

# H2GLOBAL MEETS AFRICA

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# H2Global meets Africa

## Key facts

- Period: 01.01.2023 – 31.12.2025
- Budget: 4.2 Millionen €
- Funded by the Federal Ministry of Education and Research

## Project partners



## Associated partners





### Energy and climate crisis:

illustrated importance of achieving climate targets and diversifying energy supply

→ for this, a ramp up of the international hydrogen economy is crucial



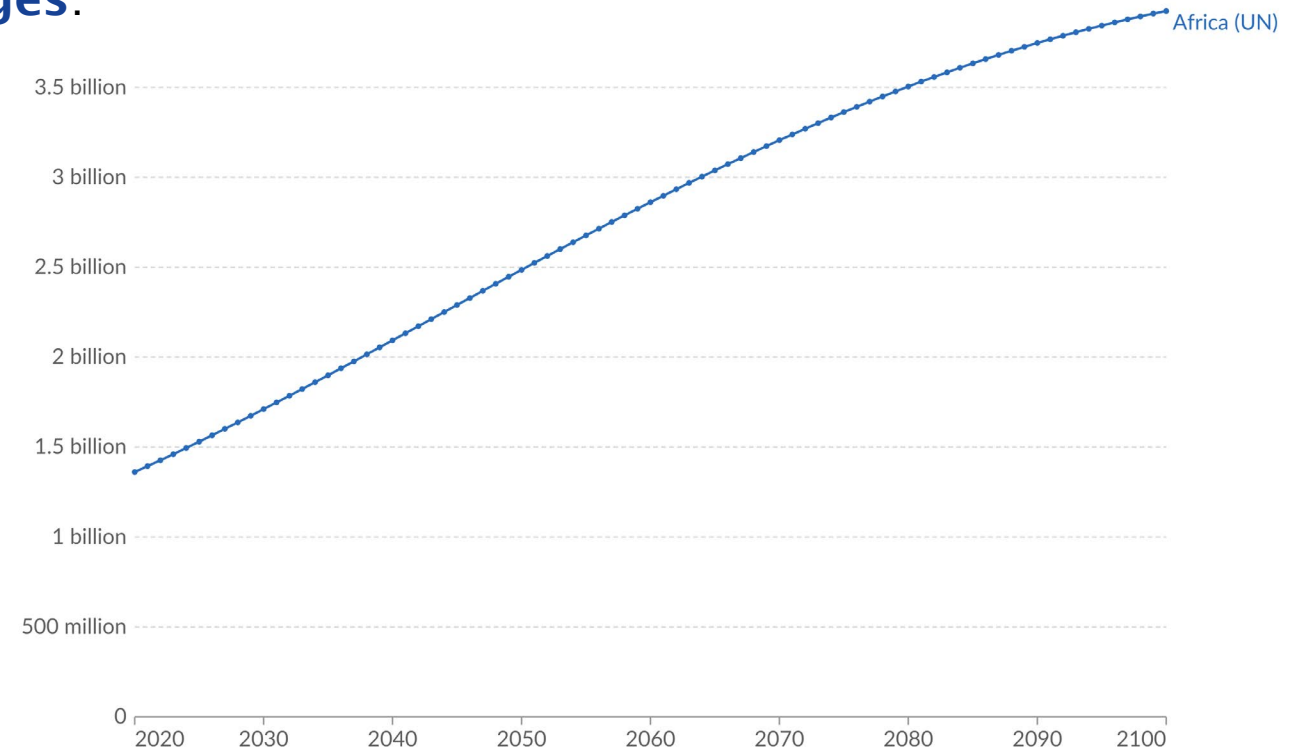
### For this ramp up two factors are elementary:

- Stable international partnerships
- Stable legal and financial framework

### Continent of Africa is facing major challenges:



Population doubles by 2050



Data source: United Nations, World Population Prospects (2022)

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### Continent of Africa is facing major challenges:



Population doubles by 2050



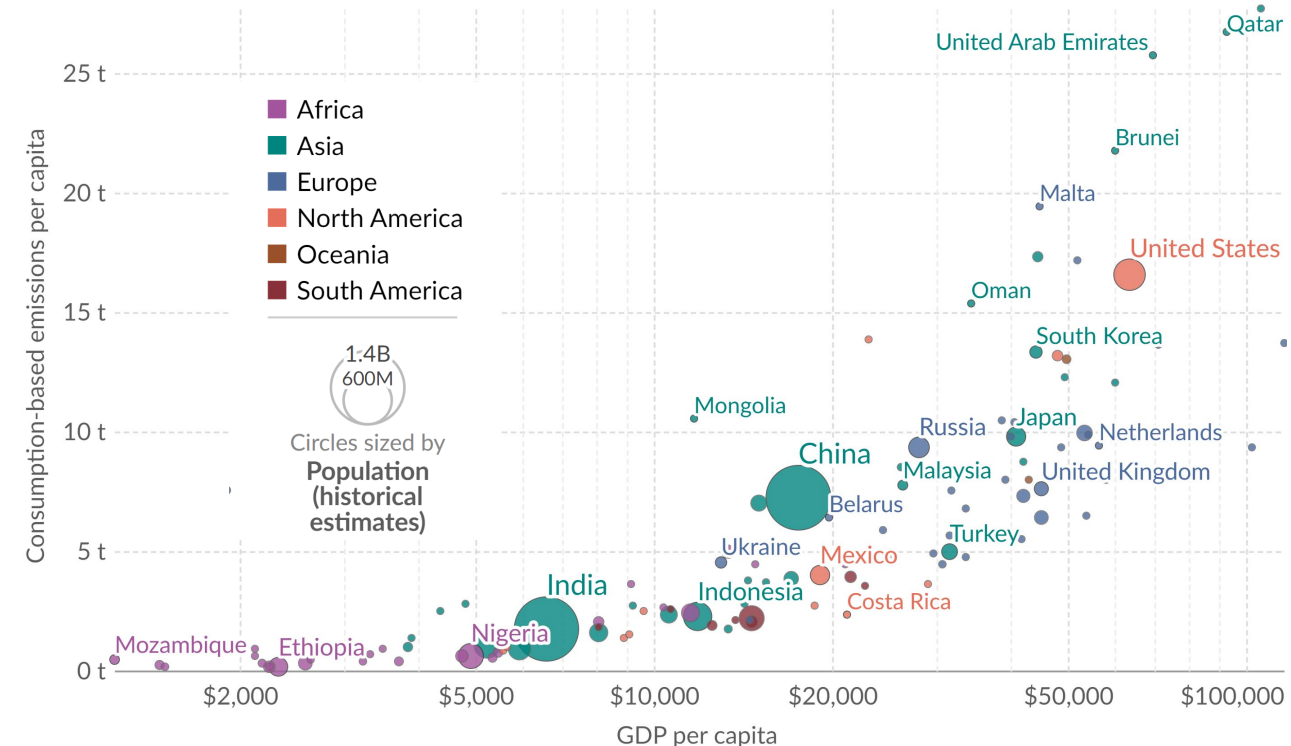
Average GDP of 2000\$ per capita  
(global average: 10,500\$)



