encouraged to reduce harmful emissions; they are legally required to follow specific phase-out strategies. This indicates a shift from voluntary compliance to regulated accountability, with administrative plans functioning as extensions of the law.

Additionally, the article emphasizes inter-agency coordination and regulatory hierarchy—the competent authority holds both scientific and enforcement power. The article also aligns with international environmental obligations, such as the Montreal Protocol, which mandates the phasing out of ozone-depleting substances.

Article 10 serves as a detailed and operational provision within the broader legislative framework for environmental protection, specifically addressing the protection of the ozone layer. Unlike Articles 1 and 1(1), which provide definitional and aspirational guidance, and Article 9, which outlines general obligations to phase out harmful substances, Article 10 imposes specific, enforceable restrictions on the handling of ozone-depleting substances (ODS) and related products.

The first two paragraphs of Article 10 introduce a permit-based regulatory scheme. Paragraph 1 prohibits the import, export, re-export, circulation, manufacture, or use of ODS—unless authorized through permits issued by the competent authority. Paragraph 2 extends this restriction to equipment and products—new or recycled—that contain such substances. This shows a deliberate shift from regulating substances in isolation to a life-cycle control approach, targeting both raw materials and the products in which they are embedded.

This dual-layer control mechanism has important legal and environmental implications. From a regulatory standpoint, it ensures upstream and downstream accountability, addressing both the

source and application of ODS. From an environmental perspective, it enhances preventive governance, minimizing the risk of ODS leaks throughout the product lifecycle.

Paragraph 3 mandates the disposal of ODS-containing materials, equipment, and products, again in accordance with regulations. This provision signals the law's commitment to a cradle-to-grave management strategy for hazardous substances. Disposal is not left to voluntary practice or industry discretion; it is regulated by law, likely under environmentally sound management (ESM) guidelines.

This reflects alignment with global environmental norms, particularly the Basel Convention on hazardous waste management and the Montreal Protocol, which requires proper disposal of ODS to prevent further atmospheric degradation. Legally, this provision creates a positive obligation on parties to not only cease usage but also safely eliminate existing stockpiles—an essential component of ozone recovery efforts.

Paragraph 4 introduces the most restrictive measure: an outright **ban on the import of used equipment and products** that contain ODS. This uncompromising stance is significant for two reasons:

- It **prevents the transfer of environmental risks** from other jurisdictions, a practice often seen when used or outdated technologies are exported from developed to developing countries.
- It **eliminates regulatory loopholes**, where ODS could re-enter the domestic market under the guise of second-hand goods.

Analytically, this absolute prohibition illustrates a **precautionary legal philosophy**—when uncertainty or potential harm exists, regulation errs on the side of environmental protection. It also positions the regulation as **proactive rather than reactive**, aiming to prevent future harm rather than merely responding to existing pollution.

Article 10 works in close synergy with **Article 9**, which mandates the gradual phase-out of substances affecting air quality and the ozone layer. However, while Article 9 emphasizes implementation plans and procedural compliance, **Article 10 introduces hard legal controls and enforcement tools**. This elevates the law from **programmatic commitment to operational enforcement**.

In essence, Article 10 reflects the transformation of environmental norms into **binding regulatory instruments**. It articulates a comprehensive legal strategy that:

- Establishes clear prohibitions and exceptions,
- Delegates authority to a competent regulatory body,
- Ensures environmentally sound disposal practices,
- Closes off avenues for non-compliant imports.

These components collectively reinforce the legal regime's **integrity, enforceability, and alignment with international best practices**.

In conclusion, **Article 10 represents the legislative backbone of ozone layer protection** within this regulatory framework. It introduces enforceable restrictions, requires responsible disposal, and bans high-risk imports—all under the oversight of a competent authority. From an analytical

standpoint, it exemplifies how environmental protection objectives and definitional clarity **(Article 1)** can be translated into clear, enforceable legal obligations. It reflects a strong commitment to environmental governance that is not only aligned with global treaties but also tailored to national enforcement priorities.

While substantive provisions of environmental legislation set the objectives, standards, and prohibitions essential for protecting air quality and public health, they are only effective if supported by a robust and enforceable implementation mechanism. **Article 48** of the law addresses this critical requirement by mandating the issuance of executive regulations to operationalize its provisions, including those pertaining specifically to air quality.

