Webinar

New SEI tools support integrated climate and development planning

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Agenda

10 min	**Introduction to benefits of integrated climate and development planning**
20 min	**Overview of the new toolset:** • AMES: the Adaptable Macroeconomic Extension for Sustainability analysis, a tool for national-scale macroeconomic modeling and integrated energy-economy analyses • FOLU: a tool for assessing climate mitigation benefits from forestry, and other land use and land use change • AgHealth: a tool for assessing health, climate, air pollution, and environmental impacts of food production in LEAP models • SEI Africa Model: an open-source continental-scale model of Africa built in LEAP with national-scale resolution for regional energy, climate, and air pollution assessment
25 min	**Q&A and open discussion with SEI experts and tool developers** • Charlie Heaps, Energy Modeling Program Director and LEAP developer • Chris Malley, Senior Scientist and FOLU and AgHealth developer • Eric Kemp-Benedict, Equitable Transitions Program Director and AMES developer
5 min	**Closing**

Why is it necessary to conduct integrated planning for climate and development?

Rapid and decisive action required **to limit global warming** to 1.5 °C

Paris Agreement **Agenda 2030**

Substantial risks of trade-offs between stringent mitigation action and develpment


Poverty


Hunger


Water


Energy

Need for integrated climate and development planning

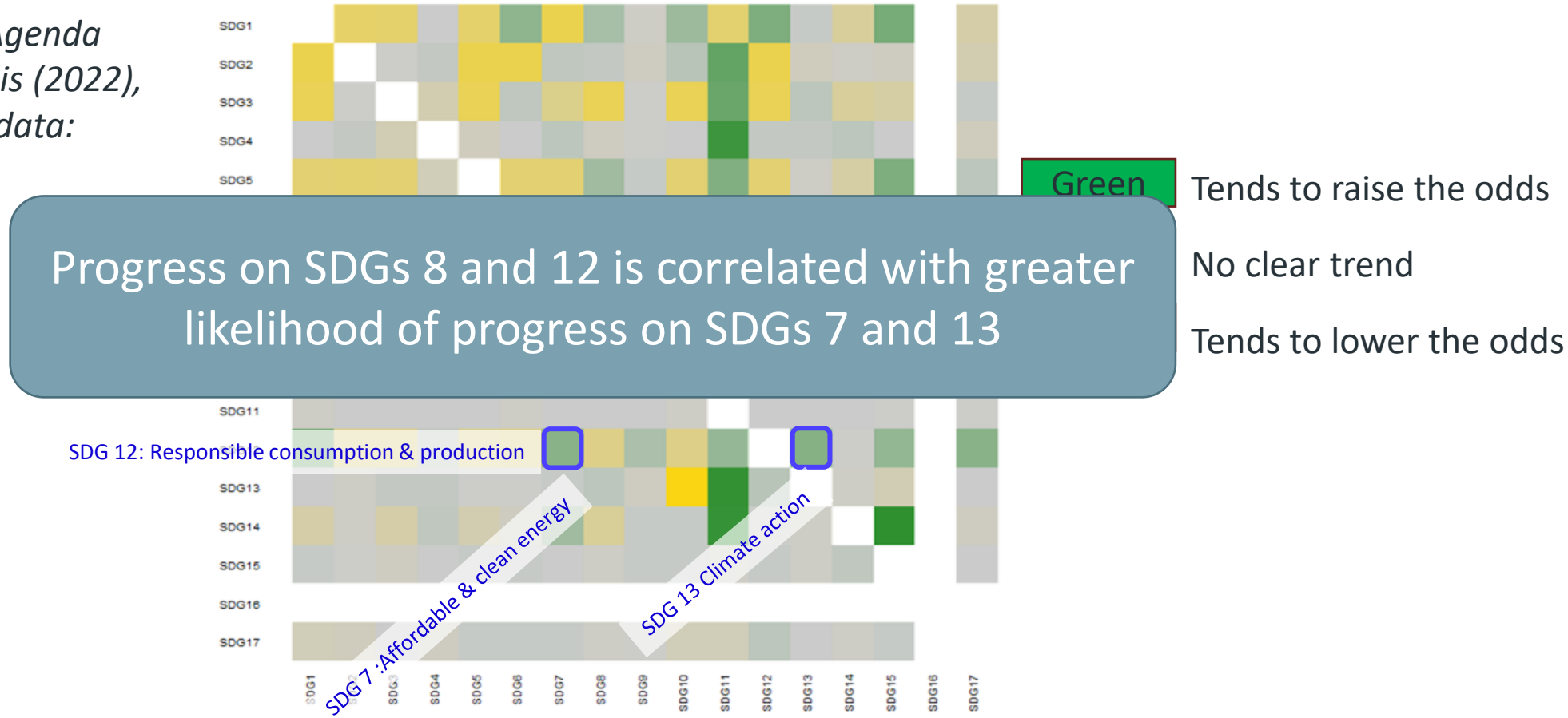
synergies & resource use efficiency

negative trade-offs

Example: Synergies between the economy and energy policy

If you made progress on SDG *X* (on left), how does that affect the odds that you made progress on SDG *Y* (on bottom)?

From SEI 2030 Agenda Compass analysis (2022), using historical data:



Progress on SDGs 8 and 12 is correlated with greater likelihood of progress on SDGs 7 and 13

Successful climate and development planning requires adequate tools

1. **Perspective:** Does the tool consider historical data and policies only (***retrospective***), or can it analyze potential future policies and scenarios (***prospective***)?
2. **Methodology:** Is the tool ***qualitative*** or ***quantitative***?
3. **Exploratory power:** Can the tool be used to compare different sets of possible planning decisions (***comparative***), or are planning decisions taken as a given (***static***)?
4. **Accessibility:** For most users, does the tool require paid access (***proprietary***), or is it freely available (***open access***)?
5. **Policy coverage:** Does the tool analyze both **SDGs** and **NDCs**?

SEI

Existing tools leave gaps for integrated planning

	Perspective	Methodology	Exploratory power	Accessibility	Policy coverage
NDC explorer tool[1]	Retrospective	Qualitative	Static	Open access	SDGs & NDCs
NDC-SDG connections[2]	Retrospective	Qualitative	Static	Open access	SDGs & NDCs
NDC-SDG linkages[3]	Retrospective	Qualitative	Static	Open access	SDGs & NDCs
SDG interlinkages visualization tool[4]	Retrospective	Quantitative	Static	Open access	SDGs
SDG synergies tool[5]	Prospective	Qualitative	Comparative	Proprietary	SDGs
iSDG[6]	Prospective	Quantitative	Comparative	Proprietary	SDGs

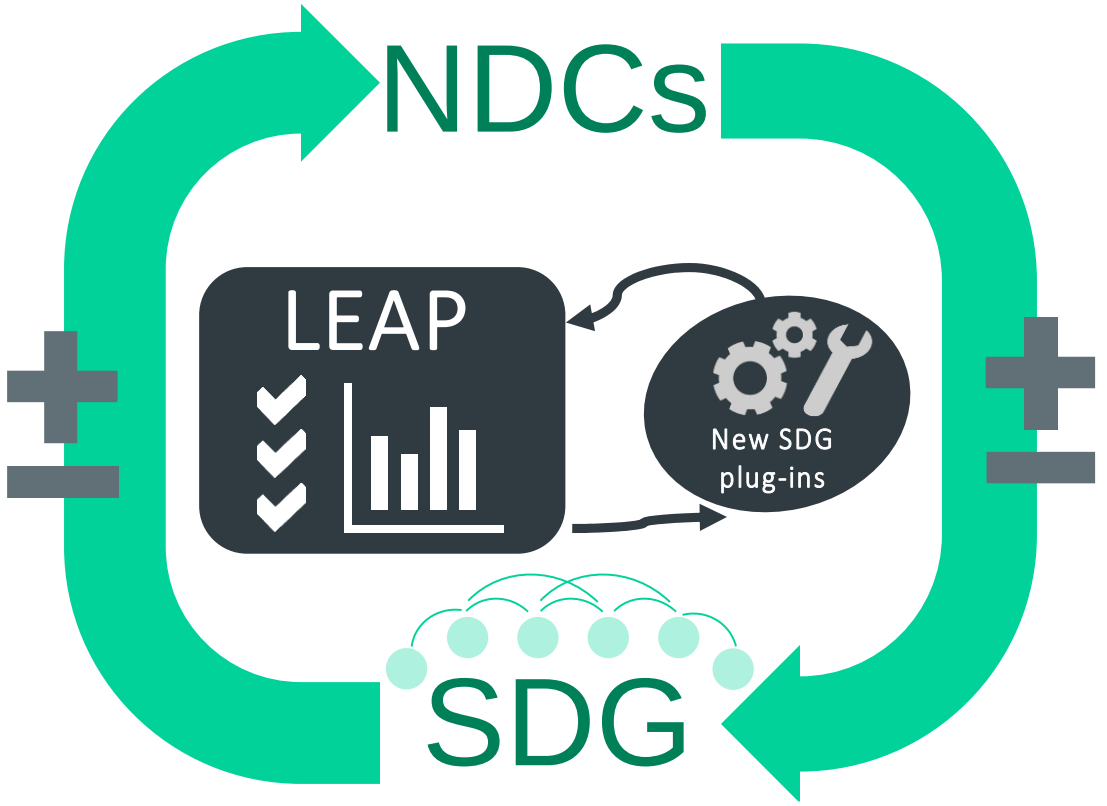
[1](German Development Institute 2022a); [2](German Development Institute 2017b); [3](World Resources Institute 2016); [5](Stockholm Environment Institute 2020); [6](Millennium Institute 2021); [4](Institute for Global Environmental Strategies 2021)

