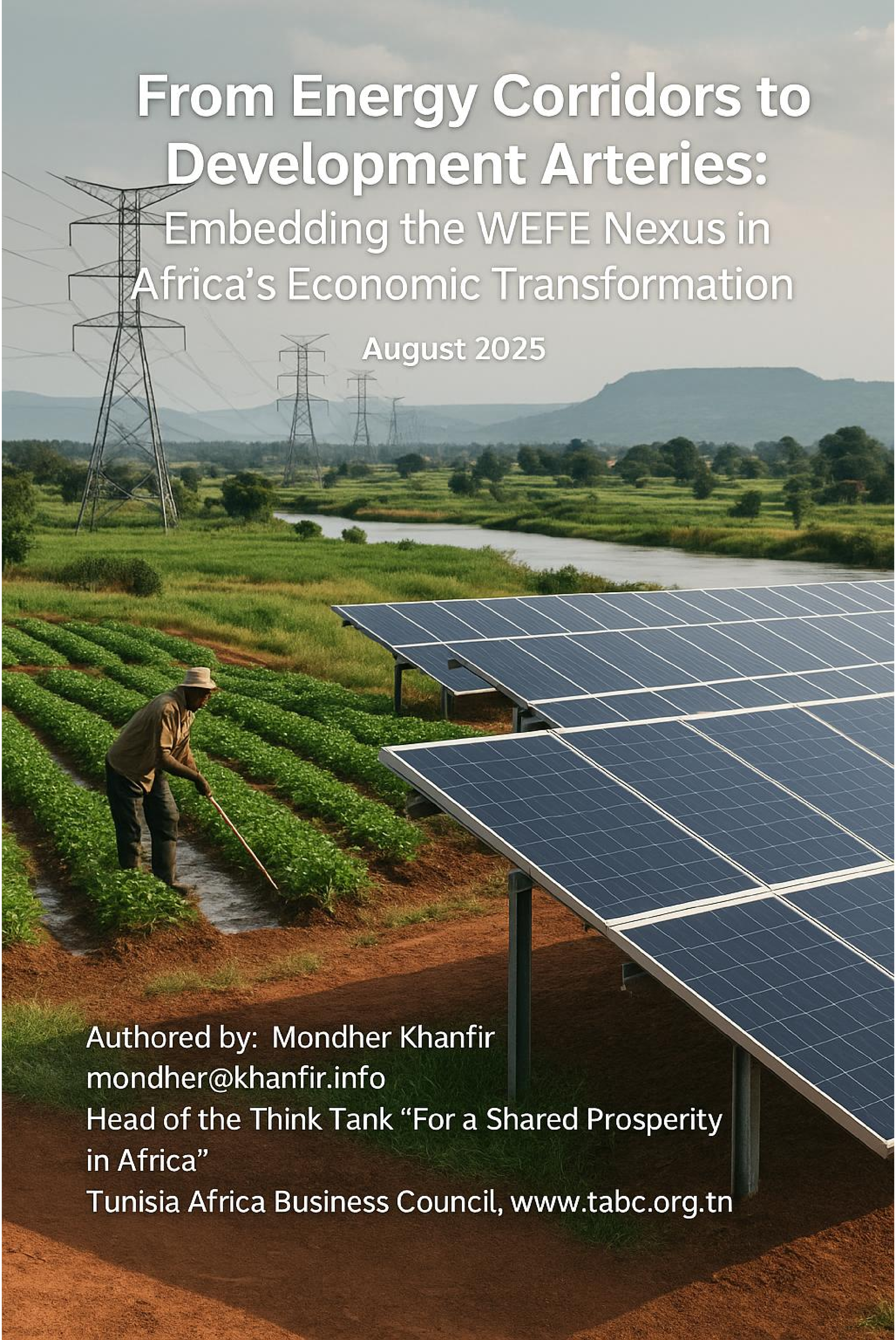


From Energy Corridors to Development Arteries:

Embedding the WEFE Nexus in Africa's Economic Transformation

August 2025

Authored by: Mondher Khanfir
mondher@khanfir.info
Head of the Think Tank "For a Shared Prosperity in Africa"
Tunisia Africa Business Council, www.tabc.org.tn

From Energy Corridors to Development Arteries:

Embedding the WEFE Nexus in Africa's Economic Transformation

(August 2025)

Authored by: Mondher Khanfir, mondher@khanfir.info
Head of the Think Tank «For a Shared Prosperity in Africa»
*Tunisia Africa Business Council, **www.tabc.org.tn***

Abstract
Africa's energy corridors -spanning electricity interconnections, gas pipelines, and emerging hydrogen routes- are pivotal to unlocking the continent's productive transformation, regional integration, and ecological resilience. However, their current conception often confines them to linear transmission roles. This paper advances a paradigm shift: **positioning energy corridors as multi-sector development arteries capable of energizing communities, catalyzing industries, and restoring ecosystems.**

Using the **Water–Energy–Food–Ecosystem (WEFE) Nexus** and the **Triple Transformation Pathway (technological, infrastructural, institutional)**, the analysis redefines how corridors are planned, financed, and governed. It argues for a systemic approach that integrates territorial development objectives, mobilizes blended finance, and leverages private sector investment as a driver for large-scale, inclusive transformation.

Case studies -from the ELMED link in North Africa and the West Africa interconnection to the Grand Inga project, the East African Geothermal Corridor, and Southern Africa's hydrogen networks- demonstrate how corridor-based projects can enable solar-powered desalination, renewable-driven cold chains, Green hydrogen fertilizer production, and water-smart agro-processing. These interventions reduce energy costs, expand local value chains, and extend access to underserved regions.

The paper proposes **eight policy actions, embedding nexus principles** in planning, establishing Corridor Ecosystem Governance, harmonizing cross-border rules, and creating a continental Green Corridor Certification Scheme.

By **transforming energy corridors into integrated territorial ecosystems**, Africa can accelerate its Green transition, secure energy sovereignty, attract long-term capital, and strengthen its position in the global low-carbon economy-**advancing the ambitions of the "Africa We Want".**

Table of Content

List of Abbreviations

Acronym	Definition
AfCFTA	African Continental Free Trade Area
AfDB	African Development Bank
ARGeo	African Rift Geothermal Development Facility
AU	African Union
AUC	Africain Union Commission
AUDA	African Union Development Agency
CAPP	Central African Power Pool
CAR	Central Africa Republic
CBA	Community Benefit Agreement
CBAM	Carbon Border Adjustment Mechanisms
CLSG	Côte d'Ivoire–Liberia–Sierra Leone–Guinea Power Interconnection Project
DFI	Development Finance Institution
DRC	Democratic Republic of the Congo
DSCR	Debt Service Coverage Ratio
EAPP	Eastern Africa Power Pool
EBRD	European Bank for Reconstruction and Development
ECOWAS	Economic Community of West African States – 15 West African countries
ELMED	Tunisia–Italy Power Interconnection Project
EPC	Engineering, Procurement, and Construction
ESG	Environmental, Social and Governance
EU	European Union
FX	Foreign Exchange
GCC	Green Corridor Certification
GCF	Green Climate Fund
GDP	Gross Domestic Product – total value of goods and services produced in a country
GHG	Greenhouse Gas
GW	Gigawatt – a unit of power equal to one billion watts
HVDC	High Voltage Direct Current
ICT	Information and Communication Technologies
IEA	International Energy Agency
IFC	International Finance Corporation
IPP	Independant Power Producer
IRENA	International Renewable Energy Agency
ITFE	Improving Trade Facilitation Environment project (East Africa region)
JICA	Japan International Cooperation Agency
LCOE	Levelized Cost of Electricity. Measure of average net present cost of electricity generation
LCY	Local Currency
LLCR	Loan Life Coverage Ratio
MIGA	Risk Garantee Agency (World Bank Group)

MRV	Monitoring, Reporting, and Verification
MW	Megawatt – unit of power equal to one million watts
NEP	Nigeria Electrification Project
NEPAD	New Partnership for Africa's Development
ONEE	Moroccan National Office of Electricity and Water
PCG	Partial Credit Garantee
PIDA	Programme for Infrastructure Development in Africa
PIDG	Private Infrastructure Development Group
PPA	Power Purchase Agreements
PPP	Public Private Partnership
PRG	Partial Risk Garantee
PUF	Productive-Use Facility
PV	Photo Voltaic
RBF	Results-Based Finance
RE	Renewable Energy
REA	Rural Electrification Agency
REC	Regional Economic Communities.
SADC	Southern African Development Community
SAPP	Southern African Power Pool
SDG	Sustainable Development Goals
SLB	Sustainability-Linked Bonds
SME	Small and Medium Entreprise
SPV	Special Purpose Vehicle
STYIP	Second Ten-Year Implementation Plan of Agenda 2063
TCX	Currency Exchange Fund
TSO	Transmission System Operator
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Programme
USD	United States Dollar
VGF	Viability Gap Funding
WAGP	West Africa Gas Pipeline
WAPP	West African Power Pool – regional electricity market for West Africa
WEFE	Water–Energy–Food–Ecosystems Nexus

List of Graphs and Tables

Bibliography

✧ African Development Bank (AfDB) (2021) Kenya–Ethiopia Electricity Highway Project. Available at: https://www.afdb.org/en/projects-and-operations/p-ke-f00-006

✧ African Development Bank (AfDB) (2022) African Energy Transition Framework.

✧ African Energy Commission (AFREC) (2023) East Africa Gas Infrastructure Outlook.

✧ African Union Commission (AUC) (2015) Agenda 2063: The Africa We Want.

✧ African Union Commission (AUC) (2024) Second Ten-Year Implementation Plan of Agenda 2063.

✧ African Union Development Agency (AUDA-NEPAD) (2020) PIDA Priority Action Plan 2.

✧ Economic Community of West African States (ECOWAS) (2022) Revised Master Plan for the Development of Regional Power Generation and Transmission Infrastructure, Volume 2.

✧ European Commission (2023) ELMED Project Factsheet.

✧ Hydrogen Council (2023) Hydrogen in Africa: Export and Domestic Opportunities.

✧ International Energy Agency (IEA) (2014) The Future of Africa's Energy Supply.

✧ International Energy Agency (IEA) (2022) Africa Energy Outlook 2022. https://www.iea.org/reports/africa-energy-outlook-2022

✧ International Energy Agency (IEA) (2023) Global Gas Security Review.

✧ International Renewable Energy Agency (IRENA) (2023) Green Hydrogen Supply Chains in Africa.

✧ International Renewable Energy Agency (IRENA) (2024) Renewable Power Generation Costs in 2023.

✧ Joint Research Centre (JRC) (2021) Water–Energy–Food Security–Ecosystems in Africa. European Commission. https://publications.jrc.ec.europa.eu

✧ Khanfir, M. and El-Alimi, S. (2025) Energy Corridors in Africa: Key to Regional Integration and Ecological Transition. Tunis: Tunisia Africa Business Council.

✧ Khanfir, M. (2024) Corridor 2.0 - The New Geopolitics of Integrated Infrastructure Development in Africa. https://www.linkedin.com/in/mondherkhanfir

✧ Lazard (2023) Levelized Cost of Energy Analysis – Version 16.0.

✧ Moroccan National Office of Electricity and Water (ONEE) (2020) Agadir Desalination Plant Project Overview. Available at: https://www.onee.ma/en

✧ Southern African Power Pool (SAPP) (2022) Annual Report 2021/22.

