LEAP-RE RE4AFAGRI (PILLAR II, WP12)

RENEWABLES FOR AFRICAN AGRICULTURE: INTEGRATING MODELLING EXCELLENCE AND ROBUST BUSINESS MODELS

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IIASA

Kigali, 2nd LEAP-RE Stakeholder Forum

10th October 2023

LEAP-RE

Long-Term Joint EU-AU Research and Innovation Partnership on Renewable Energy

RE4AFAGRI

Renewable Energy for African Agriculture

The LEAP-RE project has received funding from the European Union's Horizon 2020 Research and Innovation Program under Grant Agreement 963530.

WP12: RE4AFAGRI

LEAP-RE

Sub-Saharan African's agricultural sector presents challenges

- In sub-Saharan Africa (SSA) about **80% of the agricultural production comes from smallholder farmers**
- **More than half** of the population depends directly or indirectly on **agriculture as their labour and income source**
- Most farmers practice **rainfed agriculture (covering >90% of cropland)**

Rainfed agriculture and **no electricity** in the community

Low **productivity** and **raw crops sold** to wholesale **(lack of cold storage and crop processing)**

Poverty and **inequality** traps, **food** insecurity

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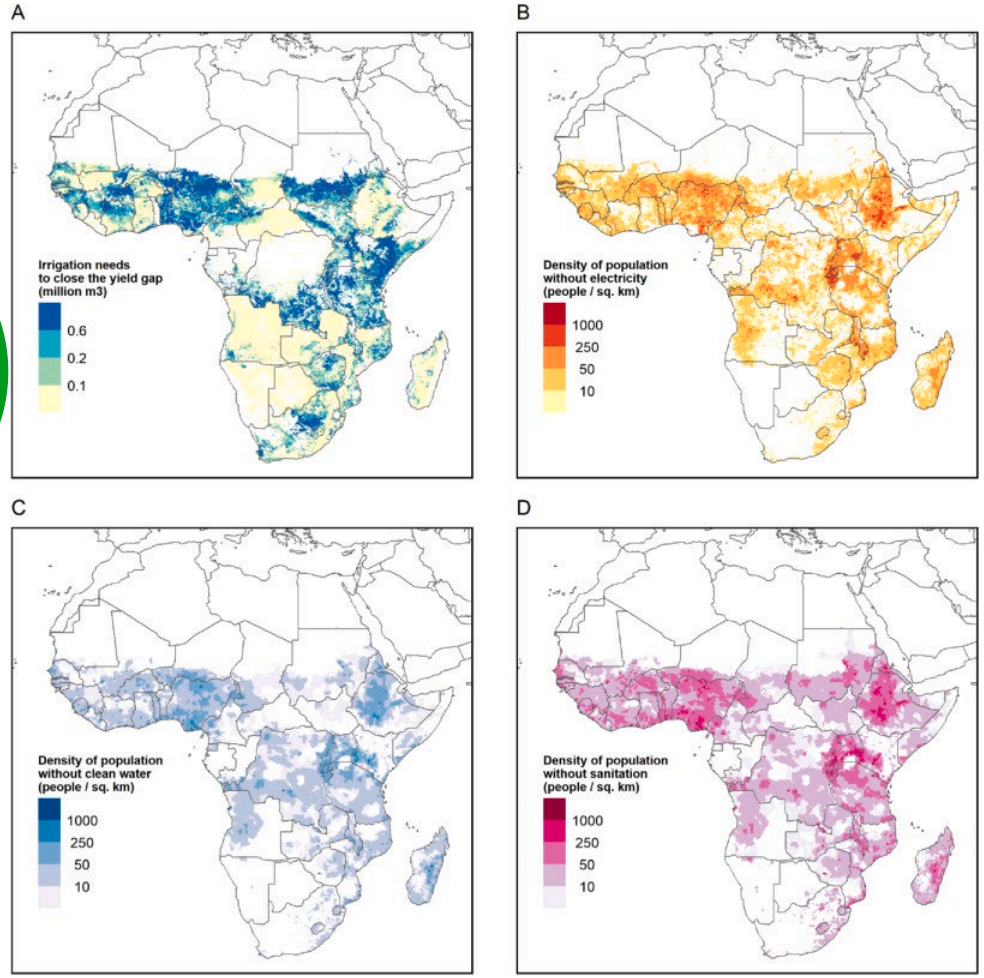
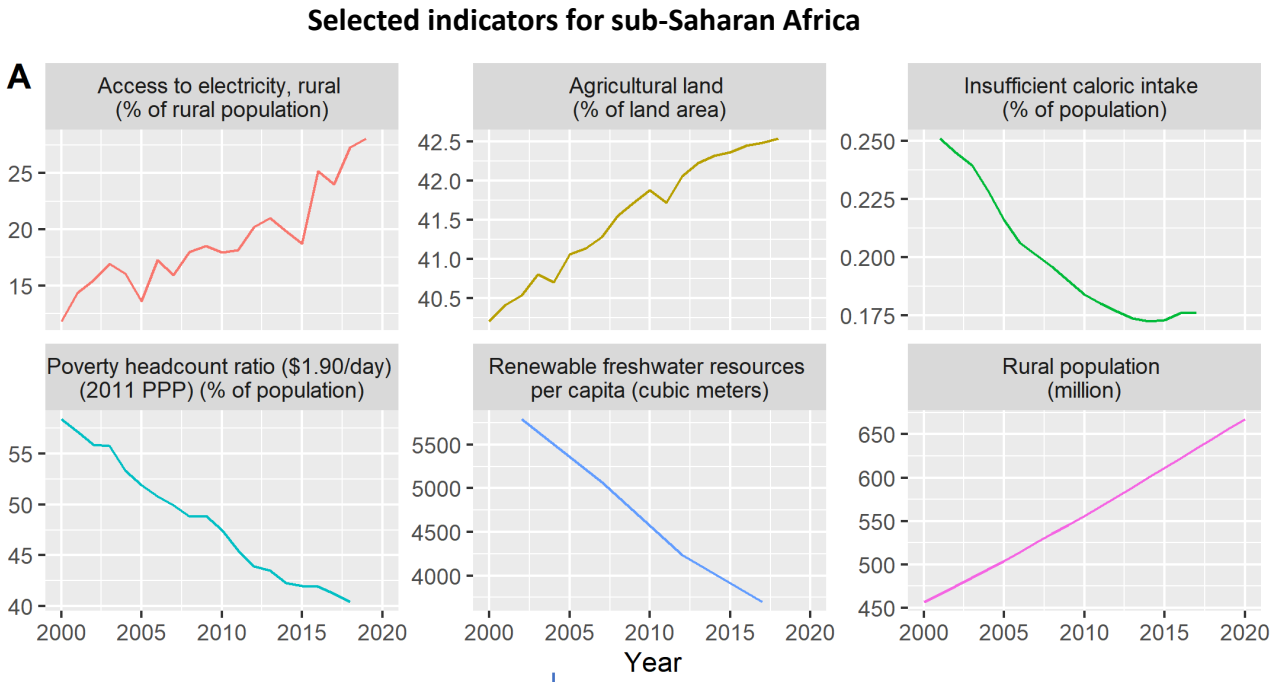
Challenges are multi-dimensional and overlapping