Article 48 serves as the bridge between legislative intent and administrative execution. It delegates authority to the competent administrative or executive body—typically a ministry of environment or equivalent regulatory agency—to draft and enact the detailed executive regulations necessary for enforcement. These regulations translate the often broad or abstract principles of the law into concrete, actionable rules, such as:

- Technical standards for air pollutant emissions;
- Permitting procedures for ozone-depleting substances (as in Article 10);
- Monitoring and reporting requirements;
- Penalties and compliance timelines.

Analytically, this demonstrates a two-tiered regulatory structure, where primary legislation sets legal obligations and policy direction, while secondary legislation fills in the technical and procedural detail. This is a hallmark of modern administrative law, ensuring flexibility and responsiveness without undermining the supremacy of the legislative framework.

By mandating executive regulations, Article 48 grants the competent authority legal and institutional flexibility. Environmental science and air quality standards are constantly evolving; executive regulations can be updated more efficiently than primary laws. This adaptive capacity is crucial in environmental governance, allowing regulators to respond to new pollutants, emerging technologies, or updated international commitments (e.g., amendments to the Montreal Protocol or updated WHO air quality guidelines).

From an analytical perspective, this provision enables a dynamic regulatory environment—one that evolves in step with scientific advancements and policy priorities. It also underscores the principle of subsidiarity, allowing technically qualified bodies to define and enforce the specific means of meeting legislative ends.

While Article 48 empowers the executive to issue implementing rules, it also implicitly requires that these regulations remain legally consistent with the objectives and provisions of the primary law. In most legal systems, executive regulations are subject to:

- Judicial review for legality and procedural fairness;
- Public consultation during drafting (as part of participatory environmental governance);
- Legislative oversight, especially where significant rights or obligations are concerned.

Thus, Article 48 not only facilitates implementation-it also reinforces transparency, accountability, and legal coherence.

Regarding the integration with the broader framework, Article 48 plays a critical role in activating other key provisions of the law:

- It gives regulatory effect to definitions (Article 1) by enabling the setting of measurable air quality criteria;
- It allows the development of enforcement procedures and phase-out plans as required by Articles 9 and 10;
- It supports the operationalization of national environmental objectives (Article 1) through practical regulation and guidance.

The article (48) transforms legislative vision into regulatory reality. In other words, Article 48 is the legal engine of implementation. Without it, the law's commitments to air quality and environmental protection would remain largely declaratory. It ensures that obligations set out in substantive articles are translated into specific, enforceable rules through detailed executive regulations. Analytically, this article affirms a fundamental truth in environmental law: effective protection requires not only strong legal principles but also efficient, science-based, and adaptive administrative systems to carry them out.

Executive Regulations for Air Quality:

In accordance with Article 48, the Ministry of Environment, Water, and Agriculture issued the Executive Regulations for Air Quality, which include:

- **Monitoring and Evaluation:** Establishing mechanisms for monitoring sources and levels of air pollution, and evaluating air quality indicators.
- **Standards and Controls:** Proposing environmental standards, criteria, controls, and requirements related to air quality and its protection from pollution.
- **Permits and Licenses:** Defining the scope of work for the National Center for Environmental Compliance regarding the approval of rules, conditions, and controls for permits and licenses related to air quality.
- **National Plans:** Preparing and implementing national plans and projects aimed at reducing air pollution and limiting its effects.

Executive Regulations for Air Quality reflect Saudi Arabia's commitment to environmental preservation and international efforts to reduce the causes of climate change. They emphasize the Kingdom's adherence to international standards and agreements as part of global programs lau3nched by specialized organizations. One of the key strategies promoted is the circular carbon economy, through which emissions can be managed comprehensively and interactively, aiming to mitigate the impact of climate challenges.

Article 3 of the Executive Regulations for Air Quality provides the institutional and functional backbone for implementing the air quality provisions of the national environmental law. It does so by **defining the roles and responsibilities of the National Center for Environmental Compliance (NCEC)**-the primary agency tasked with executing air quality governance in practice. This article can be understood in terms of four core functions: standard-setting, monitoring, data management, and project implementation. Each of these elements plays a distinct yet interdependent role in realizing the objectives of environmental protection and sustainable development.

