Concept Note: Artificial Intelligence and Renewable Energy in Africa

Introduction

Climate change and digital transformation are the two seismic shifts that define the 21st century (U.N., 2021). The two phenomena can amplify already heightened inequalities that have been further confounded by COVID. More importantly, A.I. could potentially resolve the decarbonization and socio-economic development challenges mentioned previously. The centre will, therefore, consider the interactions between energy-intensive artificial intelligence (A.I.)[1] systems and renewable energy as a theme under the beneficial A.I. and sustainable development stream.

Main Idea and Literature Review

Little is known and documented about the interactions between energy-intensive artificial intelligence (A.I.) systems and green economy, particularly decarbonized-renewable energy mini-grid and decentralized power systems to electrify energy-intensive A.I. infrastructure at the national and supranational levels. This research aims to map out the energy requirements for crucial and pooled backbone A.I. facilities in Africa and clarify the policies, capabilities, and institutional arrangements required for a more sustainable A.I. and greener and decarbonized energy transition on the continent.

Previous academic and applied economic policy research on the benefits of A.I. focuses on the automation and integration of A.I. technologies in the production processes of advanced societies. Where it has been extended to Africa and the renewable energy sector in particular, it has largely only explored the potential for adoption and implementation of A.I. technologies in the production processes of selected utilities (e.g., Smart Grids), independent power producers (e.g., cross-border energy trading platforms), and manufacturing enterprises, and how these play out across different renewable energy technologies such as wind, hydro, and solar (Strusani and Houngbonon, 2019; Jha et al., 2017). More specifically, the current work looks at how A.I. can optimize energy generation and storage, demand and supply forecasting, power transmission, fault prediction, identification of ideal maintenance schedules, and loss prevention from informal connections (Makala and Bokovic, 2020; Mou, 2019).

A rarely explored dimension of A.I. policy and technology strategy in Africa is how energy-intensive and crucial backbone infrastructure for A.I. such as networks, platforms, and data centres for data storage and processing and other complementary, power-hungry digital technology innovations such as blockchain, will access adequate and uninterrupted back-up electricity particularly given the reliability of supply challenges that plague the sub-Saharan power sector (cf. Kapika and Eberhard, 2013; Foster and Briceno-Garmendia, 2010 for a deeper discussion of the electricity

[1] AI in the context of this concept note refers to a series of approaches, methods, and technologies that display intelligent behaviour by analysing their environments and taking actions – with some degree of autonomy – to achieve specific targets in energy (Makala and Bokavic, 2020:2)

generation capacity constraints in Africa). Inadequate power supplies remain the most significant risk to the emergence and consolidation of A.I. (Makala and Bokovic, 2020) and the digital economy in Africa, and hence the acute need for an energy policy that aligns well with the continent's decarbonization, technology, A.I., and digital economy strategies. Another limitedly researched dimension of A.I. policy and strategy is how these AI-green energy transitions will impact Africa's socio-economic development outcomes and business models (Alcayaga, 2019).

Research Objectives and Questions

The objective of this study is to outline the energy requirements and would-be locations for crucial and pooled backbone A.I. facilities in Africa and elucidate the business models, capabilities, and institutional arrangements required for a more cost-effective, socially and gender-inclusive, and sustainable A.I. and renewable energy provision in Africa.

The research questions to be considered over the initial three year-funding cycle will be:

(i) What are the critical energy infrastructure requirements for the large-scale deployment of A.I. in Africa?

(ii) What policy frameworks, institutional arrangements, business models, and capabilities are necessary to achieve the most cost-effective, sustainable, and welfare-enhancing outcomes at the nexus of A.I. and renewable energy provision in Africa?

(iii) Where are the most cost-effective and sustainable locations to situate A.I. infrastructure allocations on the continent?

Proposed Methodology

The research will comprise three phases. More specifically:

- **Phase I:** We will survey 2000 stratified and randomly selected firms registered with the registrars of companies in South Africa and Kenya/Morocco (Africa's most technologically advanced economies with distinct/similar energy country profiles) and listed as involved in one or several aspects of the A.I. ecosystem (vis, cabling and networks, data preparation and centres, model building and production – cloud computing, platforms/applications, machine learning, and blockchain) (Cotterill, 2021), and will complement the surveys with key informant interviews with the chief operating officers of these respective firms to address the first research question.
- **Phase II:** The study will employ theoretical sampling and comparative case studies of effective and ineffective A.I. and renewable energy nexuses in the five sub-sectors of AI-related sectors and ecosystems mentioned previously to address the second research question. More pointedly, the analysis will examine the emerging patterns from an inter-firm evaluation of standalone and outsourced cloud computing service providers, vertically integrated businesses with hardwired A.I. systems and processes, and mobile network providers and their ecosystem of decentralized smartphone recharging kiosks. A combination of key informant interviews and focus group discussions with the chief operating officers, firm employees, contractors (across the A.I. and renewable energy value chains), sector associations, and relevant community interest groups will be used to generate the key data required.

- **Phase III:** We will complement the data collected for the first (i) and second (ii) research questions with secondary data from the literature to determine the optimal location of A.I. infrastructure in specific locations at a national and continental level, and thereby, addressing the third research question.

Intended Outputs

The primary outcome of this research will be 4 research papers, policy briefs and opinion pieces that provide empirical evidence for the enhanced coordination of national and supranational technology policy, A.I. and decarbonized energy transition strategies, and green and digital economy infrastructure developments. A more precise description of these outputs is provided below:

Description	**Objective**	**Implementation**
Bi-annual brown bag	Validation of Findings	2 internal research seminars to test the validity of the findings, and 2 high-level panel discussions with selected policymakers.
Research papers	Output delivery	2 RIA research and conference papers based on the three research phases.
Policy Briefs, Op-Eds, and Tweets	Policy Engagement and Dissemination	2 blog posts that link the study research results to current affairs.

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