Engineering a Greener and Sustainable World: Context Setting And Review of Progress Made Globally

Role of financial institutions in accelerating progress using Platform Capital Energy Solutions for the Oil, Gas, and Extractive Industries as a case study

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SECTION 1: Preamble

Introduction and Context

PREAMBLE

Global Emissions

Global greenhouse gas (GHG) emissions has emerged as one of the most persistent environmental challenges of the 21st century. Greenhouse gases are critical to maintaining Earth's temperature within a range that supports life. Naturally occurring greenhouse gases such as water vapour (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and ozone (O_3) create an insulating effect by absorbing and re-radiating infrared radiation from the Sun. Without this natural greenhouse effect, Earth's average temperature would be approximately -20°C, making it inhospitable to most life forms (British Geological Survey [BGS], 2025). However, since the onset of the Industrial Revolution in the mid-18th century, human activity—with the burning of fossil fuels being finger-pointed as biggest culprit by many—has dramatically increased the concentration of greenhouse gases in the atmosphere. This anthropogenic enhancement of the greenhouse effect is the primary driver of current global warming trends (BGS, 2025).[1]

The primary greenhouse gases contributing to global warming include:

Carbon Dioxide (CO2): This is the most significant anthropogenic GHG, accounting for approximately 76% of total global GHG emissions in recent years (Our World in Data, 2023). Its main sources are the combustion of fossil fuels (coal, oil, and natural gas) for energy production, industry, transportation, and heating, as well as deforestation and land-use change.[2]

Methane (CH4): A potent GHG, methane contributes about 16% of total emissions. It has a much higher warming potential per molecule than CO2 over a shorter period. Major sources include agriculture (livestock enteric fermentation, rice cultivation), fossil fuel extraction and transport (leakage from oil and gas operations), and waste decomposition in landfills (IEA, 2023a).

[1] British Geological Survey (2025). The greenhouse effect. Discovering Geology – Climate change. Retrieved from https://www.bgs.ac.uk/discovering-geology/climate-change/how-does-the-greenhouse-effect-work/
[2] Our World in Data. (2023). Greenhouse Gas Emissions. Retrieved from https://ourworldindata.org/greenhouse-gas-emissions (Accessed June 2025)

Nitrous Oxide (N2O): Accounting for roughly 6% of total emissions, N2O primarily originates from agricultural activities, particularly the use of nitrogen-based fertilizers, as well as industrial processes and the combustion of fossil fuels (EPA, 2024).[3]

Fluorinated Gases (F-gases): These synthetic gases (including HFCs, PFCs, SF6, and NF3) contribute around 2% of emissions but have extremely high global warming potentials, persisting in the atmosphere for thousands of years. They are used in refrigeration, air conditioning, aerosols, and various industrial processes (UNEP, 2022).

Recent Trends and Scale

Global GHG emissions have shown a consistent upward trend since the Industrial Revolution, primarily driven by economic growth and population increase. In 2022, global energy-related CO2 emissions, which constitute the largest share of total GHGs, reached a record high of over 36.8 gigatonnes (GtCO2) (IEA, 2023b). When all GHGs are considered and converted to CO2 equivalents (CO2eq), total anthropogenic GHG emissions reached approximately 57.4 GtCO2eq in 2021 (UNEP, 2022). The energy sector remains the largest contributor, followed by industry, agriculture, forestry, and transportation.

Impacts and Consequences

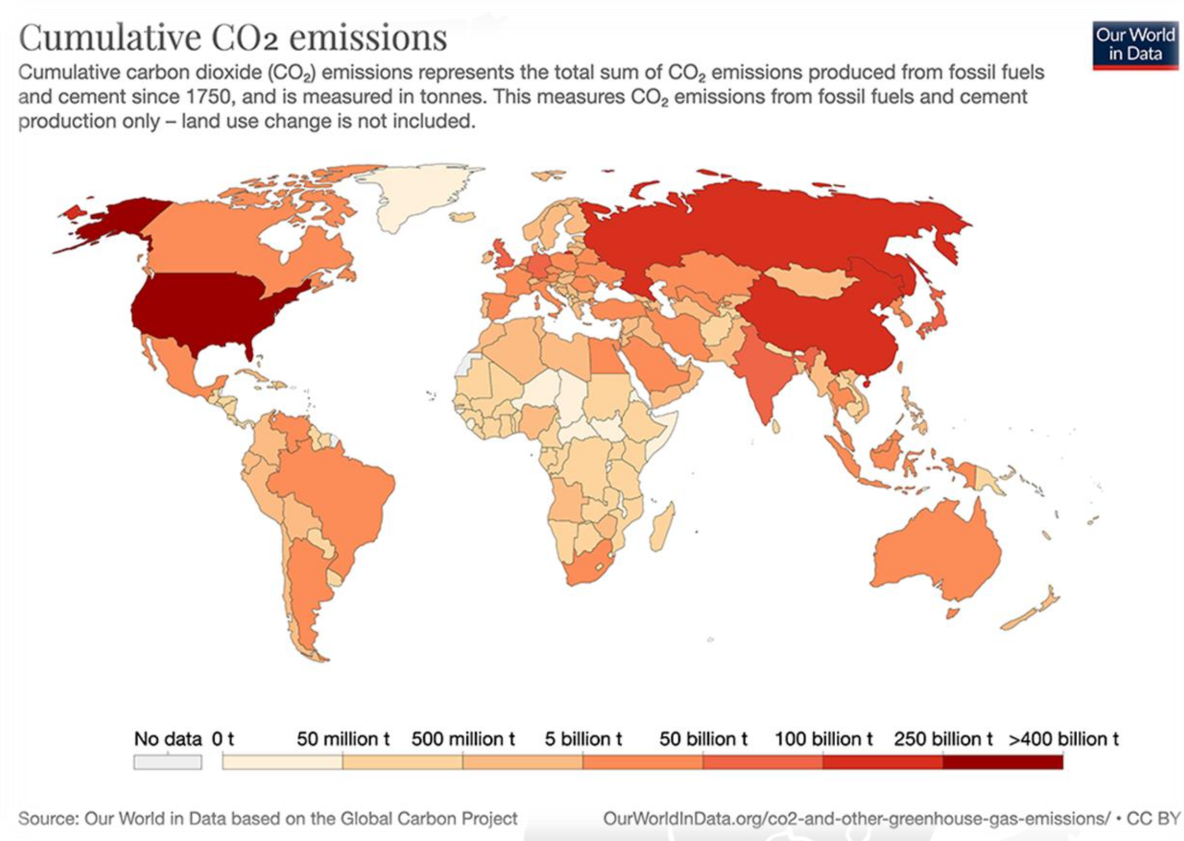
The continued increase in GHG concentrations in the atmosphere is directly correlated with rising global temperatures, leading to a cascade of severe environmental impacts. These include more frequent and intense extreme weather events (heatwaves, droughts, floods, wildfires), sea-level rise threatening coastal communities, ocean acidification, biodiversity loss, and disruptions to food and water security (IPCC, 2023).

Emissions Disparity Between the Global North and Global South

The global distribution of greenhouse gas (GHG) emissions reveals a striking disparity between the Global North and the Global South—one that continues

[3] Environmental Protection Agency (EPA). (2024). Overview of Greenhouse Gases. Retrieved from https://www.epa.gov/ghgemissions/overview-greenhouse-gases (Accessed June 2025)

to shape international climate negotiations and debates on climate justice. The Global North, consisting of industrialized nations like the United States, Canada, and much of Europe, bears historical responsibility for the bulk of global emissions, largely due to early and sustained industrialization. According to Pardikar (2020), the Global North is responsible for 92% of excess carbon emissions, with the United States alone contributing 40% and the European Union 29% to the current climate breakdown.



Emissions between the Global North and Global South (Source: Carnegie Europe 2021)

In contrast, the Global South, comprising developing countries across Africa, Asia, and Latin America, has contributed minimally to historical emissions but is now experiencing rising emission levels due to industrialization and population growth. In 2017, the Global South was responsible for approximately 58% of total CO_2 emissions, though these emissions are highly concentrated—China and India alone accounted for nearly 60% of the South's emissions (Pardikar, 2020). By comparison, over 120 countries in the Global South contribute just 22% of its total emissions, underscoring the diversity and inequality within the group itself. This imbalance intensifies the demand from the Global South for climate finance and technology transfer from the North. While per capita emissions in countries like the U.S. reached 16 tonnes in 2019, many nations in the Global South emit less than 2 tonnes per person, yet bear the brunt of climate impacts such as drought, flooding, and food insecurity (World Bank, 2022).

Sectors Contributing to Emissions

The rise in global greenhouse gas (GHG) emissions is intrinsically linked to activities across several key economic sectors, each contributing a significant portion to the atmospheric concentration of heat-trapping gases. According to the World Resources Institute (2025), a clear breakdown of these contributions helps pinpoint where mitigation efforts must be concentrated.

	2023 vs 1990	2023 vs 2005	2023 vs 2022
Power Industry	+96%	+36%	+2%
Industrial Combustion and Processes	+91%	+41%	+2%
Buildings	+1%	+3%	+1%
Transport	+78%	+26%	+4%
Fuel Exploitation	+48%	+23%	+2%
Agriculture	+20%	+15%	0%
Waste	+56%	+37%	+2%
All sectors	+62%	+28%	+2%

Global Green House Gases emission trends by sector and key years

By far, the Energy sector is the dominant source of global greenhouse gas emissions, accounting for a staggering 75.7% worldwide (World Resources Institute, 2025). This broad category encompasses various sub-sectors that power modern society:

Electricity and Heat Production is the single largest component within the energy sector, responsible for 29.7% of all global emissions. This primarily stems from the combustion of fossil fuels (coal, natural gas, oil) in power plants to generate electricity and heat for residential, commercial, and industrial use (World Resources Institute, 2025).

Transportation follows as another major energy-related emitter, contributing 13.7% of all emissions. This includes emissions from road vehicles, aviation, shipping, and rail, largely driven by the burning of petrol, diesel, and jet fuel (World Resources Institute, 2025). Road transportation specifically accounts for a significant 12.2% of global emissions, highlighting its substantial footprint (World Resources Institute, 2025).

Manufacturing and Construction are responsible for 12.7% of global emissions. This segment captures the energy consumed in industrial processes and construction activities, often relying on fossil fuels for power and heat (World Resources Institute, 2025).

Buildings contribute 6.6% of global emissions directly through energy consumed for heating, cooling, lighting, and appliances (World Resources Institute, 2025). When considering all energy used in homes, including grid electricity generation, residential buildings alone account for 12.5% of all global emissions, emphasizing their role in both direct fossil fuel use (e.g., gas for cooking) and indirect emissions from electricity generation (World Resources Institute, 2025).

The energy sector's extensive footprint also includes "fugitive emissions," which are greenhouse gases (like methane) released during the extraction, processing, and transmission of fossil fuels, as well as emissions from other forms of fuel combustion not explicitly categorized above (World Resources Institute, 2025).

Beyond energy, other vital non-energy sectors collectively contribute roughly one-quarter of global emissions:

Agriculture stands as the second-highest emitting sector after energy, generating 11.7% of global emissions (World Resources Institute, 2025). This includes significant releases of methane from livestock farming (enteric fermentation and manure) and agricultural soils (e.g., nitrous oxide from fertilizer use). Agricultural expansion can also indirectly drive emissions through associated land-use changes and embedded energy use (World Resources Institute, 2025).

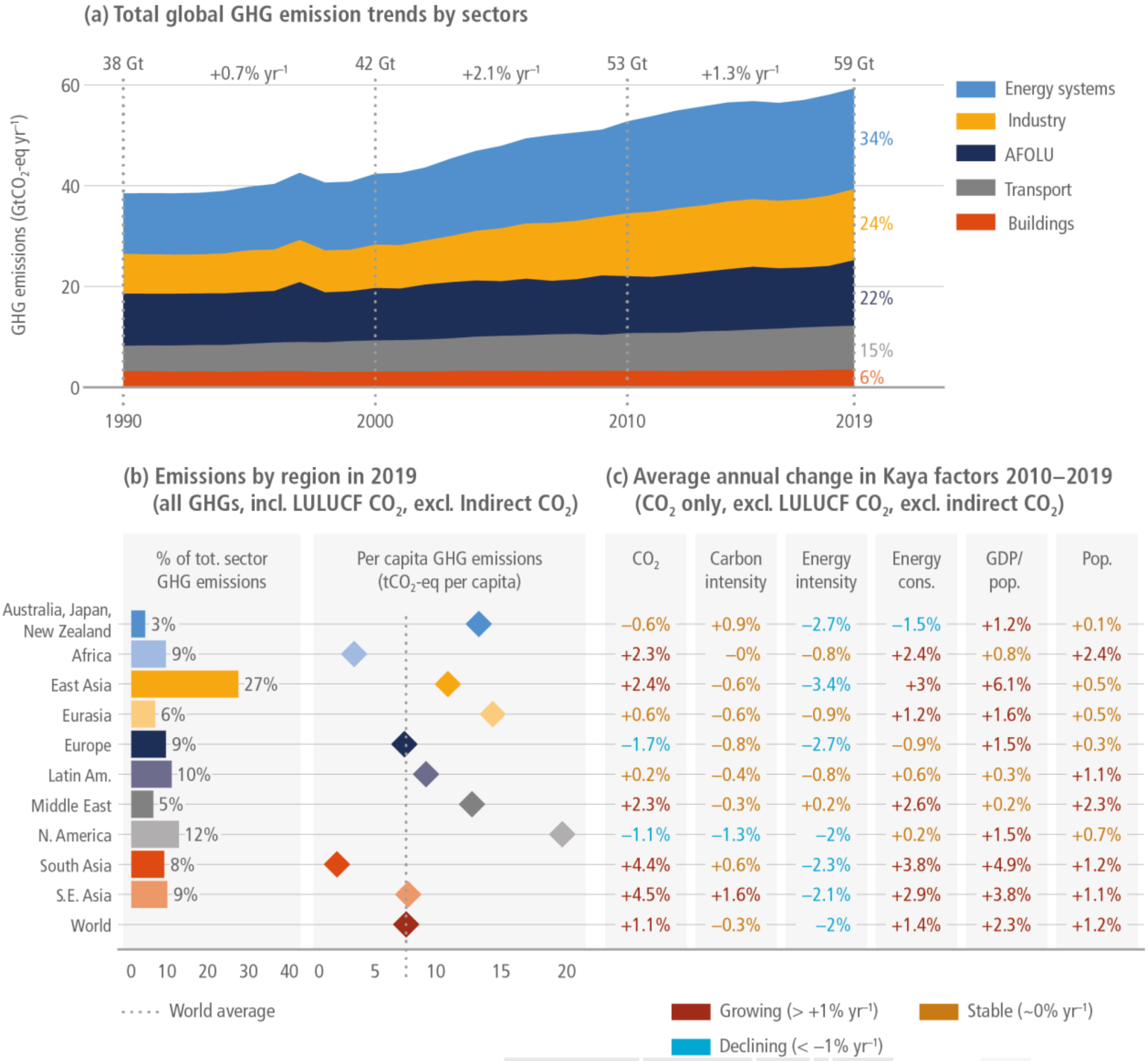
Industrial processes themselves, excluding their energy consumption, make up 6.5% of global emissions. This category covers direct emissions from chemical reactions inherent in the production of materials like cement and various chemicals (World Resources Institute, 2025).

Waste management contributes 3.4% of the global total (World Resources Institute, 2025). The primary emission here is methane, generated from the anaerobic decomposition of organic waste in landfills, along with some nitrous oxide from wastewater treatment.

Land use, land-use change, and forestry (LULUCF) account for a net total of 2.7% of global emissions (World Resources Institute, 2025). This figure represents the balance between emissions released (e.g., from deforestation, soil organic matter breakdown) and carbon removed from the atmosphere by growing forests and other vegetation. Gross emissions from this sector, before accounting for carbon removals, are therefore higher (World Resources Institute, 2025).

Emission Drivers in the Global South

Greenhouse gas (GHG) emissions in the Global South have been rising rapidly, primarily driven by industrialization, urbanization, and the globalization of manufacturing. Over the past two decades, there has been a significant shift in global production patterns, with manufacturing increasingly relocating from developed countries to emerging economies due to lower labour costs, relaxed environmental regulations, and expanding consumer markets (Rooper, 2024).



Trends and drivers of global GHG emissions, including: (a) trends of GHG emissions by sectors 1990–2019; (b) share of total and per capita GHG emissions by world region in 2019; and (c) Kaya decomposition of CO2 emissions drivers. Source: Crippa et al. (2021), IEA (2021c), Minx et al. (2021).

This industrial migration has not simply transferred emissions from one region to another—it has exacerbated them. The Global South often relies on carbon-intensive energy sources, such as coal and diesel, to power factories and infrastructure. As a result, global industrial emissions have increased by 60%, with a notable portion attributed to the carbon loophole—emissions from goods produced in one country (typically in the South) but consumed in another (typically in the North) (Rooper, 2024). This phenomenon underscores the global interconnectedness of carbon accountability. The Global South's rapid growth, while crucial for poverty alleviation and economic development, is unfolding in a carbon-intensive manner. In many cases, environmental standards are compromised to attract foreign investment and maintain export competitiveness. Without strong climate governance, the incentive structure favours firms that produce cheaply but at high environmental cost.

Tackling the Emission Problem

Industries worldwide are increasingly recognizing their role in contributing to global emissions and are independently undertaking significant efforts to combat them within their respective domains. Given the inherent tension between industrialized nations ; mostly Northern Hemisphere domiciled who have deployed fossil fuels over almost a century to build their nations and Southern Hemisphere nations seeking to rapidly scale their development and as such need significant amount of energy resources to do achieve their goals , Oue approach to this publication is to show progress made on both northern and southern hemisphere countries and how there is a gradual meeting of mind and ideas and pooling of resources to tackle this that growing emission challenge. While the scale and success vary, each key sector identified above is developing and deploying unique strategies for decarbonization:

Energy Sector (Electricity and Heat Production):

This sector is at the forefront of the transition. Energy companies are heavily investing in renewable energy sources like solar, wind, hydropower, and geothermal to replace fossil fuel power plants. They are also improving grid efficiency through smart grid technologies and deploying large-scale battery energy storage systems (BESS) to manage the intermittency of renewables. For unavoidable emissions from existing thermal plants, Carbon Capture, Utilization, and Storage (CCUS) technologies are being explored and developed to capture CO2 before it enters the atmosphere.

Global North

The Global North has made significant strides in decarbonizing electricity generation by rapidly transitioning from fossil fuels to low-carbon and renewable energy sources. In 2024, low-carbon power sources, including solar, wind, hydro, and nuclear, accounted for 40.9% of global electricity generation—the highest level since the 1940s when hydro alone comprised over 40% (Ember, 2025). Among these, solar and wind are the fastest-growing technologies, collectively producing 15% of global electricity—surpassing both hydropower (14.3%) and nuclear (9%). Fossil fuel use for electricity generation has continued to decline. Although absolute fossil generation has increased due to rising energy demand, its share dropped from 68.3% in 2007 to 59.1% in 2024. Coal-fired power generation fell from 40.8% in 2007 to 34.4% in 2024, while gas generation declined for the fourth consecutive year to 22%, down from 23.9% in 2020 (Ember, 2025).