Average CO<sub>2</sub> per capita of 0.8 t  
(advanced economies: 8 t)

### The Final Question:

Not if net-zero by 2050 is possible, but how  
with tenfold economic growth.



Data source: Global Carbon Budget (2023); Population based on various sources (2023); World Bank (2023)  
[OurWorldInData.org/co2-and-greenhouse-gas-emissions](https://OurWorldInData.org/co2-and-greenhouse-gas-emissions) | CC BY

# H2Global meets Africa

## Methodology

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### Goals:



Identify possible German-African green hydrogen partnerships



Bidirectional knowledge transfer



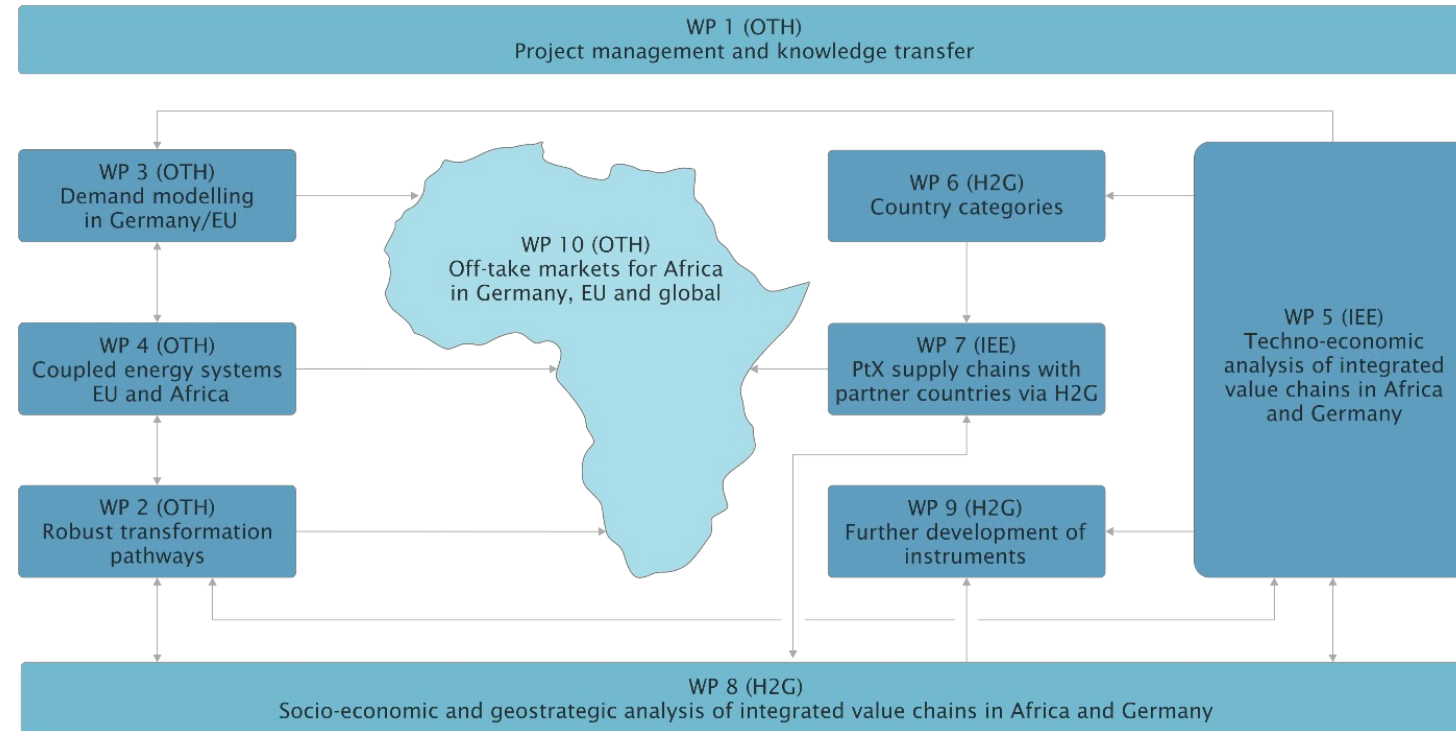
Evaluating specific H<sub>2</sub>/PtX value and supply chains with energy system modelling