✧ United Nations Environment Programme (UNEP) (2020) African Rift Geothermal Development Facility (ARGeo). https://www.unep.org/gef/projects/african-rift-geothermal-development-facility-argeo

✧ West African Power Pool (WAPP) (2019) ECOWAS Master Plan for the Development of Regional Power Generation and Transmission Infrastructure (2019–2033), Volume 0.

✧ West African Power Pool (WAPP) (2020) Business Plan 2020–2023.

✧ World Bank (2022) Second Djibouti–Ethiopia Power System Interconnection Project (P173763).

✧ World Bank (2024a) Implementation Completion and Results Report: WAPP CLSG Power Interconnection Project.

✧ World Bank (2024b) CLSG Interconnection Project Completion Report.

✧ World Bank ESMAP (2022) Tracking SDG 7: The Energy Progress Report.

1. Introduction

Africa's infrastructure deficit remains a major bottleneck to productive transformation and regional integration. Energy corridors, traditionally framed as electricity transmission routes, are increasingly being re-imagined as development arteries that transport multiple energy vectors while unlocking cross-sector benefits.

In practice, energy corridors in Africa are often perceived narrowly as high-voltage transmission lines linking generation centers to demand hubs. While electricity is central, this perspective is incomplete. A comprehensive definition encompasses multi-vector infrastructure systems capable of transporting:

- Electricity through high-voltage AC/DC interconnections enabling regional grid integration.

- Gaseous fuels via natural gas pipelines serving baseload generation, industrial feedstock, and domestic energy.

- Hydrogen and derivatives including Green hydrogen pipelines and ammonia transport systems, which are emerging as key enablers of Africa's Green industrialization and export ambitions (IEA, 2022).

In all cases, these corridors combine physical assets (generation, transmission, pipelines, storage) with institutional, regulatory, and logistical frameworks that enable cross-border trade and efficient energy distribution. By integrating the Water–Energy–Food–Ecosystems (WEFE) Nexus, corridors evolve from linear networks into dynamic platforms for inclusive and resilient regional development.

This vision aligns with the Corridor 2.0 paradigm -see the box below- where infrastructure becomes an 'energy river' capable of irrigating territories at marginal cost—delivering not only electricity but also agricultural water, food-processing capacity, and ecosystem restoration (JRC, 2021). Rather than bypassing rural areas, these corridors anchor local economic ecosystems and foster integration.

Corridor 2.0
It's a re-imagined infrastructure corridor that transcends traditional transport or energy pathways by integrating multiple infrastructure systems-including energy, logistics, water, and ICT, to function as multi-sector development arteries. Unlike conventional corridors designed purely for transit, Corridor 2.0 aligns with geopolitical, economic, and social aspirations by:

-Embedding the WEFE -Water, Energy, Food, and Ecosystems- Nexus to ensure cross-sectoral synergies and inclusive impact;
-Extending access via distributed off-take points, enabling landlocked and peripheral communities to benefit directly;
-Serving as a platform for value chain anchoring, territorial transformation, and integration under a Green, sustainable development model.

2. Rethinking Energy Corridors as Multi-Vector "Development Rivers"

2.1 Energy Corridors as catalysts for Economic Transformation Financing

Beyond their technical function, energy corridors can be leveraged as strategic investment vehicles that mobilize and channel long-term capital into transformative development agendas. By bundling infrastructure deployment with industrial and social outcomes, they become bankable platforms for blended finance, climate funds, and private investment.

This positioning rests on three mutually reinforcing roles:
- Anchor Projects for Regional Value Chains
Corridors power energy-intensive industries such as Green metallurgy, fertilizer production, agro-processing, and digital infrastructure. When integrated into national industrial strategies, they create predictable demand for energy and generate revenue streams that improve the bankability of upstream investments.

- De-risking Mechanisms for Infrastructure Finance
Energy corridors often benefit from multi-country participation and long-term off-take agreements, which reduce project risk for investors. Coupled with blended finance instruments - concessional loans, guarantees, and results-based grants - they can attract private capital to regions otherwise perceived as high-risk (see example in the box below).

- Multipliers for Climate and SDG aligned funding
When corridors are designed within the WEFE Nexus, they unlock co-benefits in agriculture, water security, and biodiversity protection. These co-benefits broaden eligibility for global climate funds, development finance, and ESG-oriented private investment, effectively turning infrastructure corridors into multi-mandate investment platforms.

In this expanded perspective, the financing of energy corridors is no longer limited to sector-specific budgets or donor-driven power projects. Instead, it becomes a structuring tool for financing Africa's economic transformation, linking hard infrastructure with productive sectors, social inclusion, and environmental stewardship.

Blended Finance for Energy Access: The example of Nigeria Electrification Project (NEP)
Nigeria has one of the world's largest energy access deficits, with over 80 million people lacking reliable electricity. Rural communities, MSMEs, and essential service providers (schools, clinics) are particularly affected, limiting agricultural productivity, health outcomes, and economic development.

Intervention
Nigeria Electrification Project (NEP), led by the Rural Electrification Agency (REA), mobilized USD 550 million in blended finance:
World Bank: USD 350 million / African Development Bank: USD 200 million
This mix of concessional loans and grants was structured to de-risk private sector participation in deploying mini-grids and solar home systems in underserved areas.

WEFE Nexus Opportunities
Water: Solar-powered pumps for irrigation in rural communities.
Energy: Reliable off-grid electricity replacing costly diesel generation.
Food: Cold storage for perishable goods, boosting agri-food value chains.
Ecosystems: Reduced GHG emissions and pollution from diesel generators.

Blended Finance Mechanism
Public and development bank funding absorbs early-stage and operational risks, through partial grants, results-based financing, and credit enhancements. This has enabled small-scale developers to attract commercial loans and equity.

Results & Expected Benefits
Over 500,000 households and MSMEs targeted for connection.
Improved service delivery in schools and clinics.
Market creation for renewable energy enterprises in Nigeria.

Data Source: World Bank (2022), African Development Bank (2021), REA Project Briefs.

2.2 Energy Corridors as "Development Rivers"

Energy corridors can be envisioned as "development rivers" - continuous flows of electricity, gas, or hydrogen that traverse vast distances, much like rivers carrying water across entire landscapes. Just as rivers nourish ecosystems, these corridors have the capacity to "irrigate" surrounding territories with affordable and reliable energy, enabling the emergence of vibrant economic and social ecosystems along their route.

This analogy re-frames corridor planning from a narrow point-to-point transmission model into a territorial development strategy. The emphasis shifts from merely delivering energy to end nodes, toward creating distributed access points -"off-take stations" strategically positioned to maximize regional spillovers. These nodes can:

- ✓Supply landlocked and remote communities with competitively priced energy, reducing geographic inequalities.
- ✓Anchor local value chains by powering agro-processing plants, light manufacturing, and digital service hubs.
- ✓Reduce dependency on imported fossil fuels, thus strengthening national and regional energy sovereignty.
- ✓Stabilize fragile systems by integrating decentralized renewable generation into corridor networks, enhancing resilience to shocks.

By embedding this spatial vision into design and investment decisions, corridors transform into development backbones that distribute benefits across multiple sectors and territories (see example below).

Hydropower-Driven Agro-industrialization: The example of Bumbuna II, Sierra Leone

Sierra Leone's limited energy access-less than 30% nationwide-has constrained agro-processing and industrial development. Located within the Cote d'Ivoire-Liberia-Sierra Leone-Guinea Power Corridor, the Bumbuna II hydropower expansion is designed to integrate with regional energy trade under the West African Power Pool (WAPP).

Intervention

The USD 750 million project is financed through a blended structure involving the African Development Bank, Private Infrastructure Development Group (PIDG), and Standard Chartered Bank, with risk guarantees provided by MIGA (World Bank Group).

WEFE Nexus Opportunities

Water: Improved reservoir management supports irrigation downstream.
Energy: Hydropower replaces diesel in rural industries and powers new agro-processing zones.
Food: Cold-chain facilities for fisheries and cocoa exports in Freetown and secondary towns.
Ecosystems: Environmental flow requirements built into dam operation.

Results & Expected Benefits

Doubling Sierra Leone's generation capacity.
Stable power for industrial parks along the corridor.
Export potential to neighbouring Guinea and Liberia via CLSG line.

Data Source: AfDB (2022), PIDG Impact Report (2021), WAPP Masterplan (2021).

2.3 The WEFE Nexus as a Strategic Planning Lens

Integrating the WEFE Nexus into energy corridor design ensures that infrastructure is not treated as an isolated utility, but as a multi-sectoral enabler of territorial transformation. The interconnections are both functional and mutually reinforcing:

Water – Energy corridors power pumping stations, large-scale irrigation schemes, desalination plants, and wastewater treatment facilities, thereby supporting agriculture and human consumption in water-scarce regions.
Energy – Affordable, reliable supply is the foundational driver of productive transformation, enabling industrial clusters, ICT hubs, and essential public services.
Food – Stable energy supports mechanized farming, refrigeration, cold chains, and agro-industrial processing, reducing post-harvest losses and improving food security (AfDB, 2021).
Ecosystems – Well-planned corridors integrate biodiversity protection, optimize land use, and enhance climate resilience through nature-positive infrastructure design.

The WEFE framework also highlights the importance of complementary policies. Examples include preferential tariffs for landlocked economies, incentives for decentralized renewables, and corridor-based industrial zoning. Such measures ensure that the benefits of large-scale energy investments are not concentrated only in high-demand urban or export markets, but are shared equitably across regions, strengthening both economic competitiveness and social cohesion (see example in the box below).

Renewable Hydrogen for Water and Food Security: Namibian Hydrogen Corridor
Namibia's southern coastal corridor (Lüderitz–Walvis Bay) has exceptional solar and wind potential. National plans link Green hydrogen exports with domestic water and food security projects, aligning with the Southern African Renewable Energy Corridor concept.

Intervention
Feasibility studies, supported by KfW Development Bank, the European Union's Global Gateway, and private consortia, are structuring a USD 10 billion blended finance framework. Public funds and climate finance are used to underwrite the first electrolyser plants and desalination facilities.

WEFE Nexus Opportunities
Water: Co-located desalination plants supply agriculture and municipal systems.
Energy: Large-scale renewable generation dedicated to hydrogen production and grid stability.
Food: Irrigation-enabled horticulture in arid coastal regions; cold storage for fish exports.
Ecosystems: Sustainable brine management and habitat restoration around desalination outfalls.

Results & Expected Benefits
Export of hydrogen derivatives to EU and Asia.
Domestic energy cost reductions for industry.
Climate-resilient water supply for Namib Desert agriculture.

Data Source: Namibian Ministry of Mines and Energy (2023), KfW (2023), EU Global Gateway (2023).

2.4 From "Power Lines" to "Territorial Development Rivers"

Traditional corridors deliver energy from generation to demand hubs. In a WEFE-integrated model, they are designed to:

- ✓Electrify rural and peri-urban zones via distributed connections.
- ✓Anchor industrial parks and agro-processing hubs.
- ✓Integrate water infrastructure for agricultural and domestic supply.
- ✓Include ecosystem restoration and environmental buffer zones.

The corridor thus becomes a development spine, catalyzing territorial transformation and improving resilience (see example in the box below).