Several Global North countries are leading this shift. China, despite being classified differently geopolitically, has emerged as a major force, generating 37% of global electricity from solar and wind in 2023. Its solar capacity alone doubled in just three years, with 81% of its new electricity demand in 2024 met by clean energy sources (Ember, 2025). OECD countries such as the United States, Canada, the UK, Germany, and the Netherlands are actively pursuing net-zero electricity targets, aiming for 100% clean power by 2035. The European Union is working to cut electricity and gas demand by 15% through efficiency upgrades and renewable adoption.

In France and Japan, nuclear energy is being revitalized, helping to stabilize baseload supply with zero emissions. Meanwhile, India—though part of the Global South—is also seeing rapid growth in solar PV, with its generation share projected to reach 10% (Ember, 2025). These developments showcase a systemic transformation across the Global North toward sustainable, clean, and secure electricity generation.

Global South

The energy transition underway in the Global South is playing a pivotal role in reducing greenhouse gas emissions from electricity generation. Historically reliant on fossil fuels, many countries in the Global South are now increasingly investing in renewable energy sources such as solar, wind, hydropower, and geothermal energy. This shift is being driven by a combination of falling technology costs, increasing energy demand, and international climate finance. According to Ukoba et al. (2024), solar and wind power generation in the Global South has been growing at an average annual rate of 23% over the past five years. In 2024, 87% of the capital expenditure for electricity generation in the region was directed toward clean energy sources. This trend demonstrates the growing commitment to decarbonizing power systems across Latin America, Sub-Saharan Africa, Southeast Asia, and South Asia.

Several countries are emerging as leaders in renewable energy deployment. For example, Sub-Saharan Africa and Bangladesh have witnessed remarkable growth in off-grid solar solutions, which are particularly useful for rural electrification. Between 2012 and 2019, off-grid solar capacity in Sub-Saharan Africa expanded from 30 MW to over 1,100 MW (Ukoba et al., 2024). Similarly, solar PV is projected to become the most affordable power source across Africa by 2030, offering a sustainable path to meet rising electricity demand while minimizing emissions. In addition, initiatives like the Just Energy Transition Partnerships (JETP) are enabling countries like Indonesia and Vietnam to move away from coal and accelerate renewable energy adoption (Ukoba et al., 2024). Hydropower and geothermal projects are also gaining traction in regions where natural conditions allow.

While challenges such as infrastructure gaps, financing barriers, and policy inconsistency persist, the Global South is making notable progress. With continued international cooperation, technology transfer, and capacity-building, the region can further reduce its electricity-related emissions and contribute meaningfully to global climate goals.

Agriculture:

Efforts in agriculture focus on reducing methane and nitrous oxide emissions. Farmers are adopting precision agriculture techniques to optimize fertilizer use, minimizing N2O release. Improved livestock management, including dietary adjustments and selective breeding, aims to reduce methane emissions from cattle. Practices like no-till farming and cover cropping enhance soil carbon sequestration, while anaerobic digesters convert manure into biogas, capturing methane and generating renewable energy.

Global North

The Global North has made significant strides in mitigating greenhouse gas emissions from agriculture, primarily through public policies, market-based tools, and technological innovation. Agriculture accounts for a sizable portion of global emissions, largely from methane (CH_4) produced by livestock and nitrous oxide (N_2O) from fertilizer use. Addressing this challenge is essential to achieving broader climate goals. According to Samad et al. (2025), countries in the Global North have implemented carbon pricing mechanisms—such as taxes and cap-and-trade systems—which, although not agriculture-specific, create incentives for emissions reduction across all sectors. For instance, the European Union's Emissions Trading System (EU ETS) indirectly affects agriculture by placing limits on industrial processes that supply fertilizers.

Policy frameworks also aim to restrict practices contributing to deforestation and excessive nitrogen use. Norway, for example, has pledged to eliminate deforestation linked to agricultural commodities (Samad et al., 2025). Additionally, many EU countries have implemented restrictions on nitrogen fertilizer application, recognizing its role in N_2O emissions. Climate-Smart Agriculture (CSA) is another cornerstone approach. CSA integrates resilience, sustainability, and productivity by promoting techniques like cover cropping, minimal tillage, and efficient fertilizer use. International institutions such as the World Bank support CSA development and implementation in the Global North (Samad et al., 2025). Improved livestock management, particularly around manure and feed, is also being pursued to reduce methane emissions.

Technological advancements such as precision agriculture are further reducing emissions. These technologies enable farmers to optimize water and fertilizer use, thus reducing waste and emissions. Methane-reducing innovations, such as feed additives, are also under development. The Global Methane Pledge, supported by over 150 countries including the US, Canada, and EU members, seeks a 30% reduction in methane emissions by 2030, with agriculture as a major target (Samad et al., 2025). Despite progress, challenges remain. These include limited data availability, uneven implementation across regions, and the global nature of food systems, which can shift emissions geographically. Nevertheless, the Global North continues to lead in aligning agricultural practices with climate mitigation goals.

Global South

Agricultural emissions in the Global South present both critical challenges and emerging opportunities. With a strong focus on food security, many countries in this region are adopting sustainable practices to reduce emissions while boosting productivity and resilience in the face of climate change. However, efforts remain uneven, and data gaps continue to hinder precise evaluation of progress. According to Farmonaut (2025), Climate-Smart Agriculture (CSA) has gained traction across the Global South. Countries are increasingly adopting practices such as conservation agriculture, drought-resilient crop varieties, and improved irrigation techniques to balance emission reduction with food production goals. These strategies not only enhance productivity but also contribute to reduced emissions from key sources such as rice cultivation, fertilizer use, and livestock. Deforestation, a significant contributor to agricultural emissions, is being addressed in several regions. Brazil, for instance, while historically linked to high deforestation rates, has emerged as a leader in sustainable practices like no-till farming and integrated crop-livestock systems. Similarly, countries like Nigeria and Angola have implemented World Bank-supported projects focusing on sustainable land use, water management, and crop diversification to reduce emissions while increasing yields and revenues (Farmonaut, 2025).

In India, efforts such as direct-seeded rice and precision fertilizer application aim to reduce methane and nitrous oxide emissions—two potent greenhouse gases. Vietnam is piloting seaweed feed supplements to cut methane from livestock, while also modernizing irrigation systems in rice fields. Despite progress, data availability and methodological inconsistencies present major obstacles. Accurate emission measurements across diverse agricultural systems remain limited, complicating national and regional planning (Farmonaut, 2025). Nevertheless, countries are making tangible gains, often seeing emission reductions as co-benefits of their resilience and food security agendas.

Waste Management:

The waste sector is primarily combating methane emissions from landfills. Strategies include implementing landfill gas capture systems, which collect methane and use it for electricity generation. Promoting composting and anaerobic digestion of organic waste diverts it from landfills, preventing methane formation. Increased recycling and waste reduction initiatives also decrease the overall volume of waste requiring disposal.

Global North

Waste management in the Global North has evolved significantly over the past few decades, with many countries adopting integrated and technologically advanced systems to reduce emissions, limit landfill use, and promote sustainability. However, progress varies across nations, reflecting differences in policy commitment, public engagement, and infrastructure development. Countries like Sweden, Germany, Switzerland, and Austria are global leaders in sustainable waste management. Sweden has adopted a waste-to-energy (WTE) strategy, where incineration of non-recyclable waste generates electricity and heat for households. With less than 1% of municipal waste sent to landfills, Sweden even imports waste from other countries to fuel its WTE plants (Sensoneo, 2025). Germany operates under the "Green Dot" system, which mandates that producers take responsibility for packaging waste, thereby incentivizing recyclability and reducing waste at the source (Sensoneo, 2025). Similarly, Switzerland and Austria have robust recycling infrastructures and extensive waste diversion programs, drastically reducing the amount of landfill waste.

In contrast, countries like Canada, Australia, and the United States still send a significant portion of their municipal waste to landfills. Despite having access to advanced recycling technologies, these nations face challenges in waste separation, inconsistent regional policies, and limited investment in WTE or circular economy strategies (Sensoneo, 2025). The U.S., for example, has shown uneven progress, with states like California making strides in composting and plastic bags, while others lag behind. General trends across the Global North include increased use of incineration with energy recovery, investment in advanced recycling technologies, and a growing shift toward circular economy models that emphasize waste minimization and resource reuse. Furthermore, regulatory frameworks like Extended Producer

Responsibility (EPR) and carbon pricing mechanisms are motivating industries to reduce waste-related emissions (World Bank, 2022).

Global South

Countries in the Global South are increasingly recognizing the environmental and economic impacts of poor waste management and are implementing innovative solutions to tackle emissions from waste. Although challenges such as limited infrastructure, urbanization pressures, and financing gaps persist, several nations are making strides through anaerobic digestion, waste-to-energy (WTE) projects, and adoption of circular economy principles (Rahman et al., 2024). China has emerged as a leader in organic waste treatment, with large-scale anaerobic digestion facilities converting kitchen and municipal waste into biogas, thereby reducing methane emissions and providing renewable energy. In addition to technical deployments, China's results-based incentive programs have encouraged household-level waste separation and supported the construction of regional biogas plants, directly benefiting millions and significantly reducing landfill reliance (Rahman et al., 2024).

India has also adopted decentralized biogas plants, especially in rural areas, where organic waste from households and livestock is converted into energy. These systems not only reduce greenhouse gas (GHG) emissions but also provide a reliable source of clean cooking fuel. Furthermore, India is expanding its portfolio of WTE projects, utilizing incineration to handle urban solid waste and generate electricity, though the environmental impact of such methods depends on proper emission controls (World Bank, 2023). Brazil, a major agricultural economy, has prioritized biogas production from agro-industrial residues and urban organic waste. This helps offset fossil fuel use and supports rural electrification. Additionally, Brazil is embracing circular economy models, with policies aimed at reducing, reusing, and recycling materials to limit landfill waste (Rahman et al., 2024).

In Southeast Asia, Thailand and Malaysia utilize anaerobic digestion to manage industrial waste, such as palm oil mill effluent, converting waste into energy and reducing environmental pollution. Elsewhere, initiatives like SWITCH Africa Green in countries like Burkina Faso are promoting industrial symbiosis, where waste from one industry becomes input for another, enhancing resource efficiency and lowering emissions. Overall, while infrastructure and funding remain challenges, the Global South is leveraging innovative approaches to manage waste sustainably and reduce emissions, contributing meaningfully to climate action goals.

Land Use, Land-Use Change, and Forestry (LULUCF):

This sector's efforts revolve around enhancing carbon sequestration and preventing emissions from land degradation. Initiatives include aggressive reforestation and afforestation programs to absorb atmospheric CO2. Sustainable forest management practices ensure forests remain carbon sinks. Peatland rewetting prevents the release of stored carbon, and agroforestry integrates trees into agricultural landscapes, boosting carbon capture and providing additional benefits.

The Global North

The Global North has implemented diverse strategies to manage emissions from the Land Use, Land-Use Change, and Forestry (LULUCF) sector, which plays a crucial role in carbon sequestration and climate mitigation. While some countries report net removals, others continue to emit more greenhouse gases than they absorb, reflecting varied land management practices and policy approaches. In the European Union (EU), the LULUCF sector has demonstrated substantial success in carbon removal. In 2022, it removed a net 236 million tonnes of CO_2 equivalent ($MtCO_2e$), accounting for 7% of the EU's total emissions, and this figure rose to an estimated 257 $MtCO_2e$ in 2023 (European Environment Agency [EEA], 2024). The EU has committed to increasing net removals by an additional 42 $MtCO_2e$ by 2030, relative to the 2016–2018 average, but projections indicate that member states may fall short of this target (EEA, 2024). Efforts include reforestation, sustainable forest management, and incentives for maintaining natural carbon sinks.

In contrast, the United States saw its LULUCF sector remove 13% of total U.S. GHG emissions in 2022, but total sequestration has declined by 11% since 1990 (U.S. Environmental Protection Agency [EPA], 2023). Contributing factors include reduced forest carbon accumulation, land conversion due to urbanization, and increased emissions from wildfires—intensified by climate change (EPA, 2023). Other Global North nations like Lithuania have set ambitious LULUCF goals. Lithuania plans to become carbon neutral by 2050, with 20% of emissions offset by LULUCF activities such as afforestation (Climate Action Tracker, 2024). Similarly, countries including Norway, Canada, and New Zealand are advancing sustainable land use policies aligned with Paris Agreement commitments.

The Global South

The Global South's approach to managing emissions from the Land Use, Land-Use Change, and Forestry (LULUCF) sector is multifaceted, with diverse strategies ranging from afforestation and sustainable land management to international collaborations. These initiatives are critical given the sector's dual role as both a major source and sink of greenhouse gases in the region. Countries like Brazil have historically contributed significantly to global deforestation, particularly in the Amazon. Despite efforts to promote agroforestry and sustainable land practices, illegal logging and agricultural expansion persist (FAO, 2023). Indonesia, driven by palm oil production, is combating forest loss through REDD+ initiatives, aiming to reduce emissions by incentivizing forest preservation (UN-REDD, 2024). India has seen measurable progress through afforestation and reforestation campaigns under the Green India Mission, which enhance carbon sinks and support rural livelihoods (MoEFCC, 2023). China's "Green Great Wall" afforestation program has increased carbon sequestration by reforesting arid regions, although concerns over biodiversity and monoculture persist (Zhao et al., 2024).

Agroforestry, which integrates trees into farmland, is increasingly adopted to improve soil health, biodiversity, and carbon storage. Several Global South countries also implement conservation agriculture, reduced tillage, and improved grazing systems to limit soil degradation and boost carbon retention (Rahman et al., 2024). REDD+ mechanisms have gained traction in countries like Democratic Republic of Congo (DRC) and Nigeria, offering financial support for emission reductions. However, weak land tenure systems and governance challenges often hinder effective implementation (UNEP, 2023).

Data limitations, inconsistent reporting, and lack of technical capacity impair monitoring, reporting, and verification (MRV) efforts. In regions like West Africa, where nations such as Benin, Liberia, and Senegal are exploring carbon pricing or Emissions Trading Systems (ETS), financial and institutional constraints remain (World Bank, 2024). Additionally, balancing developmental needs with forest conservation presents an ongoing challenge. Despite these hurdles, the Global South continues to play a vital role in global climate mitigation through improved land-use strategies and international cooperation.

Transportation:

The transportation industry is shifting towards electrification, with significant investment in electric vehicles (EVs) for road transport. For aviation and shipping, which are harder to electrify, the focus is on developing and deploying sustainable aviation fuels (SAFs) and advanced biofuels. Efficiency improvements in vehicle design, route optimization, and the expansion of public transport infrastructure are also key strategies to reduce fuel consumption and emissions per kilometre.

Global North

The Global North is adopting a multifaceted approach to reduce emissions in the transportation sector, focusing on technological innovation, regulatory policies, and infrastructure investment. Central to this effort is the transition to electric vehicles (EVs), along with enhancements in public transit systems, fuel efficiency standards, and sustainable mobility strategies. Electric vehicles have become a primary strategy for decarbonizing transport. In 2024, Tesla led the global EV market with over 1.92 million battery and plug-in hybrid vehicles sold, accounting for 11.1% of global EV sales (Autovista24, 2024). Major automakers like Ford and General Motors are aggressively expanding their EV lineups, with GM targeting a fully electric portfolio by 2035. European manufacturers such as BMW and Volkswagen are scaling production to meet rising demand, supported by EU incentives. Emerging players like Rivian and Lucid Motors are targeting specific niches like electric trucks and luxury EVs (Autovista24, 2024; IEA, 2024).

In the United States, electric vehicle sales have surged from under 20,000 in 2011 to over 1 million in 2023 (IEA, 2024). The U.S. has implemented fuel efficiency standards and is expanding EV charging infrastructure, though gaps remain. The European Union has enforced strict vehicle emission standards and operates an Emissions Trading System (ETS), though its effectiveness in the transport sector is still debated (European Commission, 2023). The United Kingdom plans to ban the sale of new petrol and diesel cars by 2030, promoting modal shifts to walking, cycling, and public transit. It is also investing in sustainable aviation fuel research (UK Department for Transport, 2023).

China has solidified its position as the global leader in electric vehicle (EV) adoption, production, and export in 2024. Nearly half of all car sales in China this year were electric, demonstrating the country's aggressive push toward transportation decarbonization (IEA, 2024). This dominance is not only domestic—China also produced 12.4 million electric vehicles, accounting for more than 70% of global EV production, a significant rise from prior years (Bloomberg NEF, 2024). In terms of sales, China sold nearly 13 million electric and hybrid vehicles in 2024, up from approximately 6.8 million in 2022. This surge reflects strong policy support, consumer incentives, and investment in charging infrastructure (China Association of Automobile Manufacturers [CAAM], 2024). Additionally, about 40% of global EV exports originated from China, underscoring its role not only as a manufacturing powerhouse but also as a key global supplier of clean transportation technology (Statista, 2024). Japan promotes fuel-efficient hybrids, hydrogen fuel cells, and EVs, while Canada focuses on public transit and EV subsidies (IEA, 2024; Government of Canada, 2023).

Global South

The transportation sector in the Global South is undergoing a critical transformation aimed at reducing emissions and promoting sustainable mobility. With rapid urbanization, growing vehicle use, and limited infrastructure, many countries are turning to cleaner fuels, public transportation, and electrification to address environmental and economic concerns. Countries such as Nigeria are actively researching and implementing cleaner alternatives to traditional fuels. A study by Aba et al. (2023) evaluated the potential for transitioning to compressed natural gas (CNG) and renewable electricity in Nigeria's transport sector. Results revealed that using natural gas could reduce resource consumption by 33% and emissions by 52%, while CNG and CNG-hybrid powertrains offered the lowest levelized cost of driving. Electrification using renewable energy sources showed the highest emission reductions—up to 98%—except in scenarios using coal-based electricity.

Electric vehicle (EV) adoption in the Global South is shaped by a mix of structural challenges and gradual policy-driven developments. A key factor is the low motorization rate—many countries have fewer vehicles per 1,000 people compared to the global average, reducing the scale of immediate EV transitions. Financial exclusion also hinders EV adoption, as limited access to affordable credit and high upfront costs place EVs out of reach for most consumers. Infrastructure gaps remain a major barrier. Public EV charging networks are sparse, particularly in sub-Saharan Africa, where very few countries have more than ten public charging stations. In addition, grid reliability is a concern; frequent outages in some regions threaten the feasibility of widespread EV use. Despite these constraints, several countries are making progress. South Africa had only about 1,000 EVs out of 12 million vehicles in 2022, but targets 2.9 million EVs by 2050. Kenya had around 350 EVs from a fleet of 2.2 million. Ethiopia's 10-year plan includes importing 800 electric buses and 148,000 EVs. Namibia aims to deploy 10,000 EVs by 2030. These efforts reflect a growing recognition of e-mobility's potential, despite the hurdles ahead.