Develop measures to promote market ramp up



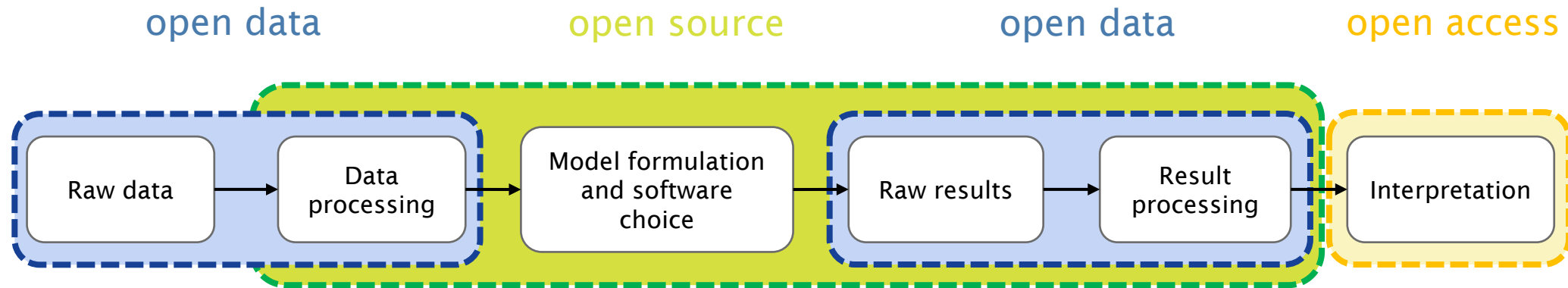
Key project results will be available open source



# H2Global meets Africa

## Following the Idea of Open Energy Modelling

The whole chain from raw data to modelling results should be open:



open data + free software → transparency + reproducibility

# H2Global meets Africa

## Energy Transformation Pathways

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### Main Models:

- PyPSA-Earth
- PyPSA-Earth-Sec
- PyPSA-Eur



### PyPSA-Earth. A new global open energy system optimization model demonstrated in Africa

Maximilian Parzen<sup>a,\*</sup>, Hazem Abdel-Khalek<sup>b</sup>, Ekaterina Fedotova<sup>c</sup>, Martin Mahmood<sup>a</sup>, Marthia Maria Frysztacki<sup>a</sup>, Johannes Hampf<sup>d</sup>, Lukas Franken<sup>a</sup>, Leon Schumm<sup>b,e</sup>, Fabian Neumann<sup>a</sup>, Davide Poli<sup>f</sup>, Aristides Kiprakis<sup>g</sup>, Davide Fioriti<sup>h,i</sup>

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### GRAPHICAL ABSTRACT



### ARTICLE INFO

Document link: <https://github.com/pypsa-meets-earth/pypsa-earth-paper>

**Keywords:**  
 Macro-energy systems  
 Optimization  
 OpenStreetMap  
 PyPSA-Earth  
 PyPSA-Earth  
 PyPSA-meets-Earth