The first duty of the NCEC under Article 3 is to propose environmental standards, criteria, controls, and requirements for air quality protection. These are then submitted to the Ministry for final approval. This process reflects a technocratic delegation of scientific and technical expertise to a specialized agency, ensuring that environmental regulation is based on evidence and international best practices.

From a legal and analytical standpoint, this provision supports the principle of environmental rationality—the idea that environmental decision-making must be grounded in data, risk analysis, and public health concerns. It also demonstrates the division of authority between the NCEC (as a proposing body) and the Ministry (as the final decision-maker), maintaining institutional checks and balances.

The second function—monitoring and assessing air quality and pollution sources—ensures that environmental regulation is not static but dynamic and responsive to real-time data. This role is critical in maintaining compliance with the environmental standards and criteria proposed earlier.

In analytical terms, this provision transforms legal norms into measurable environmental outcomes. It also enhances regulatory credibility and enforcement capacity, allowing authorities to identify high-risk areas, evaluate the effectiveness of policy interventions, and ensure that emissions are within permissible limits.

This aligns with international environmental principles such as the "right to a healthy environment" and the "duty to prevent harm", both of which require proactive surveillance and risk management.

Article 3 also empowers the NCEC to obtain data from individuals, government entities, and NGOs. This clause formalizes a legal right to access environmental information—a prerequisite for transparent governance, accountability, and scientific integrity.

From an analytical perspective, this reflects adherence to Principle 10 of the Rio Declaration (1992), which promotes public access to environmental information. It also operationalizes the concept of collaborative governance, where multiple actors—including civil society and private stakeholders-participate in providing information critical to environmental protection.

This mechanism facilitates horizontal coordination across sectors and vertical integration between central and local authorities, enhancing institutional coherence in air quality governance.

Finally, the article authorizes the NCEC to develop and implement national projects aimed at reducing air pollution. This provision shows that the agency is not merely a regulatory body, but also a developmental and implementation-focused institution. Projects under this clause may include clean air initiatives, industrial transition programs, green infrastructure, or community-based pollution mitigation schemes.

Analytically, this function reinforces the integrated policy approach needed for complex environmental challenges like air pollution. It also shows the transition from traditional command-and-control environmental regulation to a policy-mix model, where law, projects, incentives, and partnerships are combined for effective environmental governance.

Article 3 of the Executive Regulations acts as the practical counterpart to Articles 1, 9, 10, and 48 of the primary environmental law. Where those articles establish definitions, prohibitions,

and enforcement mechanisms, Article 3 assigns the institutional responsibilities required to bring them to life.

- It supports Article 48 (Executive Regulations) by giving substance to how air quality regulations will be developed and enforced.
- It enables the implementation of Article 9 and 10 of the environmental law, which require careful monitoring and control of ozone-depleting and polluting substances.
- It gives effect to the broader objectives of Article 1(1) by embedding the institutional capacity to ensure sustainable development.

Article 3 of the Executive Regulations establishes the National Center for Environmental Compliance as the operational hub for air quality governance. Through its mandates in standard-setting, monitoring, information management, and project implementation, the article ensures that environmental laws are not only aspirational but enforceable and actionable. Analytically, the article reflects modern principles of environmental law—transparency, scientific-based regulation, institutional coordination, and adaptive governance—while empowering a specialized body to act decisively in protecting public health and environmental integrity.

Article 5 of the Executive Regulations for Air Quality mandates that facilities emitting air pollutants must install environmental monitoring and surveillance systems and submit periodic reports on ambient air quality. This requirement marks a critical shift from reactive to preventive environmental management, reinforcing a system of continuous oversight, transparency, and evidence-based policy enforcement.

At its core, Article 5 places the legal responsibility on polluting entities—primarily industrial and commercial facilities—to monitor their environmental impact. By obligating these entities to install environmental surveillance systems, the regulation ensures that emissions are not only limited but also quantitatively recorded, enabling both self-regulation and governmental oversight.

From an analytical standpoint, this reflects a key environmental law principle: "the polluter must monitor." It reinforces the polluter pays and precautionary principles, shifting part of the monitoring burden from government agencies to private actors, while ensuring that non-compliance is traceable and punishable through empirical data.

The requirement for facilities to submit periodic reports on ambient air quality serves a dual purpose. Firstly, it creates a systematic stream of data for environmental authorities to assess air pollution trends, identify high-risk zones, and adjust regulatory approaches accordingly. Secondly, it fosters regulatory transparency and strengthens public trust, as such data may eventually support public health studies, environmental impact assessments, and community right-to-know programs.