Scaling Solar for Industry and Agriculture: Benban Solar Park, Egypt

Egypt's Benban Solar Park in Aswan is one of the largest solar complexes in the world, with 1.8 GW of installed capacity. The project is a key node in the North Africa–Mediterranean energy corridor, enabling renewable exports through interconnections to Sudan and the EU (via Egypt–Greece/Italy plans).

Intervention

Structured under Egypt's Feed-in Tariff (FiT) programme, the project mobilized USD 2 billion from a mix of development banks, climate funds, and private investors. The International Finance Corporation (IFC), European Bank for Reconstruction and Development (EBRD), and Green Climate Fund (GCF) provided concessional finance and guarantees, reducing currency and payment risks for developers.

WEFE Nexus Opportunities

Water: Solar-powered pumping for irrigation in surrounding agricultural areas.

Energy: Large-scale renewable generation feeding national grid and potential export interconnectors.

Food: Reliable electricity supports cold storage for Upper Egypt's horticulture exports.

Ecosystems: Reduced reliance on fossil fuels, lowering CO_2 emissions by ~2 million tonnes/year.

Results & Expected Benefits

32 individual plants developed by independent power producers (IPPs).

Powering irrigation schemes and agro-industrial plants.

Supports regional corridor ambitions for clean energy exports.

Data Source: IFC (2020), EBRD (2021), IRENA (2022).

2.5 The Triple Transformation theory of change

The Triple Transformation Theory of Change provides a systemic framework for repositioning African energy corridors from linear infrastructure assets into territorial development backbones. It recognizes that technological, infrastructure, and institutional dimensions must evolve in parallel to unlock the full multi-sector potential of corridors and ensure long-term sustainability.

1. Technological Transformation – Decentralization, decarbonization, and digitization
African energy corridors must integrate cutting-edge technologies that increase efficiency, flexibility, and sustainability. This includes:

Renewables Integration large-scale solar, wind, hydro, and geothermal plants strategically connected to corridor backbones (e.g., Ethiopia's geothermal expansion along the Rift Valley).

Smart Grids & Digitization deployment of AI-driven grid management, predictive maintenance, and real-time balancing to handle variable renewable output and optimize cross-border flows.

Energy Storage Solutions lithium-ion batteries, pumped hydro, and emerging hydrogen-based storage to address intermittency and ensure reliability for off-take communities.

Green Hydrogen Technologies co-locating electrolysers with renewable clusters to supply industry and transport, and developing export pipelines aligned with global hydrogen trade routes.

These examples of innovations not only improve technical performance but also create new industries, skilled jobs, and investment opportunities in emerging energy markets.

2. Infrastructure Transformation – Multi-Vector, Climate-Resilient, and Interoperable Systems
Traditional, single-commodity energy lines limit the economic and social benefits corridors can provide. Infrastructure transformation calls for:

Multi-Vector Corridors enabling simultaneous transmission of utilities (electricity, gas, or hydrogen) and Data through integrated rights-of-way to maximize spatial efficiency and lower investment duplication.

Interoperability Standards harmonizing technical specifications so that grids, pipelines, and storage facilities can connect seamlessly across borders, reducing transaction costs and project delays.

Climate-Resilient Design incorporating flood protection, heat-resistant materials, and redundancy planning to safeguard corridor operation in a changing climate.

The objective is to ensure that corridors can adapt to evolving demand, resource shifts, and technological breakthroughs over decades.

3. Institutional Transformation – Governance, Finance, and Inclusion

Even the most advanced technology and resilient infrastructure cannot deliver transformational change without robust institutional frameworks. This requires:

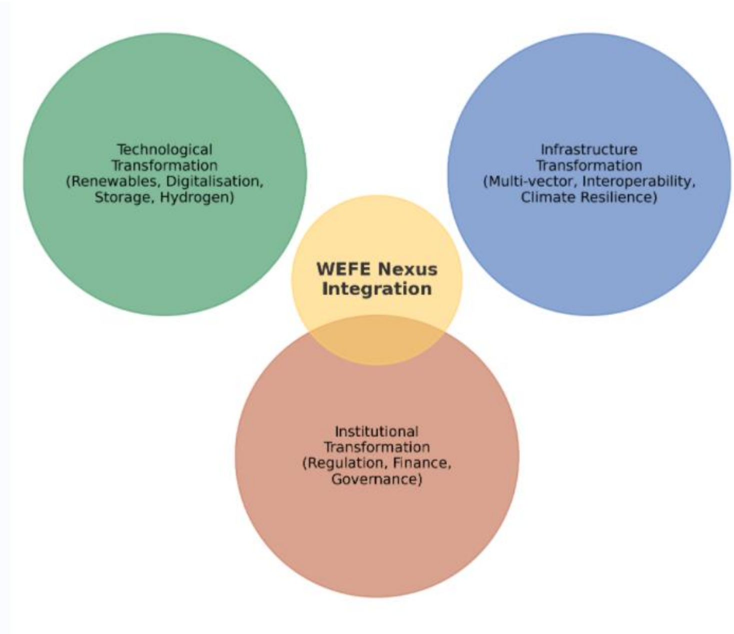
Harmonized Regulations aligning tariffs, grid codes, and environmental standards across countries to facilitate predictable, secure energy trade.

Innovative Finance Mechanisms mobilizing blended finance, Green bonds, and regional infrastructure funds to spread risk and attract both public and private capital.

Participatory Governance embedding local governments, communities, and private actors into planning, decision-making, and benefit-sharing frameworks to ensure legitimacy and local ownership.

By aligning policy frameworks with long-term development goals, corridors become catalysts for inclusive economic integration and sustainable regional growth.

In summary, the Triple Transformation approach moves the conversation from "how to build an energy line" to "how to design a multi-vector development corridor". Each transformation, technological, infrastructural and institutional, reinforces the others, and together they unlock the WEFE Nexus benefits, enhance resilience, and accelerate Africa's integration into a Green, regionalized, and inclusive economy.



Graph 1: The Triple Transformation centered on the WEFE Nexus

2.6 Strategic Relevance for Africa's Agenda 2063

Africa's Agenda 2063 envisions a continent that is integrated, prosperous, and driven by sustainable industrialization. Energy corridors -when conceived as multi-vector systems embedded in the WEFE Nexus and steered by a Triple Transformation pathway- are not just infrastructure projects; they are strategic levers for systemic transformation.

1. Powering competitive regional value chains

To power competitive regional value chains, next-generation infrastructure corridors must be designed as multi-utility and digital platforms, integrating electricity, gas, hydrogen, water, and data as a fifth utility into a unified and interoperable backbone. This holistic infrastructure enables cost-effective service delivery, climate-resilient agriculture, industrial decarbonization, and real-time commodity market integration. Practically, this involves the co-location of utilities (e.g., HVDC lines, gas/hydrogen pipelines, desalinated/recycled water infrastructure, ammonia transport, fiber optics) along a shared Right-of-Way, reducing land use and maintenance costs. In high-density agro-industrial zones, modular trenches and shared utility nodes allow for integrated power conversion, irrigation, Green molecule storage, and IoT-based environmental monitoring. Hydrogen-ready pipelines enable molecule logistics for fertilizers and clean fuels, while embedded fiber and edge computing systems collect and transmit data on CO_2 emissions, water use, and yield performance—feeding into traceability dashboards, Green commodities exchanges, and ESG finance tools. This convergence transforms energy corridors into smart, climate-aligned backbones for inclusive growth and sustainable value chain development.

2. Integrating landlocked and coastal economies

Energy corridors become development bridges between landlocked nations and coastal ports, enabling energy-intensive industries in the interior to thrive while linking them to global markets. They also create shared infrastructure that facilitates cross-border industrial clusters, fostering economic interdependence and political stability. This spatial integration is a direct enabler of the African Continental Free Trade Area (AfCFTA).

3. Driving low-carbon, climate-resilient development systems

By embedding renewable energy sources, smart grids, and climate-resilient designs, multi-vector corridors are aligned with Africa's ecological transition goals. They can displace high-emission fossil fuel generation, lower greenhouse gas footprints, and provide adaptive capacity against climate shocks. This is particularly critical for water-intensive sectors, where energy-efficient pumping, desalination, and irrigation systems can safeguard food security under changing climatic conditions.

Ultimately, the integration of these three dimensions makes energy corridors structural enablers of Agenda 2063's aspirations -accelerating industrialization, deepening regional integration, and anchoring Green growth in Africa's development trajectory.

2.7 Illustrative WEFE-compatible projects along development rivers

When energy corridors are conceived as multi-vector "development rivers", they evolve into backbones for decentralized, low-cost, and high-impact interventions that directly benefit communities while reinforcing territorial resilience. These projects, enabled by the State of the Art of Technologies for Energy production (**see appendix a**), and systematically integrated along the corridor route, can transform what is traditionally linear infrastructure into a diversified territorial development platform.

1. Water Security and Management
Seawater desalination plants powered by renewable energy from the corridor, supplying potable water to coastal cities and extending inland via pipelines for agriculture and industry. The Namibia hydrogen–water hubs offer an early model of such integration.
Irrigation pumping stations enabling smallholder farmers to irrigate crops year-round, reducing dependence on seasonal rainfall and improving food security.
Wastewater treatment and reuse systems powered by corridor electricity, supporting circular water management and reducing pressure on freshwater sources.

2. Food systems and agro-industrial development
Agro-processing units (milling, oil pressing, dairy processing) connected to corridor grids to reduce post-harvest losses and generate local employment.
Cold storage hubs strategically placed along agricultural transport routes, extending the shelf life of perishable goods and enabling access to higher-value markets.
Hybrid solar-electric drying facilities for high-value export crops such as tomatoes or mango, allowing small-scale producers to diversify income and meet export quality standards.

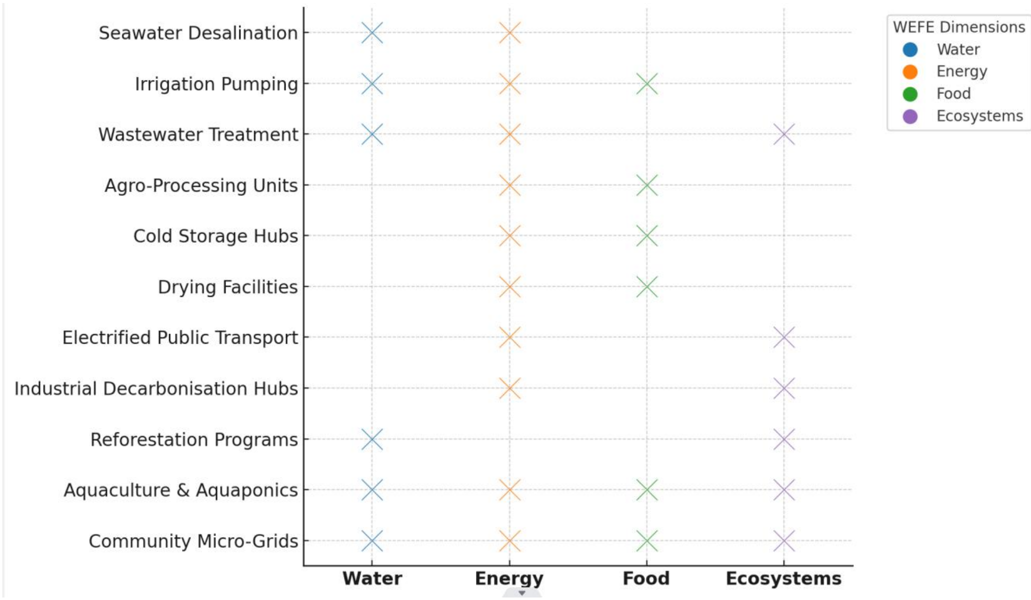
3. Sustainable mobility and industrial decarbonization
Electrified public transport systems operating along peri-urban sections of the corridor, reducing air pollution and greenhouse gas emissions.