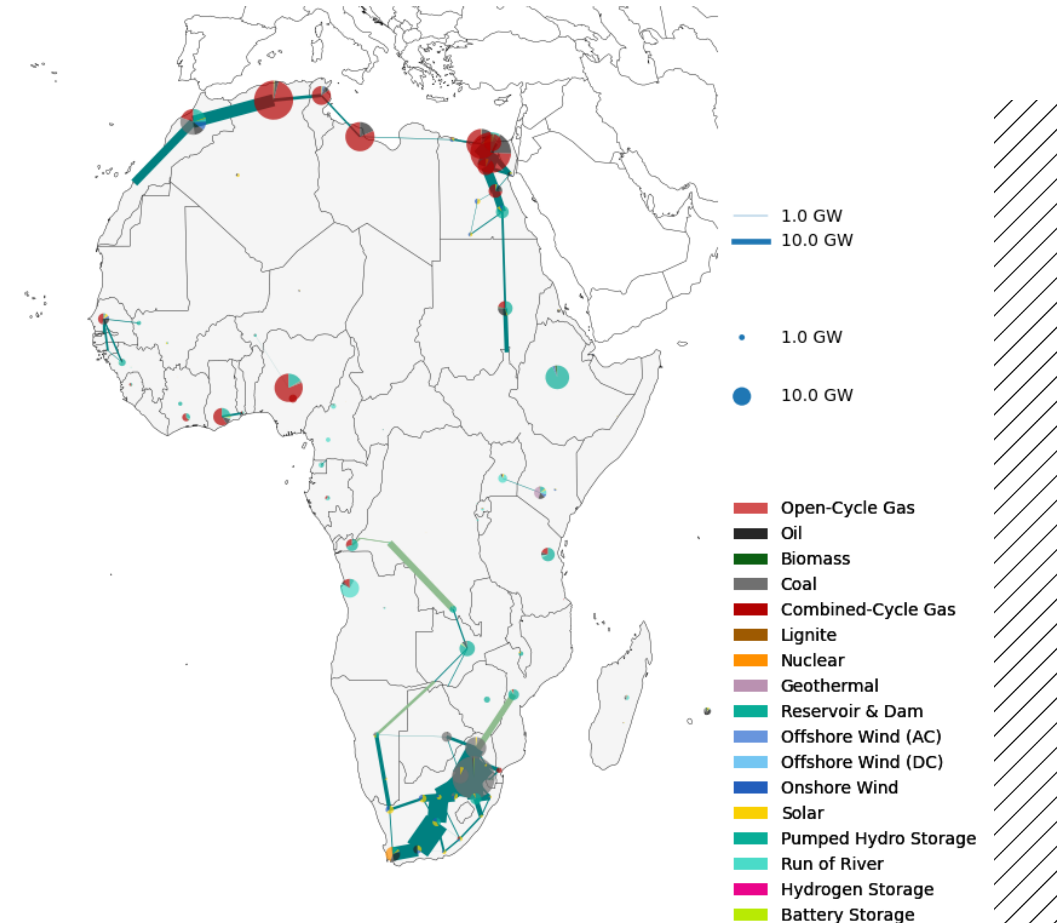
### ABSTRACT

Macro-energy system modelling is used by decision-makers to steer the global energy transition towards an affordable, sustainable and reliable future. Closed-source models are the current standard for most policy and industry decisions. However, open models have proven to be competitive alternatives that promote science, robust technical analysis, collaboration and transparent policy decision-making. Yet, two issues slow the adoption: open models are often designed with particular geographic scope in mind, thus hindering synergies from collaborating, or are based on low spatially resolved data, limiting their use. Here we introduce PyPSA-Earth, an open-source global energy system model with data in high spatial and temporal resolution. It enables large-scale collaboration by providing a tool that can model the world's energy system or any subset of it. The model is suitable for operational as well as combined generation, storage and transmission expansion studies. In this study, the novel power system capabilities of PyPSA-Earth are highlighted and demonstrated. The model provides two main features: (1) customizable data extraction and preparation with global coverage and (2) a PyPSA energy modelling framework integration. The data includes electricity demand, generation

Check out  
PyPSA-Earth here:



Check out  
PyPSA-Earth-Sec here:



Quelle: Erstellt mit PyPSA-Earth und [https://github.com/pypsa-meets-earth/documentation/blob/main/notebooks/viz/regional\\_transm\\_system\\_viz.ipynb](https://github.com/pypsa-meets-earth/documentation/blob/main/notebooks/viz/regional_transm_system_viz.ipynb)



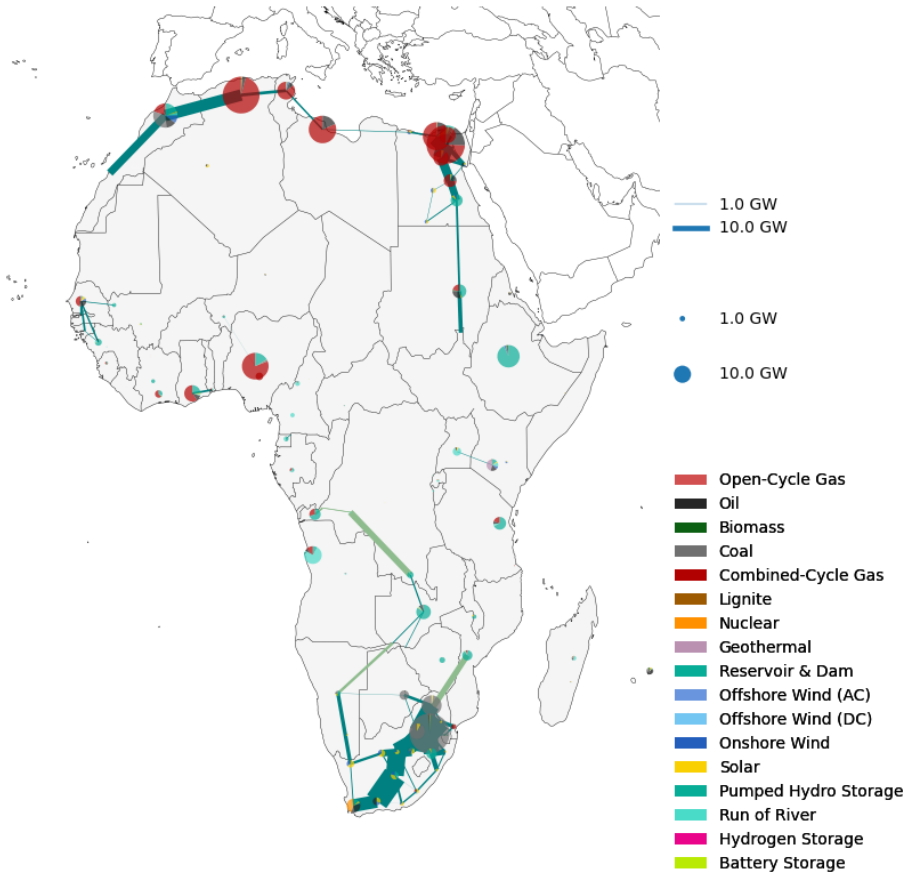
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## Model coupling Africa/Europe

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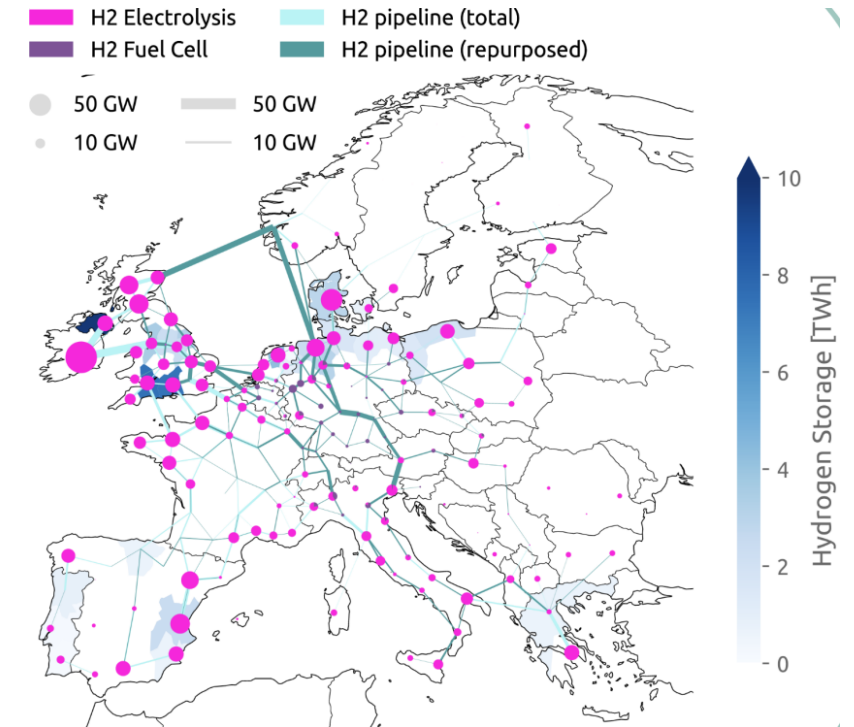