Analytically, this aligns with international environmental governance norms such as Principle 10 of the Rio Declaration (1992), which promotes access to information and participation in environmental matters. It also conforms with OECD guidelines on industrial emissions monitoring, reflecting a globally recognized best practice in environmental compliance systems.

Regarding its Importance for Air Protection, air pollution is a leading cause of premature deaths, respiratory diseases, and ecosystem degradation. The installation of monitoring systems allows regulators and the public to better understand the composition, concentration, and dispersion of

pollutants such as nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter ($PM_{2.5}$/PM_{10}), and volatile organic compounds (VOCs).

Through this provision, Article 5 makes it possible to:

- Detect pollution spikes in real time;
- Enforce emissions limits more precisely;
- Tailor air quality action plans based on actual da
- Hold emitters accountable through direct evidence.

In essence, this article provides the tools to measure progress toward national and international air quality goals and ensures that protective measures are backed by scientifically verified information.

For its relevance to climate change mitigation, while ambient air quality regulation primarily targets local and regional pollutants, Article 5 also has significant climate co-benefits. Monitoring systems often detect not just classical air pollutants, but also greenhouse gases (GHGs) such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Facilities compelled to monitor their emissions are more likely to:

- Track their carbon footprint;
- Identify opportunities for emission reductions;
- Shift toward cleaner technologies to remain compliant.

Therefore, Article 5 indirectly supports national climate mitigation strategies, particularly under commitments like Saudi Arabia's Vision 2030 Environmental Objectives, the Saudi Green Initiative, and international frameworks such as the Paris Agreement.

Article 5 also represents a procedural innovation in Saudi Arabia's environmental legal framework. It shifts from traditional reliance on periodic inspections to a continuous compliance culture, where regulated entities become co-participants in safeguarding the environment. This not only increases enforcement efficiency for the National Center for Environmental Compliance (NCEC) but also builds a comprehensive environmental information system for long-term planning.

Furthermore, the mandatory nature of this article signals that environmental surveillance is not optional—it is an enforceable legal obligation. Failure to comply can be tied to administrative sanctions, license suspensions, or fines, strengthening the deterrent effect of the regulation.

Article 5 of the Executive Regulations for Air Quality is a pivotal provision that empowers the legal system to move from passive environmental oversight to active, data-driven governance. Its requirement for environmental monitoring and reporting transforms regulated facilities into accountable actors, fosters regulatory transparency, and enables timely interventions against air pollution. Critically, it also supports climate resilience by enabling data collection on emissions that contribute to global warming. As such, Article 5 is not only essential for improving ambient air quality, but also represents a strategic legal tool for advancing environmental protection and climate change mitigation in Saudi Arabia and beyond.

On the other hand, Article 7 targets a specific and often underestimated source of air pollution: the generation and dispersal of dust and aerosols from construction, excavation, demolition, and material transport activities. This article legally obligates all individuals and entities involved in such activities to implement specific mitigation measures designed to reduce air pollutant emissions at the source.

The activities mentioned-exploration, excavation, demolition, and transportation—are inherently dust-intensive and contribute significantly to particulate matter (PM_{10} and $PM_{2.5}$) emissions, which are dangerous to human health and degrade air quality. The regulation recognizes that non-industrial and mobile sources of pollution, such as construction sites and material transport vehicles, are increasingly relevant in urban and rapidly developing regions like Saudi Arabia.

The **three core mitigation obligations** under this article are:

1- Material Containment

Operators must cover volatile materials (like sand, cement, or debris), spray them with water, or store them in enclosed spaces. This reduces the risk of dust becoming airborne, especially in arid regions where wind erosion is common.

2- Transport Emission Control

Vehicles used in transporting such materials must be specially equipped to minimize leakage and dust escape during loading, transit, and unloading. This includes sealed containers, covered truck beds, and controlled unloading mechanisms.

3- Route and Method Management

The design of transport routes and handling methods must be optimized to reduce the emission of dust and volatile particles at worksites. For example, using paved roads, restricting operations during high-wind periods, or deploying localized air suppression systems.

