New Developments with LEAP: The Low Emissions Analysis Platform

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Outline

• Quick introduction to the LEAP and NEMO modeling systems.

• New Developments:
  • Modeling Ambient and Indoor Air Pollution Impacts in LEAP
  • Modeling Net Zero Pathways in LEAP
  • Coming Developments: a LEAP Roadmap
What is LEAP?

- A Windows-based tool for energy planning and GHG mitigation assessment developed over the last 30+ years by the Stockholm Environment Institute (SEI).

- Widely applied in 200 countries and territories. At least 38 used LEAP to help develop their NDCs.

- A scenario-based modeling tool that explores how emissions may change in the future under alternative policy settings (e.g., baselines and low emissions development scenarios).

- Typically used at the national scale but also works for cities, regions and multi-country analyses.

- Primarily focused on energy sector GHG emissions but can be used across for modeling non-energy sectors.

- Not just for modeling supports data management & documentation, results visualization & stakeholder communication.

- NEMO (Next Energy Modeling system for Optimization) is a fast optimization modeling engine that works with LEAP for least cost energy planning: a foundation for future improvements to LEAP.

- LEAP & NEMO are available at no charge to governments, NGOs and academics in low-income and lower-middle income countries and at low cost in upper-middle-income countries.

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Using LEAP to Assess the Co-benefits of Climate and Ambient Air Pollution Mitigation

- LEAP includes IBC, The Integrated Benefits Calculator: designed to assess the avoided health and climate impacts arising from climate and ambient air pollution mitigation measures.

- IBC works with national- and regional-scale LEAP models and has so far been calibrated for 120 countries.

- It works as follows:
  - Base year pollutant concentrations are derived either from LEAP’s own emissions or from satellite-based measurements.
  - National emission scenarios calculated in LEAP are combined with rest-of-world emissions scenarios from the IIASA GAINS ECLIPSE scenarios, and used as input to a global atmospheric-geochemistry calculation: based on the Geoschem-Adjoint (GA) model.
  - This calculation results in population-weighted concentrations of secondary pollutants in each target country.
  - Concentration-exposure-response functions developed for the Global Burden of Disease study are then used to calculate premature mortality impacts.
  - Other functions calculate ozone-related crop losses and climate (temperature change) impacts.

- All data and calculations occur quickly with results displayed using LEAP’s results visualization capabilities.

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Assessing the Health Benefits of Clean Cooking: Indoor Air Pollution

- LEAP 2020 complements the ambient air pollution calculations in IBC with a new set of calculations of the health impacts from indoor air pollution.

- The approach is based on the Household Air Pollution Intervention Tool (HAPIT) developed by the Clean Cooking Alliance and is closely aligned to the methods employed by the WHO.

- The methodology accounts for likely levels of exposure from various cooking technologies among different household members (cooks, other adults, children) and genders (male and female).

- The approach uses the same concentration-exposure-response functions used by IBC and includes methods that avoid double-counting impacts due to the overlap between ambient and indoor air pollution.

- As with IBC, all data and results are shown directly within LEAP and can be disaggregated by disease, by age and by gender: making them highly relevant for studying pathways to achieve the sustainable development goals.

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The 2021 UNEP Emission Gap Report notes that “All countries need to make their net-zero plans more concrete and rapidly begin...putting them into action.”

But planning for net zero is challenging: it requires fundamental changes to our energy and economic systems and may imply large changes in how we use land.

LEAP can be used to help support such planning.

For energy systems, LEAP and NEMO already support modeling of:
- High penetration of variable renewable energy in power systems
- Flexible time slicing (seasonal, weekly and diurnal)
- Energy storage
- Transmission power flow modeling
- Detailed modeling of energy efficiency Demand-side load shapes.
- Hydrogen demand and supply
- Stock turnover modeling of EV adoption
- Negative emission factors for carbon capture and storage/utilization, direct air capture
- Cost effectiveness analysis across all sectors

We are also improving LEAP & NEMO to allow them to support other crucial facets of net zero planning such as the modeling of land-use and forestry and to provide greater insights into topics such as transmission planning and production cost modeling for systems with high penetration of renewables and energy storage.
Rapid Economic-COVID-19 Response Simulator (RECOVRS)

- RECOVRS is a new software tool developed at SEI that is designed to analyze the impact of COVID-19 recovery on economic baselines, and to generate climate and energy planning scenarios that include the economic ramifications of the pandemic.

- Allows exploration of different public health measures, such as:
  - Lockdowns
  - Social distancing
  - Testing and tracing programs
  - Travel restrictions

- Can be adapted according to national circumstances and used in conjunction with tools such as LEAP.

- Allows planners to explore alternative scenarios for global trends, incl. GDP, infection rates, and public health measures.

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Planned New Capabilities:
LEAP Roadmap for 2022/2023 (1/2)

- **LEAP Plugins**: LEAP will support the ability to work with “plug ins”: mini-models that are developed by subject-matter experts, maintained in online repositories, and integrated into LEAP models as needed. Plug-ins will make LEAP development easier and more modular: providing users with new methods and better geographically-appropriate default data.

- **Internet Data Links**: A new system for linking LEAP models directly to internet-hosted databases. This will simplify data entry and data collection and allow users to easily update their models whenever new data becomes available. Will connect to standard data covering energy, emissions, and development topics (U.N. population prospects, U.N. energy statistics, EDGAR emissions database, Word Bank Development indicators, plus SEI-developed databases such as default emission factors)

- **LULUCF**: LEAP already includes methods for modeling biomass energy demand and supply. We plan to build on this in a future release to fully support GHG mitigation modeling of land use, land-use-change and forestry. This will include track carbon emissions and above- and below-ground carbon stocks guided by IPCC GHG inventory guidelines methods.
LEAP Roadmap for 2022/2023 (1/2)

• **Energy System Optimization Modeling:** Optimization modeling in LEAP is currently limited to least cost planning for a single sector (e.g., electric generation). NEMO already supports full energy system optimization modeling and LEAP will also support this capability soon: similar to tools like TIMES and MESSAGE.

• **LEAP for the Web:** We are developing a new web-based portal, which users will be able to use to host the results of their LEAP models for easy-access by stakeholders. The portal will provide interactive access to all the various results produced in LEAP: charts, tables, maps, MAC curves, energy balances, Sankey diagrams etc.

• **LEAP HD:** LEAP’s User Interface is being updated to take advantage of the new 4K resolution monitors, including newly high-res icons and an optional dark mode.
Thanks!

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