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Quelle: Erstellt mit PyPSA-Earth und [https://github.com/pypsa-meets-earth/documentation/blob/main/notebooks/viz/regional\\_transm\\_system\\_viz.ipynb](https://github.com/pypsa-meets-earth/documentation/blob/main/notebooks/viz/regional_transm_system_viz.ipynb)

Direct model coupling  
↔  
Common optimization of  
selected countries



Quelle: Neumann, Fabian; Zeyen, Elisabeth; Victoria, Marta; Brown, Tom (2022): Benefits of a Hydrogen Network in Europe

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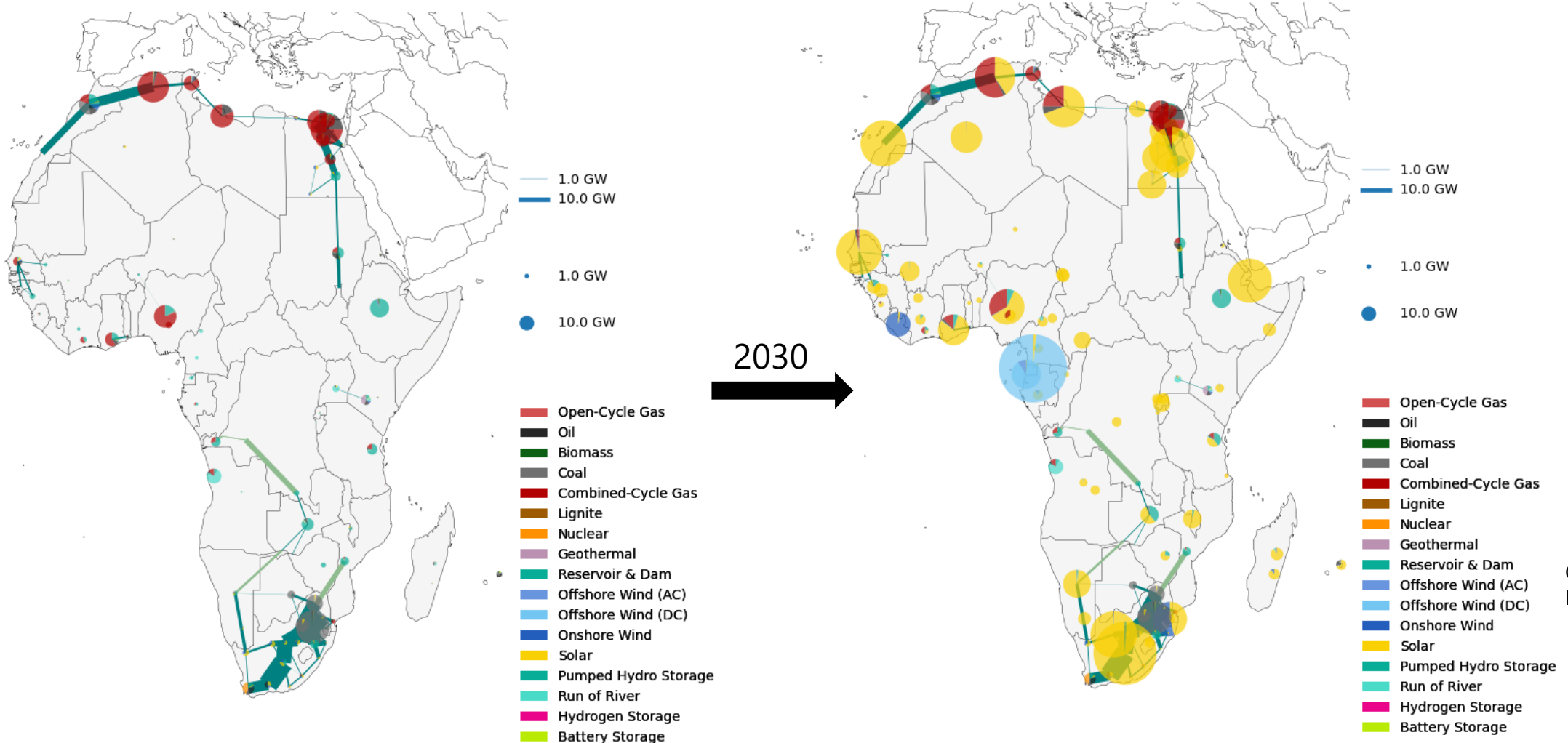
## Results