Decarbonization hubs for energy-intensive industries (cementry, metallurgy, chemistry), connecting them to renewable electricity or Green hydrogen pipelines to reduce carbon footprints and comply with emerging Green trade standards.

4. Ecosystem restoration and climate resilience
Reforestation and watershed protection programs integrated with corridor right-of-way management to combat erosion, enhance biodiversity, and improve water retention.
Aquaculture and aquaponics systems powered by corridor electricity and supplied with treated water, contributing to diversified livelihoods and local nutrition.

5. Inclusive energy access
Community micro-grids branching from the main corridor to power schools, health clinics, water kiosks, and small businesses in off-grid settlements, ensuring that the benefits of large-scale infrastructure are distributed equitably.

By systematically embedding such projects into corridor planning, investments move beyond utility revenues to deliver multi-sector dividends-including poverty reduction, climate adaptation, food security, and enhanced regional competitiveness. In doing so, energy corridors become structural accelerators of sustainable development rather than mere conduits of energy transport (see graph 2).



Graph 2: WEFE Nexus contributions of corridors-linked projects

3. Current landscape of African energy corridors

3.1 Overview and continental mapping

Africa's energy corridors are no longer just linear infrastructures linking isolated power plants to major consumption centers. They are evolving into integrated, multi-vector backbones of continental transformation, carrying electricity, gas, hydrogen, and even embedded digital services across borders, while catalyzing value chains along their routes.

This evolution is embedded in strategic frameworks such as:

- **Agenda 2063** positioning infrastructure as a core enabler of inclusive growth, industrialization, and trade-led development.

- ➢ **Second Ten-Year Implementation Plan (STYIP)**[1] shifting from convergence to acceleration, with a strong emphasis on continental market integration and Green transition.
- ➢ **Programme for Infrastructure Development in Africa (PIDA)**[2] identifying priority regional projects that interconnect power pools, expand renewable integration, and improve access for landlocked and under served regions.

Existing and planned corridors fall broadly into three categories:

- ◆ **Electricity Transmission Corridors** – high-voltage AC/DC interconnections anchoring the four African Regional Power Pools (WAPP, EAPP, SAPP, CAPP), enabling bulk power trade and grid stability.
- ◆ **Gas Corridors** – pipelines delivering natural gas for baseload generation, industrial feedstock, and household consumption, with growing potential for blue hydrogen transition.
- ◆ **Emerging Hydrogen Corridors** – large-scale renewable energy export platforms combining solar, wind, and desalination to produce Green hydrogen, ammonia, and synthetic fuels for both domestic transformation and global markets.

Financing needs and systemic vision

The scale of ambition is unprecedented. According to the AfDB and IEA estimates, meeting Africa's power infrastructure targets under PIDA and the African Single Electricity Market (AfSEM) will require USD 40–70 billion annually up to 2040. This covers generation, transmission, storage, and enabling infrastructure such as substations, interconnectors, and control systems. Hydrogen-ready and multi-vector corridors could push this figure higher, into the USD 80–100 billion/year range once water, port, and pipeline systems are included.

Such capital requirements cannot be met by public funding alone. This is why a systemic, multi-actor vision is essential:

- Public sector leads in planning, regulatory harmonization, and de-risking frameworks through policy stability and guarantees.

- Private sector investors and operators provide capital, technology, and operational expertise through Independent Power Producer (IPP) projects, PPP models, and equity stakes in corridor consortia.

- Blended finance instruments combine concessional loans, grants, and private equity to crowd-in investment for early-stage or high-risk segments, especially in fragile states.

- Local capital markets and sovereign wealth funds mobilize domestic resources to complement international flows, ensuring local ownership and returns.

---

[1] The STYIP is the second decade in the Agenda 2063 framework, building on the first (2014–2023). While the first decade focused on convergence, the second emphasizes acceleration across all fronts of Africa's development agenda. It was officially launched in early February 2024, marking a renewed push for unity, prosperity, and African-led development.

[2] PIDA is the African Union's strategic framework for infrastructure development across the continent, designed to promote regional integration, economic growth, and poverty reduction by improving energy, transport, transboundary water, and ICT networks.

3.2 From infrastructure to economic transformation

Viewing energy corridors solely as engineering projects misses their deeper potential. When planned as "development corridors", they:

- Unlock industrial nodes – agro-processing, mineral beneficiation, and manufacturing clusters linked to reliable, low-cost energy.

- Support WEFE Nexus priorities – by integrating water pumping, irrigation, desalination, cold storage, and ecosystem management directly into corridor design.

- Catalyse trade and integration – by synchronizing with transport corridors, logistics hubs, and AfCFTA value chain strategies.

In this sense, financing energy corridors is financing Africa's economic transformation. The return on investment is not limited to electricity sales but extends to higher GDP growth, regional value chain resilience, and improved food, water, and environmental security.

3.2.1 Electricity Transmission Corridors

Electricity transmission corridors form the structural spine of Africa's regional power pools, enabling large-scale integration of renewable generation, cross-border electricity trade, and improved supply reliability. By linking high-potential generation zones with growing demand centers, they offer a cost-effective platform for both industrialization and inclusive rural electrification. Here after the main related initiatives:

West Africa – CLSG Interconnection
The 1,303 km, 225 kV Côte d'Ivoire–Liberia–Sierra Leone–Guinea (CLSG) line links four countries in the West African Power Pool (WAPP)[3] (World Bank, 2024a).This project has enhanced cross-border electricity access and reliability while enabling rural agro-industrial clusters to flourish-resulting in reduced tariffs for SMEs and new cold chain capacities (ECOWAS[4] Master Plan, 2022; WAPP Business Plan, 2020).
WEFE potential: Powering rural agro-processing hubs in Liberia and Sierra Leone; electrifying irrigation for rice production.

North Africa–Europe – ELMED Interconnection
A 600 MW HVDC Tunisia–Italy link designed to integrate North African renewables into EU markets (European Commission, 2023).
WEFE potential: Using corridor electricity for desalination and agricultural water supply in Tunisia's Sahel.

[3] WAPP: West Africa Power Pool
[4] ECOWAS: The Economic Community of West African States

3.2.2 Gas Corridors

Gas corridors provide a flexible and relatively lower-carbon alternative to coal, supplying baseload power, industrial heat, and feedstock for fertilizer and petrochemical industries. In Africa, they also present an opportunity to co-develop renewable-powered infrastructure along their rights-of-way, supporting the gradual shift toward cleaner energy systems while maintaining energy security. Here after the main gas corridors:

West Africa Gas Pipeline (WAGP) – Extends from Nigeria through Benin and Togo to Ghana, supplying gas for power and industry (ECOWAS, 2022).

WEFE potential: Stable supply for fertilizer plants (food security) and desalination in coastal Ghana.

East African Gas Corridor – Proposed network linking Tanzanian offshore gas to Kenya and Uganda (African Energy Commission, 2023).

WEFE potential: Energy for agro-processing and fishery cold chains along Lake Victoria.

3.2.3 Emerging Hydrogen Corridors

Hydrogen corridors are at the frontier of Africa's energy transition, positioning the continent as a potential global supplier of Green hydrogen and derivatives such as ammonia.

These projects combine renewable energy generation, large-scale water desalination, and advanced transport infrastructure, offering synergies with agriculture, water management, and regional value chain development. Here after some pioneering projects:

Namibia–South Africa–Botswana Hydrogen Corridor – Harnesses Namibia's solar and wind to produce Green hydrogen for domestic use and export (IRENA, 2023).

WEFE potential: Co-located desalination for hydrogen production and agricultural irrigation.

North Africa Hydrogen Export Corridors – Morocco, Egypt, and Mauritania are developing large-scale hydrogen and ammonia export projects to Europe (Hydrogen Council, 2023).

WEFE potential: Fertilizer production for domestic agriculture, reducing imports.

When electricity, gas, and hydrogen corridors are planned through a WEFE Nexus lens, they maximise socio-economic returns, through:

- ✓ Irrigating landlocked countries (Mali, Niger, Chad, CAR) with low-cost energy through strategic off-take points.
- ✓ Anchoring Green industrial clusters along routes to reduce logistics costs.
- ✓ Implementing community access programs via micro-grid connections at marginal cost.
- ✓ Developing modern logistics ecosystems with refrigerated warehouses for perishable goods.
- ✓ Integrating hubs with digitized supply chains and data centers.

3.3 Impact of low-cost Green Energy on the WEFE Nexus

The sustained decrease in renewable energy costs with utility-scale solar PV averaging USD 0.044/kWh and onshore wind USD 0.033/kWh globally (IRENA, 2024), represents more than a technical milestone; it marks a structural shift in Africa's development economics. The Levelized Cost of Energy (LCOE) -**see appendix b**- for renewables now undercuts not only imported fossil fuels (diesel gensets often exceed USD 0.25–0.40/kWh) but, in many cases, the retail tariffs of grid-supplied electricity. This price inversion opens an unprecedented opportunity to re-imagine energy corridors as development arteries that integrate the WEFE Nexus.

Water – Securing water resources at scale
Lower renewable costs make energy-intensive water services financially viable for a broader range of users. Large-scale seawater desalination, powered by corridor-linked solar or wind farms, can supply both urban demand and inland agriculture via pumping stations. The reduced operational cost per cubic metre of treated water directly enhances climate resilience for drought-prone regions and mitigates conflict over scarce water resources. In addition, affordable energy enables wastewater treatment and reuse, which can replenish aquifers and support sustainable agriculture.

Energy – Catalyzing Green industrialization
With renewable energy costs approaching those of the cheapest fossil options, African industries gain a structural competitiveness edge. Energy corridors supplying low-cost Green power to industrial clusters can lower production costs in heavy and medium industries such as fertilizes, cement, and aluminium, enabling them to compete in export markets increasingly shaped by Carbon Border Adjustment Mechanisms (CBAMs). The steady cost base of renewables also shields industries from the volatility of global fossil fuel markets, improving investment predictability.

Food – Enabling modern, resilient Value Chains
Affordable, reliable electricity along corridor routes can transform agri-food systems. Cold chains for perishable goods - from fish to fresh produce - become financially viable in rural areas, reducing post-harvest losses that currently average 30–50% in some African countries. Low-cost energy also enables mechanized farming, irrigation pumping, grain milling, oil pressing, and food drying facilities, all of which increase productivity, reduce manual labour burden, and expand market reach for smallholders and SMEs.

Ecosystems – Enabling nature-positive Infrastructure
Replacing fossil-fuel-based generation with corridor-linked renewables reduces greenhouse gas emissions, cuts local air pollutants, and lowers pressure on fragile ecosystems. Moreover, corridors can integrate biodiversity buffers, reforestation programs, and sustainable land-use planning into their rights-of-way, aligning with "nature-positive" infrastructure principles. By linking environmental services to infrastructure design, energy corridors contribute to both mitigation and adaptation goals under Africa's climate commitments.

4 Case Studies: Synergizing energy corridors with WEFE Nexus

The convergence of low-cost Green energy and integrated WEFE planning positions energy corridors as more than transmission or pipeline infrastructure. They become financially self-reinforcing development backbones, able to attract blended finance, climate funds, and private investment precisely because their benefits span multiple SDGs and regional integration priorities under Agenda 2063.

