GEOSPATIAL AND TECHNO-ECONOMIC ASSESSMENT OF OSMOTIC MEMBRANE SYSTEMS FOR SUSTAINABLE GREEN HYDROGEN PRODUCTION IN KENYA

PRESENTED

BY

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BACKGROUND & PROBLEM STATEMENT

Global Energy Transition

Hydrogen is a **key enabler of the global energy transition**, supporting the decarbonization of hard-to-abate sectors, including:

- ✓ Heavy Industry
- ✓ Transport
- ✓ Chemical Manufacturing
- ✓ Long-Duration Energy Storage

Global Hydrogen Outlook

Less than 1% of global hydrogen production is generated through **low-emission pathways**, green hydrogen technologies highlighting the urgent need to accelerate the deployment of sustainable

Kenya's Context

Strengths

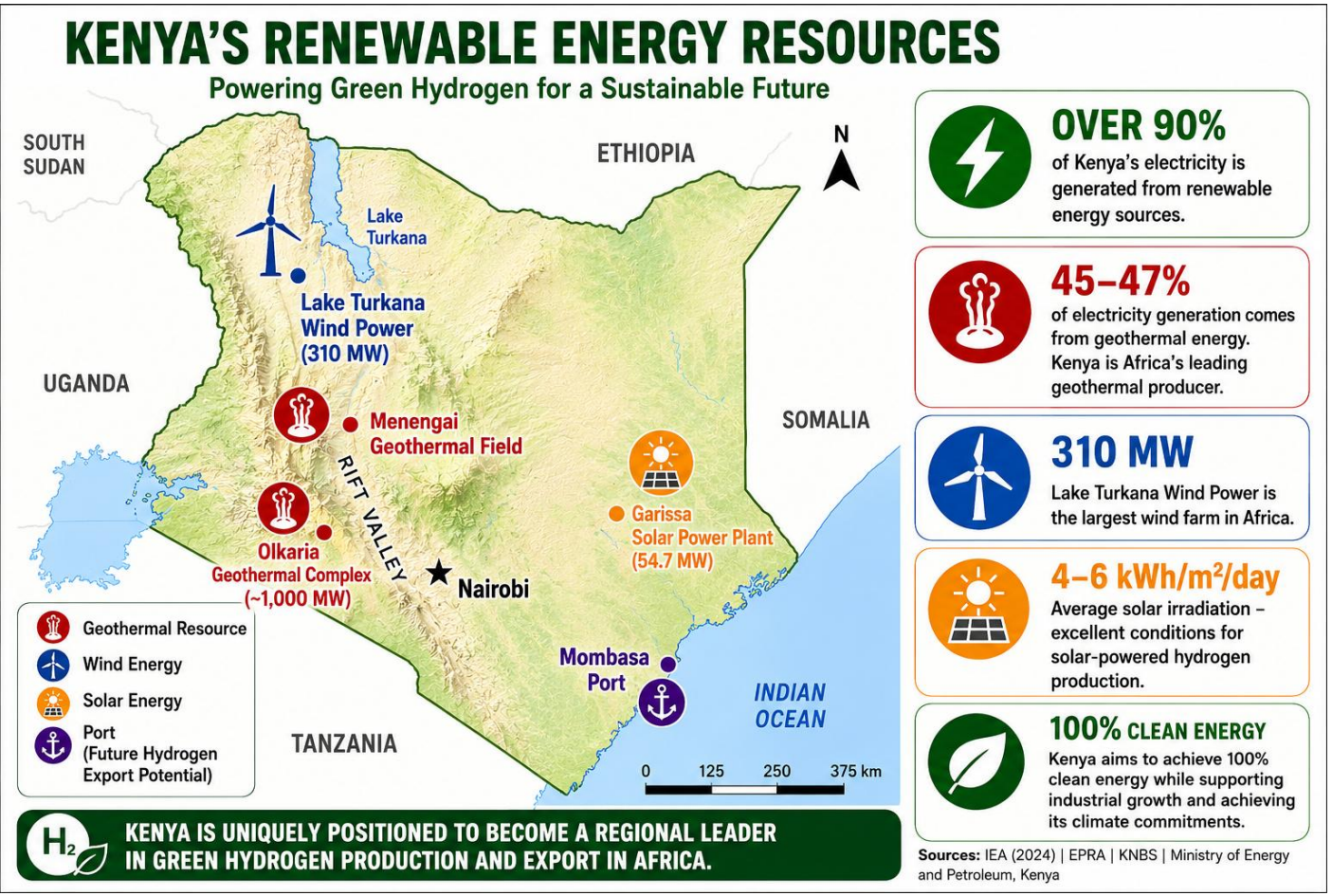


Figure 1. Kenya's Renewable Energy Resources and Strategic Locations for Green Hydrogen Production *(Sources: EPRA, KNBS, IEA, Ministry of Energy*

Current Challenges

- ✓ Limited spatial planning for green hydrogen production facilities
- ✓ High production costs and limited techno-economic assessments
- ✓ Limited evaluation of emerging hydrogen production technologies
- ✓ Lack of integrated decision-support tools for investment and policy development

RESEARCH AIM & OBJECTIVES

RESEARCH AIM

To evaluate the geospatial and techno-economic feasibility of osmotic membrane systems for sustainable green hydrogen production in Kenya.