10.1016/j.esr.2022.100922

Figures: Falchetta (2021)
Data: World Bank, FAO



Under baseline trends, most **development gaps still open** (or even larger) by 2030, together with a rapidly growing population (900+ million people by 2050, UN 2019 prospects)

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But solutions exist and opportunities for development are huge!

RE4AFAGRI

- Sustainable **irrigation** and **community-wide renewable electricity**
- Increased **productivity** & local **crop processing**
- Agriculture as **leverage** for reduction of poverty and inequality

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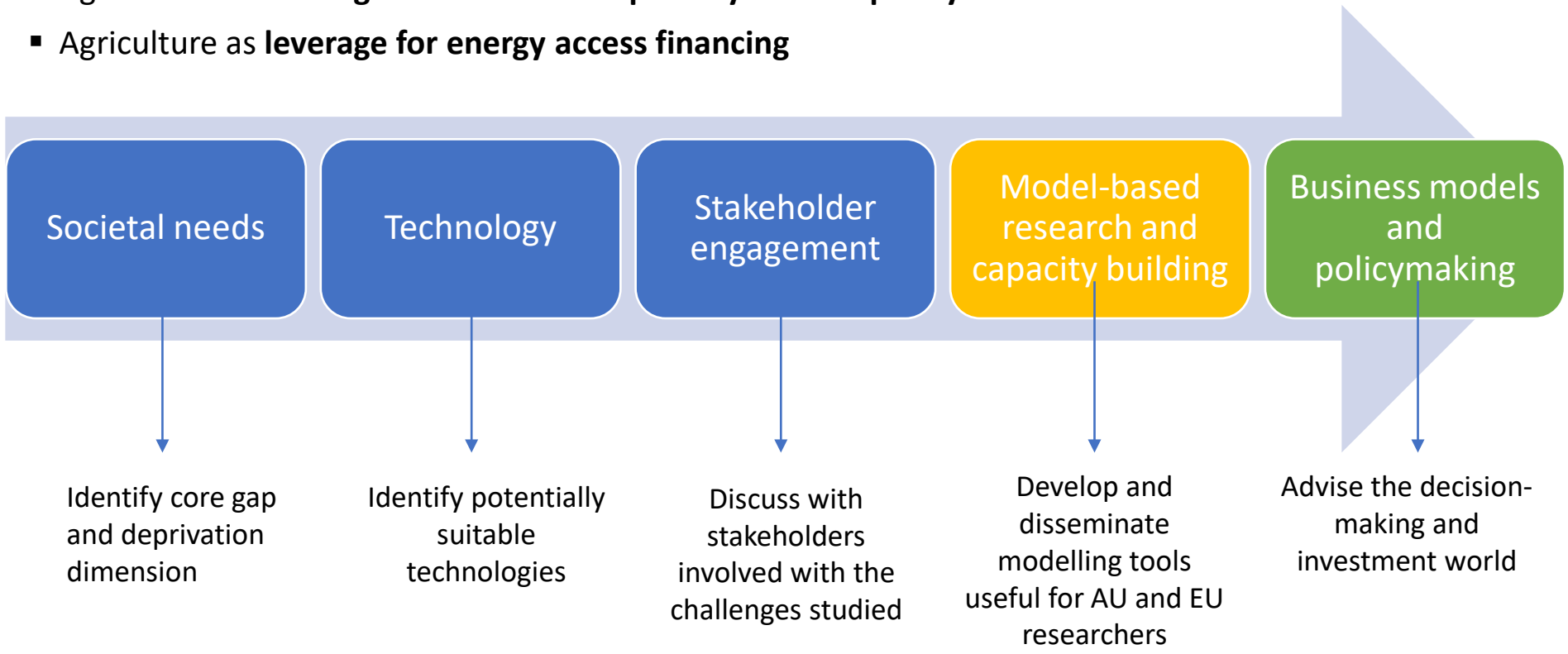
Aims of the project

- Demonstrating **technological, economic, and business model pathways** to:
  - Sustainable cropland **irrigation** and community-wide renewable **electricity access**
  - Increased agricultural **productivity, local crop processing and cold storage**
  - Agriculture as **leverage** for reduction of **poverty and inequality**
  - Agriculture as **leverage for energy access financing**