Integrated climate and development planning research at SEI

SEI is focused on developing and applying methods that **quantify** the **prospective impacts** of **climate change mitigation plans** on **SDGs.**

Support planners and policy makers in:

1. Prioritizing decisions that increase synergies and reduce negative trade-offs between sustainable development and climate change mitigation
2. Concentrating activity in areas offering the greatest returns



Integrated climate and development planning research at SEI

Using LEAP, climate planners can quantify impacts on SDGs in areas that have the greatest potential risks and benefits from stringent climate mitigation action:

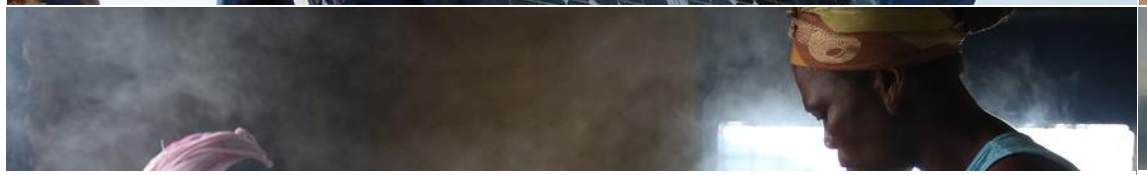
- SDG 2 (zero hunger)
- SDG 3 (health)
- SDG 5 (gender equality)
- SDG 6 (education)
- SDG 7 (energy)
- SDG 8 (work and economic growth)
- SDG 9 (industry)
- SDG 11 (cities and communities)
- SDG 12 (consumption and production)
- SDG 13 (climate)
- SDG 15 (life on land)

Integrated Climate and Development Planning Initiative

Using LEAP, climate planners can quantify impacts on SDGs in areas that have the greatest potential risks and benefits from stringent climate mitigation action:

Energy and economy

Forestry and land use



Agriculture and health

Climate, air pollution, health

Integrated climate and development planning research at SEI

Using LEAP, climate planners can quantify impacts on SDGs in areas that have the greatest potential risks and benefits from stringent climate mitigation action:

AMES

FOLU

AgHealth

Africa Model

LEAP-AMES model

Modeling economic feedbacks in long-term low emission planning

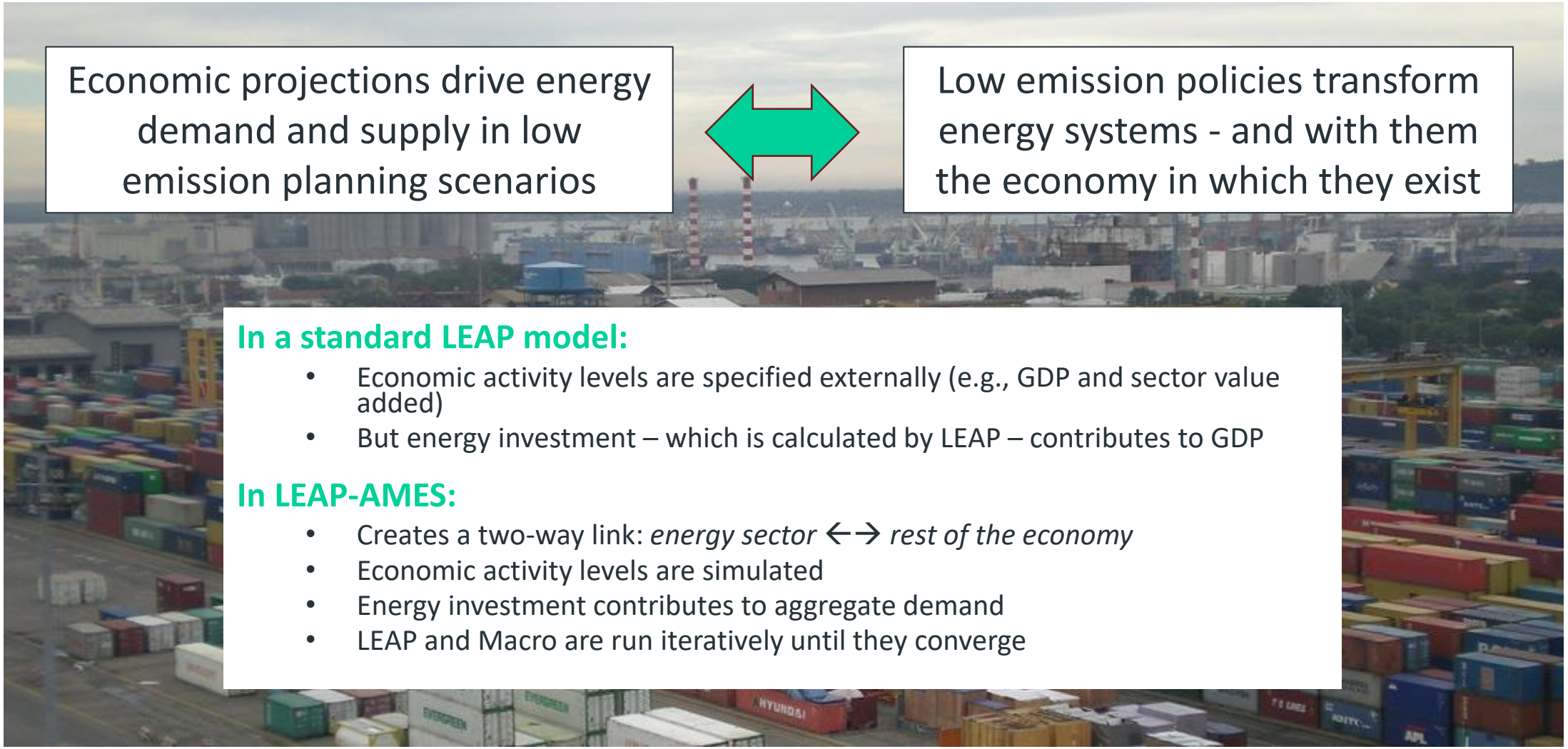
Adaptable Macroeconomic Extension for Sustainability analysis (AMES)

AMES is an open-source macroeconomic model for LEAP

- Designed to provide consistent economic drivers to the widely used Low Emissions Analysis Platform (LEAP) - LEAP and AMES form a hybrid energy-economy model
- Multi-sector, demand-led, structuralist model
- Simulates feedbacks between energy policies and rest of the economy, realistically capturing economic costs and benefits of energy transitions
- Focus is on low-emission development strategies in low- and middle-income countries

https://www.sei.org/publications/ames-energy-economic-and-environmental-assessment-model/

AMES model: Motivation



Economic projections drive energy demand and supply in low emission planning scenarios

Low emission policies transform energy systems - and with them the economy in which they exist

In a standard LEAP model:

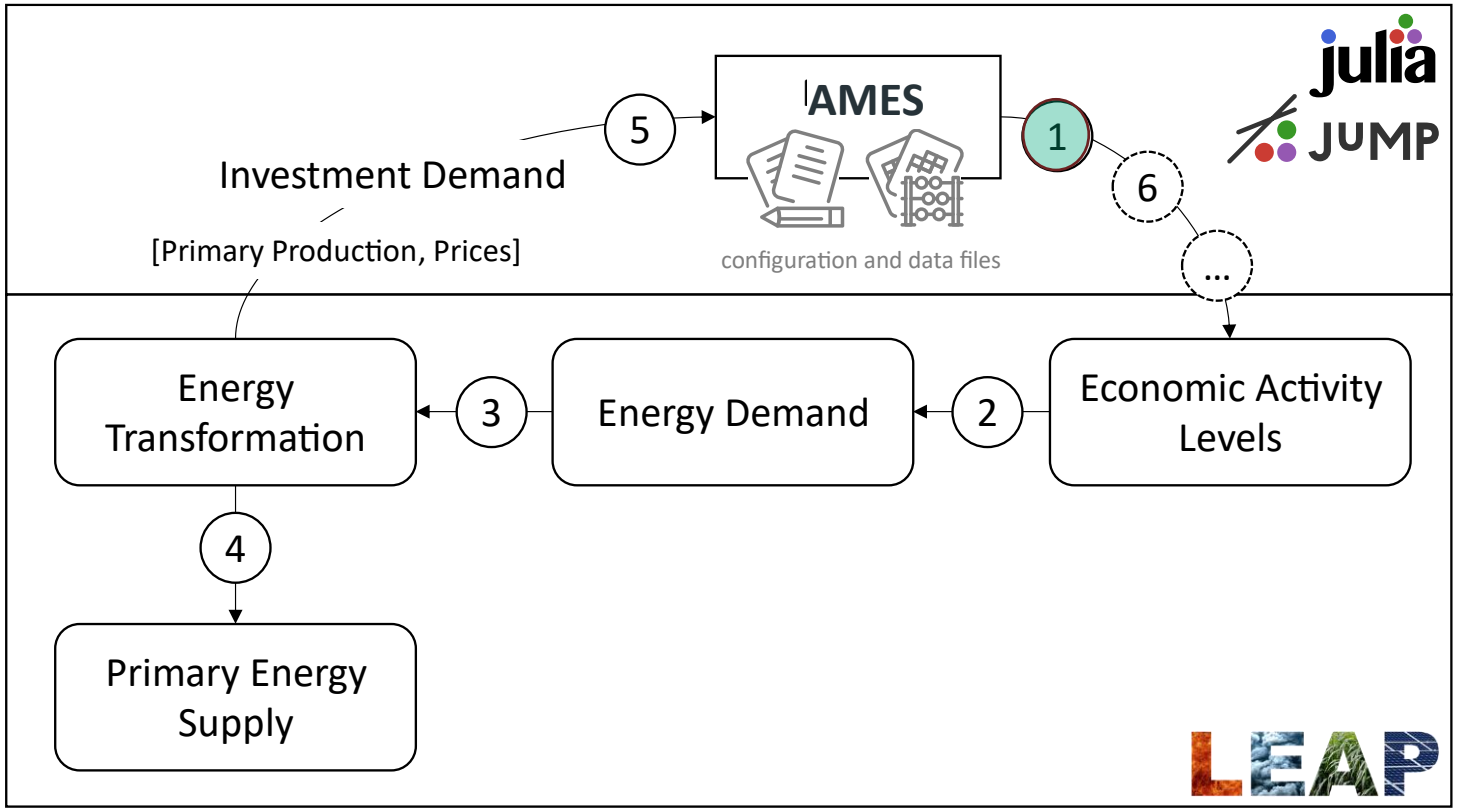
- Economic activity levels are specified externally (e.g., GDP and sector value added)
- But energy investment – which is calculated by LEAP – contributes to GDP

In LEAP-AMES:

- Creates a two-way link: *energy sector* ←→ *rest of the economy*
- Economic activity levels are simulated
- Energy investment contributes to aggregate demand
- LEAP and Macro are run iteratively until they converge

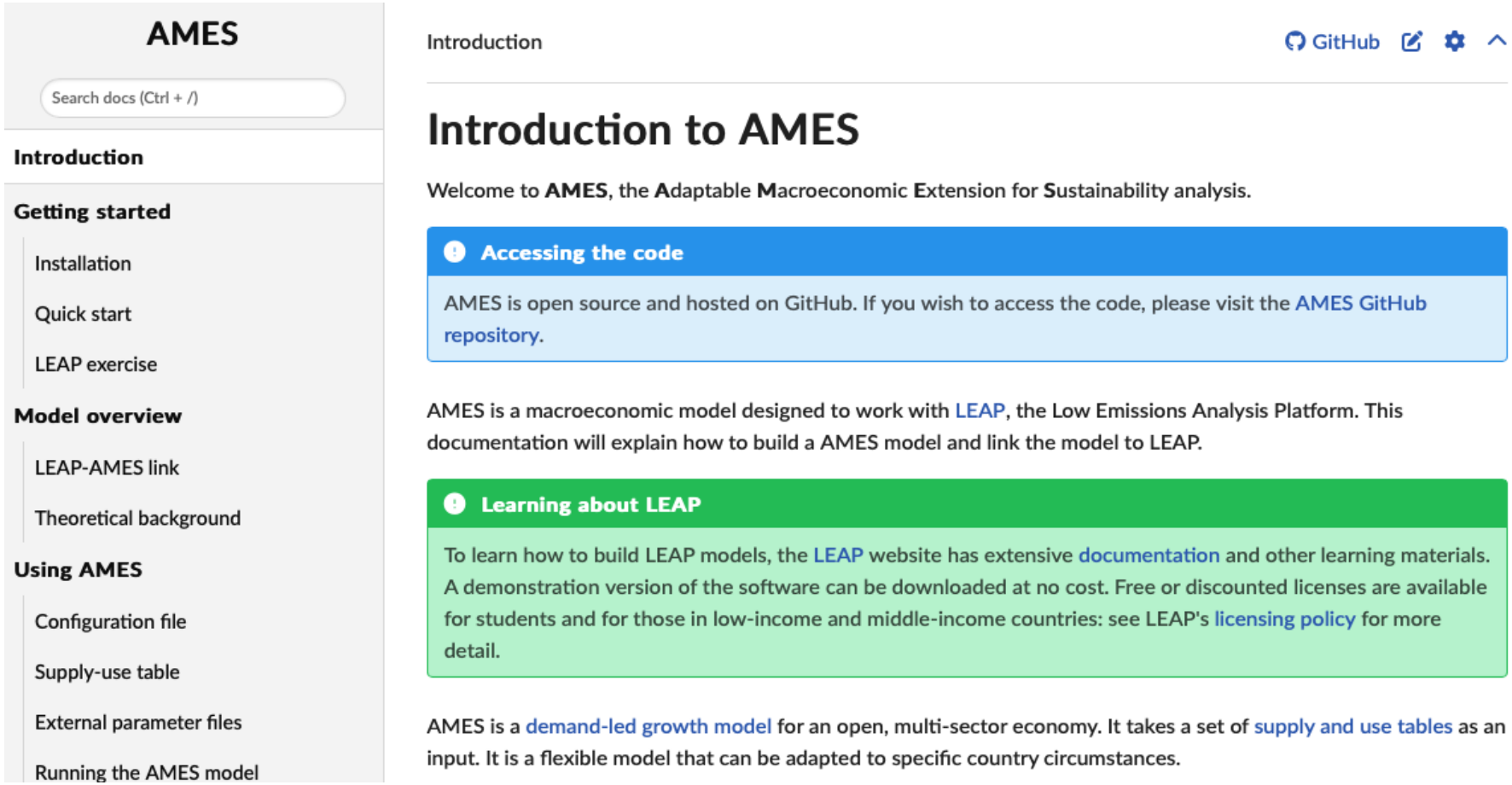
Logic of the LEAP-AMES link

1. AMES passes economic activity levels to LEAP
2. LEAP simulates the energy system
3. LEAP passes investment (and optionally production and prices) to AMES
4. Process repeats….



