129

Energy Trade Across Africa and Europe: Long-term National Investment and Infrastructure Pathways for Electricity and Natural Gas

Elias Kousoulos Kovachian[1], Constantinos Taliotis[1], Theodoros Zachariadis[1], Amir Fattahi[2,3], Francesco Dalla Longa[2], Mobi van der Linden[2], Bob van der Zwaan[2,4,5]
[1]The Cyprus Institute, Nicosia, Cyprus. [2]TNO - Energy and Materials Transition, Amsterdam, Netherlands. [3]Utrecht University - Copernicus Institute of Sustainable Development, Utrecht, Netherlands. [4]University of Amsterdam - Faculty of Science (HIMS and IAS), Amsterdam, Netherlands. [5]Johns Hopkins University, School of Advanced International Studies (SAIS), Bologna, Italy

Extended Abstract

Download file

Abstract Summary

The global energy transition is advancing under the Paris Agreement and related initiatives, yet progress remains fragmented across regions. Africa's growing energy markets and abundant renewable resources, together with Europe's technological expertise and investment capacity, are uniquely positioned to forge a transformative energy partnership. Despite their complementary strengths, cooperation between the two continents remains limited. This study develops an open-source cost-optimisation model using the Open Source Energy Modelling System (OSeMOSYS) framework, covering forty-eight African and thirty European countries, to assess the long-term costs and emissions impacts of electricity and natural gas trade. The model identifies cost-optimal energy pathways under alternative interconnection and decarbonisation scenarios, explicitly representing cross-border grid interconnectors and gas pipelines. Results indicate that deeper grid interconnections can reduce Europe's cumulative electricity-system costs by up to 18% and Africa's installed capacity needs by up to 17%, while enabling more active cross-border exchange for system balancing and moderating power-sector CO_2 emissions. In contrast, natural-gas trade is corridor-based and highly sensitive to infrastructure availability, dominating unconstrained pathways but declining under Net-Zero pathways as electrification advances. Battery storage deployment rises sharply under Net-Zero scenarios, whereas expanded interconnection reduces storage requirements through spatial balancing. These findings highlight the importance of coordinated electricity and gas infrastructure planning to deliver cost-efficient, resilient, and low-carbon energy systems

across Africa and Europe. The model and underlying datasets are open source, providing a transparent foundation for future research on Africa–Europe energy cooperation.

Presenting Author Biography

Elias Kousoulos is a PhD candidate and Graduate Research Assistant at the Energy, Environment and Water Research Center of the Cyprus Institute. He holds a degree in Chemical Engineering from the National Technical University of Athens. His research focuses on energy system modelling, with emphasis on decarbonisation pathways, infrastructure planning, and cross-regional energy trade. His current work integrates large-scale models of Europe and Africa to assess electricity and natural gas trade and support evidence-based policy for the energy transition.