SPECIFIC OBJECTIVES

1

GIS SITE SELECTION

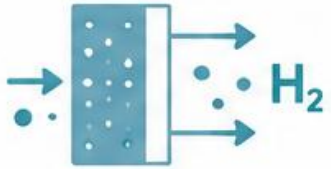
Identify suitable locations for green hydrogen production using Geographic Information Systems (GIS).

2

RENEWABLE RESOURCE ASSESSMENT

Assess the availability and suitability of renewable energy resources (geothermal, wind, solar, and hydropower) for hydrogen production.

3



OSMOTIC MEMBRANE EVALUATION

Evaluate the technical performance and applicability of osmotic membrane systems for sustainable hydrogen production.

4

TECHNO-ECONOMIC ANALYSIS

Conduct a techno-economic assessment to determine the economic viability of green hydrogen production pathways.

5

POLICY & INVESTMENT RECOMMENDATIONS

Develop evidence-based recommendations to support investment, policy formulation, and large-scale deployment of green hydrogen technologies in Kenya.

EXPECTED CONTRIBUTION | The research will provide an integrated decision-support framework for identifying optimal production sites, evaluating economic feasibility, and

SLIDE 3

RESEARCH METHODOLOGY

An integrated approach combining geospatial analysis, technology evaluation, and economic assessment

1 LITERATURE REVIEW

Review global and national studies on green hydrogen. Identify knowledge gaps, best practices, and research needs.

2 DATA COLLECTION

Collect data on renewable resources, water, infrastructure, topography, land use, and policy & economic factors.

3 GIS SPATIAL ANALYSIS

Use MCDA and GIS to map site suitability and identify optimal locations for green hydrogen production.

4 OSMOTIC MEMBRANE EVALUATION

Evaluate technical feasibility, compare performance with conventional electrolysis, and assess water & energy efficiency.

5 TECHNO-ECONOMIC ASSESSMENT

Estimate costs, calculate Levelized Cost of Hydrogen (LCOH), and conduct financial and sensitivity analyses.

6 DECISION-SUPPORT FRAMEWORK

Integrate GIS and techno-economic results to recommend optimal locations and support policy and investment decisions.

EXPECTED OUTPUT

An integrated GIS-based decision-support framework for identifying economically viable and sustainable green hydrogen production sites in Kenya.

Research Deliverables

Integrated GIS Decision Support Framework	Identify optimal locations for sustainable green hydrogen production using spatial suitability analysis.
Renewable Energy Resource Database	Comprehensive assessment of solar, wind, geothermal, and hydropower resources across Kenya.
Osmotic Membrane Feasibility Report	Technical performance evaluation and operational suitability for hydrogen production.
Techno-Economic Decision Model	Cost, efficiency, and investment analysis supporting commercialization decisions.
Policy & Investment Roadmap	Evidence-based recommendations for government, investors, and industry stakeholders.