Efforts to decarbonize transport are often paired with renewable energy strategies. Suriname, for example, is targeting a 35% renewable energy share by 2030, aiming to power EVs and public transport infrastructure sustainably (UNEP, 2024). Investments in Bus Rapid Transit (BRT) systems are reshaping urban transport in many Global South cities. BRT systems in Lagos, Accra, and Jakarta offer faster, more energy-efficient alternatives to private cars. Bangladesh is also making strategic modal shifts from road to rail, including metro development and expanded BRT corridors (ADB, 2023).

Buildings (Residential and Commercial):

Emissions from buildings are being tackled through a dual approach of efficiency and electrification. Extensive energy efficiency upgrades, such as improved insulation, energy-efficient windows, and smart building management systems, reduce overall energy demand. The adoption of heat pumps for heating and cooling, replacing fossil fuel-based boilers, is a major decarbonization pathway. On-site renewable energy generation, particularly rooftop solar panels, directly offsets grid demand.

Global North

In the European Union, efforts are underway to renovate 3% of existing buildings annually, as part of the European Green Deal and the Renovation Wave initiative. Countries like Germany and Denmark have pioneered energy-efficient building standards, including near-zero energy buildings and integration of renewable heating systems (European Commission, 2023). The United States, through the Environmental Protection Agency (EPA), has implemented initiatives such as ENERGY STAR and Better Buildings Challenge, targeting reductions in energy use intensity across residential and commercial spaces (U.S. EPA, 2024). Canada has adopted similar strategies, including updates to national building codes and financial incentives for retrofitting homes with solar panels and insulation upgrades (Natural Resources Canada, 2023).

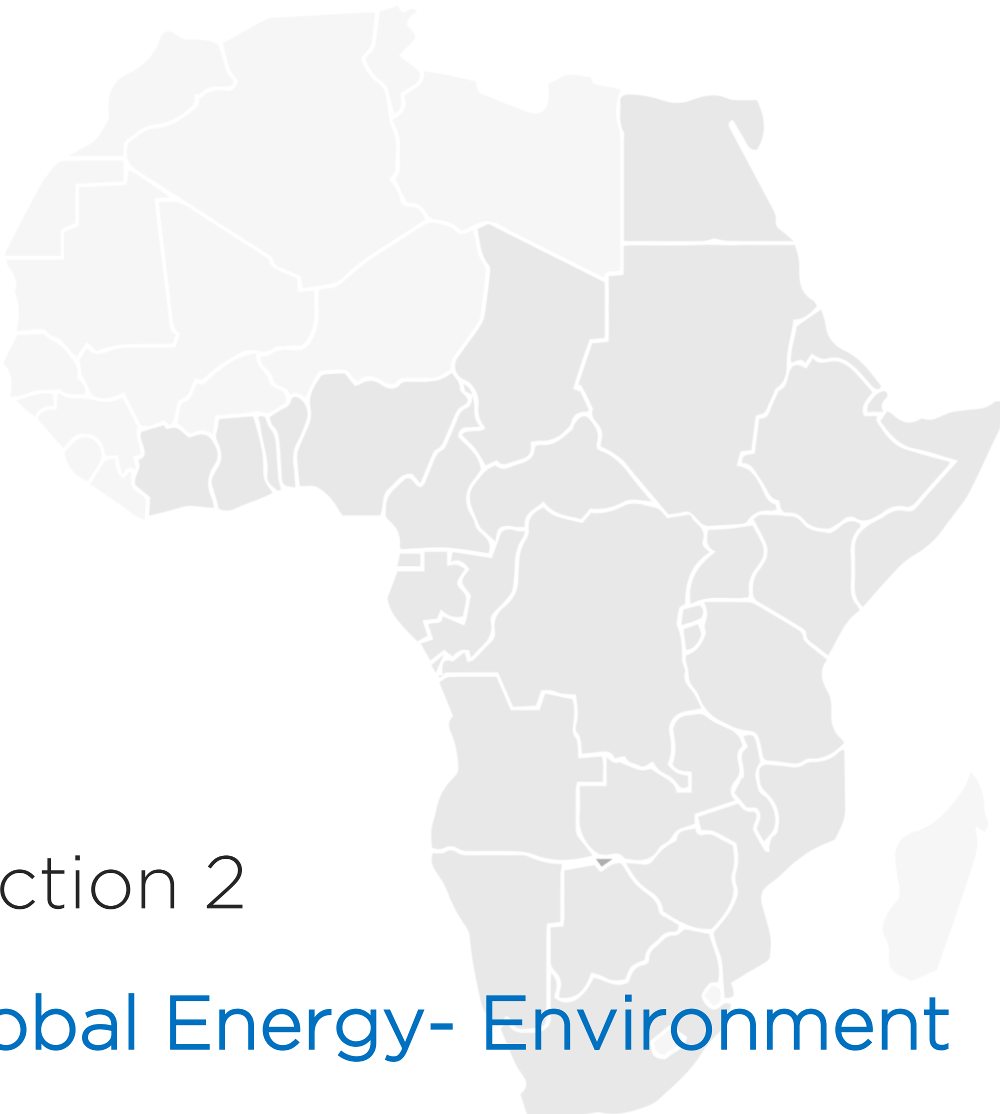
Japan promotes energy-efficient architecture and is advancing prefabricated housing technologies, which reduce energy use and construction waste. These homes often include superior thermal insulation and smart energy management systems (METI, 2024). South Korea is targeting full energy transition by 2050, with substantial investments in green hydrogen, building electrification, and net-zero building standards (MOE Korea, 2024). However, challenges persist. Embodied carbon—emissions generated from the production and transportation of building materials—remains a substantial yet underregulated issue (WorldGBC, 2023). Moreover, the retrofitting rate of old buildings is insufficient to meet climate goals, requiring accelerated efforts and funding. Behavioural change also plays a vital role; sustainable consumption patterns and active participation in energy-saving programs by occupants are necessary (IEA, 2023).

Global South

Many countries have adopted or strengthened building energy codes to improve the performance of new and existing buildings. For example, China has implemented stringent energy efficiency standards that govern insulation, lighting, and HVAC systems in both urban and rural areas (Zhang et al., 2022). Similarly, India's Energy Conservation Building Code (ECBC) has set mandatory minimum performance standards for commercial buildings (BEE, 2023). These efforts are supported by minimum energy performance standards (MEPS) for appliances and materials to reduce overall energy demand. To accelerate low-carbon construction, some governments offer incentives for green buildings, such as tax reductions and fast-track permitting. Countries like South Africa are also exploring carbon pricing mechanisms to shift investments toward sustainable building solutions (UNEP, 2023).

Promoting energy-efficient appliances, renewable integration, and smart building technologies is becoming more common. For instance, Brazil has introduced solar water heating in public buildings, while China is integrating solar PV in urban developments (IEA, 2023). Reducing embodied carbon from materials like cement and steel is a growing priority. Lifecycle assessments and sustainable sourcing practices are being promoted to reduce the environmental impact of construction. Circular economy principles are being applied in countries like India and Vietnam, where reuse and recycling of materials are gaining ground (GABC, 2023).

Despite these advances, major challenges remain, particularly in financing and capacity building. There is a pressing need to train professionals in sustainable building practices and to improve access to international finance mechanisms. International collaboration and knowledge exchange are key to bridging technical and resource gaps across regions (UN-Habitat, 2023).



Section 2

Global Energy- Environment Nexus

Owner: Dr. Akintoye Akindele, CFA, DBA, FICA **Supported by:** Morayo Akintola **Designed by:** Stephen Adediran

The Global Energy-Environment Nexus

The global energy-environment nexus refers to the intricate and interdependent relationship between energy production, consumption, and environmental sustainability. It captures the dual challenge of meeting the world's growing energy demands while minimizing environmental degradation and addressing climate change. At the core of this nexus lies the fact that the global economy is heavily dependent on fossil fuels—coal, oil, and natural gas—which account for about 80% of global energy consumption (IEA, 2023). While these sources have historically fuelled industrial development, urbanization, and economic growth, they are also the primary contributors to greenhouse gas (GHG) emissions, particularly carbon dioxide (CO_2) and methane. The combustion of fossil fuels for electricity, heat, and transportation is the largest source of anthropogenic GHG emissions globally, intensifying the impacts of global warming, rising sea levels, and extreme weather events.

The energy-environment nexus is also shaped by resource exploitation, where mining, drilling, and extraction practices disturb ecosystems, degrade land, pollute water sources, and threaten biodiversity. In addition, energy infrastructure such as pipelines, refineries, and power plants often contribute to air and water pollution, with negative effects on public health. Addressing this nexus requires balancing energy security, economic development, and environmental stewardship. Transitioning to renewable energy (e.g., solar, wind, hydro, and geothermal) and improving energy efficiency are seen as essential pathways. Equally important are technological innovations like carbon capture and storage (CCS), smart grids, and electrification of transport systems.

In essence, the global energy-environment nexus highlights the urgent need for integrated policies and global cooperation to ensure sustainable development. A failure to decouple energy use from environmental harm risks undermining climate goals and compromising future generations' well-being.

Industrial Processes and Their Contribution to Global Emissions

Industrial activity is a cornerstone of modern economies, driving infrastructure development, manufacturing, and technological innovation.

However, it also represents one of the largest sources of greenhouse gas (GHG) emissions globally. Industrial processes contribute significantly to climate change through the direct release of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases during manufacturing, processing, and material transformation activities. According to the Intergovernmental Panel on Climate Change (IPCC), the industrial sector is responsible for approximately 21% of global GHG emissions, excluding emissions from electricity and heat production consumed by industry (IPCC, 2023).

These emissions arise from a combination of factors, including fossil fuel combustion for heat and energy, chemical reactions in production processes (e.g., in cement and steel making), and fugitive emissions from machinery, pipelines, and industrial storage systems. As economies industrialize, emissions from this sector have grown steadily, especially in developing countries where industrial expansion is often powered by coal and other high-carbon fuels (IEA, 2022). In addition to energy-related emissions, industries are also significant sources of process emissions—those that occur during the transformation of raw materials into finished products.

Among the various industrial sectors, the oil and gas industry is particularly emissions-intensive. It contributes both direct and indirect emissions at multiple stages of the production and supply chain. Upstream activities, such as exploration, drilling, and extraction, often involve the combustion of fossil fuels to power heavy equipment, as well as fugitive emissions from methane leaks and gas flaring. Midstream and downstream processes, including refining and petrochemical production, consume vast amounts of energy and involve complex chemical reactions that release additional CO_2 and volatile organic compounds (VOCs) (IEA, 2023).

One of the major concerns in the oil and gas sector is the release of methane (CH_4), a potent greenhouse gas with a global warming potential over 80 times greater than CO_2 over a 20-year period (UNEP, 2021). Methane leaks can occur throughout the value chain—from wellheads and pipelines to storage tanks and compressors—often as unintended consequences of poor infrastructure maintenance or outdated equipment. Despite being preventable through available technologies, methane emissions remain a critical problem for the sector and a key area of concern for global climate targets.

In addition, gas flaring—the combustion of excess natural gas during oil extraction—contributes significantly to CO_2 and black carbon emissions. While flaring is often practiced for safety or due to the lack of gas capture infrastructure, it represents a substantial waste of energy and a preventable source of emissions. According to the World Bank, the oil and gas industry flared over 140 billion cubic meters of gas in 2022, equating to around 400 million tonnes of CO_2 emissions annually (World Bank, 2023).

The extractive industries—including mining and quarrying—also represent a major source of industrial emissions. These operations are energy-intensive and often located in remote regions where grid access is limited, making diesel generators the dominant source of power. Mining operations contribute to emissions through excavation, drilling, blasting, material handling, and ore processing—all of which require large quantities of energy. Furthermore, land disturbance, deforestation, and soil degradation associated with mining activities indirectly contribute to GHG emissions by releasing stored carbon and reducing natural carbon sinks (UNEP, 2022).

As demand for raw materials such as metals, minerals, and fossil fuels continues to rise, emissions from the extractive sector are expected to grow unless significant mitigation strategies are adopted. This includes transitioning to renewable energy sources for powering operations, electrifying transport and equipment, capturing fugitive emissions, and adopting circular economy practices to reduce material waste and extend product lifecycles. This self-reliant energy model contributes significantly to operational costs and carbon emissions. As a result, the extractive sector is under increasing pressure to decarbonize operations by adopting cleaner, more efficient energy alternatives. This dual role positions the extractive industry at the heart of the global energy-environment nexus.

Heavy Reliance on Fossil Fuels

The production processes within this sector—ranging from drilling, blasting, refining, smelting, compressing, transporting, and processing—require vast amounts of energy. This energy is predominantly derived from fossil fuels for several reasons:

Availability and Internal Supply: Many companies in the sector use the fossil fuels they extract, especially natural gas and diesel, to power onsite operations.

Industrial Machinery: Equipment such as haul trucks, rotary drills, compressors, and heavy-duty engines rely heavily on diesel and natural gas.

Refining and Processing: Oil refining and ore processing involve high-temperature and high-pressure processes that are typically powered by fossil fuels.

Remote Locations: Many extractive operations are located in off-grid or remote areas where renewable energy infrastructure is unavailable, making fossil fuels the default source of energy.

This dependency on fossil fuels has made the extractive industry one of the largest contributors to greenhouse gas (GHG) emissions. The environmental impact is twofold:

Direct Emissions: Resulting from burning fossil fuels onsite for power and heat.

Indirect Emissions: From supply chains, transportation of materials, and flaring of natural gas during drilling.

According to the International Energy Agency (IEA), the oil and gas industry alone accounts for over 40% of global industrial GHG emissions, when both direct and indirect emissions are considered. Mining, especially for coal and minerals like bauxite and iron ore, also contributes significantly due to diesel-powered machinery and methane release from underground mines. The outcome is a substantial carbon footprint, which not only accelerates climate change but also intensifies regulatory scrutiny and societal pressure for energy transition.

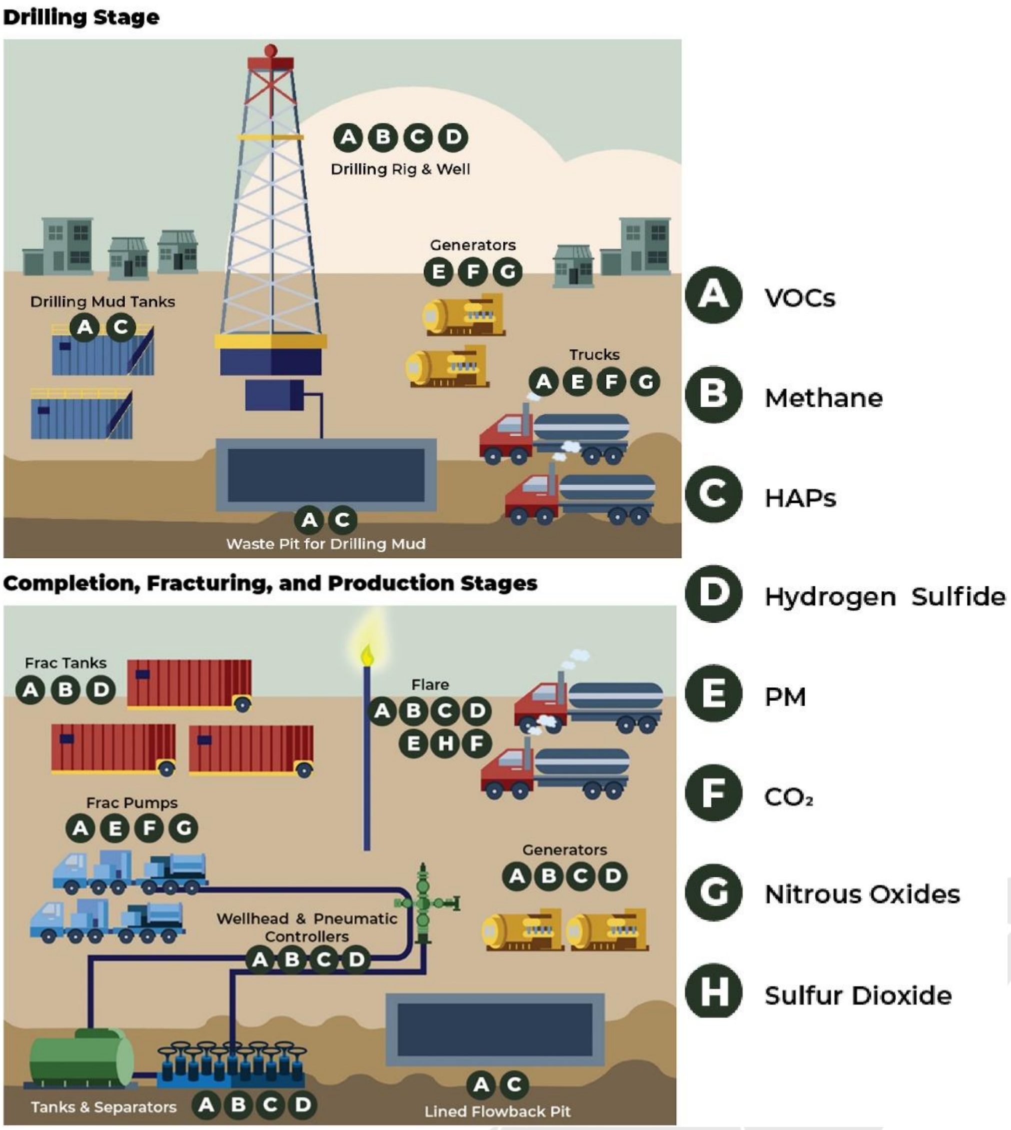
Oil and Gas Industry Contributions to Emissions in the Global South

The oil and gas industry, along with other extractive sectors, is a major contributor to greenhouse gas (GHG) emissions in the Global South. These emissions arise from various phases of fossil fuel operations, including extraction, processing, transportation, and combustion. In resource-rich developing regions, such activities have intensified in recent decades, driven by global demand and local economic growth, but often at the expense of environmental sustainability (Davis & Shafaie, 2023).

Upstream Oil and Gas Emissions in the Global South

The **upstream sector** of the oil and gas industry, which includes **exploration, drilling, and production of crude oil and natural gas**, is a major contributor to greenhouse gas (GHG) emissions in the **Global South**. These emissions result from both **direct operations** and **fugitive releases**, significantly impacting local and global climate systems.

One of the primary sources of emissions in upstream operations is **methane leakage** during drilling and extraction. Methane (CH_4), which is over 80 times more potent than CO_2 in the short term, often escapes from wells, pipelines, and processing facilities. According to the International Energy Agency (IEA, 2023), methane emissions from upstream oil and gas activities in developing countries are significantly underreported and underregulated.