From an environmental health perspective, Article 7 is crucial because particulate matter (especially $PM_{2.5}$) is linked to serious health conditions such as asthma, lung cancer, cardiovascular diseases, and premature mortality. Construction dust often contains not only dirt but also silica, heavy metals, and other harmful substances, especially when demolishing older buildings or handling industrial materials.

By mandating on-site mitigation, the article helps protect workers, nearby residents, and the general public from direct exposure, especially in densely populated or urbanized areas.

Article 7 provides a preventive framework that enables environmental regulators to assess compliance based on observable, enforceable practices. Rather than relying solely on end-of-pipe emission testing, the article shifts focus to behavioral and procedural compliance, making it easier to inspect and enforce.

It also complements other articles such as:

- **Article 5** (monitoring air quality) — by reducing dust emissions at the source, facilities are less likely to breach air quality thresholds.
- **Article 3** (NCEC authority) — enabling the National Center to set and enforce dust control standards.

- **Article 9 (environmental law)** — reinforcing obligations to prevent the release of air pollutants harmful to the environment and human health.

Although dust and aerosols are not greenhouse gases (GHGs), their control has climate co-benefits:

- Dust and aerosols can affect local climate patterns by altering radiation absorption and cloud formation. Reducing their emission supports climate stability.
- Some dust particles, particularly black carbon, contribute directly to global warming by absorbing solar radiation.
- Effective dust management reduces the need for cleanup operations and improves the efficiency of green infrastructure projects, such as urban afforestation and solar panel deployment (which is sensitive to dust accumulation).

Moreover, the practices encouraged under Article 7 (e.g., route planning, emission-reducing transport) are consistent with sustainable development principles and can even support circular economy strategies if combined with material recycling requirements.

From a legal perspective, Article 7 operationalizes Saudi Arabia's environmental obligations under both national regulations and international frameworks, such as:

- The Stockholm Convention on Persistent Organic Pollutants, which encourages measures to reduce unintentional emissions;
- The UN Sustainable Development Goals (SDG 11 and 13), related to sustainable cities and action on climate.

Institutionally, this article empowers regulatory bodies to issue site-specific guidelines, conduct spot inspections, and penalize violators. It also encourages the construction and transport sectors to adopt environmental management systems (EMS) and modernize their operations through greener practices and technologies.

In summary, **Article 7** of the Executive Regulations for Air Quality plays a vital role in proactive pollution control. It ensures that dust and aerosol emissions from physical operations—especially construction and material transport—are minimized through practical, enforceable measures. The article not only protects public health and improves ambient air quality, but also aligns with broader climate resilience and sustainable development strategies by addressing the environmental impact of infrastructure growth. In a rapidly developing country like Saudi Arabia, this article is essential for balancing economic expansion with ecological responsibility.

Executive Regulation for Apprehension of Violations and Imposition of Penalties

The **Executive Regulation for Apprehension of Violations and Imposition of Penalties** is a fundamental legal instrument within Saudi Arabia's environmental regulatory framework. Its primary objective is to ensure compliance with environmental laws—including those that govern air quality—by establishing clear procedures for identifying, prosecuting, and penalizing violations. It translates the preventive and protective goals of environmental legislation into actionable enforcement mechanisms.

This regulation complements the broader Environmental Law and the Executive Regulations for Air Quality, particularly by ensuring that violations do not go unchecked, and that polluters are held accountable through a structured legal process.

Article 2. Violations Apprehension, defines what constitutes a **violation** under environmental law. It includes unauthorized emissions of pollutants, failure to install monitoring equipment, breach of licensing terms, use of prohibited substances (like ozone-depleting chemicals), and non-compliance with air quality thresholds.

This provision ensures that both intentional and negligent behaviors that harm the environment are legally recognized and subject to penalties.

• **Article 3. Violations Apprehension Procedures,** here, the regulation outlines how violations should be detected, documented, and processed. Competent authorities such as the National Center for Environmental Compliance (NCEC) are empowered to carry out inspections, monitor activities, and gather evidence. This procedural clarity is essential to avoid arbitrary enforcement and ensures that violators are prosecuted based on verified data—such as air quality monitoring reports, site inspections, and third-party complaints.

• **Article 4. Penalties.** This article stipulates a range of penalties based on the nature and severity of the violation. These may include:

- Fines for exceeding pollution limits
- Suspension or revocation of environmental licenses
- Shut-down orders for facilities causing significant harm
- Obligatory remediation or restoration measures
- Public disclosure or naming of violators in extreme cases

Penalties are designed not just to punish, but to deter future violations, encourage prompt corrective actions, and incentivize investments in cleaner technologies.