In this sense, each corridor acts as a multi-vector investment platform, where energy pricing dynamics catalyze a chain reaction of productivity gains, social inclusion, and ecological restoration. This re-framing is essential for mobilizing the scale of capital required -from sovereign wealth funds to Green bonds- to build corridors that truly connect Africa's energy wealth with its integration and Green transition ambitions.

The following table provides a census and a comparative overview of Africa's strategic energy corridors, highlighting their current status, technical capacity, and investment volumes. It also assesses both existing and projected industrial impacts. Importantly, the table integrates WEFE oportunities and implications, showing how each corridor presents multi-sectoral synergies through the WEFE lens, not only supplying electricity but also enabling climate-resilient water access, food systems transformation, and ecosystem preservation.

Corridor	Capacity & Technical Specs	Investment Volume (USD)	Projected Industrial Impact	WEFE opportunities and implications
ELMED Interconnection (Planned)	600 MW HVDC, ±500 kV, ~200 km subsea + ~400 km onshore	~1.3–1.6 billion	Irrigation-powered horticulture exports; green hydrogen/ammonia.	Electrification of agro-processing zones reduces food loss; reliable energy for pumping, irrigation, and clean water delivery in rural zones. Energy access for groundwater pumping and treatment; supports water reuse systems in mining zones; power backbone for food cold chain and storage. Massive hydro potential to power Green fertilizer industries; provides energy to lift urban & agricultural water supply; climate-resilient food security through irrigation. Geothermal energy for low-cost greenhouse heating and dairy processing; stable power for irrigation and water conservation; mitigates ecosystem degradation from wood fuel. Wind/solar power for large-scale desalination; supports solar irrigation and off-grid water solutions; H_2 economy can decouple food-energy-water dependence on fossil fuels.
CLSG Interconnection (Operational)	1,303 km, 225 kV double circuit	~500 million	Cold-chain fisheries; agro-processing; rural mini-grids	Electrification of agro-processing zones reduces food loss; reliable energy for pumping, irrigation, and clean water delivery in rural zones. Energy access for groundwater pumping and treatment; supports water reuse systems in mining zones; power backbone for food cold chain and storage. Massive hydro potential to power Green fertilizer industries; provides energy to lift urban & agricultural water supply; climate-resilient food security through irrigation. Geothermal energy for low-cost greenhouse heating and dairy processing; stable power for irrigation and water conservation; mitigates ecosystem degradation from wood fuel.

				Wind/solar power for large-scale desalination; supports solar irrigation and off-grid water solutions; H_2 economy can decouple food-energy-water dependence on fossil fuels.
North–South Power (Operational)	330–400 kV AC; >3 GW transfer	~1.5–2 billion	Agro-industrial parks; PGM beneficiation	Electrification of agro-processing zones reduces food loss; reliable energy for pumping, irrigation, and clean water delivery in rural zones. Energy access for groundwater pumping and treatment; supports water reuse systems in mining zones; power backbone for food cold chain and storage. Massive hydro potential to power Green fertilizer industries; provides energy to lift urban & agricultural water supply; climate-resilient food security through irrigation. Geothermal energy for low-cost greenhouse heating and dairy processing; stable power for irrigation and water conservation; mitigates ecosystem degradation from wood fuel. Wind/solar power for large-scale desalination; supports solar irrigation and off-grid water solutions; H_2 economy can decouple food-energy-water dependence on fossil fuels.
Grand Inga & West African Linkages (Planned)	>40 GW hydro (full); Inga III ~4.8 GW; multi-HVDC	>80 billion (full); ~14 billion (Inga III)	Green metals; fertilizers; electrified logistics	Electrification of agro-processing zones reduces food loss; reliable energy for pumping, irrigation, and clean water delivery in rural zones. Energy access for groundwater pumping and treatment; supports water reuse systems in mining zones; power backbone for food cold chain and storage. Massive hydro potential to power Green fertilizer industries; provides energy to lift urban & agricultural water supply; climate-resilient food security through irrigation. Geothermal energy for low-cost greenhouse heating and dairy processing; stable power for irrigation and water conservation; mitigates ecosystem degradation from wood fuel. Wind/solar power for large-scale desalination; supports solar irrigation and off-grid water solutions; H_2 economy can decouple food-energy-water dependence

				on fossil fuels.
East African Geothermal Corridor (Partially operational)	500 kV HVDC, 2,000 MW; >10 GW geothermal potential	~1.3B (transmission) + ~5B (generation)	Dairy, horticulture, fruit drying	Electrification of agro-processing zones reduces food loss; reliable energy for pumping, irrigation, and clean water delivery in rural zones. Energy access for groundwater pumping and treatment; supports water reuse systems in mining zones; power backbone for food cold chain and storage. Massive hydro potential to power Green fertilizer industries; provides energy to lift urban & agricultural water supply; climate-resilient food security through irrigation. Geothermal energy for low-cost greenhouse heating and dairy processing; stable power for irrigation and water conservation; mitigates ecosystem degradation from wood fuel. Wind/solar power for large-scale desalination; supports solar irrigation and off-grid water solutions; H_2 economy can decouple food-energy-water dependence on fossil fuels.
Southern African Renewable Energy Corridor (Planned)	>10 GW solar/wind; H_2 pipelines/HVDC under study	>20 billion	fertilizers; hydrogen exports; desalination-linked agriculture	Electrification of agro-processing zones reduces food loss; reliable energy for pumping, irrigation, and clean water delivery in rural zones. Energy access for groundwater pumping and treatment; supports water reuse systems in mining zones; power backbone for food cold chain and storage. Massive hydro potential to power Green fertilizer industries; provides energy to lift urban & agricultural water supply; climate-resilient food security through irrigation. Geothermal energy for low-cost greenhouse heating and dairy processing; stable power for irrigation and water conservation; mitigates ecosystem degradation from wood fuel. Wind/solar power for large-scale desalination; supports solar irrigation and off-grid water solutions; H_2 economy can decouple food-energy-water dependence on fossil fuels.

Table 1: Census of Corridors projects in Africa and their potential impact

5. Capturing value from energy corridors to finance WEFE Nexus projects

Energy corridors can be more than conduits for electrons or molecules, they can also be cash-flow engines that finance high-impact WEFE projects. The premise is simple: the cost savings and new revenues unlocked by corridor-enabled infrastructure can be ring-fenced, monetized, and leveraged to attract private capital into desalination plants, cold chains, smart irrigation systems, crop drying platforms, and Green fertilizer production.

Even a 15–20% drop in energy costs can shift the competitiveness of agro-processing, mining beneficiation, and cold-chain logistics, while making desalination affordable for both municipal and agricultural use. By blending asset-level project finance with platform-level corridor or continental finance, and deploying robust de-risking tools, corridors can evolve into self-financing territorial development platforms. This requires translating engineering efficiency into bankable cash flows-and ensuring they are accessible to institutional investors, local financiers, and community stakeholders.

5.1 Instruments: a practical toolbox

Deploying the right financing instruments is essential to bridge the gap between infrastructure ambition and investable projects, ensuring WEFE-linked assets can attract capital at scale. Here are the main expected and promising ones:

A) Corridor & WEFE Bonds

Green Use-of-Proceeds Bonds: proceeds to desalination plants, cold-chain warehouses, SME agro-parks fed by corridor power; ring-fenced with trustee oversight.

Sustainability-Linked Bonds (SLB): coupon step-ups/step-downs tied to corridor KPIs (renewable share, KWh delivered to rural feeders, m^3 desalinated with RE).

Revenue Bonds: secured by specific cash flows (availability payments, wheeling fees, water tariffs, cold-store lease income).

Pros: scalable. Cons: requires stable policy and disclosure; needs credit enhancement in early years.

B) Local-Currency Solutions

Municipal/utility local bonds: for substation-adjacent water or cold-chain assets.

Development Finance Institution (DFI)-anchored Local Currency (LCY) credit lines: on-lending to SMEs for productive-use equipment (dryers, mills, ice plants).

Currency risk hedging windows: via Currency Exchange Fund (TCX) type facilities or partial indexation clauses.

C) PPP & SPV Structures

Corridor Special Purpose Vehicle (SPV) -Transmission/ Pipeline-: Transmission System Operator (TSO) anchored, availability-based revenue.

WEFE SPVs (brownfield/greenfield): 15–20-year concession, blended CAPEX, tariff + Viability Gap Funding (VGF) + results-based subsidies (e.g., per m^3 water, per ton chilled).

Anchor-tenant leases: agro-processors, fisheries, logistics firms take 7–10-year leases in cold hubs-stabilizes cash flows.

D) De-risking and Guarantees

Partial Risk Guarantees (PRGs)/ Partial Credit Guarantees (PCGs): cover off-taker/sovereign payment risk for both corridor and WEFE SPVs.

Political risk insurance: expropriation, currency inconvertibility, breach of contract (MIGA-like).

Construction risk wraps: completion guarantees, performance bonds, Engineering, Procurement and Construction (EPC) liquidated damages.

Results-Based Finance (RBF): disburse on verified outputs (hectares irrigated, tons dehydrated, vaccine-grade cold storage uptime).

E) Climate & Carbon Finance

Voluntary Carbon[5]: credits from diesel-to-grid switching, process heat electrification, methane abatement in cold chains.

Resilience grants: watershed restoration around hydro, coastal buffers for desalination intakes.

F) Certification and Standards

Green Corridor Certification (GCC): taxonomy alignment + MRV for energy mix, biodiversity buffers, social inclusion. Lowers cost of capital via eligibility for Green investors.

5.2 Revenue models that make WEFE assets financeable

Even the most innovative financing tools require predictable and diversified income streams; robust revenue models are the foundation for making WEFE assets bankable and investor-ready.

- Desalination: blended tariff (municipal + agri bulk water), floor via availability payments; energy indexed to corridor tariff.
- Irrigation & Pumping: prepaid smart-meter bundles for farmer groups; seasonal minimum offtake contracts.
- Cold-chain hubs: anchor leases (3–5 tenants, 60–70% capacity pre-booked), pay-per-pallet for SMEs; logistics value-added services (sorting, packing).
- Drying & Processing platforms: tolling contracts with cooperatives; floor volumes backed by development partners during ramp-up.
- Green fertilizer (ammonia): long-term off-take with national distributors; part of price floors backed by climate facilities in early years.

5.3 Corridor-by-corridor financing blueprints

No two corridors are alike-each demands a customized financing stack, risk-mitigation package, and cost-of-capital target tailored to its resources, markets, and governance realities (see table 2).

To unlock the full potential of energy corridors for WEFE-linked development, the financing strategy must target both bankability and scale. Four interlinked objectives guide this approach, from securing predictable cash flows to ensuring climate alignment and investor confidence.

1– Bankability of "last-mile" development: ring-fence predictable cash flows (off-take, user fees, shadow tariffs) from WEFE assets connected to the corridor.

2– Crowd-in institutional investors: translate corridor cost savings (lower LCOE, fewer outages) into credit metrics (higher DSCR/LLCR) for bonds and private placements.

3– Local currency resilience: hedge FX via local-currency bonds/loans and blended facilities to reduce tariff stress.

4– Climate eligibility: certify corridors as Green Corridors so projects qualify for Green/climate bonds and results-based climate finance.