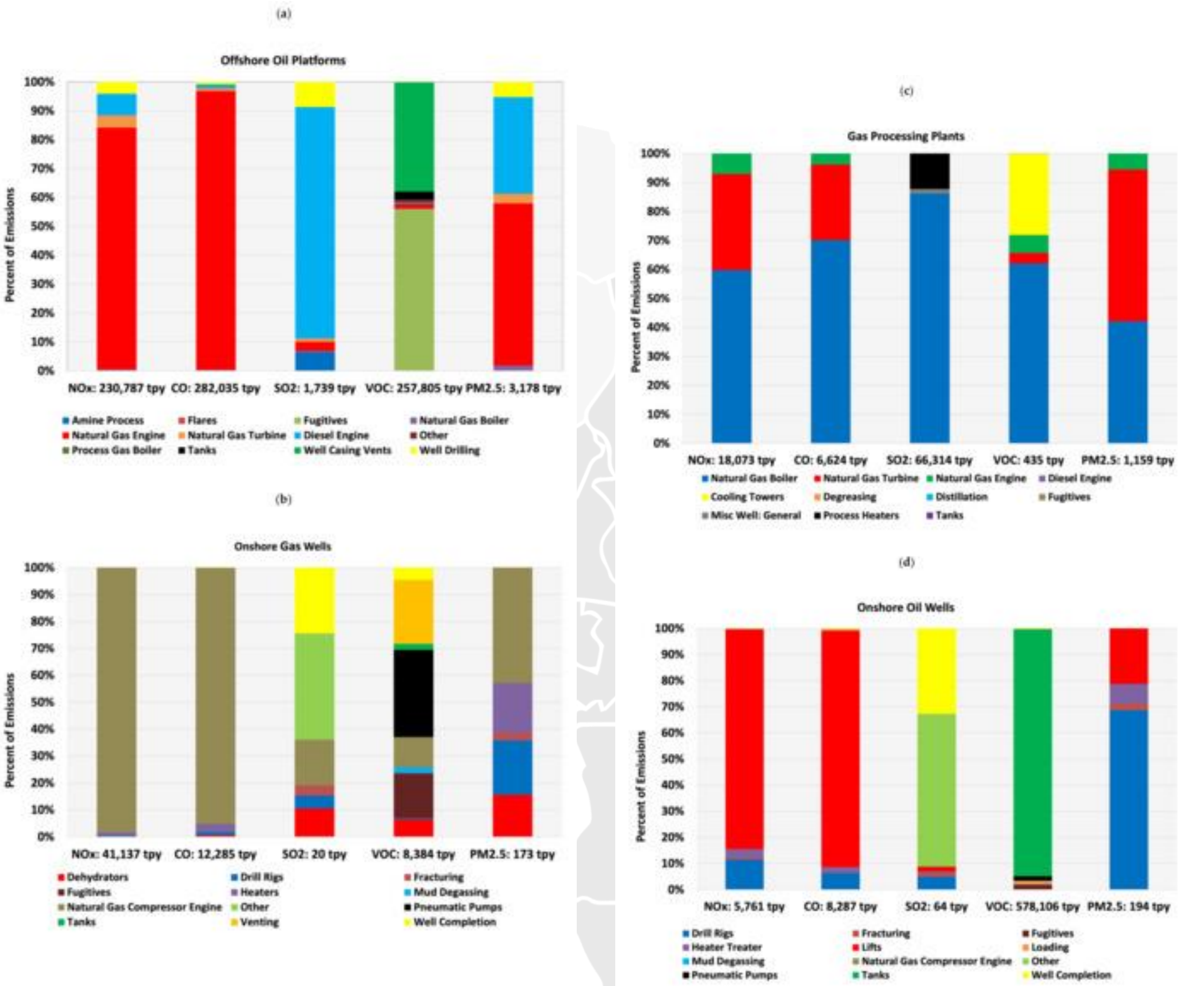
Gas flaring—the burning of natural gas that cannot be processed or transported—is another major source of CO_2 and black carbon. In countries such as Nigeria and Angola, gas flaring is widespread due to inadequate infrastructure and weak enforcement (World Bank, 2022). The **Global Gas Flaring Reduction Partnership** reports that Sub-Saharan Africa accounts for over 40% of global flaring, a substantial portion of which comes from upstream operations.

Emission sources by oil and gas segment Source: Calderon et al., 2022

Additionally, the **deforestation and land degradation** that accompany oil exploration activities exacerbate emissions by destroying carbon sinks and disrupting ecosystems (Davis & Shafaie, 2023). In the Amazon region, upstream oil extraction has led to significant forest loss and biodiversity threats.

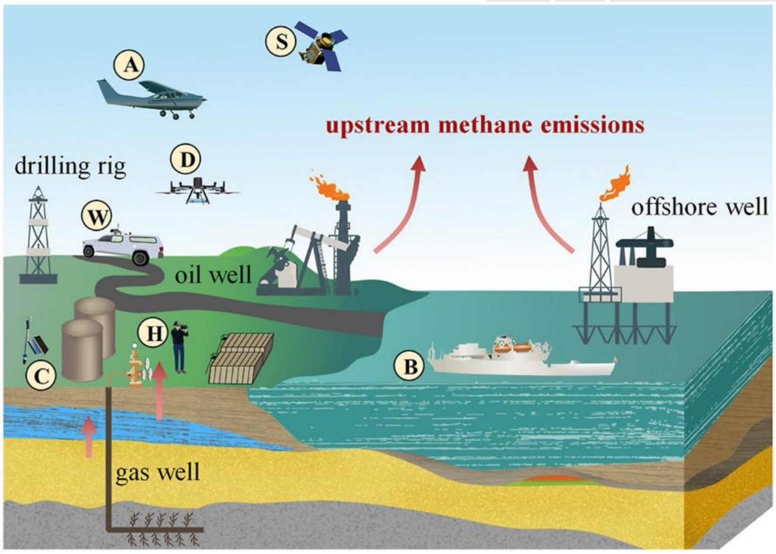
As developing economies expand exploration to boost revenue, upstream activities remain a significant driver of emissions in the Global South, reinforcing the need for sustainable practices and stronger environmental governance.

Midstream Oil and Gas Emissions in the Global South



The midstream sector of the oil and gas industry, responsible for the transportation, storage, and wholesale distribution of crude oil and natural gas, is a significant contributor to greenhouse gas (GHG) emissions in the Global South. While often overshadowed by upstream and downstream operations, midstream activities generate emissions primarily through pipeline leaks, compression and pumping stations, and liquefied natural gas (LNG) operations. One of the key sources of emissions is methane leakage during transportation through pipelines. Many countries in the Global South, including Nigeria, Indonesia, and parts of Latin America, lack the modern infrastructure and regulatory oversight to detect and prevent leaks. As a result, fugitive methane emissions from aging or poorly maintained midstream infrastructure are widespread (IEA, 2023).

Additionally, the combustion of fossil fuels used to power compressor stations and oil pumping systems contributes directly to CO_2 emissions. These stations, necessary for maintaining the flow of hydrocarbons over long distances, often run on diesel or natural gas, both of which emit GHGs during combustion (UNEP, 2022). LNG facilities, which are growing rapidly in Global South countries such as Mozambique and Qatar, contribute to emissions during the liquefaction, storage, and regasification stages. These processes are highly energy-intensive and emit substantial CO_2, especially when powered by fossil fuels (Zhang et al., 2021). Moreover, frequent oil spills and gas leaks during transit or storage pose both environmental and climate risks. Inadequate response systems in many Global South nations exacerbate these impacts. To reduce these emissions, investment in leak detection, low-emission transport technologies, and clean energy integration into midstream operations is urgently needed.



Downstream Oil and Gas Emissions in the Global South

Downstream Emission in the Global South

The downstream sector of the oil and gas industry—which includes refining, distribution, and end-use of petroleum products—is a major contributor to greenhouse gas (GHG) emissions in the Global South. This sector plays a critical role in the final stages of hydrocarbon processing and consumption, where significant emissions are generated both directly through industrial activity and indirectly through product use. One major source of emissions is petroleum refining, a highly energy-intensive process that releases large amounts of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Refineries in the Global South often operate with older, less efficient technologies, resulting in higher emissions per barrel processed compared to counterparts in the Global North (IEA, 2023). In countries like Nigeria, Indonesia, and India, the absence of stringent environmental regulations exacerbates this problem (UNEP, 2022).

Combustion of refined petroleum products—such as gasoline, diesel, and kerosene—used for transportation, power generation, and household cooking represents another significant downstream emission source. In Africa and parts of Asia, kerosene and diesel remain widely used for lighting and domestic energy, contributing to both CO_2 emissions and indoor air pollution (World Bank, 2020). Additionally, the distribution and retail infrastructure, including fuel stations and storage depots, often experience fugitive emissions from fuel evaporation, leakage, and poor containment practices. The lack of vapour recovery systems and advanced monitoring further increases GHG emissions (OECD/IEA, 2021).

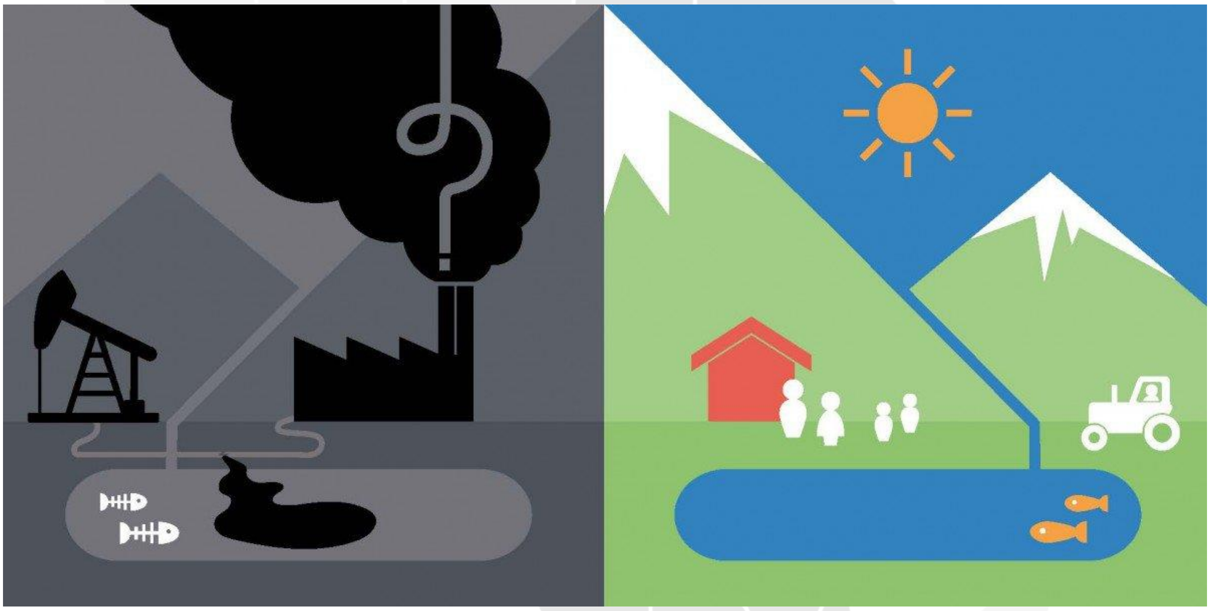
1. Direct Emissions from Extraction and Processing: The process of extracting oil and gas from beneath the earth's surface emits substantial amounts of carbon dioxide (CO_2) and methane (CH_4). Methane, in particular, is a highly potent greenhouse gas—approximately 84 times more effective than CO_2 at trapping heat over a 20-year period (Scott & Pickard, 2020). Processing operations, including refining and separation of hydrocarbons, further contribute to emissions through energy consumption and chemical leaks.

2. Combustion of Fossil Fuels: The primary driver of CO_2 emissions from the oil and gas industry is the combustion of fossil fuels for electricity generation, industrial heating, and transportation. In many Global South countries, fossil fuels remain the dominant source of energy, leading to heavy CO_2 output as infrastructure and energy demand grow rapidly (Scott & Pickard, 2020).

3. Fugitive Emissions and Methane Leakage: Fugitive emissions—unintentional leaks of gases during extraction, processing, and transportation—are another significant source of GHGs. Pipelines, storage tanks, and compressor stations often leak methane, especially in countries with outdated or poorly maintained infrastructure (IEA, 2023).

4. Gas Flaring: Gas flaring, the routine burning of excess natural gas during oil extraction, is a common practice in several Global South countries. It releases vast amounts of CO_2 and black carbon into the atmosphere, worsening local air quality and contributing to global warming (Scott & Pickard, 2020).

Indirect Impacts and Broader Environmental Effects



Beyond direct greenhouse gas emissions, the oil, gas, and broader extractive industries exert a wide range of indirect environmental impacts that contribute to ecological degradation and exacerbate climate vulnerabilities in the Global South.

Indirect Impacts and Broader Environmental Effects in the Global South

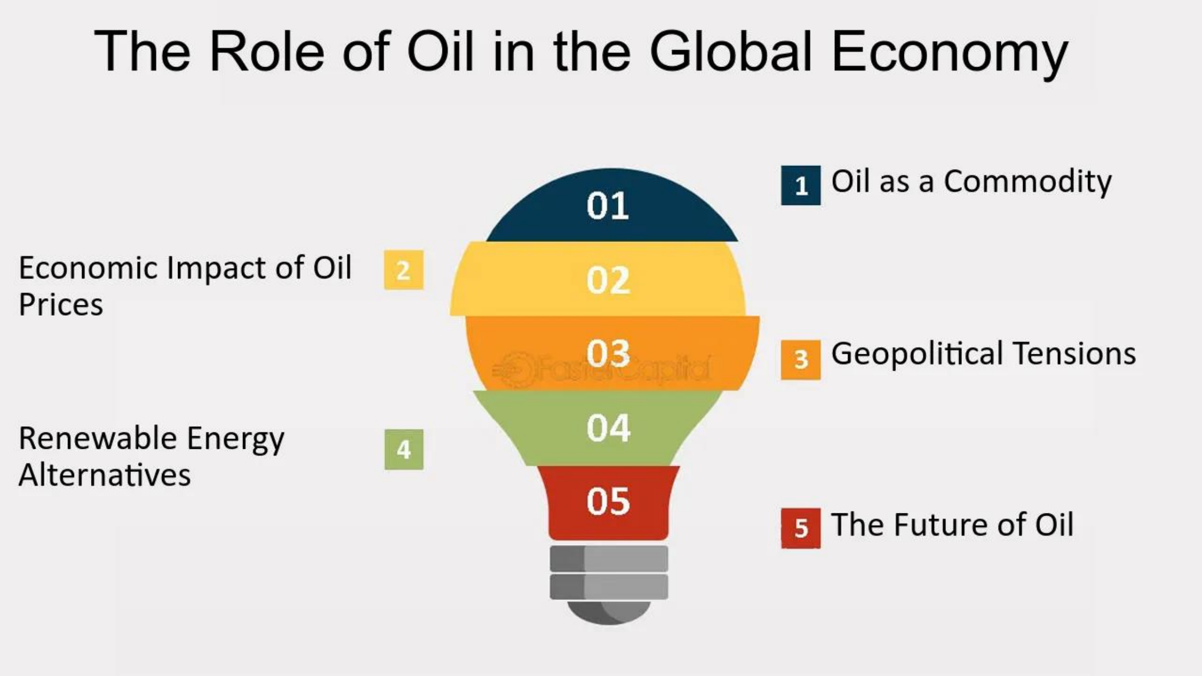
Land Use Change: Infrastructure development is integral to extractive operations. The construction of roads, pipelines, drilling platforms, and processing facilities often necessitates significant land clearing, leading to deforestation, loss of biodiversity, and ecosystem fragmentation. In forest-rich regions, such as the Niger Delta or parts of the Amazon Basin, extractive activities displace wildlife habitats, disrupt local livelihoods, and reduce the natural carbon sequestration capacity of forests—intensifying the greenhouse effect.

Water Contamination: Oil spills, mining runoff, and leaks from poorly managed tailing ponds introduce hazardous chemicals into rivers, groundwater, and wetlands, affecting aquatic ecosystems and human populations that rely on these resources for drinking water and agriculture. Contaminants such as heavy metals, hydrocarbons, and sulphates persist in the environment, causing long-term damage to water quality and food chains.

Air Pollution: In addition to GHGs, extractive operations emit pollutants such as particulate matter (PM), volatile organic compounds (VOCs), and nitrogen oxides (NO_x). These airborne toxins are linked to respiratory illnesses, cardiovascular problems, and increased mortality in nearby communities. Gas flaring, a common practice in oil-rich regions, is a major source of these pollutants.

Waste Management: Improper disposal of industrial waste—including drilling muds, chemical by-products, and mine tailings—leads to soil and water contamination, affecting agriculture and groundwater. In many parts of the Global South, weak regulatory oversight and lack of environmental safeguards exacerbate these issues, contributing to environmental injustice and community displacement. Together, these indirect effects amplify the environmental and social costs of fossil fuel dependence, underlining the urgency for sustainable alternatives.

Economic Drivers and Development



The oil and gas industry remains a powerful economic driver in the Global South, contributing significantly to government revenues, employment, and infrastructure development. However, this dependence on fossil fuel-based growth also poses challenges to economic diversification and long-term sustainability.