• **Article 8. Violations Review Committee.** This article establishes a specialized Review Committee tasked with evaluating violations and reviewing appeals. It ensures that enforcement is accompanied by procedural fairness and due process, allowing entities to defend themselves and seek redress when needed.

Regarding its importance for air protection, air pollution poses a significant risk to public health and ecosystems, particularly in regions undergoing rapid industrial and urban expansion. This regulation helps address these risks in the following ways:

- It creates a legal deterrent against non-compliance with air quality standards.
- It ensures regular monitoring and enforcement of obligations, such as installing surveillance systems, reporting emissions, and phasing out ozone-depleting substances.
- It compels polluters to adopt mitigation technologies and best practices, as the cost of non-compliance becomes higher than the cost of prevention.

Importantly, enforcement through this regulation strengthens the **implementation of Articles 5, 7, 9, and 10** of the Executive Regulations for Air Quality—each of which deals with pollutant control, monitoring, and environmental management systems.

Role in climate change mitigation, while the regulation does not directly address greenhouse gas (GHG) emissions, it plays an indirect yet powerful role in climate change mitigation:

1. **Regulatory Pressure on Polluting Industries**: By enforcing air emission limits and penalizing unlicensed emissions, it encourages polluting sectors (e.g., energy, construction, transport) to upgrade their technologies and reduce not only conventional pollutants (e.g., SO_2, NOx, PM) but also climate-relevant gases.

2. **Support for International Agreements**: The regulation reinforces Saudi Arabia's commitments under the **Paris Agreement**, the **Montreal Protocol**, and the **Kigali Amendment**, especially regarding ozone protection and the gradual phase-out of HFCs and HCFCs.

3. **Enhancing Transparency and Accountability**: Climate policy is increasingly driven by data and public disclosure. This regulation mandates reporting and record-keeping, which supports **climate transparency mechanisms** and **national greenhouse gas inventories**.

From a legal perspective, this regulation strengthens the **rule of law in environmental governance**. It enhances the ability of regulators like the NCEC to:

- Issue cease and desist orders
- Monitor compliance in real time
- Use digital reporting systems
- Track violations and repeat offenders
- Provide legal remedies through a transparent appeals process

It also supports interagency coordination, enabling collaboration with other ministries such as the Ministry of Environment, Water, and Agriculture (MEWA), the Ministry of Industry, and municipal authorities.

The **Executive Regulation for Apprehension of Violations and Imposition of Penalties** is a cornerstone of Saudi Arabia's environmental enforcement strategy. It transforms environmental norms into enforceable legal duties, thereby protecting air quality, safeguarding public health, and contributing to climate mitigation efforts. By introducing clear definitions, procedures, and sanctions, the regulation builds institutional capacity for environmental compliance and supports the country's broader vision of sustainable development and climate responsibility.

Regarding the implementation mechanisms, the National Center for Environmental Compliance is tasked with monitoring environmental compliance across all establishments impacting the environment. It supervises programs for monitoring sources of environmental pollution, including air quality, and approves environmental impact studies and licenses for development projects. The Center also coordinates with relevant authorities to improve environmental compliance through pollution monitoring, assessment, and guidance.

The Center worked to enhance the efficiency of environmental compliance and oversight, and reduce environmental pollution. This work included identifying 2,971 environmentally degraded sites, developing plans for their rehabilitation, addressing 487 environmental reports, issuing 195 licenses to environmental service providers to increase private sector participation, issuing 15,246 environmental permits, and implementing ongoing environmental monitoring to ensure that facilities with environmentally impacting activities comply with environmental laws and regulations (The National Center for Environmental Compliance, 2024).

Concerning ensuring compliance with the Environmental Law and its implementing regulations, the Center issues permits to establishments with activities that impact the environment in all

categories, to increase the efficiency of establishments' compliance with the Environmental Law and its implementing regulations, and to contribute to enhancing economic sustainability in the environmental sector. The center issued 15,246 environmental permits, contributing to the creation of job opportunities in the environmental sector and contributing to economic sustainability (The National Center for Environmental Compliance, 2024).

The center conducted 61,550 inspection tours, covering all activities with an environmental impact, to ensure that facilities comply with environmental regulations and requirements.