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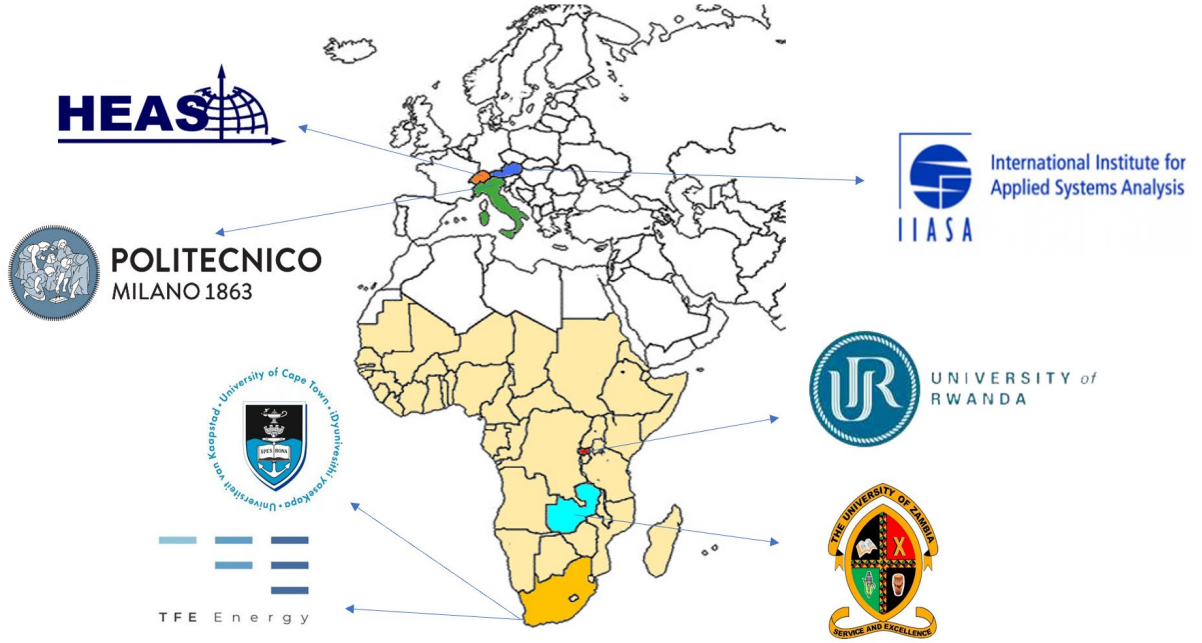
Consortium

The RE4AFAGRI consortium combines climate-water-energy-land-food-development nexus modelling expertise (**IIASA, UCT, POLIMI/TO**) with business model and policy development capacity (**TFE-A, HEAS***) and a deep knowledge of the local realities and the implied research avenues (**UNIZA, UNIRWA**).