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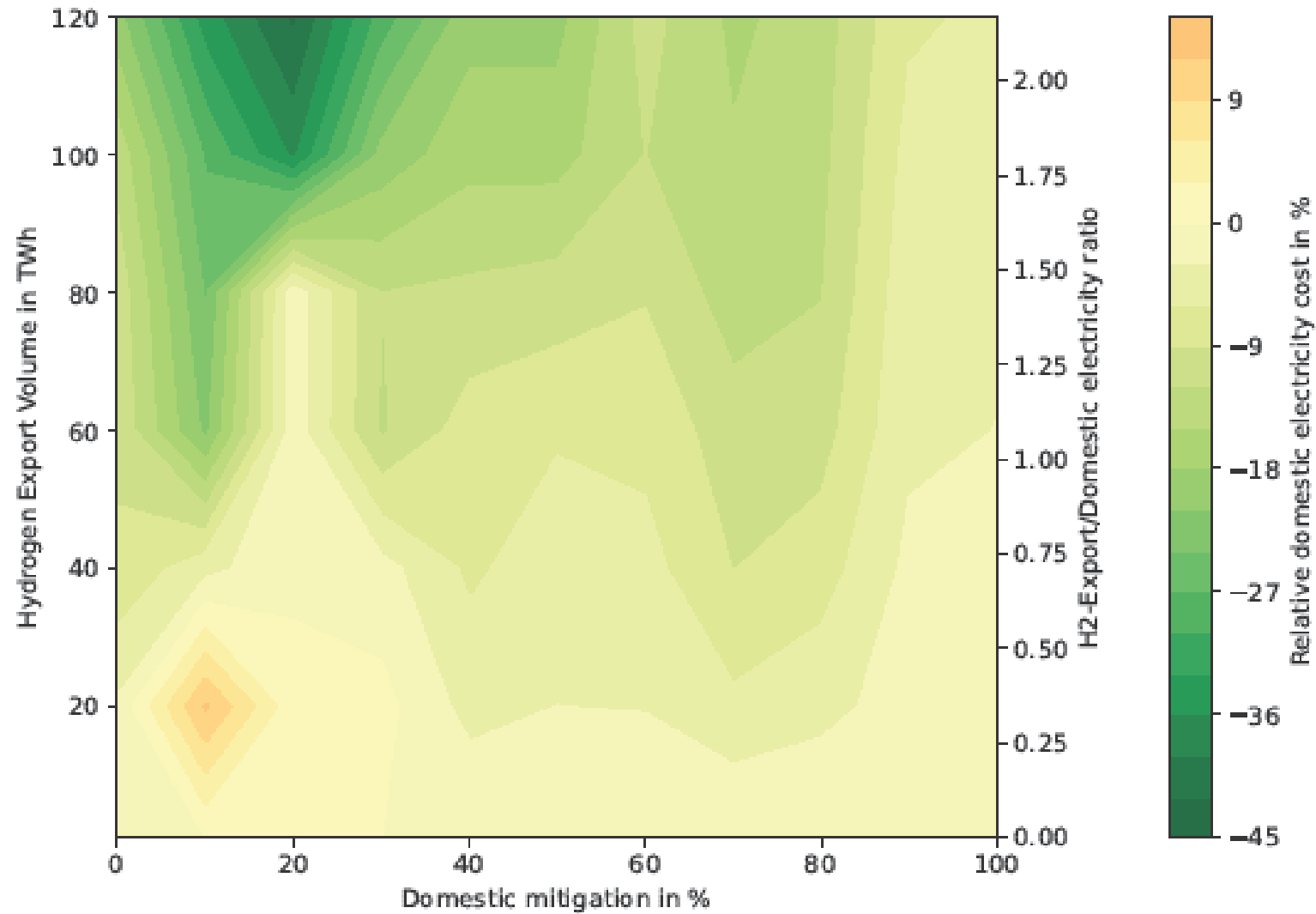


Check out  
PyPSA-Earth here:



# H2Global meets Africa

## Results



### Personal next steps:



Integrating desalination into PyPSA-Earth, apply it to **Namibia** and investigate the potential influence to fair partnerships.



Integrating GIS based hydrogen underground storage into PyPSA-Earth, apply it to **Tunisia** and investigate the influence of hydrogen underground storage on hydrogen exports.



Investigate hydrogen production in landlocked countries with regards to export difficulties and difficulties in water access (no desalination) for the case of **Ethiopia** with a focus on local value chains.

### Further question to the audience:



New EU > 90 % RE green hydrogen regulatory:  
Does this regulation play any role in the choice of location for project planners?

# The H2Global market-driven compensation mechanism ensures the most efficient use of funds for maximum impact

*Core value of H2Global's auction design:*

H2Global auctions **uncover** **supplier** and **offtake pricing** dynamics.

To create **liquidity** and support market development, **short-term** and **broad-based price signals** are **decisive**.

Long-term purchase agreement with **supply side**, multi-year fixed price and terms

Compensation of the price difference

 **Hintco**

Short-term sale agreements with **demand side**, e.g., 1 year

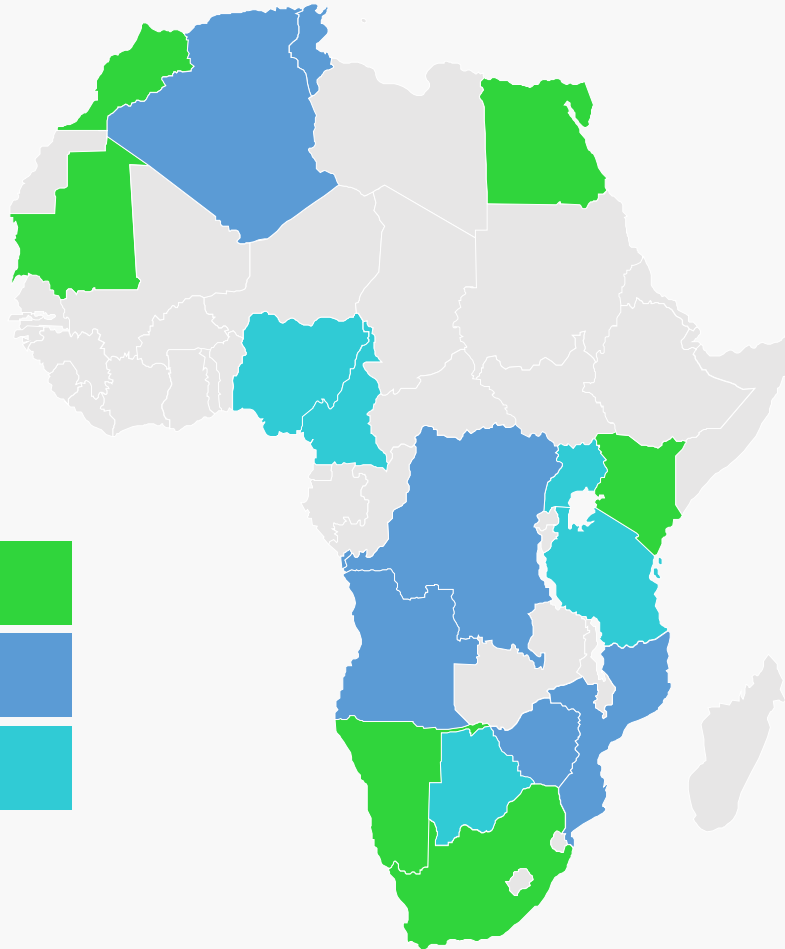
Exemplary illustration of the market development:  
Possible increase in market regulation and resulting increase in willingness to pay

PRICE (demand, supply)

TIME

# H2Global Foundation

## First Results of Country Clustering



Front runners

Upcoming stars

Strong Foundation

### Country Clustering

Based on socio-economic potential to produce renewable hydrogen.