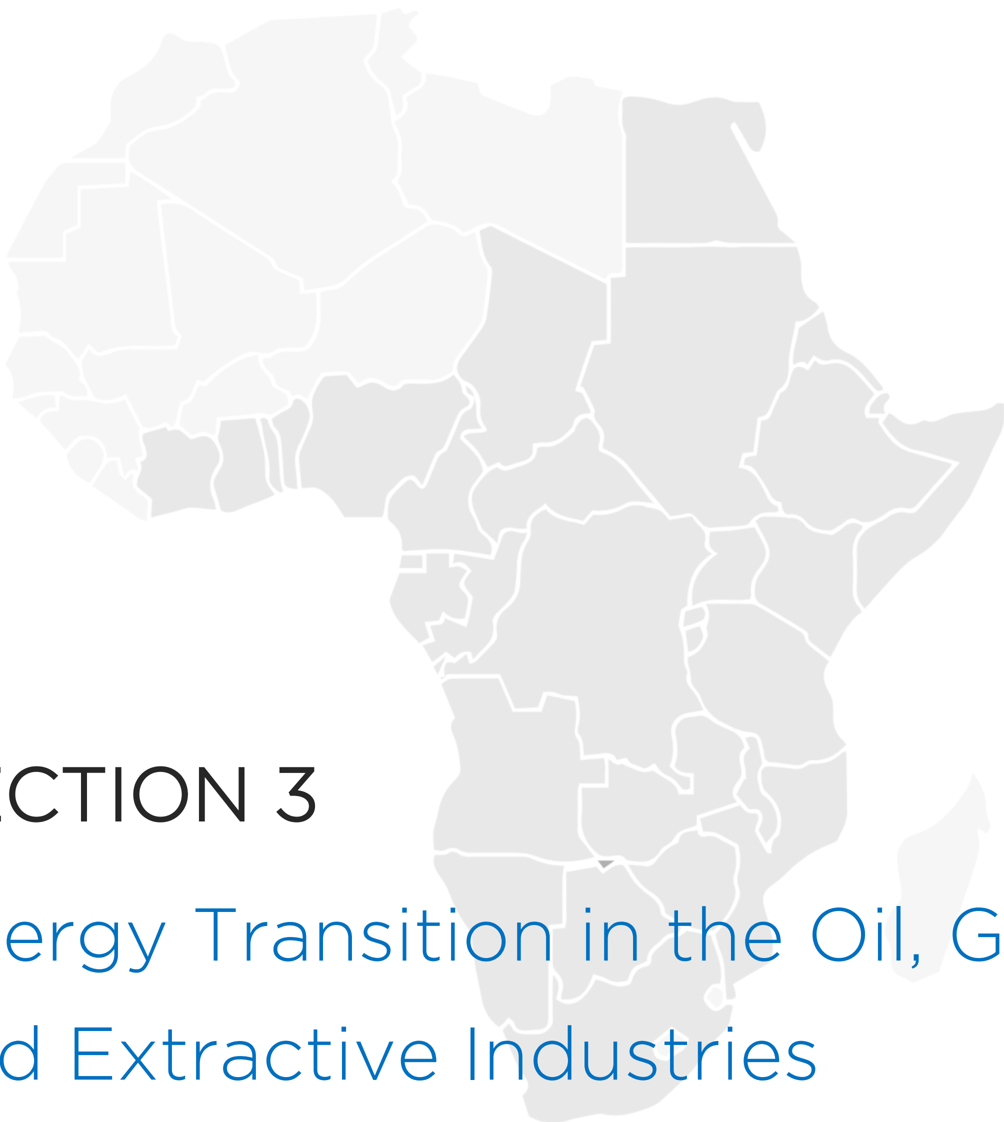
Revenue Generation: In many developing countries, oil and gas exports are a major source of national income. Governments rely on these revenues to finance public spending, fund infrastructure, and support social services. For example, Nigeria's oil sector accounts for more than 50% of government revenue and over 90% of foreign exchange earnings (World Bank, 2023). While such income can promote economic stability, it often results in fiscal over-reliance on volatile commodity markets, exposing economies to price shocks and discouraging investment in other sectors such as agriculture, manufacturing, and renewable energy (IMF, 2022).

Job Creation: Though the extractive sector is capital-intensive and provides limited direct employment, it has strong indirect and induced employment effects. Local supply chains, transportation, hospitality, and service industries often benefit from oil and gas operations. In resource-rich zones, energy projects can stimulate economic activity and regional development.

However, these jobs are frequently temporary or highly technical, limiting long-term employment gains for unskilled labour (UNDP, 2022).

Infrastructure Development: Oil and gas exploration often necessitates major infrastructure investments, including roads, ports, pipelines, and power systems. While this infrastructure can benefit broader economic development, it is often designed around the needs of the extractive industry, not local communities. In many cases, such projects result in ecological disruption, land displacement, and social inequities, especially when environmental and social impact assessments are weak or absent (Bebbington et al., 2018). Thus, while oil and gas can serve as a catalyst for development, their long-term value depends on sustainable governance, diversification, and environmental stewardship.

With the significance of oil and gas industry to countries in Africa, South America and other Global south nations, it will be impossible to ask these nation not to earn by stopping production or eradicating their biggest industry without any wholistic plan and funding in place on how they will fund their energy and infrastructure needs and avoiding a total collapse of their economies. Energy Transition conversations have been making good progress with both global north and south companies exploring ways to gradually reduce the production of these dangerous elements into the atmosphere without hindering growth



SECTION 3

Energy Transition in the Oil, Gas and Extractive Industries

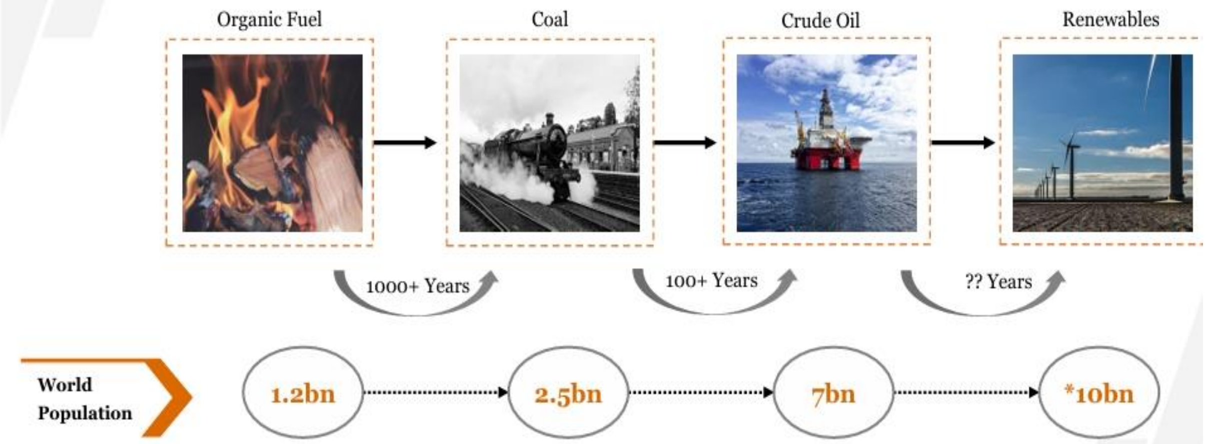
Owner: Dr. Akintoye Akindele, CFA, DBA, FICA **Supported by:** Morayo Akintola **Designed by:** Stephen Adediran

Global Overview of Energy Transition

Energy transitions have been central to the evolution of human civilization, shaping economic development, technological progress, and societal structures. Historically, humanity's first energy system was based on biomass, primarily wood and animal waste, used for heating, cooking, and basic industry. This period lasted thousands of years, with minimal environmental impact but limited energy output (Smil, 2017). The first major energy transition occurred during the Industrial Revolution in the 18th century, marked by the shift from biomass to coal. Coal powered steam engines, revolutionizing transportation and manufacturing, and fuelled the rapid urbanization and industrial growth of Europe and North America (Kander, Malanima & Warde, 2013).

Global Energy Transition Timeline

In the late 19th and early 20th centuries, another transition took place as oil



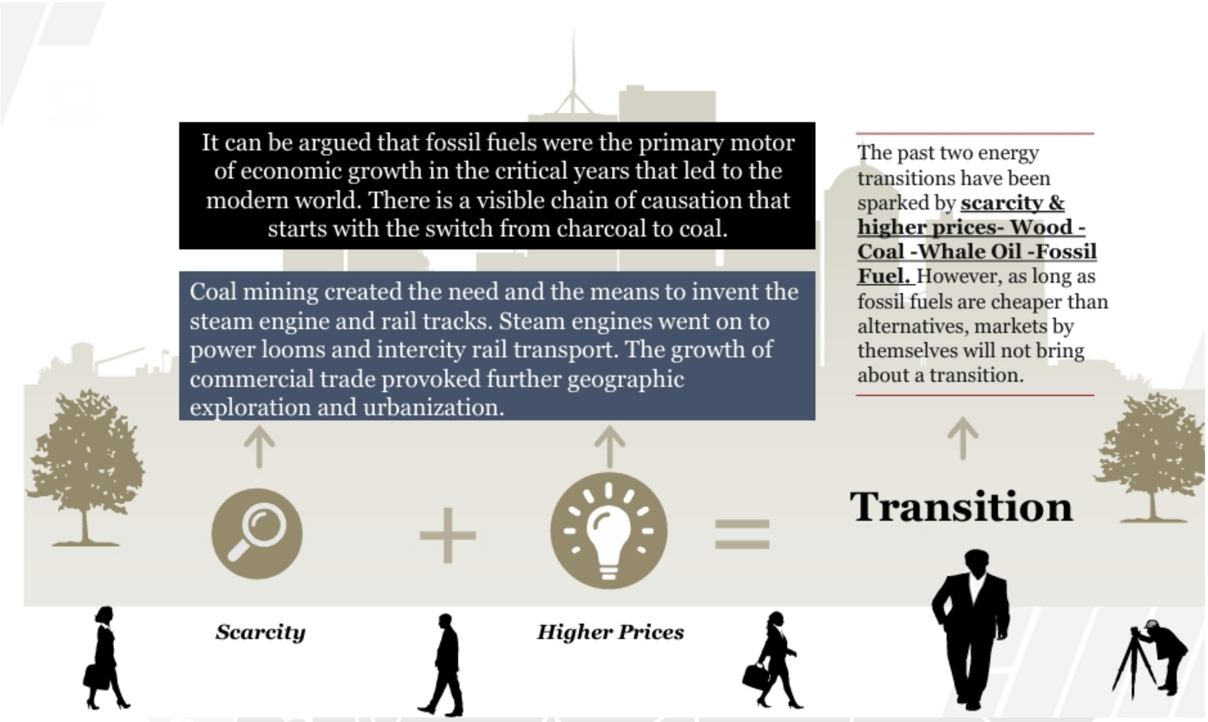
and natural gas began to displace coal, especially in transportation and electricity generation. This shift provided higher energy density and cleaner combustion, supporting modern infrastructure and global economic expansion (Fouquet, 2010). The post-World War II era saw a significant increase in energy demand, driven by global industrialization and population growth. During this time, nuclear power emerged as an alternative energy source, promising vast energy output but facing public concern over safety and waste disposal (IEA, 2021).

Today, the world is undergoing a new energy transition: the shift to renewable energy sources such as solar, wind, hydro, and geothermal. This transition is driven by climate change concerns, technological advancements, and the need for sustainable development. Unlike previous transitions, which were economically motivated, this shift is deeply intertwined with global environmental and equity goals (IRENA, 2022). Each phase of energy transition has brought both progress and challenges, and the current shift to renewables represents not just a technological change, but a profound transformation of global energy systems.

The global energy transition refers to the ongoing shift from fossil fuel-based energy systems—such as coal and oil to natural gas in the first instance as it is a cleaner form of fossil fuel and then toward cleaner, more sustainable sources like solar, wind, hydro, and bioenergy. This transformation is driven by the urgent need to reduce greenhouse gas (GHG) emissions, address climate change, improve energy security, and promote sustainable development. According to the International Energy Agency (IEA), the energy sector accounts for approximately 73% of global emissions, making it the single largest contributor to climate change (IEA, 2022). To meet the targets of the Paris Agreement and limit global warming to below 1.5°C, a significant and rapid decarbonization of energy systems is required. This includes phasing out coal, scaling up renewables, electrifying end-use sectors, and increasing energy efficiency.

Progress has been notable in recent years. In 2023, renewables accounted for over 30% of global electricity generation, with solar and wind making up the largest share of growth (IRENA, 2024). Countries such as Germany, China, and the United States are leading the transition with substantial investments in renewable infrastructure, while emerging economies are also accelerating adoption due to falling technology costs and improved policy frameworks. However, challenges remain. Global fossil fuel subsidies still exceed $1 trillion annually (IMF, 2023), and energy access disparities persist, particularly in sub-Saharan Africa and South Asia. To ensure a just and inclusive transition, global cooperation, climate finance, and technological innovation are essential.

The Natural Order of Energy Transition



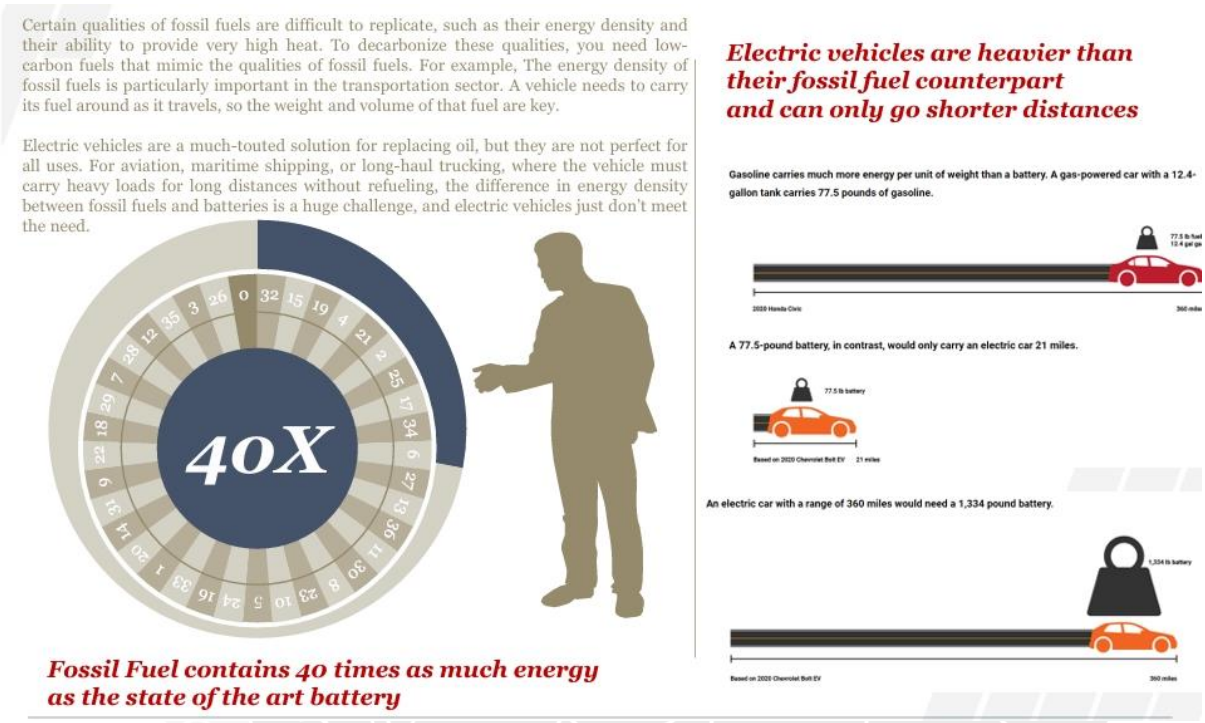
The natural order of energy transition refers to the historical and evolutionary process by which societies shift from one dominant source of energy to another—typically from less efficient and more polluting sources to cleaner, more efficient, and sustainable forms. This transition is not instantaneous but follows a gradual progression shaped by technological advancements, economic forces, policy decisions, and environmental imperatives (Smil, 2017). Historically, human civilization transitioned from biomass (wood, charcoal) to coal, followed by oil and natural gas, and now increasingly to renewable energy sources like solar, wind, and hydroelectric power (Fouquet, 2010). This order reflects improvements in energy density, ease of transport, and conversion efficiency, alongside growing awareness of the environmental costs of fossil fuel dependence.

Natural Order of Energy Transition

Today's energy transition is being accelerated by the need to mitigate climate change, driven primarily by the combustion of fossil fuels, which account for over 75% of global greenhouse gas emissions (IEA, 2023). However, the transition must also be just and equitable, especially for developing countries in the Global South, whose energy systems are still heavily reliant on fossil fuels for economic development (UNDP, 2022). A "natural" progression in energy transition also implies that countries and sectors will adopt new technologies at varying paces, based on their resource endowments, infrastructure readiness, and socioeconomic conditions. For example, countries with abundant sunlight and limited fossil reserves may leapfrog directly to solar energy solutions, bypassing the fossil-heavy stages of development (Singh, 2024).

Thus, the natural order is not just a linear path but a strategic and adaptive process tailored to each nation's context—guided by science, supported by policy, and driven by necessity.

The Problem of Energy Transition



The global energy transition—from fossil fuels to renewable energy—aims to reduce greenhouse gas emissions and combat climate change. However, this transition is fraught with complex problems involving technological, economic, political, and social challenges (IEA, 2023). One of the central problems is the scale and speed required to replace deeply embedded fossil fuel systems with cleaner alternatives. Fossil fuels still account for approximately 80% of global energy consumption, making the transition a monumental task (BP, 2022).

Problem of Energy Transition

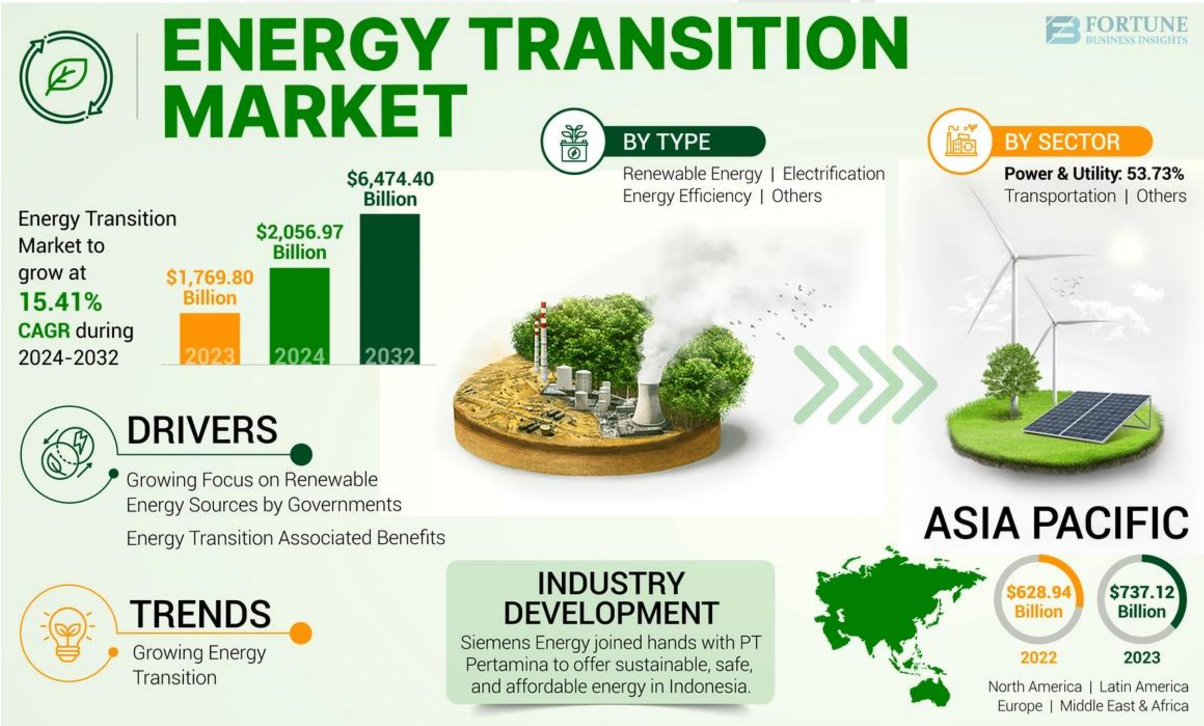
A critical issue is the unequal capacity of countries to transition. While high-income nations in the Global North have greater access to finance, technology, and infrastructure, many countries in the Global South struggle with energy poverty, inadequate infrastructure, and limited fiscal space (UNDP, 2022). For these nations, transitioning could mean jeopardizing short-term economic growth, especially where fossil fuel revenues constitute a significant share of national income.