LEAP-AMES is open access

On Github: https://sei-international.github.io/AMES.jl/dev/

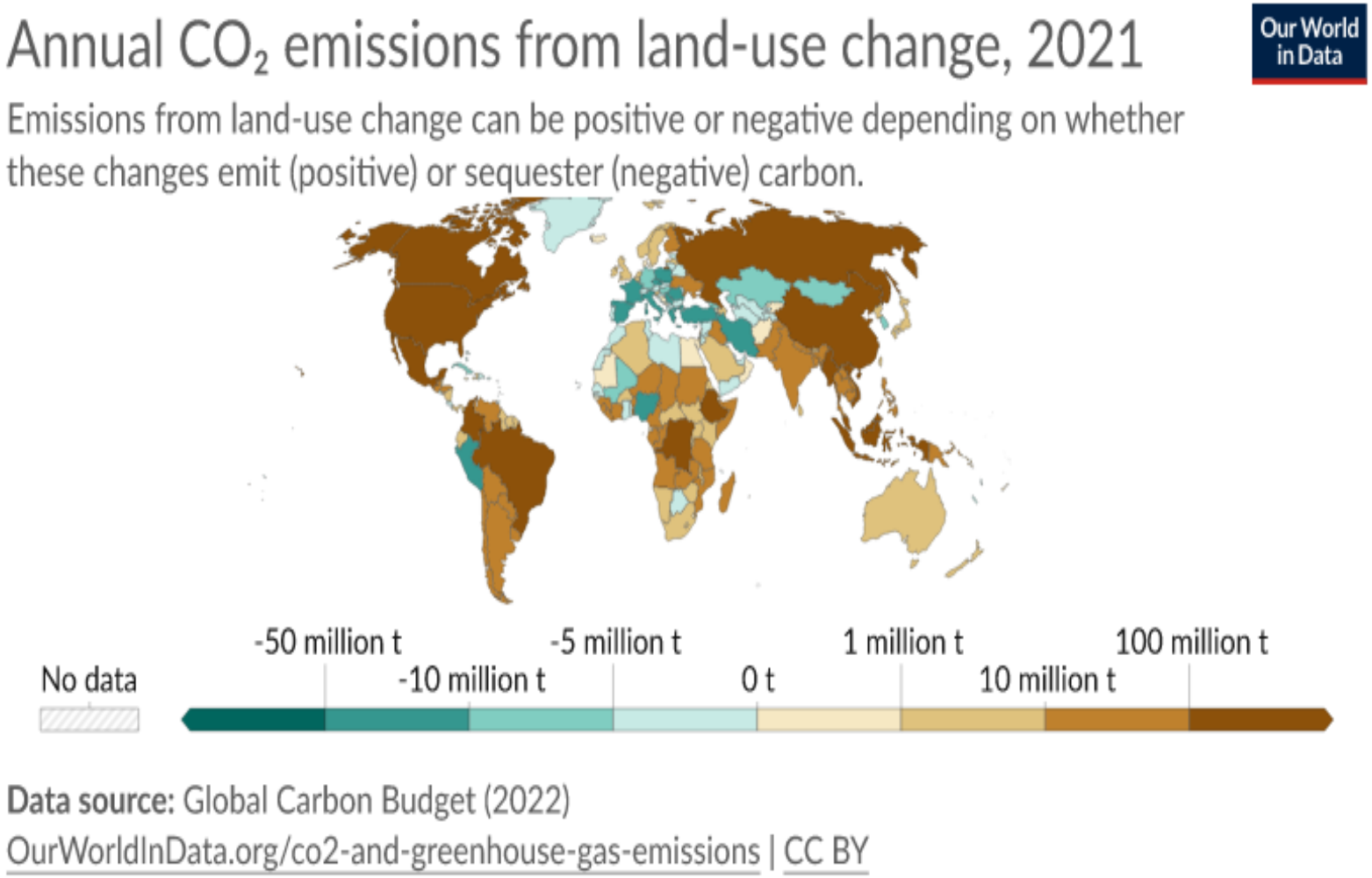


FOLU tool

Integrating forestry and land use change into low emission pathways

Forestry and land use change

- In many countries, land use emissions are key GHG emission category
- Land degradation also threatens economic livelihoods, air quality, water quality and abundance, ecosystem resilience, biodiversity
- Land use management strategies can be key to climate planning, but may be even more important for other development goals



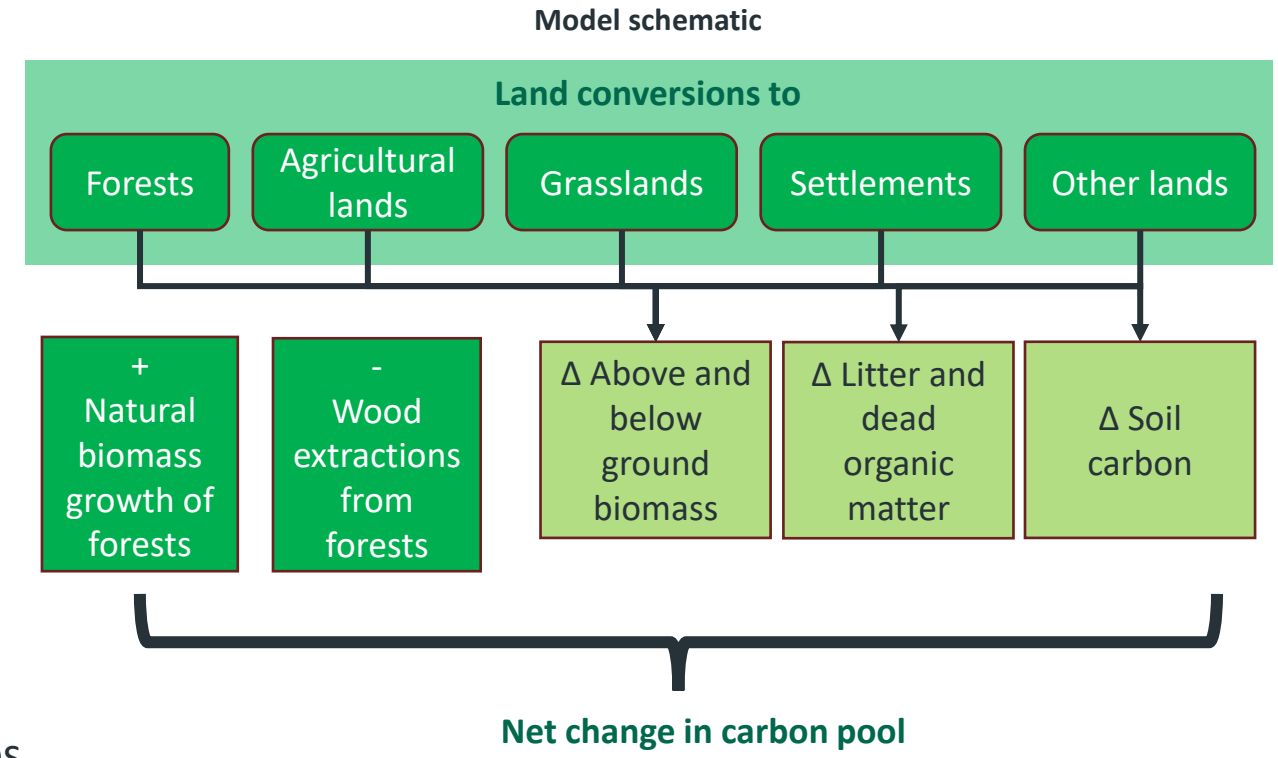
Integrated climate and development assessment of forestry and land use management

Tool set supports quantification of **climate benefits from land use management policies** :

- Improved forest management:
  - Wood extractions
  - Natural forest growth
  - De- and reforestation
  - Forest fire management
- Other land use changes
  - Land restoration
  - Improved soil management
  - Changes in agricultural practices
  - Livestock management/pastoral practices