The Center issued 565 periodic environmental monitoring reports to enhance oversight and improve environmental compliance.

In 2024, the Center announced that there were 27,064 detected environmental violations, covering all activities with an environmental impact (The National Center for Environmental Compliance Report, 2024)

Translating Environmental Rules into Action: A Review of Policies and Initiatives for Air and Climate Protection

4.1. Strategic Role of Vision 2030

Vision 2030 places strong emphasis on sustainable development and environmental protection. The **Saudi Green Initiative** aims to increase the number of trees and reduce carbon emissions. These objectives require not just policy ambition but also strong legal enforcement tools, where the Air Quality Regulation serves as a foundational instrument.

The alignment of regulatory measures with Vision 2030 goals is evident in the strategic planning documents published by MEWA, NCEC, and the Ministry of Energy.

Launched in 2016, Vision 2030 is Saudi Arabia's strategic framework aimed at diversifying its economy and reducing dependence on oil. Environmental sustainability is a core component, with goals to increase renewable energy capacity, enhance energy efficiency, and promote conservation efforts.

Introduced in 2021, the Saudi Green Initiative is a comprehensive plan to combat climate change, improve quality of life, and protect future generations. Key targets include:

- Achieving net-zero emissions by 2060.
- Reducing carbon emissions by 278 million tons annually by 2030.
- Planting 10 billion trees and rehabilitating 40 million hectares of land.
- Protecting 30% of the Kingdom's land and sea areas by 2030.

These objectives align with international commitments, such as the Paris Agreement, and demonstrate Saudi Arabia's dedication to global climate goals.

Renewable Energy Initiatives

Solar and Wind Energy Projects

Saudi Arabia aims to generate 50% of its electricity from renewable sources by 2030, targeting a total renewable energy capacity of 100 to 130 gigawatts (GW) (Joudah, 2024).

Sudair Solar PV Project

Sudair Solar PV is poised to become one of the largest single-contracted solar PV plants in the world and the largest of its kind in Saudi Arabia at an installed capacity of ~1,500MW. First project under The Public Investment Fund's (PIF) renewable energy programme, the project has recorded the second lowest cost globally for Solar PV electricity production [USD 1.239 cents/kwh] (Acwapower a, 2025).

Dumat Al Jandal Wind Farm: launched in 2019 under the National Renewable Energy Program, represents Saudi Arabia's first and largest wind power project, with an investment of $500 million. Officially becoming operational in 2022, the facility comprises 99 wind turbines and has a total generation capacity of 400 megawatts (MW). It supplies clean electricity to approximately 70,000 homes, thereby contributing significantly to the Kingdom's efforts to reduce its dependence on oil and curb carbon emissions. Beyond its environmental benefits, the project has also delivered economic advantages to the Al Jouf region through job creation and increased foreign investment in the renewable energy sector.

Remarkably, the project achieved a record-low electricity generation cost of $0.0199 per kilowatt-hour (kWh), earning it the **2019 Renewable Deal of the Year** award from *Project Finance International*. As a flagship initiative, the wind farm plays a critical role in advancing Saudi Arabia's strategic objective of generating 50% of its electricity from renewable sources by 2030 (Vision 2030 website).

Green Hydrogen Development

Saudi Arabia is positioning itself at the forefront of global green hydrogen production through the development of pioneering projects, most notably the **NEOM Green Hydrogen Project**. Recognized as the world's largest utility-scale, commercially-driven hydrogen facility powered entirely by **renewable energy**, this project marks a transformative step in the Kingdom's clean energy strategy.

Developed as an **equal joint venture** between NEOM, **Air Products**, and **ACWA Power**, the project integrates proven, world-class technologies to deliver approximately **four gigawatts (GW)** of renewable power sourced from onshore solar, wind, and advanced energy storage systems. Upon its planned commissioning in **2026**, the facility is expected to produce:

- **600 tonnes of green hydrogen per day** via electrolysis using **ThyssenKrupp technology**.
- Industrial-scale **nitrogen production** through air separation, employing **Air Products' proprietary systems**.
- Up to **1.2 million tonnes of green ammonia annually**, facilitating global transportation and export of clean energy (NEOM Green Hydrogen Company, 2025).