Technological barriers also pose a significant problem. Intermittency in renewable energy sources such as solar and wind demands complementary investments in energy storage, smart grids, and transmission infrastructure—investments that are often expensive and logistically challenging (IRENA, 2023). Moreover, the mining of critical minerals required for renewable technologies (e.g., lithium, cobalt) may create new environmental and human rights concerns, particularly in resource-rich but governance-weak states (IEA, 2021).

Another challenge is the social cost of transition. Jobs in fossil fuel sectors risk being lost without adequate support systems for retraining and social safety nets. This creates political resistance, particularly in regions economically dependent on fossil energy (Frye, 2024). Additionally, inadequate policy coherence, insufficient regulatory frameworks, and weak international cooperation hinder coordinated progress toward global energy goals. Thus, while the energy transition is essential for planetary health, it must be managed equitably and strategically, ensuring that no country or community is left behind.

Energy Transition in the Global North

The energy transition in the Global North refers to the systemic shift from fossil fuel-based energy systems to sustainable, low-carbon sources, such as solar, wind, hydro, and geothermal power. This shift is central to global efforts to combat climate change, enhance energy security, and foster economic innovation (IEA, 2022). Advanced economies are leading this transition due to their technological capacity, financial resources, and strong policy frameworks. A primary driver of the transition is climate change mitigation, as the Global North seeks to reduce greenhouse gas emissions in line with the Paris Agreement goals. The transition also supports energy security, reducing reliance on volatile fossil fuel imports and insulating nations from geopolitical shocks, such as the Russia-Ukraine crisis, which exposed Europe's vulnerability to gas supply disruptions (European Commission, 2023).



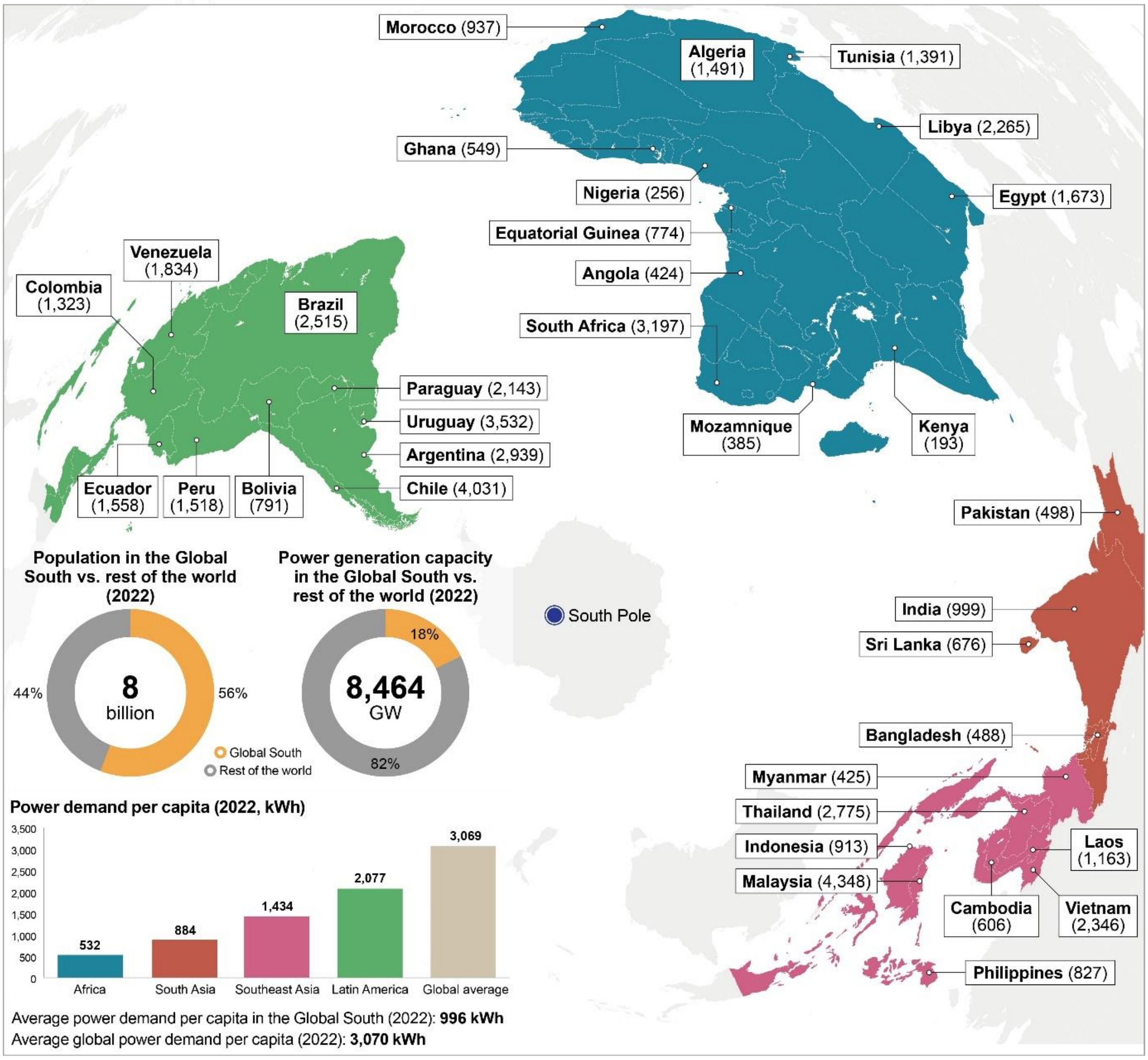
Energy Transition Trend in the Global North

Significant progress has been made. For instance, Nordic countries like Sweden, Finland, and Denmark have implemented robust policy frameworks and invested heavily in renewables, achieving some of the highest shares of clean energy globally. Germany's Energiewende (energy transition) strategy has similarly positioned it as a leader, though it faces challenges related to grid integration, energy affordability, and nuclear phase-out (Agora Energiewende, 2022). However, the transition is not without obstacles. Investment gaps remain a concern, as the cost of overhauling infrastructure and expanding renewable capacity is immense. Additionally, geopolitical fragmentation and supply chain constraints—especially for rare earth elements and solar components—can disrupt progress (IRENA, 2023). Ensuring a just transition is equally critical. As traditional energy sectors decline, job losses and economic displacement are inevitable, requiring proactive policies for retraining and social protection.

Energy Transition in the Global South

The Global South—which includes Latin America, Africa, South Asia, and Southeast Asia—is witnessing an accelerated transition to renewable energy, surpassing the Global North in the pace of solar and wind deployment in several regions (Singh, 2024). This transition is driven by the urgent need for energy access, economic development, and a shift away from costly fossil fuel imports. While per-capita energy demand in the Global South is only one-fifth of that in the Global North, the region is rapidly scaling clean energy to meet rising consumption needs. Countries in the Global South possess 70% of the world's renewable energy potential, making solar and wind the cheapest and most feasible path to electrification and industrialization (Singh, 2024). In 2024 alone, 87% of capital expenditure in electricity generation is expected to be invested in clean energy projects, with solar and wind capacity projected to grow by 60%, adding more than 70 gigawatts (IEA, 2024).

Electric power supply and demand in the "Global South"

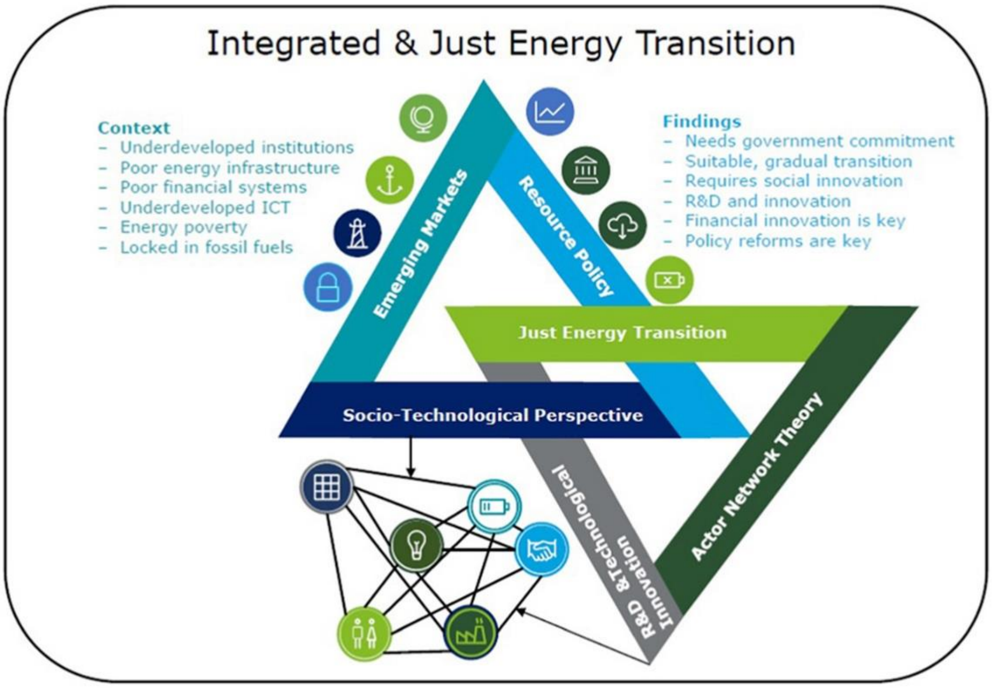


Data compiled Nov. 20, 2023.
Source: S&P Global Commodity Insights: 2011505.

This shift is not just environmental but strategic. Renewables reduce the economic burden of fossil fuel imports, which can account for more than 4% of annual GDP in some nations. Clean energy is also positioning these regions to attract global manufacturing and leapfrog toward industrial development without the environmental toll of traditional fossil-based growth (Singh, 2024).

Countries such as Brazil, Morocco, Egypt, Vietnam, and Bangladesh have outpaced parts of the Global North in electrification rates and renewable adoption. Still, the transition is uneven and hindered by financing constraints, policy gaps, and infrastructure challenges. Calls are growing—such as through initiatives like Mission 2025—for increased concessional financing, stronger Nationally Determined Contributions (NDCs), and targeted investment to triple renewables by 2030, especially in lower-income countries (IEA, 2024; Singh, 2024).

Energy Transition in the Global South: Challenges and Opportunities for Oil, Gas, and Extractive Industries



The global energy transition—from fossil fuels to renewable sources—presents a complex mix of opportunities and challenges for oil, gas, and extractive industries in the Global South. While the shift is necessary to combat climate change, it also risks economic dislocation in countries heavily reliant on fossil fuel revenues and resource extraction (Frye, 2024). One major challenge is the economic dependence on oil and gas. In countries like Nigeria, Angola, and Venezuela, fossil fuels account for a significant share of GDP, export earnings, and government revenue. A rapid reduction in global demand for fossil fuels could result in severe fiscal shocks, job losses, and social instability (Dongo & Relvas, 2025).

Ensuring a just transition is critical. Workers and communities tied to extractive industries must be supported through reskilling programs, social protection policies, and inclusive development planning. Without such measures, the transition risks deepening inequality and social unrest in already vulnerable regions (Frye, 2024). Paradoxically, the transition also increases dependence on mineral resources, such as lithium, cobalt, and rare earth elements—many of which are concentrated in the Global South. While this creates new economic opportunities, it also raises environmental and human rights concerns, particularly in countries with weak governance or poor regulatory frameworks. If not managed sustainably, increased mining could lead to ecosystem degradation, land disputes, and community displacement (IEA, 2022).

Furthermore, infrastructure gaps pose a technical and financial hurdle. Many countries in the Global South lack sufficient transmission infrastructure, storage systems, and grid stability to support renewable integration. Bridging these gaps demands substantial investment that may not be readily available, especially in debt-burdened or low-income economies (UNCTAD, 2023). Despite these challenges, the transition also offers opportunities for economic diversification, green industrial development, and improved energy access—but only if accompanied by coordinated policies, inclusive governance, and international support.

Opportunities for the Global South in the Energy Transition

While the energy transition presents notable challenges, it also offers transformational opportunities for countries in the Global South to achieve more sustainable, inclusive, and resilient development pathways.

Economic Diversification: The shift away from fossil fuels provides a crucial opening for many economies in the Global South to diversify beyond oil, gas, and extractives. This transition enables investment in renewable energy industries, green technology, and climate-smart agriculture, sectors that offer greater long-term stability and less exposure to global price volatility (IRENA, 2021). Diversification can also foster value-added industries, local manufacturing, and regional trade integration, thereby strengthening economic resilience.

Job Creation: Although the phase-out of fossil fuels may lead to job losses in traditional sectors, the renewable energy sector is highly labour-intensive, particularly during the construction, installation, and maintenance phases. According to IRENA (2023), renewable energy employed 13.7 million people globally in 2022, with the majority of new jobs created in developing regions. Clean energy projects in solar, wind, and energy efficiency can provide millions of new employment opportunities, especially when paired with reskilling and capacity-building programs.

Improved Access to Energy: The energy transition can significantly expand access to clean, affordable, and reliable electricity, particularly in rural and underserved regions of the Global South. Off-grid and mini-grid renewable systems are well-suited for remote communities that remain beyond the reach of centralized grid infrastructure (World Bank, 2022). This enhanced access not only improves quality of life but also stimulates local economies and supports education and healthcare services.

Reduced Pollution and Health Benefits: Replacing fossil fuels with renewable sources such as solar and wind leads to lower air and water pollution, significantly improving public health outcomes. Reduced emissions of particulate matter, nitrogen oxides, and sulphur dioxide can mitigate respiratory and cardiovascular diseases, particularly in urban centres exposed to high levels of pollution (WHO, 2023).

Responsible Resource Management: As demand for critical minerals (e.g., lithium, cobalt, nickel) used in batteries and clean tech grows, resource-rich countries in the Global South have a chance to leverage this demand strategically. With proper governance, transparency, and environmental safeguards, these countries can capture greater value from their natural resources while avoiding the "resource curse" (IEA, 2022).

The Role of Technology in the Transition to Solar Energy in the Oil, Gas and Extractive Industries

Technology is central to the rapid global shift toward solar energy, playing a transformative role in enhancing efficiency, reducing costs, and enabling wide-scale deployment across residential, commercial, and industrial sectors. One of the most impactful technological breakthroughs has been in photovoltaic (PV) innovation, where modern solar panels now achieve conversion efficiencies exceeding 22%, making them significantly more effective—even in low-light or sub-optimal weather conditions (IRENA, 2022). Newer technologies such as bifacial panels and thin-film solar cells offer greater flexibility, require less space, and are adaptable to various surface types, making solar installations viable in previously challenging environments.

Energy storage is another critical pillar of this transition. Cutting-edge battery technologies—particularly lithium-ion and flow batteries—allow excess solar energy to be stored and dispatched when sunlight is unavailable, ensuring a continuous and reliable power supply. These storage systems are especially vital for industrial applications where uninterrupted power is non-negotiable.

Additionally, smart grid systems and the Internet of Things (IoT) enable intelligent monitoring, load balancing, and seamless integration of solar energy into broader energy infrastructure. These systems optimize energy flow, prevent overloading, and enhance grid resilience. Artificial Intelligence (AI) and machine learning algorithms are also being employed to forecast energy demand, monitor panel performance, and optimize system output in real-time, thereby improving cost-effectiveness and system longevity (IEA, 2023).

As a result of these innovations, solar energy is no longer a supplementary power source but a central solution in the global energy mix. Technological advancements have made solar energy more reliable, scalable, and commercially viable—fundamentally changing how energy is produced, stored, and consumed.

The transition to solar energy is increasingly being embraced by the oil, gas, and extractive sectors as part of concerted efforts to reduce greenhouse gas (GHG) emissions and minimize their carbon footprints. Companies traditionally dependent on fossil fuels for high-energy operations are now deploying solar power across their activities to decarbonize output and comply with global climate goals (IEA, 2023).

Several notable projects illustrate this shift:

Cairn Oil & Gas (India) is fully converting its 705 km Mangala crude pipeline's above-ground installations to rooftop solar PV. By 2025, all 36 AGIs will be powered solely by solar, reducing around 770 tonnes of CO_2 emissions annually.

Siemens Solar has deployed **solar-powered pipeline monitoring systems**, with PV panels driving sensors and communications stations along remote oil pipelines (e.g., 50 stations in Saudi Arabia), entirely replacing diesel generators and cutting CO_2 emissions by approximately 1,500 tonnes annually.

Chevron's "Solar mine" in California is a 500 kW thin-film solar PV system powering oil field operations—one of the earliest and largest purely solar installations in the sector—avoiding fossil-fuelled electricity since 2003.

Glass Point/Petroleum Development Oman (Miraah) deploys **solar thermal to produce steam** for enhanced oil recovery, replacing natural gas with concentrated solar heat. This 1 GW thermal project saves 300,000 tons of CO_2 per year.

In the mining sector, Africa is also leading:

The **Tasiast mine (Mauritania)** installed a 34 MW PV plant (plus battery) that delivers ~20% of its needs—avoiding an estimated 530,000 tonnes of GHG emissions over the mine's lifetime.

Exxaro (South Africa) is developing a 70 MW solar farm to directly power its Grootegeluk coal mining operations, reducing overall carbon footprint by approximately 35%.

Belridge Solar (California), a joint project between Aera Energy and GlassPoint, integrates solar PV to power on-site oil-field operations, and is expected to reduce emissions by ~376,000 tonnes annually.

SECTION 4

Energy Solutions for Oil and Gas Production Companies and Extractive Companies to Reduce Carbon Footprint

Owner: Dr. Akintoye Akindele, CFA, DBA, FICA **Supported by:** Morayo Akintola **Designed by:** Stephen Adediran

DEEP OFF-SHORE DRILLING

Merganser – Pioneering Offshore Floating Solar in the North Sea

In a significant step towards addressing these challenges, SolarDuck, a Dutch clean-tech company, in collaboration with German energy giant RWE, successfully installed the "Merganser" offshore floating solar project in 2024. This innovative installation, boasting a capacity of 0.5 megawatt peak (MWp), is strategically located approximately 12 kilometres off the coast of Scheveningen in the Dutch North Sea.

Strategic Benefits:

1. The project stands as a resounding testament to the viability of offshore floating solar. Operating an active solar farm in this dynamic and one of the harshest offshore environments globally has proven that this is doable. This successful deployment in the North Sea, renowned for its consistently rough conditions, strong currents, and frequent gale-force winds (generally harsher than the Atlantic coast off West Africa), unequivocally proves that this solution works even in the most challenging maritime settings.