#### Six Dimensions

- Renewable hydrogen commitment
- Renewable energy potential & water availability
- Domestic anchor demand
- Terminals
- Sea access
- Country risk

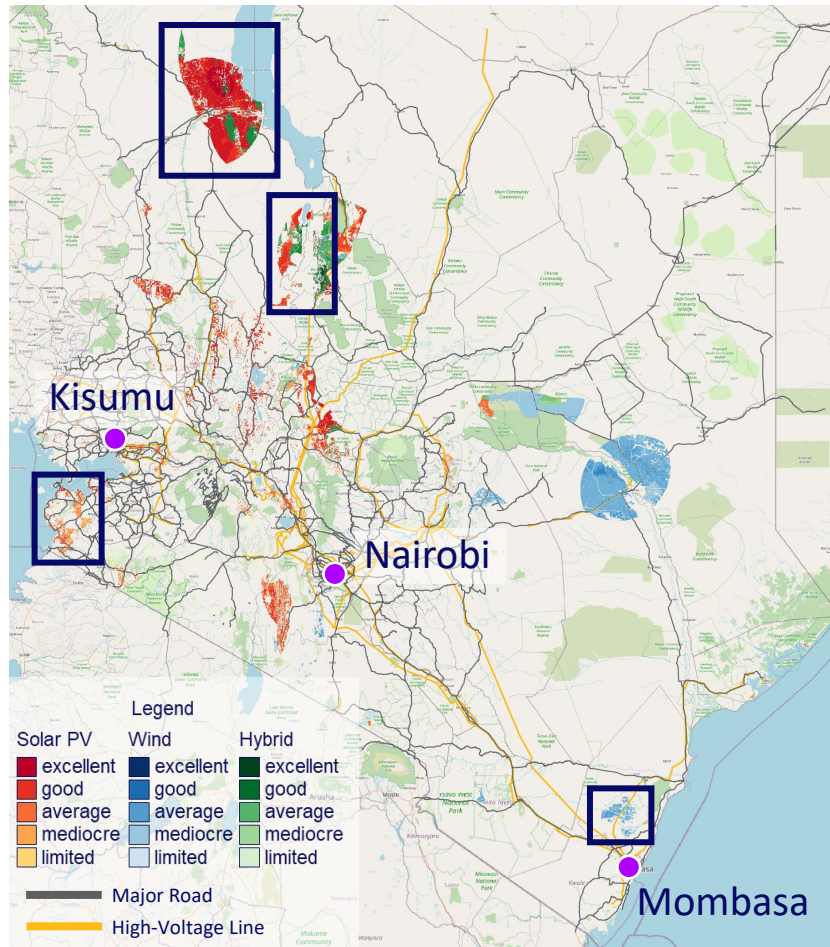
#### Clustering Approach

- Method: Hierarchical clustering
- Agglomeration of 55 countries in seven steps
- Final cluster step results in four clusters

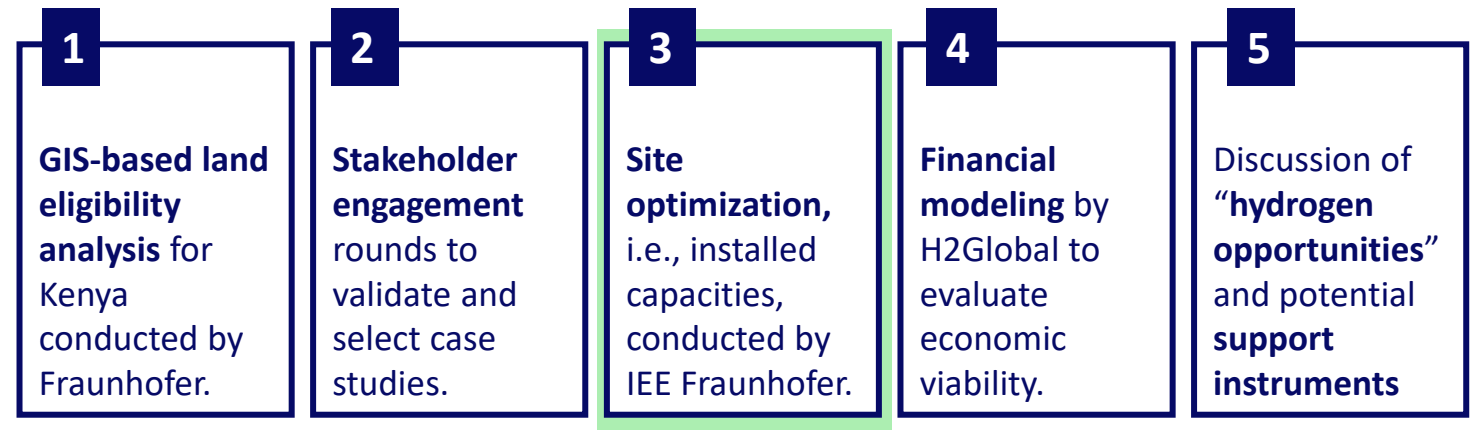
- Collaboration with the African Development Bank through a short-term research consultant
- Stakeholder workshop in Cape Town planned for Q1 2025 to discuss finance for clean H2 projects in partnership with World Bank