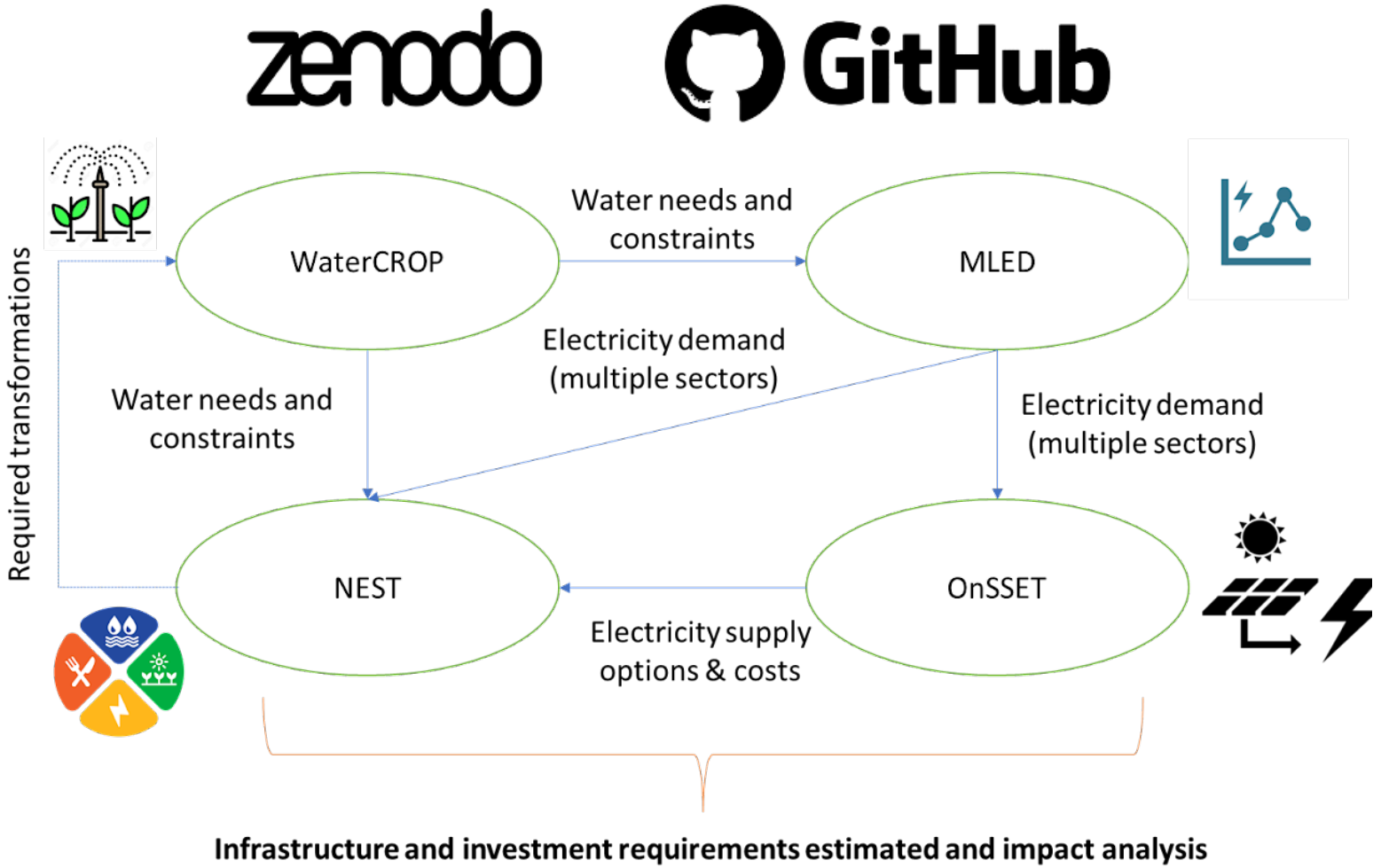


The team includes **scientists, business experts, and policy researchers** and is involved a large number of external stakeholders and target users from African institutions and international organisations through focus groups and capacity building activities.

* project coordinator

Project output products

The RE4AFAGRI modelling platform

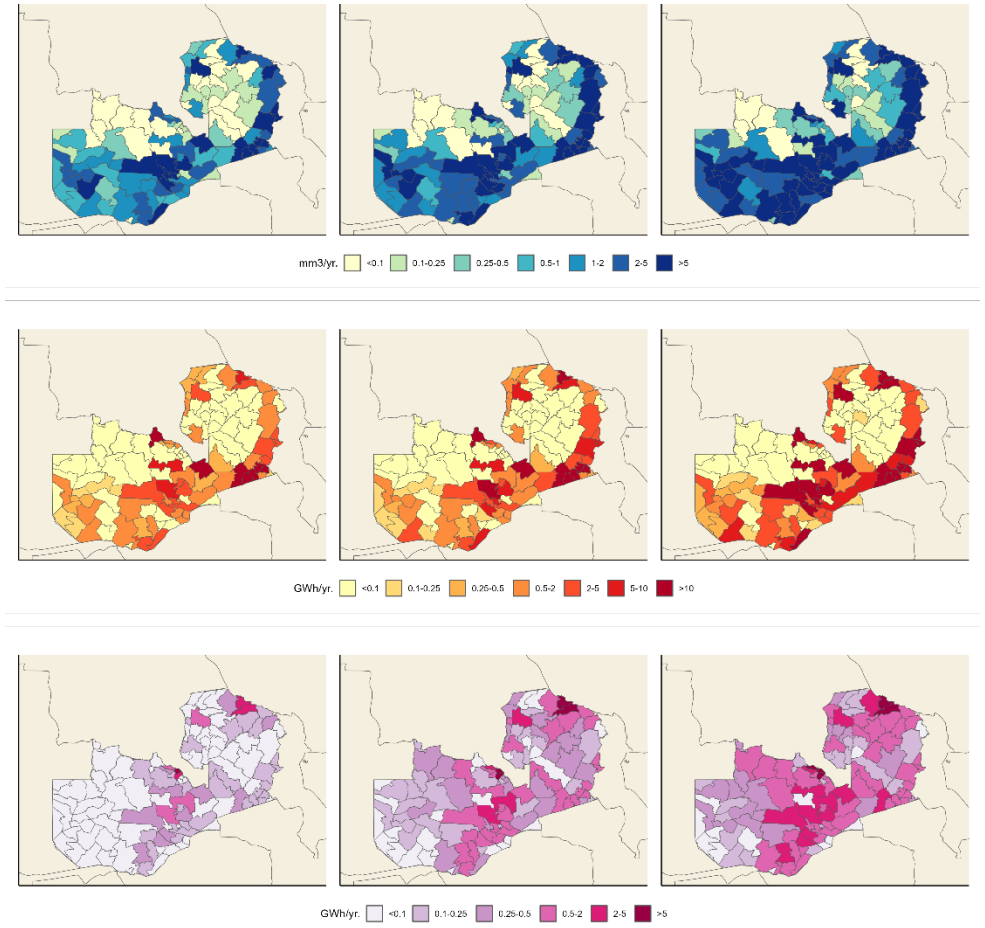


Data:
The RE4AFAGRI Zenodo channel hosts both the data products generated as outputs of the modelling platform (visualised in the Dasbhoards) and the original input data to operate the modelling platform and replicate the analysis.