FOLU tool

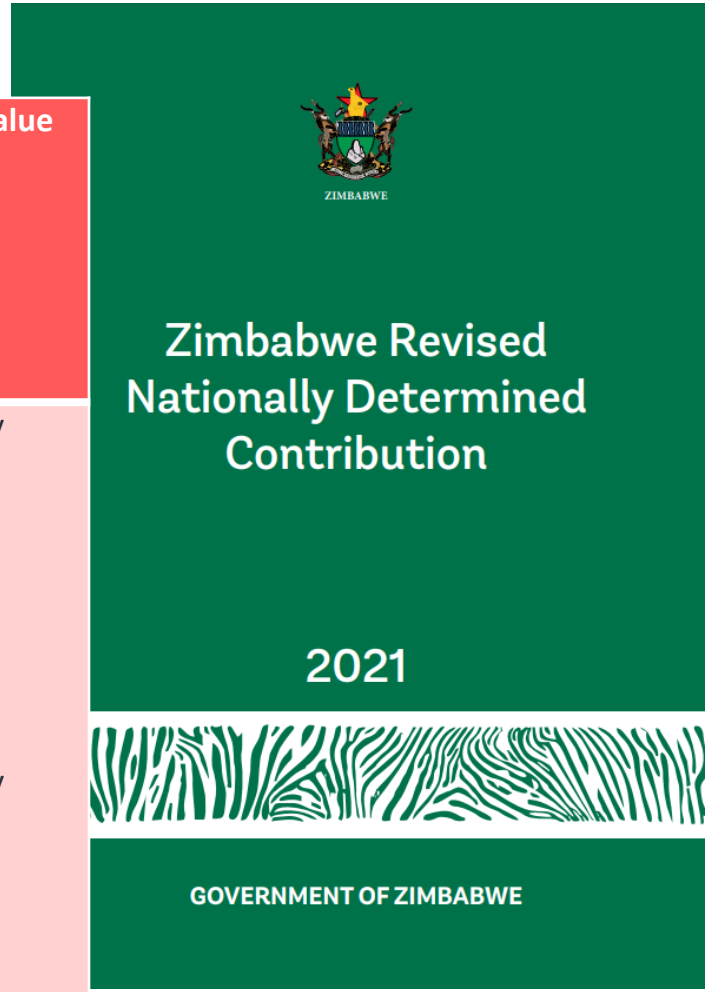
- Follows updated 2019 IPCC methodology for GHG inventories (Tier 1)
- Gains and Loss Method based on land use changes, accounts for:
  - Carbon stored in above and below ground biomass
  - Carbon stored in litter and dead organic matter
  - Carbon stored in soils
- Inputs: surface areas by land use, conversions between different land uses, wood extractions, forest fires
- Enables planners to explore climate and development potential of forestry and land use policies in long-term low-emission planning scenarios



Supports integrated planning across forestry, agriculture and other land uses and development of adjacent ecosystem service and biodiversity goals

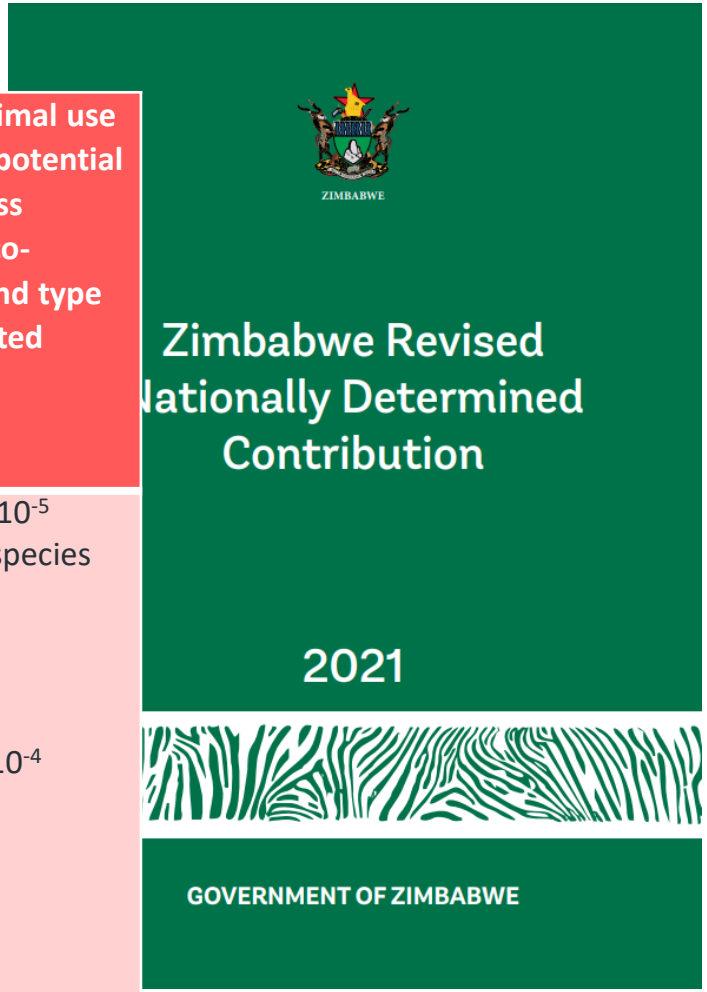
Application for Zimbabwe's NDC revision

Sustainable Development Goal Target	Indicator Quantified in GHG mitigation Assessment	Reference value for 2017	Baseline value 2030	Mitigation value 2030 NDC measures
15.2 By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally	Deforestation: hectares of land converted from forest to other land types (hectares per year)	253,859 ha/y	253,859 ha/y	161,440 ha/y
	Reforestation: Hectares of land converted from other land to forest land (hectares per year)	56,537 ha/y	56,537 ha/y	110,000 ha/y



Application for Zimbabwe's NDC revision

Sustainable Development Goal Target	Indicator Quantified in GHG mitigation Assessment	Conversion to natural forest of eco-region type (potential avoided species losses averaged across eco-region, intensity and type of land use converted from)	Conversion to minimal use plantation forest (potential avoided species loss averaged across eco-region, intensity and type of land use converted from)
15.5 Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species	Biodiversity indicators	Mammals: 0.0176 potential avoided species lost Birds: 0.0133 Amphibians: 0.0260 Reptiles: 0.0039 Plants: 0.604	Mammals: -1.081×10^{-5} potential avoided species lost Birds: -1.1×10^{-4} Amphibians: -1.4×10^{-4} Reptiles: -3.3×10^{-4} Plants: -0.0630



AgHealth

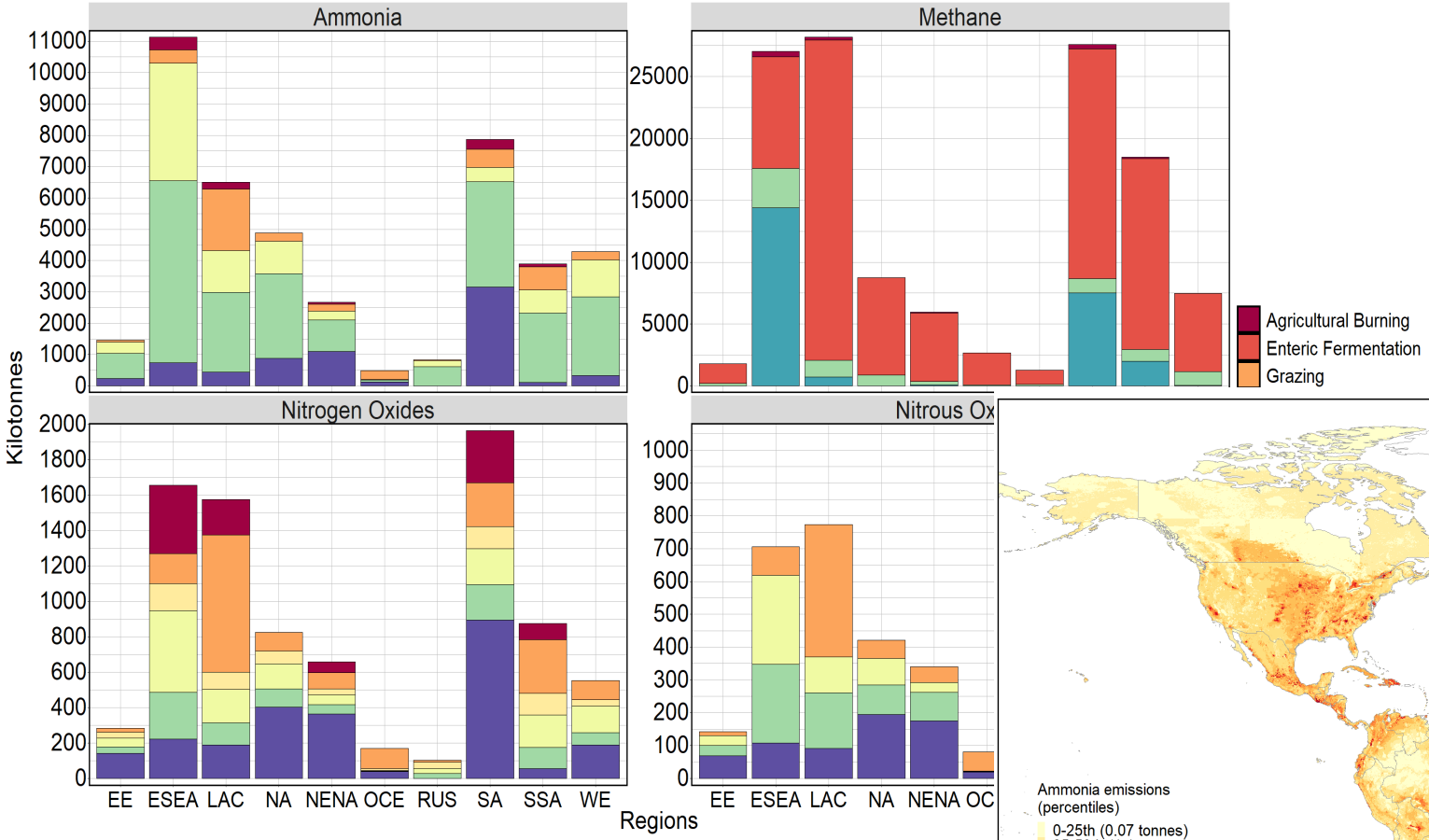
Integrating agricultural production and health benefits into climate change commitments