# H2Global Foundation

## Working on a White Paper about Kenya



### Title: “Techno-economic Assessment of the Potential to Produce Hydrogen in Kenya”



### Consortium



Strathmore  
UNIVERSITY

H2Global

Fraunhofer  
IEE



Center on  
Global Energy  
Policy

Planned publication: **Early 2025**



# *Fraunhofer Institute for Energy Economics and Energy System Technology (IEE)*

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Employees



**€ 30 Mio.**  
Annual Budget



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# **Fraunhofer IEE**

## *Overview of our research fields.*

Grid Planning and Grid Operation

Grid Stability and  
Power Converter Technology

Energy Process  
Engineering

Thermal Energy  
Technology

Energy Informatics

Energy Economics and  
System Analysis

Energy Meteorology and Renewable  
Resources



# **Fraunhofer IEE**

## *Contribution to H2 Global meets Africa.*

**Fraunhofer IEE is responsible for the work packages 5 & 7**

### **WP5: Techno-economic analysis of integrated value chains in Africa and Germany**

- **\* GIS-based area analysis and GIS-based EE time series generation**
- **\* Suitability assessment of PtX production regions**
- Determination of product quality level
- Techno-economic analysis of large-scale island systems
- **\* National and international transport of PtX fuels**
- Transformation path of the EU gas system
- Shifting effects in the PTX value chain

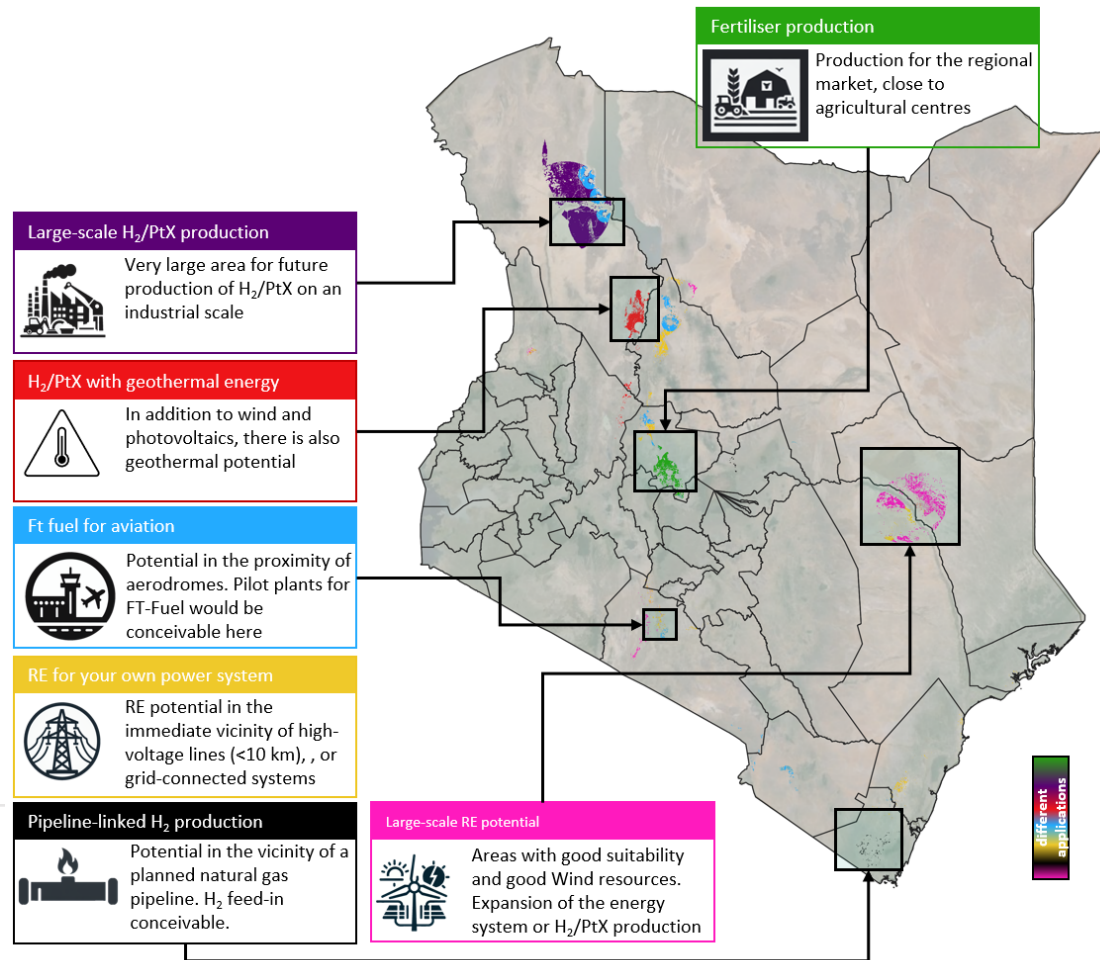
### **WP7: PtX supply chains with partners countries via H2G**

- Model construction for plant expansion at the reference site
  - Short-term Ammonia, Methanol and Power-to-Liquid
  - Analyse infrastructure requirements in the short and medium term

# Fraunhofer IEE

## Contribution to H2 Global meets Africa.

GIS-based area analysis and GIS-based EE time series generation;  
Suitability assessment of PtX production regions



National and international transport of PtX fuels

Evaluation of PtX transport options between Africa and Germany (pipeline, shipping) from an Energy System Analysis perspective

Focus on mid-term (2035): Ammonia and Methanol

In the long-term (2050) also other derivatives

Methodological: Consideration of transport delay; engagement of port infrastructure; intermediate storage

# H2Global meets Africa

## Contact us!

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