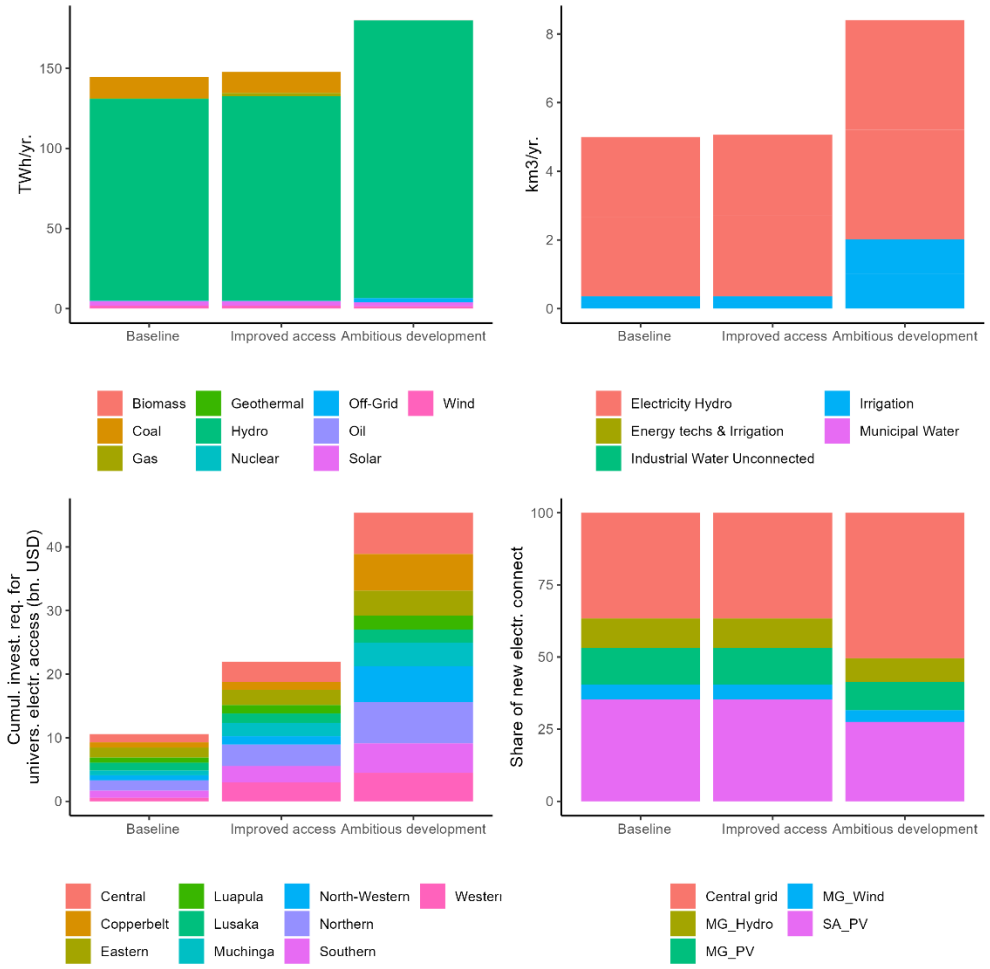
Code:
The RE4AFAGRI Github repository hosts the source code of the modelling platform, which, in combination with the data bundles, allows to run the analysis from scratch with customised assumptions and data, or adapt it to other geographies.

Documentation:
The RE4AFAGRI Wiki page hosts the official documentation of the modelling platform, to be used during the RE4AFAGRI capacity building activities, as well as by autonomous users willing to operate their own version of the platform.