---

[5] Article 6 of the Paris Agreement and Voluntary Carbon Markets (COP26)

Table 2: Corridor financing stacks and de-risking Instruments: An illustrative benchmark

Corridor	**Financing Stack (illustrative)**	**De-risking**	**Target Cost of Capital (post-blending)**	**Notes**
ELMED (TN–IT)	Interconnector: TSO/sovereign + EU/IFI loans; **WEFE**: Green UoP bond (EUR), desalination PPP SPV, agri-cold hubs via municipal LCY notes	PRG for water utility; EPC LDs; GCC label	5.0–6.5% (EUR) / 10–12% (TND LCY)	Pair cable with coastal desal + cold-chain; export hedge via EU integration
CLSG	Regional SPV ops; **WEFE**: RBF + LCY credit line for mini-grids, revenue bonds for fish cold-chains	PCG for tariff collection, political risk	8–10% (blended)	Community Access Window: 5–10% of CAPEX reserved for feeders & SMEs
North–South (SAPP)	Grid upgrades via utility + IFI; **WEFE**: SLB linked to reduction of diesel gensets; PPP cold hubs	PRG for offtake; storage viability grants	8–10%	Add battery/storage SPVs; watershed restoration financed by resilience grants
Grand Inga & links	Phased assets: concessional + export credit; **WEFE**: anchor industrial PPAs + municipal water PPPs	PRG + political risk insurance; phased modules	6–8% (generation blended)	Modularity is key; pair exports with in-country green metals & fertilizer
EA Geothermal (EAPP)	IPP drilling backed by risk insurance; **WEFE**: heat-use SPVs (greenhouses), dairy processing via LCY loans	Exploration insurance; PRG for agro PPAs	7–9%	Heat-use PUDs (public-utility districts) around plants to crowd in SMEs
Southern RE/H_2 (Nam–SA–Bot)	IPP RE + export credit for H_2; **WEFE**: desal PPP + cold hubs via green bonds	Offtake wraps (H_2); water source covenants; GCC label	6–8%	Tie export H_2 to domestic fertilizer to stabilise local revenues

5.5 Turning cost savings into credit: a simple pathway

Converting the operational efficiencies of energy corridors into bankable revenue streams requires a clear, step-by-step approach. This pathway demonstrates how quantified cost savings can be transformed into creditworthy cash flows, enabling investment-grade financing for clusters of WEFE assets.

1. Quantify avoided cost: diesel displacement, outage reduction, reduced line losses.
2. Translate to cash: e.g., USD 0.08/kWh saving × expected MWh consumed by cold hub = minimum cash coverage.
3. Structure DSCR: set tariffs/leases so base-case DSCR ≥ 1.30x; use RBF to support ramp-up years.
4. Credit enhance: PRG/PCG to lift to investment-grade for bond placement.
5. Aggregate: pool 10–20 WEFE assets in a Corridor Mini-Infra Fund (pass-through notes to local pensions).

5.6 Local-currency and SME on-lending: Productive use at the grassroots Level

For energy corridors to deliver inclusive benefits, financing must reach small and medium-sized enterprises (SMEs) that transform electricity access into productive economic activity. Access to affordable, long-tenor local-currency (LCY) finance is essential to avoid exposure to exchange rate volatility-a critical issue in African markets, where currency depreciation can quickly erode project viability.

Core mechanisms:

SME Productive-Use Facility (PUF): Capitalized at USD 50–150 million per corridor, offering 5–7-year LCY loans for equipment such as dryers, cold-storage units, milling machines, pumps, and small desalination units. Vendor finance models-where suppliers extend credit backed by facility guarantees-can accelerate uptake.

Guarantee-Backed Micro-Leasing: Especially relevant for farmer cooperatives and small fisheries. Assets remain the property of the lessor until fully paid, reducing default risk. Integration with digital payment systems (e.g., mobile money, QR code billing) can lower delinquency rates to below 5% (IFC, 2023).

Why it matters: Studies from the AfDB (2022) show that every USD 1 invested in productive-use appliances in rural areas can generate USD 1.6–2.4 in added annual income through agricultural value-addition, reduced post-harvest losses, and expanded market access.

5.7 Governance for investability: The Institutional Backbone

Private investors require predictable governance structures to price risk accurately. Without clear lines of authority and harmonized contractual standards, corridor projects suffer delays, cost overruns, and financing hesitancy.

Proposed structure:
Corridor Management Authority (CMA): Light SPV or statutory authority acting as a single counterparty for land rights-of-way, ESG compliance, and community benefits. This avoids the "multi-permit trap" where investors must negotiate with multiple ministries and local authorities.

Tariff and Contract Standardisation: Model agreements for Power Purchase Agreements (PPAs), Water Take-or-Pay Agreements (WTAs), and cold-storage leases with indexed energy clauses. Such templates, endorsed at regional REC level (WAPP, EAPP, SAPP), reduce transaction time by up to 40% (World Bank, 2023).

Monitoring, Reporting, and Verification (MRV): Corridor-level dashboards to track energy mix, WEFE outputs (m^3 water, tons chilled/dried), and biodiversity indicators, feeding directly into Green Corridor Certification (GCC) and Green bond reporting requirements.

5.8 AU-level "African corridor & WEFE Nexus Investment Facility"

Scaling up corridor-linked WEFE investments requires a continental vehicle to prepare pipelines, de-risk projects, and aggregate financing. The proposed African Corridor & WEFE Nexus Investment Facility would operate under AUDA-NEPAD, leveraging DFI capital, REC participation, and private co-investors.

Functions and windows:
Project Preparation – USD 5–10 million per corridor for feasibility studies, permitting, and community engagement.

Guarantee & Hedging Window – PRGs, PCGs, and FX hedging for cross-border projects.

Results-Based Finance (RBF) – Disbursing upon verified outputs (e.g., cubic meters of desalinated water, tonnage of refrigerated produce).

Aggregation Vehicle – Issuing corridor Green or sustainability-linked bonds and securitising WEFE receivables.

Continental coordination is key for large-scale aggregation. It can reduce financing costs by 150–250 basic points (bps) compared to standalone issuances (Lazard, 2023). It also ensures smaller countries without deep capital markets can still access long-term private funding.

5.9 Worked micro-example: Cold-chain hub on the CLSG corridor

A practical illustration underscores the potential bankability of WEFE assets when linked to corridors:

CAPEX: USD 12 million (10,000-pallet cold store, packhouse, 5 MW feeder line).

Revenues:

Anchor leases: USD 2.6 million/year.
SME pallet fees: USD 1.1 million/year.
Value-added services: USD 0.4 million/year.

Total: USD 4.1 million/year.

OPEX: USD 1.7 million/year (including electricity at corridor tariff).
EBITDA: USD 2.4 million/year → Debt service capacity ~USD 1.8 million/year.

Debt: USD 14 million Green bond @ 8.5%, 12 years → DSCR ≈ 1.3x (base case).

Enhancements: PRG + RBF USD 0.3 million/year for first three years lifts DSCR >1.4x, enabling participation from local funds and private equity.

Insight: This model is replicable for other corridor-linked WEFE facilities-especially where anchor tenants can secure 60–70% of capacity pre-bookings.

5.10 Risks and mitigations

Investing in energy corridors that integrate WEFE assets demands an in-depth understanding of risk dynamics. The multi-country, multi-sector nature of these corridors amplifies exposure to commercial, operational, political, and environmental uncertainties. If left unaddressed, these risks raise the cost of capital, shorten loan tenors, and discourage institutional investment.
The following typology outlines the key risks, their implications for corridor-linked WEFE assets, and robust mitigation strategies drawn from proven African and global infrastructure precedents.

i. Off-Taker and Payment Risk

The Challenge: In many African power pools (e.g., WAPP, SAPP, EAPP), utilities are financially fragile, often facing high technical and commercial losses and chronic delays in tariff adjustments. Similar vulnerabilities exist for municipal water utilities and agricultural boards.
Impact on WEFE Assets: A desalination plant or cold-chain hub relying on power from the corridor grid risks cash flow instability if the utility fails to honour purchase agreements or delays payments.

- ✓ **Mitigation Measures:** Partial Risk Guarantees (PRGs) or Partial Credit Guarantees (PCGs) from DFIs (e.g., World Bank, AfDB) to cover non-payment.
- ✓ Escrow Accounts holding 3–6 months of payment obligations.
- ✓ Step-in Rights for lenders to take control of operations in default scenarios.

Example: The Kenya–Ethiopia Electricity Highway included a PRG-backed payment security mechanism that reduced risk premiums for lenders by over 200 basis points (AfDB, 2021).

ii. Foreign Exchange (FX) and Currency Convertibility Risk

The challenge: Revenues from WEFE assets are often in local currency, while debt service is in USD/EUR, exposing projects to exchange rate volatility. In 2022, African currencies depreciated by an average of 8–15% against the USD, according to IMF data.

Impact on WEFE Assets: A cold storage facility leasing space in local currency could face debt service stress if currency depreciation inflates its foreign currency liabilities.
Mitigation Measures:

- ✓ Local Currency Bonds and Loans to align revenue and debt denomination.
- ✓ Natural Hedges through corridor tariff structures denominated in mixed currencies.
- ✓ Hedging Facilities like The Currency Exchange Fund (TCX) or AfDB's synthetic swaps.

Example: Nigeria's Azura-Edo IPP successfully blended USD and Naira revenues to stabilise FX exposure for both lenders and off-takers.

iii. Construction and land acquisition risk

The challenge: Cross-border corridors face multiple permitting jurisdictions, potential delays in land acquisition, and disputes with affected communities.
Impact on WEFE Assets: Delayed construction of feeder lines or water pipelines can defer the operational date of linked WEFE facilities, triggering penalty clauses and increasing interest during construction (IDC).
Mitigation Measures:

- ✓ Early Permitting Frameworks embedded in corridor treaties.
- ✓ EPC Contracts with Liquidated Damages (LDs) for schedule overruns.
- ✓ Community Benefit Agreements (CBAs) to secure local buy-in and prevent blockages.

Example: The Southern Agricultural Growth Corridor of Tanzania (SAGCOT) used CBAs to ensure that 30% of employment went to local communities, reducing disputes.

iv. Climate variability and water security risk

The challenge: Corridor-linked WEFE projects, especially hydropower-fed irrigation or desalination plants, are vulnerable to seasonal variability, droughts, and sea-level rise.
Impact on WEFE Assets: A corridor relying on hydropower for energy and irrigation water may see reduced output during drought periods, compromising both electricity supply and agricultural yields.
Mitigation Measures:
- ✓ Diversified Resource Sourcing-integrating solar and wind alongside hydro to stabilise energy supply.
- ✓ Water Storage and Buffer Systems to ensure resilience during dry periods.
- ✓ Adaptive Engineering-modular systems that can scale down operations without full shutdown.

Example: Morocco's Chtouka desalination plant combines grid and solar PV power to maintain water output during seasonal power shortfalls.

5. Policy and regulatory risk

The challenge: Shifts in tariff policies, tax regimes, or cross-border trade rules can undermine long-term financial planning for WEFE assets.
Impact on WEFE Assets: A sudden increase in export levies on Green hydrogen or restrictions on cross-border electricity wheeling could reduce revenues and strand investments.
Mitigation Measures:
- ✓ Long-Term Regulatory Covenants embedded in PPAs and corridor agreements.
- ✓ REC-Level Harmonization (WAPP, SAPP, EAPP) to align cross-border energy and water trade rules.
- ✓ Stabilization Clauses in contracts to lock in tax and regulatory terms for a fixed period.