2. The system has shown the durability of materials, the stability of the platform against aggressive waves and currents, and the actual energy yield in a maritime climate, and also the inherent ability of the system to cater to power needs through its robust design.
3. Crucially, the system has also proven that it can be deployed in modular units that can be scaled up or descaled without significant cost and demobilization, providing unparalleled flexibility.
4. Finally, this solution delivers a transformative financial impact by significantly reducing operating costs. It directly eliminates the substantial expenditures accrued from purchasing and transporting fossil fuels like diesel, liberating your operations from volatile global fuel prices and complex logistical challenges. Furthermore, by supplementing or replacing traditional power sources, it drastically reduces the Capital Expenditure (Capex) needed for acquiring new generators and minimizes the ongoing maintenance, spare parts, and overhaul costs associated with them. This comprehensive cost-saving mechanism ensures long-term economic predictability and enhances overall profitability.

SEAVOLT – Charting New Waters for Deep Offshore Floating Solar

A Belgian consortium comprising Tractebel, DEME, and Jan De Nul Group jointly developed SEAVOLT©, a ground-breaking offshore floating photovoltaic (PV) technology. This solution is designed to not only withstand the most severe offshore conditions but also to create large, stable surfaces for solar panel deployment that are effectively protected from the waves. Its modular design is a key advantage, allowing for flexible adaptation to diverse marine sites and varying energy demands. The project was successfully deployed off the Belgian coast in August 2023 and is billed to be expanded to produce 1 GW of renewable energy.

Strategic Benefits:

1. What this unequivocally proves is that our technology is not merely conceptual; it is already successfully deployed and fully operational in the North Sea – one of the planet's most unforgiving offshore environments. This real-world validation confirms its exceptional resilience and performance under extreme conditions. Consequently, this robust, proven solution can be readily replicated here, off the Atlantic coast, with even greater confidence, as these waters are generally less harsh.

2. This robust solar technology isn't a standalone replacement; rather, it's expertly designed for seamless integration into your current energy infrastructure working alongside other renewable assets, to enhance overall system efficiency and reliability. This creates a powerful, optimized setup tailored to your specific operational needs.
3. Crucially, our solution is engineered to meet and exceed the stringent ecological standards demanded by the oil and gas industry. By significantly reducing emissions and minimizing environmental footprint, it ensures compliance with the most rigorous regulations. This commitment to ecological responsibility allows operators to pursue their objectives confidently, knowing their power solution aligns with global best practices for sensitive marine and terrestrial environments
4. This solution ensures seamless scalability. As your energy demands naturally grow, additional units can be integrated effortlessly, scaling your power capacity to match. This capability means you can meet evolving requirements without escalating operational costs, delivering long-term economic stability and energy security.
5. Finally, this solution delivers a transformative financial impact by significantly reducing operating costs. It directly eliminates the substantial expenditures accrued from purchasing and transporting fossil fuels like diesel, liberating your operations from volatile global fuel prices and complex logistical challenges. Furthermore, by supplementing or replacing traditional power sources, it drastically reduces the Capital Expenditure (Capex) needed for acquiring new generators and minimizes the ongoing maintenance, spare parts, and overhaul costs associated with them. This comprehensive cost-saving mechanism ensures long-term economic predictability and enhances overall profitability.

SHALLOW OFF-SHORE DRILLING

NTPC Ramagundam – India's Landmark Floating Solar Power Plant

NTPC (National Thermal Power Corporation), India's largest power utility, commissioned a ground-breaking 100 MW (Megawatts) floating solar power plant (SPP) in 2022. This colossal project spans an impressive 243 acres on the surface of the reservoir located in Ramagundam, Telangana, in the south of the country.

The installation involved deploying thousands of photovoltaic panels mounted on special floating structures (pontoons) directly onto the reservoir's surface. This innovative approach allows the power plant to coexist with the reservoir's primary function, demonstrating a highly efficient use of available resources.

Strategic Benefit

1. The solution stands as definitive proof: shallow offshore solar technology has truly come of age. This landmark project demonstrates that the technology is no longer nascent but fully established and exceptionally reliable for large-scale power generation. Its proven success ensures that this projects can be confidently replicated, meeting significant energy demands with a reliable and sustainable

offshore approach. This is an established technology, ready for widespread deployment.

2. Furthermore, shallow offshore solar solutions integrate seamlessly with existing power systems. This powerful synergy optimizes the overall energy mix, enhances grid stability, and significantly boosts generation efficiency. Such integration maximizes existing asset utilization, creating highly reliable and robust hybrid power solutions.
3. This technology definitively proves that regardless of your specific energy demands, an effective and remarkably cost-efficient solution is achievable. Its inherent flexibility and scalability allow for tailored deployments, ensuring that power needs of any size can be met reliably and affordably. It democratizes access to clean, economical energy for diverse applications.
4. Finally, this solution delivers a transformative financial impact by significantly reducing operating costs. It directly eliminates the substantial expenditures accrued from purchasing and transporting fossil fuels like diesel, liberating your operations from volatile global fuel prices and complex logistical challenges. Furthermore, by supplementing or replacing traditional power sources, it drastically reduces the Capital Expenditure (Capex) needed for acquiring new generators and minimizes the ongoing maintenance, spare parts, and overhaul costs associated with them. This comprehensive cost-saving mechanism ensures long-term economic predictability and enhances overall profitability.

Portuguese Solaris Float – Proving Floating Solar in a Controlled Environment

In a strategic move to advance floating solar technology, Portuguese Solaris Float commissioned a 50.7 kW (kilowatt) prototype of a floating solar power plant in 2020. This significant pilot project was installed on the Oostvoornse Meer lake, located in the west of the Netherlands.

Strategic Benefits

1. Deploying our solar solution provided immediate cost advantages compared to traditional fossil fuel-based systems. By harnessing clean, renewable solar energy, the project reduced reliance on volatile fuel markets and grid tariffs. The result: a lower cost per kilowatt-hour (kWh) and significant long-term reductions in operating expenses.
2. This real-world deployment proved our model's ability to deliver predictable, measurable savings from day one. Through performance tracking and energy output analysis, we demonstrated that our clients could achieve substantial operational cost reductions over the project lifecycle, without compromising on reliability or energy quality.
3. Our solar solution operates entirely without fossil fuels, directly replacing emissions-heavy energy sources. This project contributes to meaningful CO_2 reductions, helping our clients meet their sustainability goals and enhance their Environmental, Social, and Governance (ESG) standing. Every megawatt-hour generated from solar represented emissions avoided—supporting global climate targets.

4. One of the most compelling outcomes is that the client received a fully installed, high-performing energy system with zero upfront investment. Our flexible financing structure eliminates capital barriers, enabling companies to adopt clean energy without financial strain. This model ensures they benefit immediately from lower power costs and guaranteed savings while preserving internal cash flow.

Cirata Floating Solar

In a monumental stride towards its clean energy goals, Indonesia has successfully commissioned a 192 MWp (Megawatt peak) floating solar power plant at the Cirata hydropower reservoir in West Java. This project is the result of a powerful collaboration between Indonesia's state-owned utility company PLN (Perusahaan Listrik Negara) and the Abu Dhabi Future Energy Company – Masdar, a global leader in renewable energy.

The Cirata floating solar facility represents a world-class example of co-locating renewable energy technologies. By deploying thousands of solar panels on the surface of an existing hydropower reservoir, the project leverages valuable water space that was previously unutilized for electricity generation. This synergy between solar and hydropower assets creates a highly efficient energy complex, demonstrating how a nation can maximize its energy output from a single location.

Strategic Benefits:

1. By co-locating solar panels on an existing reservoir, our floating solar project avoids the need for expensive land acquisition and

infrastructure expansion. This strategic use of underutilized water space significantly reduces installation and operational costs—translating into cheaper electricity generation per kilowatt-hour compared to conventional energy sources.

2. The integration of solar power into an already-operational system creates a complementary energy mix that optimizes generation efficiency. This synergy allows for more stable output and better load balancing, leading to lower overall system costs and guaranteed long-term savings for operators and off-takers.
3. The solution contributes to meaningful climate action by replacing fossil fuel-based electricity with clean, renewable solar energy. Every megawatt-hour generated from the floating PV system directly displaces emissions, helping the organisation significantly reduce its carbon footprint and meet national and international climate commitments.
4. With the right financing model, such as a Power Purchase Agreement (PPA), similar floating solar projects can be developed with zero upfront capital investment from the energy buyer. This model allows industrial users to enjoy the benefits of clean, affordable power without financial strain, while preserving their internal capital for core operations.

ON-PLATFORM SOLUTIONS

Powering Unmanned Offshore Wellhead Platforms: A Case Study of Orga's Integrated Solar Solutions for PTTEP

Orga BV outfitted eight of PTTEP's wellhead platforms in the Gulf of Thailand with integrated solar power systems. Each system, installed in 2019, includes a battery bank designed to produce 15 kWh/day, ensuring continuous power for "many years". Orga BV, leveraging its expertise in solar-powered aids to navigation and global oil and gas projects, served as the primary installer. Morningstar Corp. supplied their TriStar™ MPPT solar charge controllers, chosen for their compact size, robust performance in high temperatures, explosion-proof capabilities, and "fit and forget" reliability, which minimized expensive enclosure space and reduced service calls. PTTEP, seeking reliable and cost-effective solutions, engaged Orga for subsequent project phases due to the proven success.

Strategic Benefits

1. Our systems utilize high-performance, industrial-grade solar components, offering a true “fit-and-forget” experience. This translates to extended maintenance intervals, significantly fewer site visits, and drastically reduced exposure to hazardous offshore conditions—enhancing both operational safety and efficiency.
2. Our solar systems are certified for Ex zones 1 and 2, making them ideal for offshore oil and gas platforms where volatile gases are present.

With remote monitoring and automation, clients can eliminate routine fuel deliveries and manual checks, leading to substantial OPEX reductions and guaranteed savings.

3. In line with our value proposition of cheaper power, solar eliminates the high and volatile cost of fuel while minimizing service interruptions. There is no upfront capital expenditure (Capex) required—clients simply pay for the energy consumed, under a flexible model such as a Power Purchase Agreement (PPA). This makes it easy to transition to clean energy without straining financial resources.
4. Environmentally, these systems produce zero emissions, no noise, and no pollution, aligning with the sustainability goals of forward-thinking operators. By choosing Platform Capital's offshore solar solution, clients not only reduce CO_2 emissions but also strengthen their ESG credentials and improve long-term asset profitability.

LARGE-SCALE GROUND-MOUNTED PV ARRAYS FOR MINES AND QUARRIES

Sukari Gold Mine – Powering Mining with the Sun in the Egyptian Desert

A Hybrid Solar-Battery Power Plant In a pioneering move towards sustainable mining, the Sukari Gold Mine implemented a large-scale hybrid renewable energy solution. At its core is a 36 MW (Megawatts) solar photovoltaic (PV) plant, intelligently integrated with a 7.5 MW Battery Energy Storage System (BESS). This advanced system was installed directly at the Sukari Gold Mine in Egypt, leveraging the abundant solar resource available in its desert location.

The solar PV array captures sunlight during the day, converting it into electricity. The crucial addition of the BESS allows any excess solar power generated to be stored, providing a reliable power source during periods of low solar irradiance (e.g., cloudy days) or at night. This integrated approach creates a robust microgrid that seamlessly combines renewable, ensuring a continuous and stable energy supply for critical mining processes such as crushing, grinding, and ore processing.

Strategic Benefits:

1. By combining solar photovoltaic (PV) arrays with battery energy storage systems (BESS), we enable clients to generate and store their own power, reducing reliance on expensive grid or diesel-based

electricity. This leads to significantly lower energy costs per kilowatt-hour (kWh), even in remote and high-demand locations like mine sites.

2. The stored solar energy provides a consistent, uninterrupted power supply, especially during cloudy conditions or at night—eliminating the need for expensive fuel top-ups or emergency power sources. This integrated microgrid model stabilizes energy expenditure and ensures clients experience predictable, long-term savings on operational energy costs.
3. Our renewable systems operate entirely without fossil fuel dependency. By replacing carbon-intensive generators, clients achieve dramatic reductions in greenhouse gas emissions and environmental impact. This not only supports ESG and sustainability goals, but also strengthens stakeholder trust and compliance with climate regulations.
4. Platform Capital provides these advanced systems through flexible financing models, such as Power Purchase Agreements (PPAs), where clients pay only for the energy used—with zero upfront capital investment. This allows clients to adopt cutting-edge clean energy solutions while preserving liquidity and focusing their resources on core operations like production and exploration

Otjikoto Gold Mine – Shining a Light on Sustainable Mining in Namibia

A Hybrid Solar-HFO Power Plant

In a strategic move towards decarbonization and operational efficiency, the Otjikoto Gold Mine commissioned a **7 MW (Megawatts) solar facility with integrated battery storage capabilities** in **April 2018**. This pioneering project was installed directly at the Otjikoto Gold Mine in Namibia, leveraging the country's abundant solar resources.

The solution was spearheaded by a collaborative effort, with **Caterpillar** selected to supply the advanced solar PV modules and its innovative Cat Microgrid Master Controller (MMC). Their long-standing dealer, **Barloworld Power**, provided the crucial engineering, procurement, and construction (EPC) services for the project. The system seamlessly integrates the new solar farm with the mine's existing HFO power plant (also supplied by Caterpillar), allowing for a sophisticated hybrid microgrid. The Cat MMC intelligently manages the power flow from both solar and HFO sources, often leveraging implied battery storage within the microgrid suite to ensure consistent, high-quality power delivery.

Strategic Benefits:

1. By combining solar photovoltaic (PV) arrays with battery energy storage systems (BESS), we enable clients to generate and store their own power, reducing reliance on expensive grid or diesel-based

electricity. This leads to significantly lower energy costs per kilowatt-hour (kWh), even in remote and high-demand locations like mine sites.

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CONTAINERIZED SOLUTION

Nomad Solar Energy – Power on the Move for Temporary and Off-Grid Needs

Nomad Solar Energy's Innovative Solution

Addressing this critical market gap, Nomad Solar Energy has emerged as a key player by developing a sophisticated line of mobile containerized solar PV generators. These units are ingeniously designed as fully integrated, pre-wired power solutions, making them ideal for temporary and off-grid use. Currently available in versatile units of 47 kW (kilowatts) and 107 kW, these systems represent a complete power plant enclosed within a standard shipping container, ready for immediate deployment.

Each unit typically includes high-efficiency solar panels (often deployable from the container itself or mounted on a foldable structure), inverters, battery energy storage systems (BESS), and a smart energy management system, all pre-connected and tested. This "plug-and-play" design significantly reduces the need for complex on-site assembly, specialized civil works, or extensive electrical integration.

Strategic Benefits:

1. For clients operating in dynamic or remote environments, speed and flexibility are critical. Our containerized and mobile solar solutions offer a strategic advantage by enabling rapid deployment with minimal

logistical complexity. Unlike traditional power systems that require extensive civil works, long lead times, and costly installations, our modular units can be delivered using standard transport methods—by truck, sea, or air—and become operational within hours to days of arrival.

2. Our containerized solar solutions offer exceptional portability, enabling clients to redeploy energy assets across multiple project sites as operational needs evolve. When a temporary site wraps up or shifts location, the system can be quickly disconnected, packed, and transported—eliminating stranded assets and ensuring maximum return on investment. This flexibility reduces the need for new infrastructure at each site, delivering ongoing savings, zero Capex duplication, and seamless energy continuity across dynamic operations.
3. With Platform Capital's containerized solar solution, clients gain a fully mobile energy solution that adapts as operations evolve—delivering cheaper, emission-free power wherever it's needed. These systems eliminate the risk of stranded or underutilized assets by enabling rapid redeployment across sites, maximizing asset utilization. Clients enjoy guaranteed operational savings, avoid repeat infrastructure costs, and reduce their carbon footprint—all with zero Capex outlay. It's a smart, sustainable way to power progress—anytime, anywhere.

REURASIA – Delivering Turn-Key Containerized Solar for Seamless Deployment

The Containerized Solar Unit

Addressing these pain points, REURASIA has developed and offers a highly practical and efficient Containerized Solar Solution. This offering is not a singular installed project, but rather a product line designed to provide clients with a complete, pre-engineered, and ready-to-deploy solar power system.

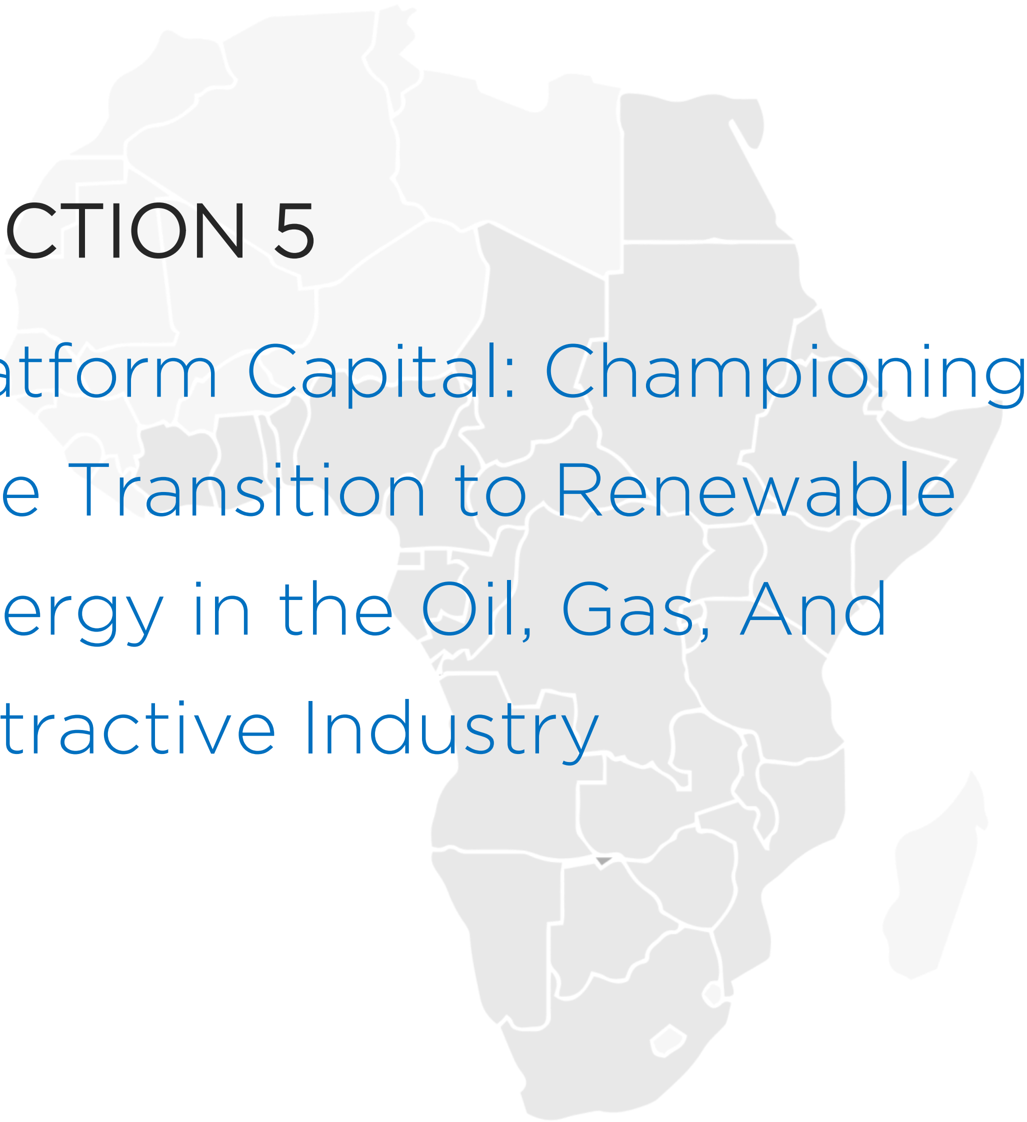
Strategic Benefits:

For clients operating in dynamic, remote, or time-sensitive environments, speed is essential. Our containerized and mobile solar systems offer a critical strategic edge by allowing for rapid deployment with minimal site preparation. Unlike traditional energy infrastructure that demands lengthy planning, permitting, and civil works, our units can be shipped via standard logistics (truck, sea, or air) and made operational within hours to days of arrival. This ensures minimal downtime, faster project ramp-up, and reliable energy access exactly when and where it's needed.