Expected Impact

✓Optimal hydrogen production site selection

✓ Improved investment confidence

✓ Sustainable utilization of renewable resources

✓ Reduced production cost through optimized system design

✓ Supports Kenya's Green Hydrogen Strategy and Net-Zero goal

MY CONTRIBUTIONS

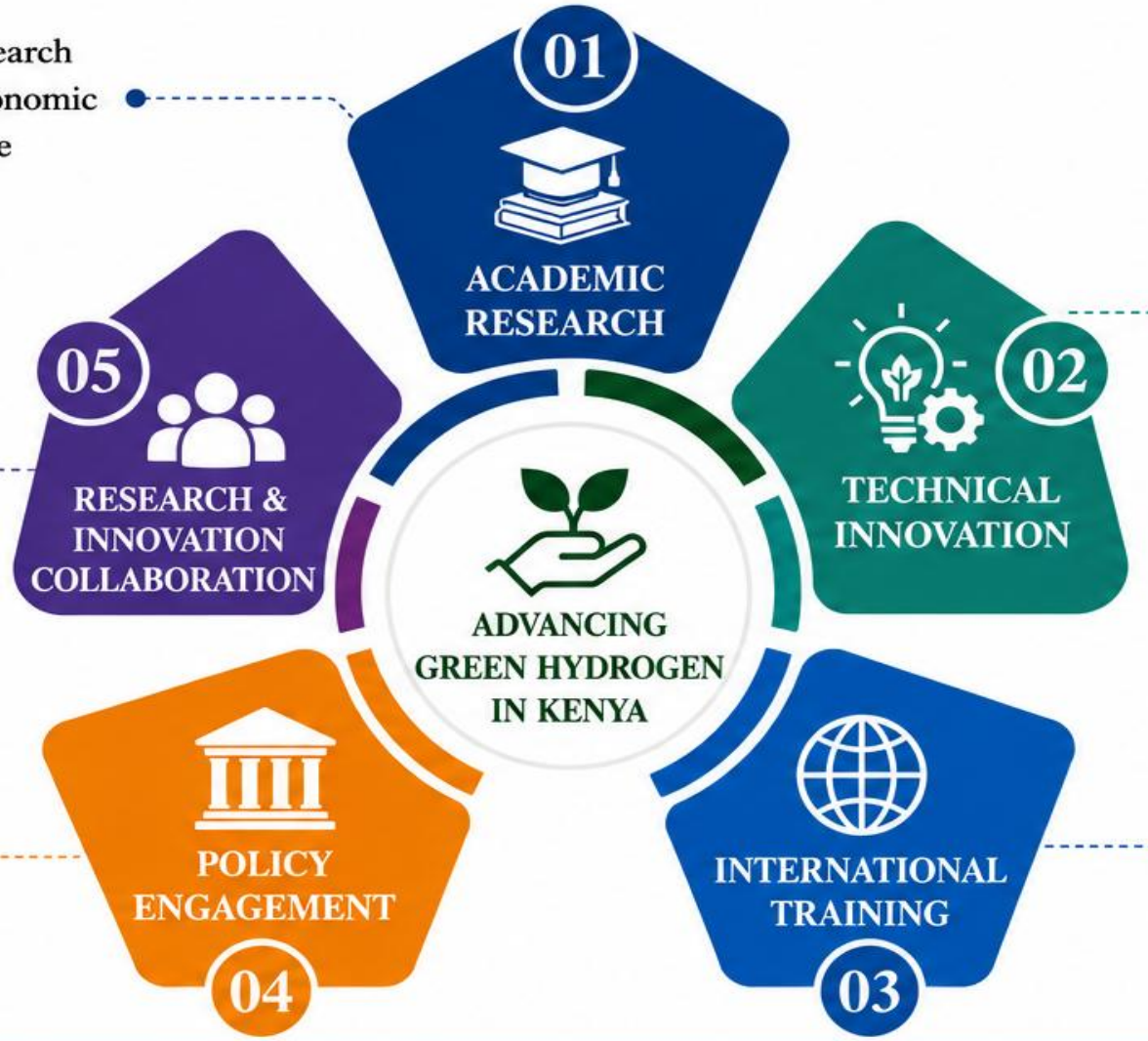
Conducting pioneering PhD research on the geospatial and techno-economic assessment of osmotic membrane systems for sustainable green hydrogen production in Kenya.

Developing an integrated GIS and techno-economic decision-support framework for optimizing renewable-powered green hydrogen production.

Building partnerships with Kenyatta University, KenGen, CTCN, GIZ, and international research institutions to advance Kenya's green hydrogen ecosystem.

Strengthened expertise through UK Water-to-Water (W2W) hydrogen systems training, emphasizing knowledge transfer and Gender Equality and Social Inclusion (GESI).

Contributing to Kenya's hydrogen ecosystem through the MITI Interministerial Technical Working Group and participation in national green hydrogen initiatives.



OVERALL CONTRIBUTION

My research integrates academic excellence, technical innovation, international collaboration, and policy engagement to advance sustainable green hydrogen technologies and support Kenya's transition to a low-carbon

SUSTAINABLE

LOW CARBON

ECONOMIC

INCLUSIVE

CONCLUSION

- Kenya's abundant renewable energy resources provide a strong foundation for **green hydrogen development**.
- This research integrates **GIS, osmotic membrane assessment, and techno-economic analysis** to support sustainable hydrogen production and informed decision-making.
- Collaboration with **KIER, KRICT, KIST, CTCN, and Kenyan institutions** can accelerate research, innovation, and deployment of green hydrogen technologies.

Together, through research, innovation, and international collaboration, we can advance sustainable green hydrogen solutions for Kenya and beyond.

THANK YOU