Project output products



A clear picture of resources and technology requirements

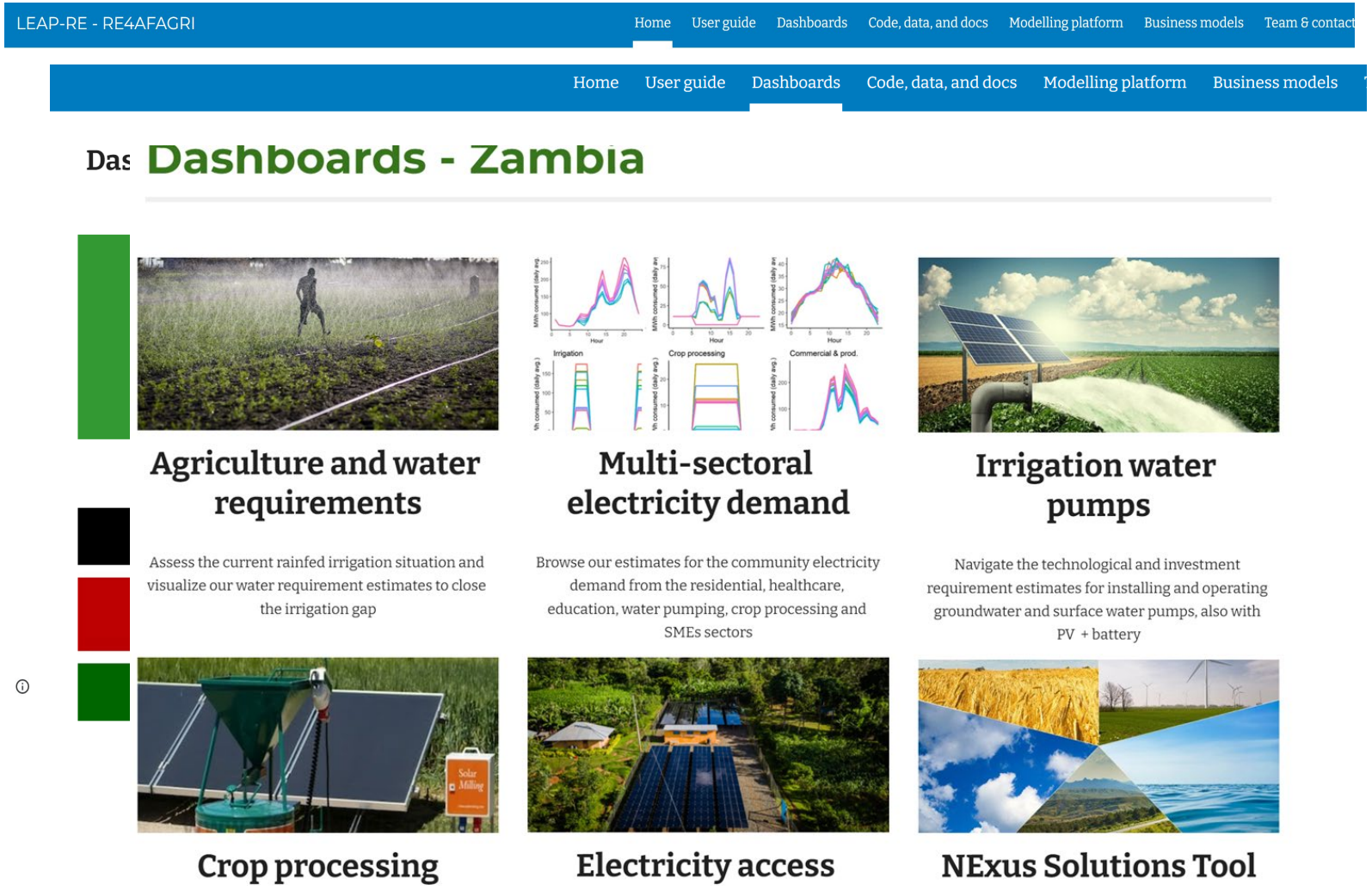


A suit-for-purpose investment outlook

Project output products

The RE4AFAGRI dashboards

www.re4afagri.africa



- A **powerful decision support tool with interactive dasbhoards**

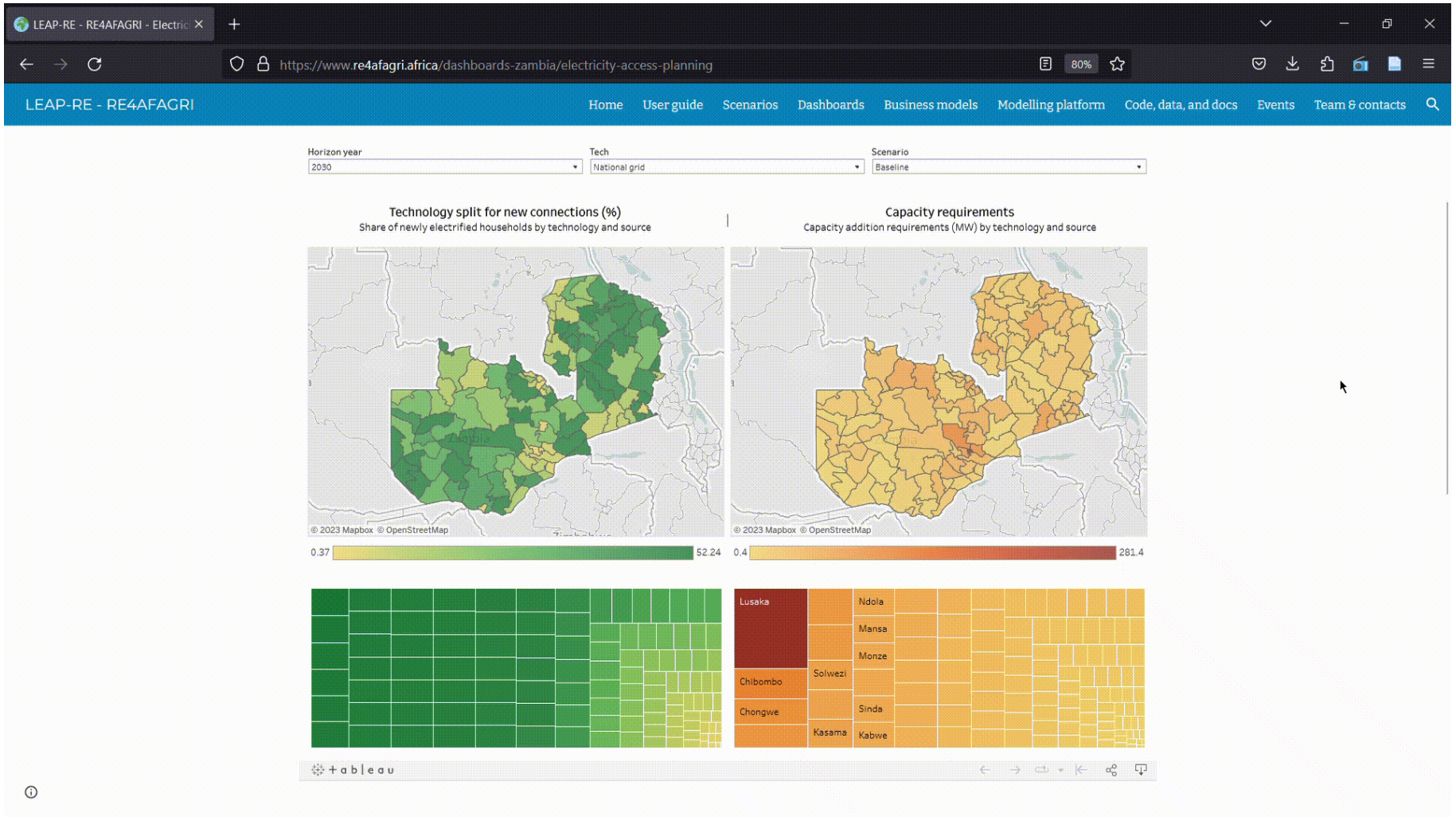
→ Support **policymaking** through sub-national gaps and needs assessment for tailored measures and investments

→ Support **private infrastructure developers** in site selection for maximising financial sustainability and development impact