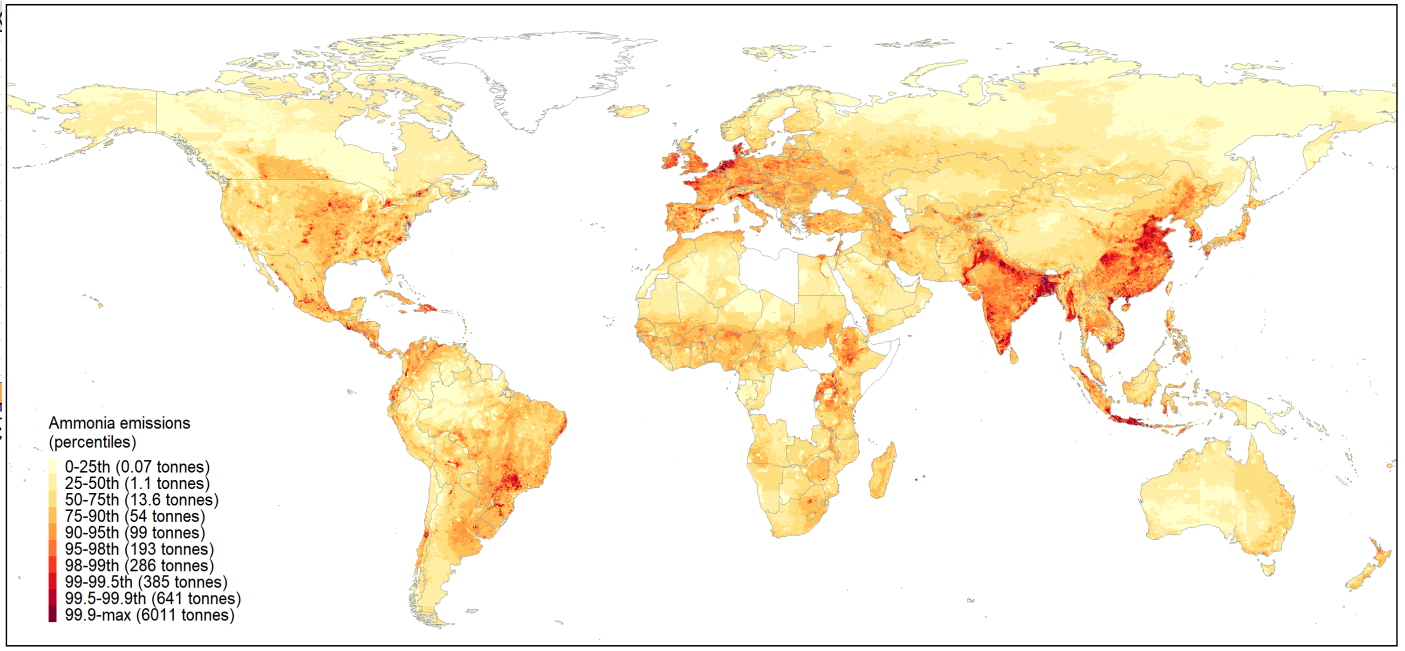
AgHealth

Tool set for quantifying GHG and air pollution emissions from livestock and crop production, and the health impacts from diet, malnutrition and obesity at national scale.

- Demand-driven
- Inputs determine domestic production of livestock and crops
  - Domestic consumption (population and average calorie consumption by food types
  - Imports
  - Exports
  - Food waste
- Outputs
  - GHG emissions
  - Air pollutant emissions
- Main modules
  - Food demand
  - Livestock
  - Crop production
  - Pasture Lands
  - Human Health impact assessment
- Available at: https://github.com/chmalle41/aghealth