Our solutions are engineered for exceptional portability and adaptability. As projects evolve or shift location, these solar systems can be easily disconnected, packed, and redeployed—helping clients avoid sunk costs and eliminate stranded assets. This modular approach supports maximum asset utilization, reduces the need for repeated infrastructure investments, and allows energy systems to scale with operational demands—ensuring continuity and cost-efficiency across changing project cycles.

With no fuel costs, no emissions, and no noise, our containerized solar systems offer a cleaner, cheaper alternative to diesel generators or grid dependency. Clients benefit from predictable, guaranteed operational savings over the life of the project, along with measurable reductions in CO_2 emissions. This supports both bottom-line performance and alignment with sustainability and ESG goals, enhancing brand credibility and regulatory compliance.

Clients can access these advanced clean energy systems with no upfront capital investment, thanks to our flexible financing models, including Power Purchase Agreements (PPAs) and lease-to-own options. This allows companies to preserve internal cash flow while still benefiting from premium, sustainable infrastructure. It's a low-risk, high-impact way to modernize operations—delivering cleaner energy, lower costs, and strategic agility without financial strain.



SECTION 5

Platform Capital: Championing The Transition to Renewable Energy in the Oil, Gas, And Extractive Industry

About Platform Capital

At Platform Capital, we bridge the gap between Africa and the world—serving not only as investors but as catalysts for sustainable transformation. With over 20 years of experience, we have cultivated a deep understanding of growth markets and established ourselves as a global investment and advisory firm with a uniquely African perspective.

Our mission is clear: to build the leading growth market-focused investment and advisory firm, delivering globally competitive returns. We achieve this by combining deep local insight, entrepreneurial business-building, and powerful local and global connectivity. With a presence across 11 nationalities, 104 direct portfolio companies, and operations spanning 9 verticals, Platform Capital is redefining what it means to invest in emerging markets.

We are guided by the BLACK values—Brother's Keeper, Loyalty, Authenticity, Capacity, and Knowledge—which shape our culture, strengthen our partnerships, and define our commitment to ethical, impactful business. Our investment strategy is centred around long-term value creation. Whether we are investing, advising, or owning and operating businesses, we prioritize sustainability, scalability, and innovation.

Beyond capital, we bring strategic value to every transaction. Our approach is holistic: we provide access to global deal flow, structure investments to protect downside while maximizing upside, and embed ourselves in the success journey of our portfolio companies. Our team of high-calibre professionals is deeply aligned with our investors, sharing both risk and reward.

We believe Africa's future lies in unlocking ideas with ideal capital in an ecosystem that fosters growth. That's why we are obsessed with changing the African narrative—deploying patient capital and social capital to transform potential into performance. From building regionally dominant businesses to improving governance and impacting 1 million families and students over the next five years, Platform Capital is committed to sustainable development. At Platform Capital, we don't just invest—we empower. We are building the Africa of tomorrow by connecting global insight with local excellence, creating businesses that are not only competitive, but transformative.

Platform Capital: Championing the Transition to Renewable Energy in the Oil, Gas, and Extractive Industry

As the global call for climate action intensifies, the need for sustainable, reliable, and cost-effective energy solutions in the oil, gas, and extractive industries has never been more urgent. These industries remain among the most energy-intensive sectors and are responsible for a significant portion of global greenhouse gas (GHG) emissions. Recognizing the critical importance of transitioning to low-carbon energy systems, **Platform Capital** is proud to be at the forefront of driving this transformation across Africa and beyond.

We at Platform Capital are championing this transition by offering innovative solar and renewable energy solutions tailored to the operational demands of oil and gas and extractive companies. Our approach goes beyond technology deployment—we make this transition seamless by **structuring and financing these projects in a sustainable and scalable manner**. We understand the capital-intensive nature of energy projects and the financial constraints many companies face in adopting renewable alternatives. Therefore, we provide flexible financing models that align with each company's cash flow and long-term sustainability goals.

Through strategic partnerships, **Platform Capital collaborates with global financiers, Original Equipment Manufacturers (OEMs), and top-tier engineering firms** to deliver holistic energy solutions. These partnerships enable us to offer fully integrated services—from project conception and feasibility studies to design, installation, and long-term maintenance. By leveraging international expertise and local insights, we ensure our solutions are both globally competitive and contextually relevant for African markets.

Our energy solutions prioritize **solar power and hybrid systems**, designed to replace diesel generators in off-grid and remote locations. These systems are not only cost-saving but also help companies achieve their carbon reduction targets by significantly lowering GHG emissions. In regions with abundant solar radiation, such as sub-Saharan Africa, solar energy offers an untapped opportunity to power industrial operations efficiently and sustainably.

We recognize that reliable electricity is the backbone of any successful operation in the oil and gas or mining sector. Our power systems are built to **guarantee uninterrupted electricity supply**, thereby enhancing operational stability, reducing downtime, and improving productivity. Whether powering drilling rigs, refining plants, mining operations, or pipeline infrastructure, our renewable energy solutions are engineered to meet the unique energy needs of each client.

Beyond environmental impact, Platform Capital's renewable initiatives contribute to broader socio-economic development. By reducing reliance on imported fossil fuels, we support energy independence and resilience in African economies. Our projects create local jobs, build technical capacity, and align with global Environmental, Social, and Governance (ESG) standards—positioning our partners as leaders in sustainable industrial development.

The Value We Deliver

At Platform Capital, the value we deliver to our clients in the oil, gas, and extractive industries is rooted in **cost efficiency, sustainability, and operational excellence**. One of the most compelling benefits of our energy solutions is the **significantly lower power cost** compared to traditional fossil fuel alternatives. By leveraging solar and hybrid renewable systems, we help our clients access **clean, affordable electricity** at a stable and predictable rate—free from the volatility of diesel or gas prices.

We also guarantee **measurable cost savings** from day one. Our projects are designed to reduce operational expenses over time, with clearly defined savings margins that positively impact our clients' bottom lines. These savings are not theoretical—they are built into the performance and pricing structure of every project we deliver.

In addition to cost savings, our solutions contribute to **substantial CO_2 emissions reduction**, helping our clients meet their environmental, social, and governance (ESG) commitments and align with global climate goals.

Importantly, we offer all this **without requiring any capital expenditure (Capex)** from the client. Our financing models allow companies to benefit from state-of-the-art energy infrastructure with zero upfront investment, making sustainability accessible and financially viable.

With Platform Capital, clients gain clean energy, operational reliability, and financial freedom—all in one package.

Flexible Contractual Solutions Tailored to Your Energy Needs

At Platform Capital, we recognize that every client has unique operational, financial, and sustainability goals. To meet these diverse needs, we offer three tailored contractual models that provide flexibility, transparency, and value, enabling companies in the oil, gas, and extractive industries to transition to renewable energy seamlessly—without compromising cash flow or operational efficiency.

1. Power Purchase Agreement (PPA)

Our Power Purchase Agreement (PPA) is ideal for clients who want a long-term, low-risk solution with zero upfront capital investment. Under this

model, Platform Capital designs, finances, builds, and operates the solar or hybrid energy system, and the client pays only for the electricity consumed, typically on a per kilowatt-hour (kWh) basis. PPAs usually range from 10 to 20 years, ensuring stable and predictable energy costs over time. At the end of the agreement, ownership of the asset is transferred to the client at no additional cost. This model is especially suitable for clients focused on pure renewable energy (RE) or hybrid solar-diesel systems, seeking to reduce carbon footprint without tying up capital.

2. Operating Lease-to-Own

The Operating Lease-to-Own model is designed for clients who prefer medium-term commitments with consistent payments and a pathway to eventual ownership. Contracts typically range from 7 to 15 years, with the client paying a fixed monthly or quarterly fee over the lease period. During this time, Platform Capital owns and maintains the energy asset, ensuring optimal performance. Upon completion of the lease tenure, full ownership of the asset transfers to the client. This model is particularly well-suited for clients interested in renewable energy systems bundled with Battery Energy Storage Systems (BESS) to ensure energy availability and reliability, especially in remote or off-grid locations.

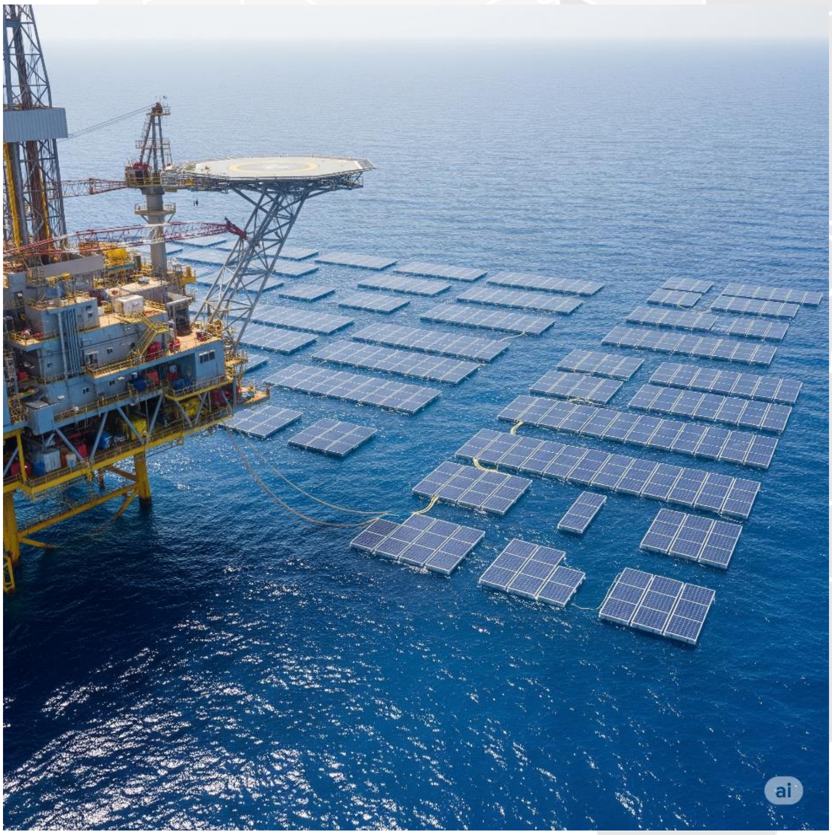
3. Finance Lease-to-Own

Our Finance Lease-to-Own model is perfect for clients who are ready to take ownership of the energy asset but prefer to spread the capital expenditure (Capex) over time. These leases typically span 3 to 5 years, during which the client pays a fixed monthly or quarterly fee. Unlike a standard loan, this lease gives clients full operational control of the system, and ownership is transferred automatically at the end of the tenure. It is an ideal solution for companies that want to own the asset outright, gain energy independence, and capitalize the system on their balance sheet, while preserving liquidity in the short term.

Through these three flexible contractual models, Platform Capital ensures that every client—regardless of financial structure or operational scale—can access sustainable, cost-effective, and reliable energy solutions.

Our Six Solar Solutions for the Oil, Gas, and Extractive Industry

At **Platform Capital**, we recognize that the energy demands of the oil, gas, and extractive industry are diverse and often situated in challenging environments. From offshore rigs to remote mining operations, ensuring a stable, clean, and cost-effective power supply is essential. To address these needs, we have developed **six adaptable solar energy solutions** that are tailored specifically to the operational realities of this sector. These solutions are fully renewable, requiring no fossil fuel augmentation, and are designed to reduce emissions, lower operational costs, and support environmental compliance.



1. Solar Solutions to Upstream Sector

Deep Sea Platforms

Deep sea platforms operate in some of the harshest and most remote environments on earth. Traditionally powered by diesel or gas turbines, these facilities face high fuel transportation costs and significant emissions. Our **floating or tethered solar solutions** integrate **high-durability marine-grade PV**

systems combined with energy storage technologies to power key operations such as communication systems, lighting, instrumentation, and control panels. These systems are engineered to withstand saltwater corrosion, high winds, and extreme weather, ensuring **reliability and safety** in offshore environments.

2. Solar Solutions for Shallow Offshore Platforms

Shallow Offshore Platforms

Shallow offshore platforms are more accessible than deep-sea rigs but still face logistical and environmental challenges. For these sites, we provide **custom-mounted PV systems** that can be installed on deck space or adjacent floating structures. These solutions reduce the need for costly fuel shipments and minimize the risk of oil spills and emissions. Solar-generated electricity is used to support platform operations such as navigation aids, monitoring systems, and electrical loads. These installations are **modular,**

scalable, and integrate with existing electrical systems for seamless operation.

3. Solar Solutions for the Midstream Sector

Onshore Platforms and Refineries

Onshore oil and gas production facilities, including pipeline compressor stations, pumping stations, and processing plants, are ideal candidates for **ground-mounted solar installations**. These platforms often occupy large land areas with clear access to sunlight. Our onshore solar solutions use high-efficiency PV modules and energy storage to **provide consistent power for process control, telecommunications, lighting, and backup systems**. The benefits include reduced electricity bills, improved grid stability, and a significant reduction in carbon emissions. These systems can be tied into microgrids or run autonomously.

4. On-Platform Solar Arrays

On-platform solar arrays

We offer customized on-platform solar arrays designed to fit the physical structure of industrial assets such as oil rigs, control rooms, substations, and plant rooftops. These systems transform unused surface areas into productive power generators. With lightweight, corrosion-resistant panels and integrated inverters, these arrays are ideal for small- to medium-load operations such as lighting, HVAC, or IT systems. On-platform arrays help reduce internal reliance on fossil-fuel Led generators and serve as a visible commitment to sustainability.

5. Large-Scale Ground-Mounted PV Arrays for Mines and Quarries

Large-Scale Ground-Mounted PV Arrays for Mines and Quarries

Mining and quarrying operations require **significant amounts of power** for drilling, crushing, hauling, and processing. Many of these sites are located in areas with high solar irradiance, making them excellent candidates for large-scale solar deployment. Our ground-mounted solar farms, combined with battery energy storage systems (BESS), can provide **primary or backup power** to support continuous operation. These systems reduce diesel consumption, lower operating costs, and dramatically cut GHG emissions. We also offer solutions that allow mines to operate entirely off-grid where needed.

6. Containerized & Mobile Solar Solutions

Containerized & Mobile Solar Solutions

Our containerized and mobile solar units are designed for flexibility and rapid deployment. Housed in rugged, weather-resistant enclosures, these systems include pre-installed PV panels, batteries, and inverters. They are ideal for temporary installations, exploration sites, emergency response, or modular expansion. Units can be easily transported to remote or inaccessible locations and set up within hours, delivering clean energy where and when it's needed. These plug-and-play solutions minimize downtime and provide a fast-track path to energy access.

These six solar solutions represent a strategic portfolio designed to serve the unique energy profiles of the oil, gas, and extractive industries. Whether powering a deep-sea platform or a remote mining site, Platform Capital delivers dependable, zero-emission energy systems that ensure operational resilience, environmental compliance, and cost savings—paving the way for a greener industrial future.

SECTION 6

Outlook and Conclusion

Outlook

We are proud to be at the forefront of starting the conversation—and the transformation—around energy transition in Africa's oil, gas, and extractive industries. Recognizing the urgency of climate commitments and the immense opportunity in renewable innovation, we are not just responding to a global trend—we are actively leading the introduction of intelligent, scalable energy systems that address Africa's unique realities and future ambitions. Our solar-powered solutions are designed specifically to support the upstream, midstream, and downstream sectors of the oil and gas industry with smart, low-emission alternatives that enhance reliability and reduce carbon footprints. From deep-sea platforms to pipeline stations and refineries, we are deploying modular solar technologies that can thrive in remote, demanding environments while meeting global ESG and compliance standards.

But innovation alone is not enough. One of the greatest barriers to renewable adoption in Africa is access to capital. We are bridging that gap through zero Capex financing models—removing upfront financial barriers and enabling companies to embrace clean energy without diverting operational budgets. We are also proud to be championing the renewable transition of Africa's mining and extractive sectors—introducing integrated solar and storage systems that ensure energy independence and emissions reduction in off-grid, high-demand settings. This isn't just about lowering emissions; it's about redefining competitiveness and positioning African resource economies as global leaders in sustainable industrial growth.

Through strategic partnerships, advisory support, and long-term investment, we are setting the stage for a just, inclusive energy future. We see ourselves not just as solution providers, but as enablers of a new industrial paradigm—where Africa leads in building a resilient, clean energy economy that serves both people and the planet. The conversation has begun. Let's build the future together.

Conclusion

As the world accelerates toward a low-carbon future, the oil, gas, and extractive industries face mounting pressure to transform. These sectors, historically reliant on fossil fuels and central to global emissions, are now at the crossroads of innovation and sustainability. Platform Capital is not only responding to this urgency but actively leading the charge—delivering tailored, technology-driven renewable energy solutions that align profitability with environmental responsibility. Through our portfolio of modular, scalable solar energy systems—from containerized mobile solutions to large-scale ground-mounted arrays—we are enabling clients to cut carbon emissions, reduce energy costs, and transition away from fossil-fuel dependency. Our financing models eliminate capital expenditure barriers, making clean energy adoption seamless, sustainable, and financially sound. Whether it's powering deep-sea platforms, remote mining operations, or onshore refineries, Platform Capital's offerings are engineered to deliver guaranteed savings, zero emissions, and operational resilience.

But our impact goes beyond technology—it lies in our partnerships. By collaborating with OEMs, global financiers, and engineering leaders, we are creating a new energy paradigm where Africa and other emerging markets don't lag in the energy transition but lead it. We don't just install solar systems; we enable strategic transformation that prepares our clients for a carbon-regulated future while enhancing competitiveness and long-term value creation. The future of energy is green, decentralized, and innovation-led. Platform Capital is proud to be a trusted partner in decarbonizing some of the most energy-intensive sectors on the planet. Together with our clients, we are turning climate ambition into climate action—powering progress while preserving the planet.

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