Example: The West African Gas Pipeline (WAGP) embedded ECOWAS-level regulatory harmonization, which reduced cross-border disputes and ensured tariff stability.

6. Technology and operational risk

The challenge: Innovative WEFE technologies-such as Green ammonia synthesis, large-scale battery storage, or smart irrigation-may lack proven track records in African operating environments.
Impact on WEFE Assets: Performance shortfalls can reduce output and revenues, undermining DSCR ratios and investor confidence.
Mitigation Measures:
- ✓ Performance Bonds from EPC contractors.
- ✓ O&M Contracts with Minimum Output Guarantees.
- ✓ Pilot Phase Deployment before full-scale roll out to validate technology in local conditions.

Example: South Africa's RE IPP programme requires two years of operational data for new tech before allowing large-scale deployment.

Table 3: Risk–Mitigation Matrix for Corridor–WEFE Nexus Investments

Risk Category	Challenge in Corridor–WEFE Context	Impact on WEFE Assets	Mitigation Instruments	Case Example	Potential Cost of Capital Impact
1. Off-Taker & Payment Risk	Weak utility/municipal balance sheets; delayed payments; high losses.	Cash flow instability for desalination, cold-chain, irrigation facilities.	- Partial Risk Guarantees (PRGs) / Partial Credit Guarantees (PCGs)- Escrow accounts (3–6 months coverage)- Lender step-in rights	Kenya–Ethiopia Electricity Highway (AfDB, 2021)	↓ Risk premium by 200–300 bps
2. FX & Currency Convertibility	Revenues in LCY, debt in USD/EUR; depreciation risk (avg. -8–15%/yr).	Debt service stress; tariff increases harming affordability.	- Local currency bonds/loans- Natural hedges via corridor tariffs- Hedging via TCX/AfDB swaps	Azura-Edo IPP (Nigeria)	↓ FX risk premium by 150–250 bps
3. Construction & Land Risk	Multiple jurisdictions; slow permits; community disputes.	Delayed WEFE asset commissioning; IDC increase.	- Early permitting frameworks in treaties- EPC contracts with Liquidated Damages (LDs)- Community Benefit Agreements (CBAs)	SAGCOT (Tanzania)	↓ Delay risk; on-time delivery ↑ bankability
4. Climate & Water Security	Seasonal/drought variability; water source vulnerability.	Reduced output for hydro-fed or desalination-linked WEFE systems.	- Resource diversification (solar/wind + hydro)- Storage/buffer systems- Adaptive engineering/modularity	Chtouka Desalination (Morocco)	↑ Reliability; stabilizes revenues
5. Policy & Regulatory Risk	Tariff/tax shifts; cross-border rule changes.	Reduced export potential; stranded assets.	- Long-term covenants in PPAs- REC-level harmonisation (WAPP/SAPP/EAPP)- Stabilisation clauses	WAGP (ECOWAS framework)	↓ Political risk margin by 100–150 bps
6. Technology & Operational Risk	New tech lacks track record in African climates.	Output shortfalls; DSCR deterioration.	- EPC performance bonds- O&M minimum output guarantees- Pilot phase before scaling	SA REIPPPP (tech vetting)	↑ Investor confidence; reduces contingency premiums

The multi-dimensional risk landscape of energy corridors integrated with WEFE assets can be managed down to investment-grade thresholds through layered guarantees, standardized contracts, and climate resilience measures. Evidence from the AfDB, IFC, and World Bank demonstrates that when these mitigations are embedded from project preparation, the cost of capital can drop by 20–35%, enabling faster and broader scaling of inclusive infrastructure.

6. Governance and Impact Assessment

6.1 Governance as a driver of inclusivity

Cross-border energy corridors are inherently complex: they cross multiple jurisdictions, involve diverse stakeholders, and require coordination across generation, transmission, and end-use sectors.

Without intentional governance provisions, they risk becoming mere transit systems, delivering benefits mainly to major industrial or urban off-takers while bypassing the communities along their routes. An inclusive governance model ensures that:

- ✓ Access: Local communities gain physical connection points and affordable tariffs.
- ✓ Cost fairness: Transmission cost advantages are shared, lowering the Levelized cost of energy (LCOE) for SMEs and households.
- ✓ Sustainability: Broader benefit sharing increases local support, reduces social risks, and enhances long-term asset security.

6.2 Positive spill-over effects on access and energy cost

When designed as "energy rivers", corridors can irrigate territories along their path at marginal cost by:

- Installing feeder lines from substations to rural distribution networks.
- Locating mini-grids and productive-use clusters along the corridor.
- Encouraging local off-take agreements with SMEs, cooperatives, and municipal utilities.

Impact on energy cost:

- Bulk cross-border supply lowers average LCOE compared to isolated diesel or small-scale generation.
- Reduced outages improve equipment utilization rates for industries.
- Stable, cheaper power enables competitive pricing for local agro-products and manufactured goods.

Example – CLSG Corridor

In rural Sierra Leone, small rice mills connected to the CLSG backbone reduced their energy cost from USD 0.30–0.35/kWh (diesel) to ~USD 0.18/kWh (hydro imports), allowing night-time operation and doubling milling volumes in the peak harvest season.

6.3 Measuring Impact beyond energy delivered

Impact assessment should go beyond megawatts transmitted, to include economic inclusion, environment and social dimensions as illustrated in the following table.

Table 4: Corridors' impact assessment dimensions

Dimension	Indicators	Example from Case Studies
Economic Inclusion	% of corridor-adjacent households connected; SME tariff reduction; jobs created in WEFE sectors	CLSG: 40% tariff drop for rice mills; 120 jobs in cold-chain facilities
Environmental	GHG reduction from diesel displacement; hectares under watershed protection; biodiversity gain	North–South: 15% emissions cut via cold-chain diesel substitution; catchment rehabilitation near Kariba
Social Resilience	Electrified schools/clinics; food security improvements from cold storage & irrigation	East African Geothermal: +35% milk output in geothermal-heated dairy processing zones

6.4 Monitoring, Governance, and Financing Sustainability

For energy corridors to deliver on their transformative promise, they must be equipped with robust systems of monitoring, reporting, and verification (MRV) that are directly linked to inclusive governance and financial sustainability. A corridor-level MRV platform should not merely collect technical data; it must serve as a transparent accountability mechanism accessible to investors, regulators, and communities alike. Such a system would track access expansion through the number of new connections and the kilowatt-hours delivered to local feeders, while also publishing tariff benchmarks that compare baseline and post-corridor LCOE for households, communities, and SMEs.

Beyond energy metrics, the platform would monitor WEFE-related outputs, including cubic meters of water desalinated or pumped with corridor power, tons of agricultural produce chilled, dried, or processed, and hectares of land irrigated or reforested. A digital dashboard, open to all stakeholders, would ensure that these results are visible and verifiable in real time.

The value of such transparency goes well beyond data collection: it directly underpins governance legitimacy and financial resilience. Inclusive governance is not only a social good; it is also a risk mitigation instrument. By diversifying revenue streams—anchoring them not only in large-scale off-takers but also in local productive-use customers—corridor operators strengthen their financial base and reduce dependency on a single source of income. Communities that benefit tangibly from reliable power, clean water, and agro-logistics infrastructure are more likely to safeguard corridor assets and facilitate their maintenance, thereby securing the social licence to operate. At the same time, transparent MRV data and documented spill-overs enhance investor confidence, making projects more attractive to Green bond issuers, climate funds, and concessional financiers.

In this way, monitoring and governance become mutually reinforcing. By embedding access, affordability, and productive-use objectives into the governance structure of energy corridors, investments evolve into self-sustaining systems: the more communities benefit, the more resilient and financially viable the corridor becomes.

7. Implementing the Triple Transformation Blueprint

Energy corridors are more than metal towers, wires, and pipelines stretching across Africa's landscapes. When they are planned wisely, they become living arteries - carrying not only electricity, gas, or hydrogen, but also the promise of development, integration, and sustainability. For this promise to become reality, African energy corridors must undergo a Triple Transformation: a shift in technology, infrastructure, and institutions, each reinforcing the other:

A First Stream – Technological Transformation
In the first stream of change, technology reshapes what is possible. Solar, wind, hydro, and geothermal generation replace expensive, polluting fuels. Smart grids predict demand surges before they happen. Storage systems smooth the peaks and valleys of renewable output.

In East Africa, geothermal heat is not only powering the grid but warming greenhouses and pasteurizing milk in the Rift Valley. In North Africa, the planned ELMED link will let Tunisia send solar energy to Europe while importing electricity when needed - a two-way lifeline across the Mediterranean. In Southern Africa, hybrid solar–wind plants will one day feed both the grid and hydrogen pipelines bound for global markets.

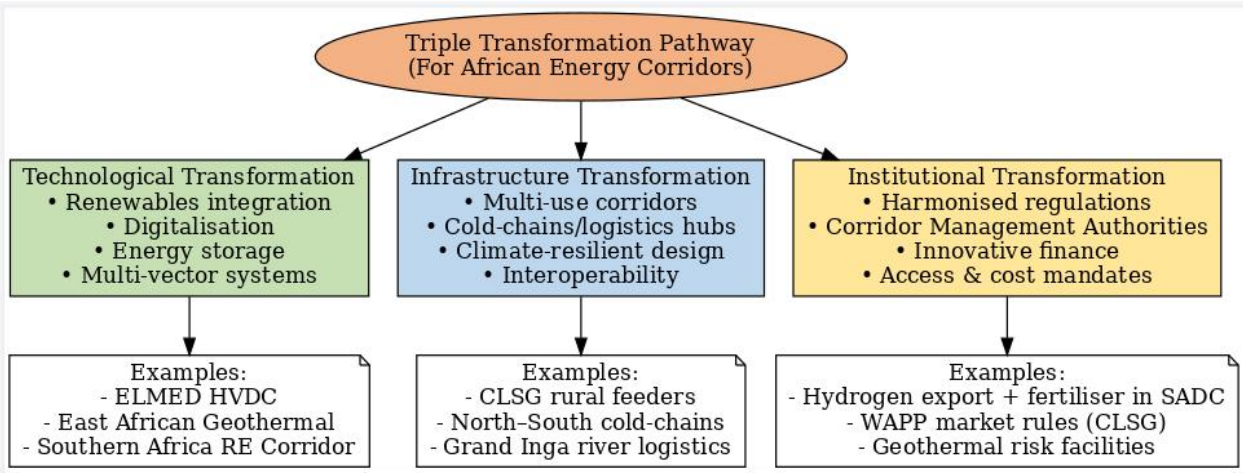
A Second Stream – Infrastructure Transformation
Technology alone is not enough. The physical corridors themselves must be re-imagined. They can no longer be designed solely as point-to-point transmission lines; they must become development spines.

Along the CLSG line in West Africa, substations have become gateways for rural electrification, powering rice mills and cold rooms for fishery cooperatives. In Zimbabwe, upgrades along the North–South Power Corridor are paired with refrigerated warehouses that extend the life of horticultural exports. The vision for Grand Inga in the DRC goes beyond mega-hydro: it includes electrified river transport and agro-industrial zones along the Congo River, turning a power project into a continental logistics and food security asset.