This project is designed to **reduce carbon emissions by an estimated 5 million metric tonnes annually**, significantly supporting the goals of the **Saudi Green Initiative (SGI)** and contributing to international decarburization efforts. As such, the NEOM Green Hydrogen Project underscores Saudi Arabia's ambition to become a leading supplier of carbon-free fuel and a key player in the global energy transition (Acwapowe b, 2025).

These efforts underscore the Kingdom's commitment to innovative solutions for reducing carbon emissions.

Urban Greening and Conservation Efforts

Green Riyadh Project

The Green Riyadh Program is designed to significantly increase the per capita share of green spaces and expand the overall percentage of greenery throughout the city. This will be achieved through widespread afforestation across all urban zones, coupled with the efficient utilization of treated wastewater for irrigation purposes. By enhancing urban vegetation, the initiative aims to improve air quality, reduce urban heat island effects, and promote a more active and healthy lifestyle among residents. These objectives align closely with the broader environmental and social sustainability goals outlined in Saudi Arabia's Vision 2030 (Royal Commission for Riyadh City, 2025).

The Green Riyadh Program aims to plant over 7.5 million trees across the city by 2030, with the objective of increasing the per capita share of green space from 1.7 square meters to 28 square meters—a sixteen-fold increase. Additionally, the initiative seeks to raise the total proportion of green areas in Riyadh from 1.5% to 9%. These efforts are expected to significantly enhance urban livability, improve air quality, and contribute to the overall quality of life for residents in line with the goals of Vision 2030 (Royal Commission for Riyadh City, 2025). This initiative reflects a holistic approach to urban sustainability and climate resilience.

Renewable Energy Capacity

By 2060, the Kingdom of Saudi Arabia aims to achieve net-zero greenhouse gas (GHG) emissions, in alignment with its long-term climate commitments. As part of its Vision 2030 framework, the Kingdom has set interim targets, including generating 50% of its electricity from renewable energy sources and reducing 278 million tonnes of CO_2 equivalent annually by 2030 (Islam & Ali, 2024).

Carbon Emissions Reduction

As of 2020, Saudi Arabia's electricity sector, with an installed capacity of 90 gigawatts (GW), plays a pivotal role in the nation's decarburization strategy. The sector is targeting a 55% reduction in emissions by 2030, supported by the Saudi Energy Efficiency Center's Energy Efficiency Action Plan, which aims to lower power intensity by 30% within the same timeframe. Further demonstrating the Kingdom's commitment to sustainability and innovation, the NEOM project includes a landmark 4 GW green hydrogen facility, positioning Saudi Arabia as a leader in clean energy technologies and the global energy transition (Islam & Ali, 2024).

Neighborhood Afforestation Projects

These projects include afforestation of the following elements (Royal Commission for Riyadh City, 2025):

43 grand parks

148 km2 of valleys and their tributaries

1205 linear km of main roads

According to the Royal Commission for Riyadh City (2025), the Green Riyadh program Projects will help:

- Reducing the air temperature by 1.5 to 2 ° C at the city level.

- Reducing the temperature of glare reflected from the surface of the earth between 8 to 15 degrees in intensive afforestation areas.
- Reducing carbon dioxide by 3-6%, increasing the rate of oxygen, and increasing the rate of air humidity, thus improving the air quality in the city.
- Reducing energy consumption by an average of 650 GWh during the year.
- Increasing the city's capacity to absorb rainwater and reduce the effects of flooding in the city.

Conclusion & Recommendations:

Saudi Arabia has made significant progress in developing a coherent national strategy, regulations for climate and air protection, demonstrated by Vision 2030, the Saudi Green Initiative, and its investments in renewable energy and biodiversity. The integration of policy, innovation, and mega-projects like NEOM positions the Kingdom as a potential regional leader in sustainability.

The environmental law and the air quality executive regulations, projects, and initiatives constitute a cornerstone of Saudi Arabia's efforts to improve air quality, and official statistics have demonstrated that they have contributed to increased compliance and monitoring. However, institutional and legislative, and technical challenges remain.

Finally, the study shows that Saudi Arabia has implemented a wide range of laws, regulations, initiatives, and projects that together form a comprehensive framework for air quality and climate protection. These efforts have positioned the Kingdom as a prominent global actor in environmental governance, serving as a model for other nations aiming to enhance their own strategies for environmental protection-particularly in the areas of air quality and climate change (Albati et al, 2024).

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