Global agricultural emissions and resulting health burdens

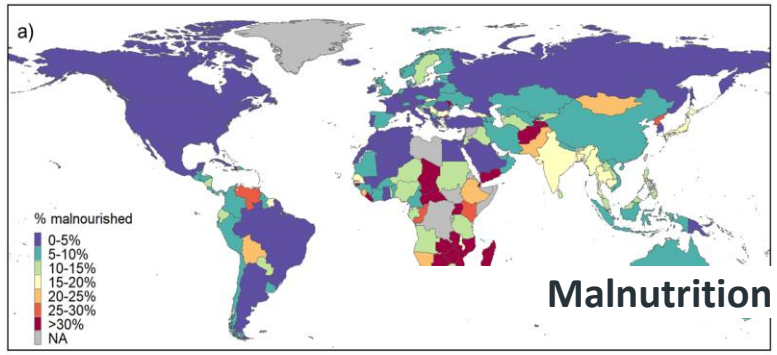




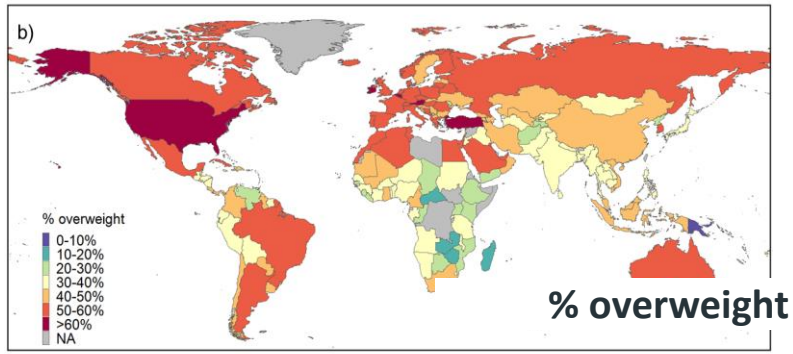
Malley et al. 2021

Global agricultural emissions and resulting health burdens

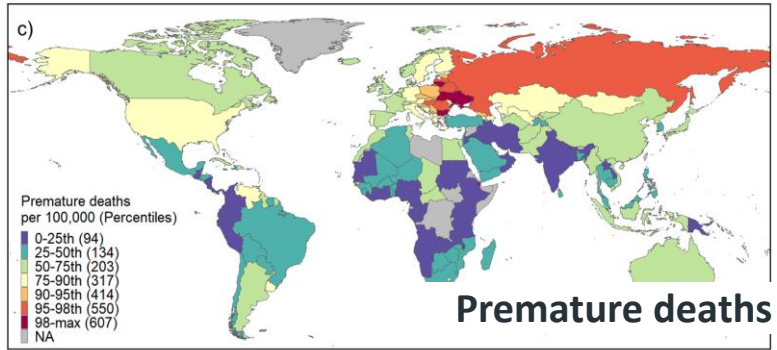
Dietary health risks and impacts



Malnutrition

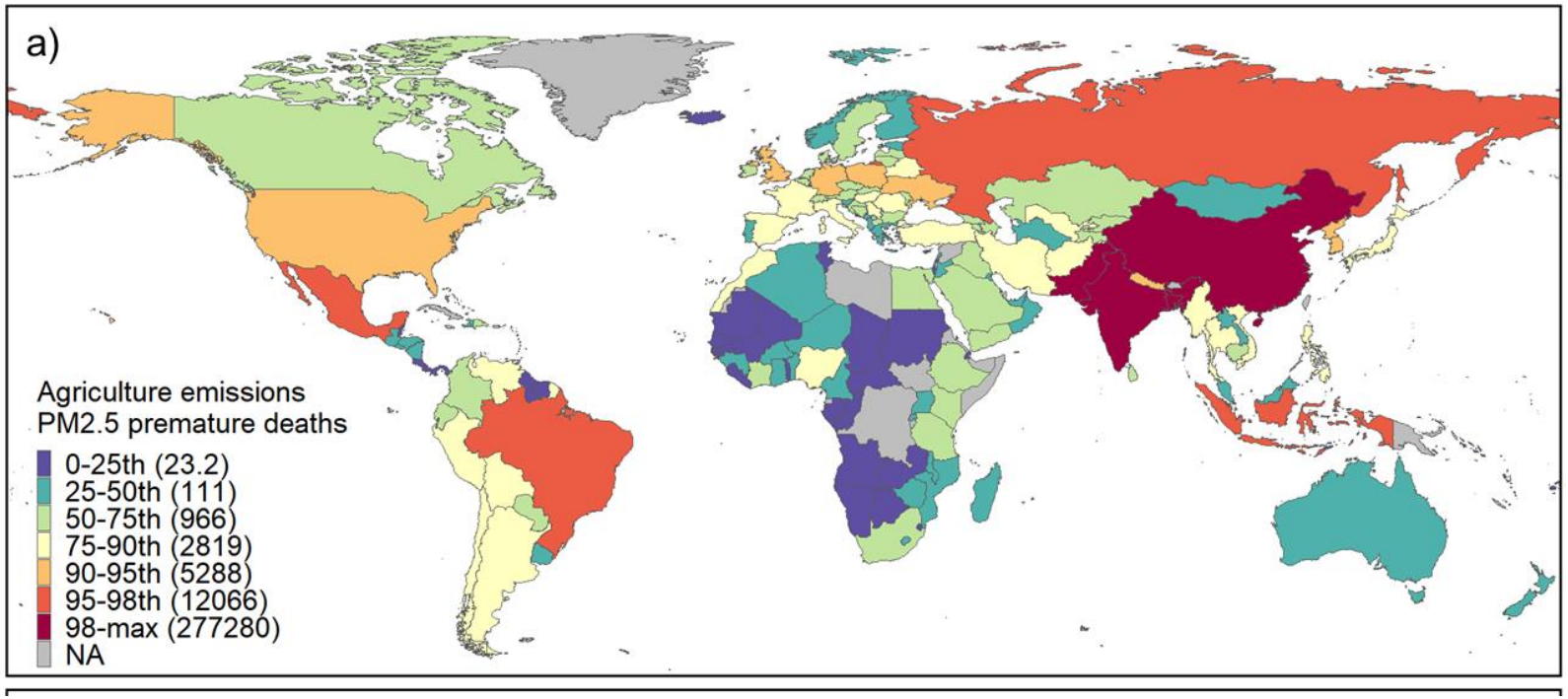


% overweight



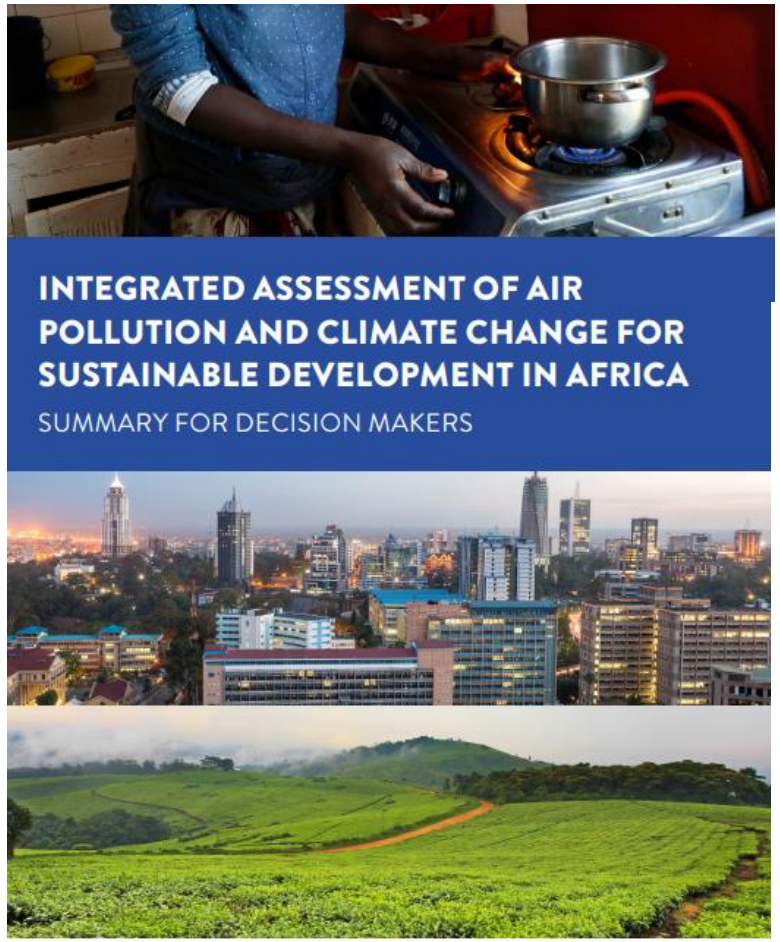
Premature deaths

Premature deaths from agricultural PM2.5



Malley et al. 2021

UNEP Africa Assessment Agriculture Scenarios



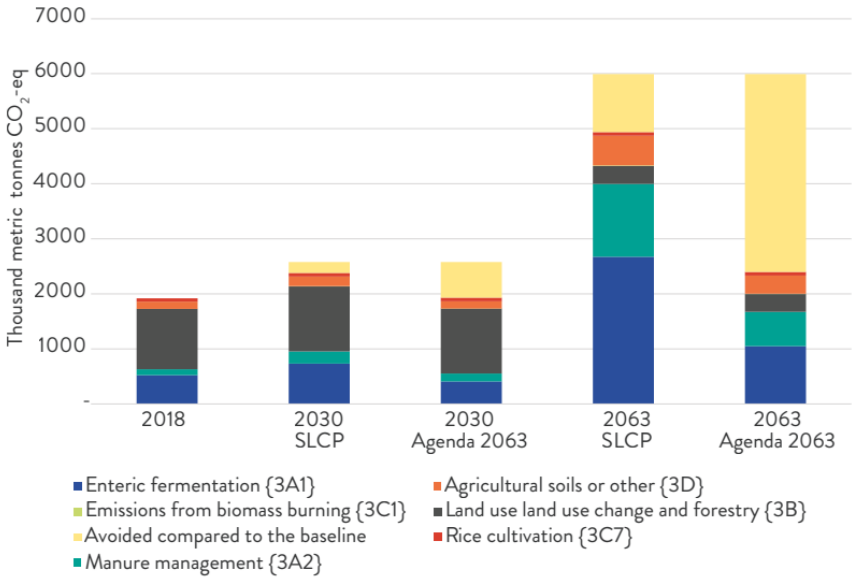


Figure 3.6 Greenhouse gas emissions from the agriculture, forestry and other land use sectors in the SLCP mitigation and Agenda 2063 scenarios, in 2018, and 2030 and 2063, thousand metric tonnes of carbon dioxide equivalent.