- Enriched with **direct access to download the raw output data**

Project output products

The RE4AFAGRI dashboards: user experience

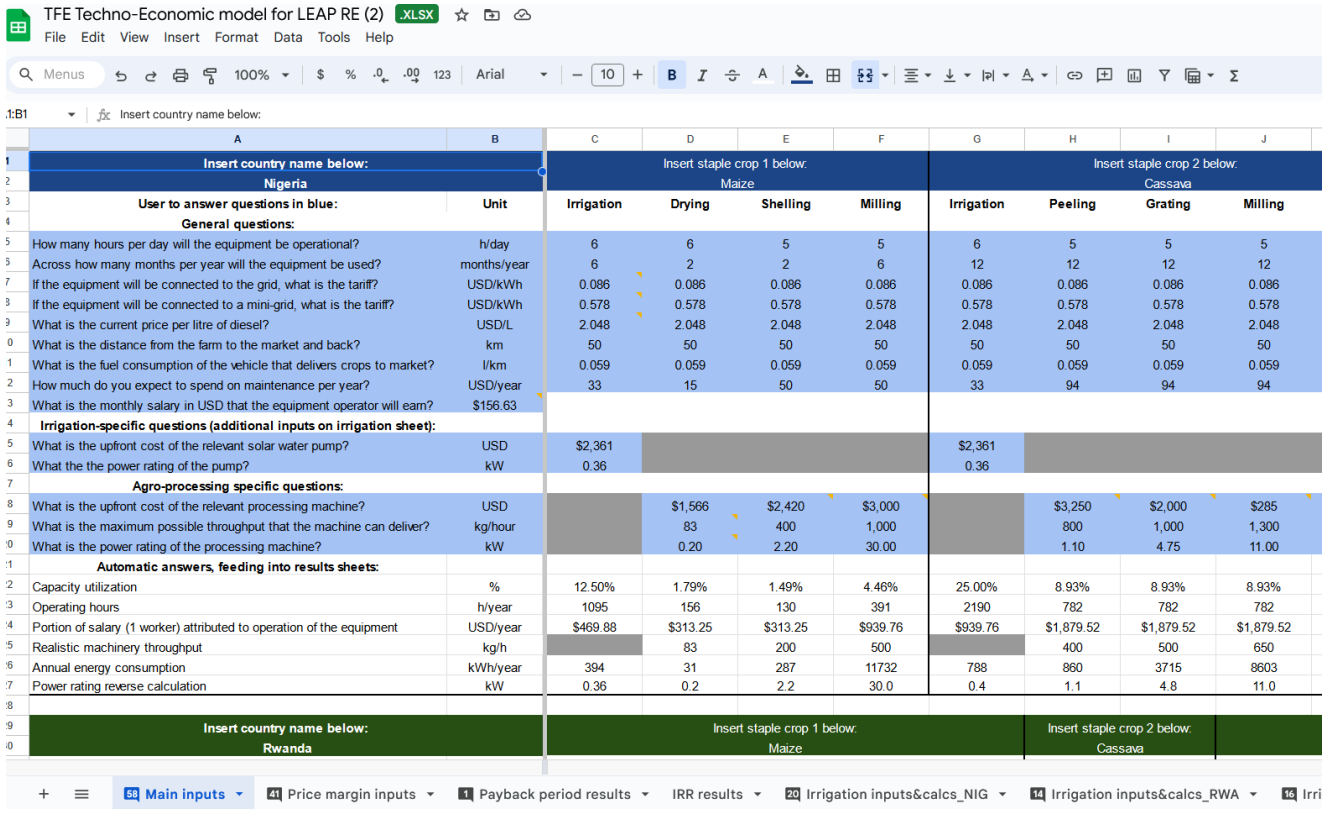


Project output products

The techno-economic model

- RE4AFAGRI & TFE's open-source **techno-economic model** to assess agricultural value chain activities that are financially viable for electrification from the perspective of the smallholder farmer in any location of their choice.

- A user guide for the model is presented in an annex to the report.



TFE Techno-Economic model for LEAP RE (2) .XLSX

File Edit View Insert Format Data Tools Help

Insert country name below:		Insert staple crop 1 below:				Insert staple crop 2 below:			
Nigeria		Maize				Cassava			
User to answer questions in blue:	Unit	Irrigation	Drying	Shelling	Milling	Irrigation	Peeling	Grating	Milling
General questions:									
How many hours per day will the equipment be operational?	h/day	6	6	5	5	6	5	5	5
Across how many months per year will the equipment be used?	months/year	6	2	2	6	12	12	12	12
If the equipment will be connected to the grid, what is the tariff?	USD/kWh	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086
If the equipment will be connected to a mini-grid, what is the tariff?	USD/kWh	0.578	0.578	0.578	0.578	0.578	0.578	0.578	0.578
What is the current price per litre of diesel?	USD/L	2.048	2.048	2.048	2.048	2.048	2.048	2.048	2.048
What is the distance from the farm to the market and back?	km	50	50	50	50	50	50	50	50
What is the fuel consumption of the vehicle that delivers crops to market?	l/km	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059
How much do you expect to spend on maintenance per year?	USD/year	33	15	50	50	33	94	94	94
What is the monthly salary in USD that the equipment operator will earn?	$156.63								
Irrigation-specific questions (additional inputs on irrigation sheet):									
What is the upfront cost of the relevant solar water pump?	USD	$2,361				$2,361			
What the the power rating of the pump?	kW	0.36				0.36			
Agro-processing specific questions:									
What is the upfront cost of the relevant processing machine?	USD		$1,566	$2,420	$3,000		$3,250	$2,000	$285
What is the maximum possible throughput that the machine can deliver?	kg/hour		83	400	1,000		800	1,000	1,300
What is the power rating of the processing machine?	kW		0.20	2.20	30.00		1.10	4.75	11.00
Automatic answers, feeding into results sheets:									
Capacity utilization	%	12.50%	1.79%	1.49%	4.46%	25.00%	8.93%	8.93%	8.93%
Operating hours	h/year	1095	156	130	391	2190	782	782	782
Portion of salary (1 worker) attributed to operation of the equipment	USD/year	$469.88	$313.25	$313.25	$939.76	$939.76	$1,879.52	$1,879.52	$1,879.52
Realistic machinery throughput	kg/h		83	200	500		400	500	650
Annual energy consumption	kWh/year	394	31	287	11732	788	860	3715	8603
Power rating reverse calculation	kW	0.36	0.2	2.2	30.0	0.4	1.1	4.8	11.0
Insert country name below:		Insert staple crop 1 below:				Insert staple crop 2 below:			
Rwanda		Maize				Cassava			