A Third Stream – Institutional Transformation
Even the best infrastructure can underperform without the right rules and incentives. Institutional transformation is about creating the agreements, capacities, and financial mechanisms that make corridors reliable and inclusive.

In Southern Africa, Green hydrogen export deals are being structured to also guarantee domestic fertilizer production, anchoring food security. The ELMED interconnector is governed by joint transmission system operator agreements to ensure fair capacity allocation. In East Africa, insurance schemes for geothermal exploration are unlocking private investment in a sector once seen as too risky.

When the Three Streams Converge, transformations happen together. The result is a powerful current of change (see Graph 3). New technology reduces the marginal cost of energy. Multi-use infrastructure ensures the benefits flow to communities, not just distant capitals. And ultimately, strong institutions create the trust and stability investors need to bring in capital at scale.



Graph 3: The Triple Transformation blueprint for African Energy Corridors

8. Policy Recommendations – Turning Corridors into Engines of Transformation

The journey from blueprint to impact is not automatic. An energy corridor can be a lifeline for entire regions - or a missed opportunity if it simply moves electrons, gas, or hydrogen from one point to another without transforming the territories it crosses.

The following recommendations build on the lessons of the six case studies, the financing innovations, and the governance frameworks introduced earlier. They are designed to help the African Union, Regional Economic Communities (RECs), governments, and development partners turn every cross-border energy investment into a platform for inclusive and sustainable development.

8.1 Make the WEFE Nexus non-negotiable in corridor planning

Why: Energy is not an isolated sector - it shapes and is shaped by water, food systems, and ecosystems. Ignoring these links risks inefficiency and conflict over resource use.
What to do: Require every corridor feasibility study to include a nexus assessment showing how the project can power desalination, irrigation, agro-processing, and ecosystem services along its route.
Use integrated resource mapping to align energy infrastructure with agricultural belts, water-stressed areas, and biodiversity corridors.
Impact: Corridors become multi-purpose development backbones rather than single-use transmission or pipeline routes.

8.2 Build inclusivity into the DNA of corridor design

Why: Too often, cross-border energy projects "fly over" the communities they cross, serving distant cities or industrial clusters.
What to do: Embed off-take points and feeder lines into engineering designs so rural and peri-urban areas can connect at marginal cost.
Set community benefit targets - for example, allocating a minimum share of corridor capacity to local supply or committing to specific SME tariff reductions.
Impact: Local economies get affordable power, SMEs grow, and political/social support for the corridor strengthens.

8.3 Create Corridor Management Authorities (CMAs)

Why: Multi-country infrastructure can easily fall victim to coordination failures unless there's a dedicated body to manage it.
What to do: Establish multi-stakeholder CMAs for each priority corridor, bringing together utilities, regulators, local governments, private sector players, and community representatives.
Give CMAs clear mandates: manage right-of-way, monitor ESG compliance, coordinate local access connections, and facilitate WEFE-linked investments.
Impact: One accountable institution acts as the "spinal cord" of the corridor, ensuring that its operations, benefits, and responsibilities are shared fairly.

8.4 Mobilize Finance through dedicated Corridor & WEFE platforms

Why: Traditional financing focuses on the main line or pipeline, leaving WEFE-linked "last-mile" projects unfunded.
What to do: Create an AU-level Corridor & WEFE Nexus Investment Facility to pool guarantees, FX hedging, and project preparation funding.
Issue Green Corridor Bonds or Sustainability-Linked Bonds tied to corridor KPIs - such as renewable share, rural connections, and GHG reductions.
Impact: Financing flows not just to metallurgy and concrete, but also to desalination plants, cold-chain hubs, irrigation systems, and local industrial parks.

8.5 Harmonize cross-border energy rules

Why: Even the best infrastructure fails if rules for tariffs, capacity allocation, and interconnection differ across borders.
What to do: Through RECs like WAPP, EAPP, SAPP, and CAPP, standardize PPAs, wheeling charges, and access rights for multi-country corridors.
Include community supply clauses in every cross-border PPA to guarantee local benefit.
Impact: Predictable rules encourage investment, lower transaction costs, and ensure communities see tangible returns from regional integration.

8.6 Treat cold-chains and logistics hubs as core infrastructure

Why: Reliable, affordable energy unlocks value chains, but without storage, processing, and logistics, farmers and fishers still lose value.
What to do: Make refrigerated warehouses, packhouses, and multimodal logistics hubs integral to corridor planning, especially in agro-industrial and fisheries belts.
Finance them through PPPs or blended finance, anchored by large off-takers and serving SMEs.
Impact: Reduced post-harvest losses, higher incomes for producers, and better food security.

8.7 Certify and Monetize Green Corridors

Why: Climate finance and ESG-driven investment require credible, verifiable sustainability claims.
What to do: Develop an African Green Corridor Certification (GCC) scheme that verifies renewable share, biodiversity protection, and social inclusion.
Link certification to MRV dashboards (Section 6) to ensure transparency.
Impact: Unlocks concessional finance, Green bonds, and carbon credits while enhancing Africa's global competitiveness in sustainable infrastructure.

8.8 Monitor, Learn, and Replicate

Why: Each corridor is a learning lab - its successes and challenges can inform the next.
What to do: Establish a continental MRV platform to collect and publish corridor-level data on access, cost reduction, WEFE outputs, and environmental impact.
Use this data to benchmark corridors and identify best practices for replication.
Impact: Accelerates learning, improves design quality, and builds a community of practice across the continent.

African energy corridors are to power more than just grids and pipelines, they must power communities, industries, and ecosystems. These eight recommendations provide the scaffolding to make that happen - turning infrastructure into a catalyst for integration, transformation, and resilience.

9. In conclusion

Africa's energy corridors stand at a decisive crossroads. They can remain narrow conduits - moving electrons or molecules from point A to point B - or they can become the arteries of a continental transformation, irrigating the territories they cross with affordable energy, new industries, and sustainable livelihoods.

The analysis in this paper has shown that by embedding the WEFE Nexus into corridor design, and by advancing along the Triple Transformation pathway - technological, infrastructural, and institutional - these projects can deliver far more than energy access and security. They can anchor regional value chains and mobilize innovative finance instruments to catalyse industrialization and accelerate Africa's ecological transition.

Integrating WEFE assessments into every project, build inclusivity into engineering design, create corridor governance bodies, mobilize dedicated financing platforms, harmonize cross-border rules, treat logistics as core infrastructure, certify Green corridors, and monitor impacts continent-wide.
In doing so, Africa will not only bridge its infrastructure gap; it will avoid the common mistake of separating asset classes investment strategies, by adopting an ecosystemic development strategy with a redefinition of infrastructure, shifting from linear assets to territorial development platforms that bind together economies, ecosystems, and communities in pursuit of Agenda 2063's vision of "The Africa We Want".

10. Appendix

a) State-of-the-Art Renewable and Clean Energy Technologies for WEFE-centric Corridor 2.0

This table summarizes key renewable and low-carbon energy technologies relevant to the Corridor 2.0 concept and their potential integration into the WEFE Nexus. For each technology, a description, advantages, disadvantages, and indicative Levelized Cost of Energy (LCOE) are provided. LCOE values are based on international benchmarks, expressed in USD/kWh, and represent ranges reflecting regional and project-specific variations. These figures should be taken as indicative estimates.

Technology	Description	Advantages	Disadvantages	Typical LCOE (USD/kWh)
ThermoVoltaic (TPV)*	Converts heat directly into electricity using photovoltaic cells optimized for infrared radiation. Can utilize waste heat from industrial processes, solar thermal collectors, or combustion.	Can operate continuously using waste heat; no moving parts; potential high efficiency; compatible with hybrid systems; scalable for distributed or large-scale applications.	Still in early commercialization; relatively high cost per kWh currently; requires stable high-temperature heat source; efficiency highly dependent on emitter-cell matching.	**0.08–0.15**
Solar Photovoltaic (PV)	Converts sunlight directly into electricity using semiconductor cells. Utility-scale and distributed systems.	Abundant resource in Africa, modular, quick deployment, rapidly declining costs.	Intermittent generation (daylight only), efficiency affected by dust/heat, requires storage for baseload.	**0.025–0.06**
Onshore Wind	Uses wind turbines to convert kinetic energy into electricity; optimal in high-wind regions.	Low operating costs, mature technology, high capacity factors in coastal/mountain areas.	Intermittency, visual/noise impact, site-specific resource variability.	**0.025–0.05**
Hydropower	Generates electricity from flowing water via dams or run-of-river systems.	Reliable baseload, storage capability (reservoirs), long lifespan.	High upfront cost, environmental/social displacement, climate-vulnerability (droughts).	**0.03–0.08**
Geothermal	Uses heat from the earth's crust to generate steam and drive turbines.	Stable baseload, low emissions, high capacity factor (>80%).	Site-specific, high exploration risk, drilling costs.	**0.04–0.09**
Biomass	Generates power/heat from organic materials (agricultural waste, forestry residues, dedicated crops).	Dispatchable, waste-to-energy potential, rural job creation.	Feedstock logistics, land-use competition, emissions if not managed sustainably.	**0.05–0.12**
Green Hydrogen	Produced via electrolysis powered by renewable energy; used as fuel or feedstock.	Energy storage, decarbonizes hard-to-abate sectors, export potential.	High current cost, infrastructure needs, energy conversion losses.	**(0.08–0.15)****

(*): indicative ranges from recent experimental and industry white papers (e.g., MIT Lincoln Laboratory, Stanford Nanophotonics Lab, and NREL studies), which estimate TV LCOE could fall in the 0.08–0.15 USD/kWh range in first commercial deployments (around 2030–2035), with potential to drop below 0.05 USD/kWh if manufacturing costs scale.

(**): Equivalent Kwh

b) Levelized Cost of Energy estimates

The Levelized Cost of Energy (LCOE) is a standardized metric that expresses the average cost per unit of electricity generated over the lifetime of a power plant, taking into account capital expenditure, operating costs, fuel expenses (if applicable), and financing costs. It enables policymakers, investors, and planners to compare the economic competitiveness of different generation technologies on an equal basis.

The table below consolidates recent LCOE estimates from multiple authoritative sources - MIT Energy Initiative (2023), Fraunhofer ISE (2022), Nature Energy (2022), IRENA (2024), IEA (2023), World Bank ESMAP (2022), Lazard (2023), and AfDB (2022). These values capture global averages or representative benchmarks, with some reflecting specific regional cost conditions.

Technology	MIT Energy Initiative (2023) USD/kWh	Fraunhofer ISE (2022) USD/kWh	Nature Energy (2022) USD/kWh	IRENA (2024) USD/kWh	IEA (2023) USD/kWh	World Bank ESMAP (2022) USD/kWh	Lazard (2023) USD/kWh	AfDB (2022) USD/kWh
Solar PV (Utility-scale)	0,035	0,04	0,036	0,044	0,039	0,042	0,037	0,046
Onshore Wind	0,032	0,038	0,033	0,033	0,034	0,035	0,031	0,036
Offshore Wind	0,085	0,095	0,09	0,079	0,082	0,087	0,083	
Hydropower	0,045	0,04	0,05	0,045	0,046	0,048		0,05
Geothermal	0,065		0,07	0,068	0,069	0,07		0,072
Biomass	0,07		0,075	0,072	0,073	0,074		0,076
Natural Gas (CCGT)	0,055		0,058		0,054		0,056	
Coal	0,06		0,065		0,061		0,062	
Hydrogen (Green, electrolysis-based)	0,11							