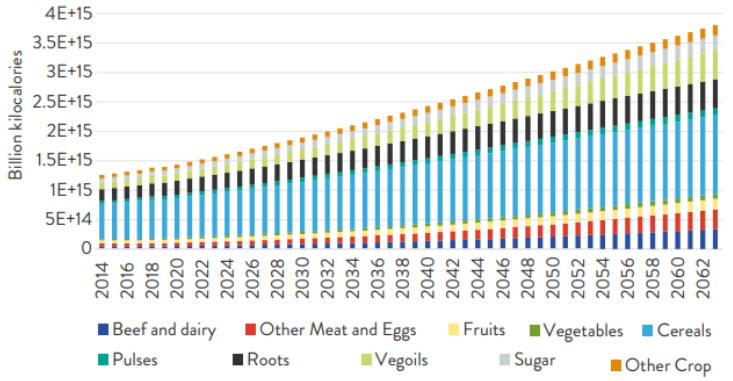


Figure 2.6 Africa, (a) average daily kilocalorie intake, 2014–2018 (historical data) and 2019–2063 for the baseline scenario, (b) total number of kilocalories consumed by Africa's population, 2014–2018 (historical data) and 2019–2063 for the baseline scenario

SEI Africa Model

Enabling integrated climate and development assessments across the continent

Integrated planning in Africa

The **African Union's Agenda 2063** describes a vision of the "**the Africa we want**"

Africa Model provides quantitative framework to:

- Examine how an ambitious **development** agenda for Africa can proceed at the same time as
  - Reducing air pollution
  - Improving health and well being
  - Limiting impacts on local ecosystems
  - Helping to avoid climate change impacts
- Provide appropriate and timely responses to inform planning by governments and other stakeholders
- Explore using modeling various options for enhanced synergies and avoided tradeoffs

SEI Africa Model

- **Africa-wide** model developed in LEAP with data for 54 African nations
- **Time Period:** Historical Period: 2000 – 2018, Projections: 2019-2063. Annual results but with particular focus on 2030 (SDG target year) and 2063
- **Geography:** Whole continent with national-scale resolution of key variables; results can be shown for Africa as a whole, for individual countries or for various country groupings
- **Sectors:** Modeling of all energy consuming and producing sectors and key non-energy sectors (agriculture, IPPU, solid waste, etc.)
- **Pollutants:** All long-lived GHGs and short-lived climate pollutants (SLCPs), and all major local air pollutants.
- **Scenarios:**
  - **Baseline** scenario, where Africa is heading under current policies
  - **SLCP:** Focused primarily on avoiding short-lived climate pollutants (CH_4, BC, OC, etc.)
  - **Agenda 2063:** Builds on SLCP scenario by adding additional CO2 mitigation measures and addressing Africa's Agenda 2063 goals

  All scenarios share the same population (UN), GDP growth (DSSP2) and urbanization projections (UN)

Integrated Africa Assessment

Model was used to support the landmark

Integrated Assessment of Air Pollution and Climate Change for Sustainable Development in Africa

published by the Clean Air and Climate Coalition (CCAC), United Nations Environment Programme, and African Union in November 2022.

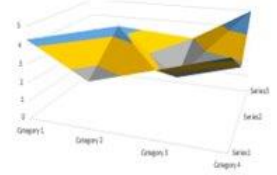
Creating a community through networks
Over 100 applications for authors/reviewers/ modelers

100 **authors** from 17 African countries in the 1st author meeting including Early Career Professionals

AUC, AMCEN and RECS participation-
>20 Countries confirmed **focal points** from the Ministry of Environment

Linkage made to **policy** global/regional/national policy framework (SDGs, Paris Agreement, UNEA, Agenda 2063, AMCEN, Regional AQ agreements, NDCs, NAQM)

Commitment from **International Advisory Group** including RECs, AUC, UNEP ROA, FAO, WHO, IEA, IHME, US EPA, IIASA, WASCAL, IMO



Robust **modelling** group developing framework & scenarios, modelling seminars- iterative **consultative** process

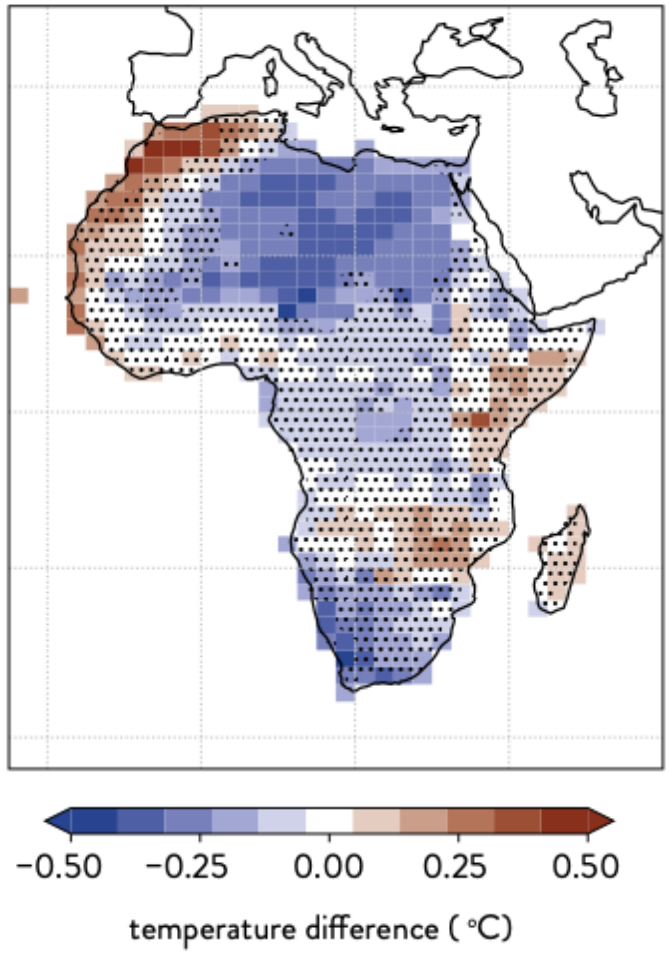
Integrated Africa Assessment

The multi-faceted development benefits of implementing the actions include:

- **Preventing** 200,000 premature deaths per year by 2030
- **Reducing** carbon dioxide emissions by 55% and methane emissions by 74% by 2063
- **Improving** food security by reducing desertification and increasing crop yields for rice, maize, soy, and wheat

These benefits come alongside making quick gains in keeping warming below 1.5°C by reducing short-lived climate pollutants (SLCPs).

Annual temperature difference in Agenda2063 scenario vs Baseline



SEI Africa Model will become open access in 2024

Major LEAP update planned for early 2024 (nearing completion) will provide a regional and national versions of the Africa model. Other highlights will include:

- **Energy System Optimization Modeling:** LEAP is currently limited to doing least-cost planning for a single sector (e.g., electric generation). The new version will support full energy system optimization (similar to TIMES & MESSAGE).
- **Cloud-based Data:** A new system for connecting LEAP models to internet-hosted databases. Will simplify data collection and allow users to automatically update their models as new data becomes available. Connects to international open-source databases covering energy, emissions, and development topics (U.N. population prospects, U.N. energy statistics, Word Bank development indicators, etc., plus SEI-developed databases such as default emission factors).
- **Plugins:** Support for mini-models developed by subject-matter experts and maintained in online repositories. Will make model development easier and more modular: providing users with new methods and better, geographically-appropriate default data.
- **Energy Affordability:** New analyses of the affordability of alternative pathways based on how different tariff structures will impact on different groups (e.g., urban vs. rural households, low income vs. high income households, industries, etc.)
- **Accessibility:** new translations of the software, data, training materials, and user manuals in multiple languages.
- **User Interface:** New high-definition user interface supporting richer display of information on screen.

Africa Model will be freely available from leap.sei.org

Access to new tools

- **AMES:** open access on Github: https://sei-international.github.io/AMES.jl/dev/
- **FOLU:** LEAP plug-in under development (to be published some time in the first half of 2024)
- **AgHealth:** open access on Github : https://github.com/chmalle41/aghealth
- **Africa model** : Africa Model will be freely available from https://leap.sei.org in early 2024

New SEI tools supporting integrated climate and development planning

Panel Discussion and Q&A

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