Main inputs | Price margin inputs | Payback period results | IRR results | Irrigation inputs&calcs_NIG | Irrigation inputs&calcs_RWA | Irri

Available for download at www.re4afagri.africa

Project output products

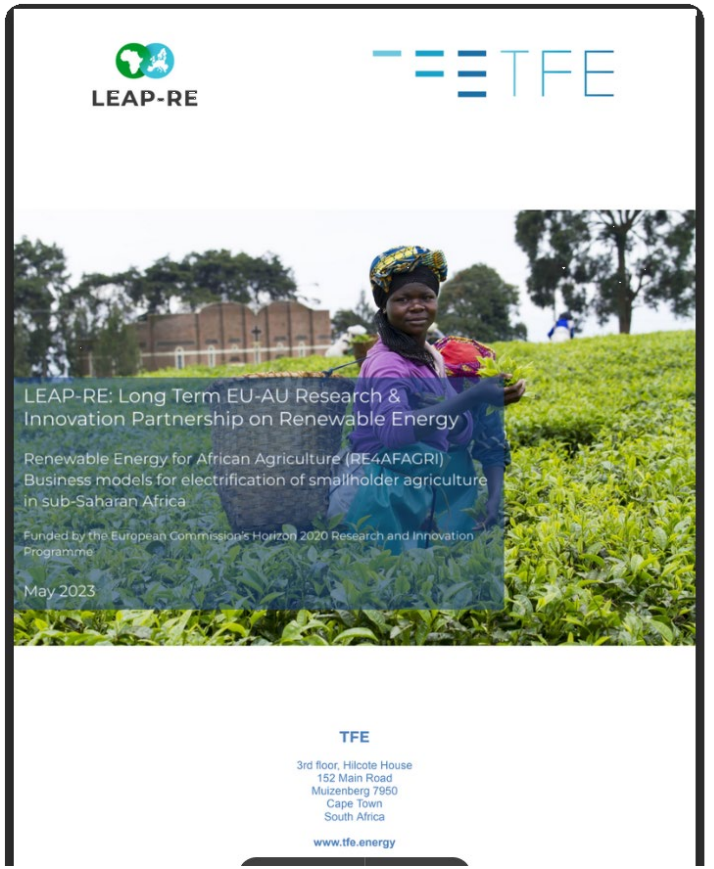
The business models report

- Introduction of "**user-led electrification interventions"** concept and proposition of approaches for how these can be designed and implemented in the context of the **agri-energy nexus.**

- **Application of the techno-economic model** in Nigeria, Rwanda, Zambia and Zimbabwe → identification of activities **viable for electrification** using mini-grids and standalone solar.

- **Best practice business models** to deploy mini-grids and standalone solar systems identified → pay-as-you-go permutations, appliance financing approaches, keymaker models and community-centred models.

- **Business models embedded in the country-specific macro-operating environments** and recommendations offered on how to make these environments more favourable for organisations.



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Policy relevance and science-policy linkages

LEAP-RE

Science-based water and energy **requirements assessment** tools

+

Science-based energy, water, and land **policy simulation and impacts** models

+

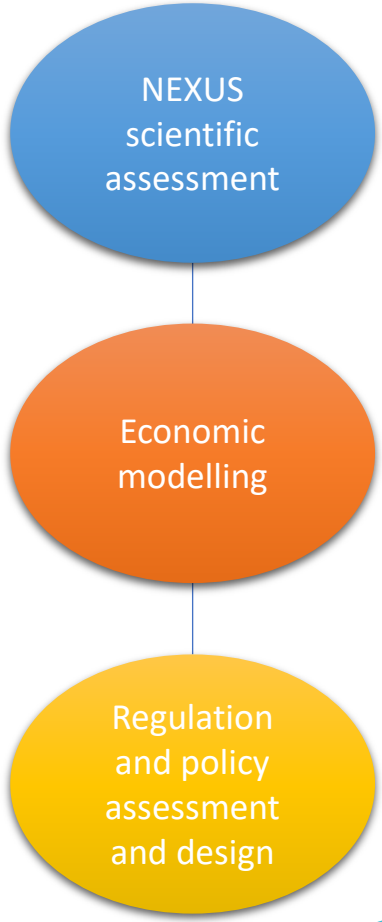
Techno-economic evaluation tool for agriculture-energy investments feasibility (and role of public regulation and subsidies)

+

Stocktaking and evaluation of national regulatory frameworks and hurdles

=

Better, science-aware public decisions and private investments



Dissemination and capacity building

This week's events in Kigali

RE4AFAGRI at the 2nd LEAP-RE Stakeholder Forum, Kigali

- Workshop 1B: **Interactive decision making tools and business models for electrification of smallholder agriculture through renewable energy**, Wednesday, 11 October 2023 from 15:30 to 18:30

- Workshop 1A.1 **Transversal workshop for business models for decentralized renewable energy**, Wednesday, 11 October 2023 from 14:00 to 15:00
- **LEAP-RE 2nd RESchool: bottom-up electricity demand assessment**, Tuesday, 10 October 2023 from 14:00 to 17:00

Dissemination and capacity building

Upcoming scientific capacity building activities

RE4AFAGRI's Joint Workshops on tools for planning, scenarios and policy analysis of the water-energy-land nexus for equitable development in rural Africa

Organised with World Resources Institute Africa, 30 in-person participants from 15 African countries in Addis Ababa,
16-20 October 2023

Open-access online course on the RE4AFAGRI modelling platform

To take place in early 2024; open-source code, data, and training materials

Co-organised and sponsored by

THANK YOU

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