INTRODUCING CCG'S ENERGY MODELLING OFFER

MODELS WITHOUT FRONTIERS

Climate Compatible Growth

COP29

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Energy modelling tools use relevant data to explore a wider variety of future scenarios for a country's energy transition. This helps policymakers select the most cost-effective, financially viable, environmentally sustainable, and climate-resilient projects for which to seek investment support.

CCG curates a suite of open-source modelling tools and frameworks that support the energy planning process for the climate transition in low- and middle-income countries (LMICs). Many of these tools are contributed to by a range of international partners, including IAEA, IRENA, and KTH.

Certain common design features of CCG's modelling ecosystem make it particularly effective and adaptable to various contexts. These features are:

- **Ease of use.** All the models are open source, which promotes transparency and reproducibility and improves accessibility by removing software costs and licensing barriers for LMICs.
- **Speed of results.** Starter data kits have been provided containing the basic data needed to start running modelling scenarios in over 60 LMICs, allowing rapid generation of preliminary results for urgent policy decisions in a rapidly evolving energy landscape.
- **Interlinkages.** While each model can be run independently, they are also strongly interconnected and can be used in conjunction to shed light on more complex issues and interactions, with outputs from one model acting as inputs to the next. Each linkage is further detailed with an online hands-on exercise for transparency and accessibility, allowing users to replicate and reproduce the workflow with ease.
- **On-demand training.** Each model in CCG's ecosystem comes with associated training material designed to support both introductory, online, and self-administered learning (through the Open University's OpenLearn Collection) and more advanced and intensive in-person learning (via the regular Energy Modelling Platform, which holds regional and global training events).

These tools aim to support countries moving along the investment pipeline from 'Data-to-Deal'. The term Data-to-Deal refers to actions taken throughout an entire process that runs from data collection, system modelling, and development planning to national financing strategies, project finance arrangements, and the agreement of a deal (i.e., receiving financing for a transaction). These are also all driven by a strong stakeholder engagement process.

Different modelling tools and frameworks have been incorporated and developed for each step of the Data-to-Deal Analytical Workflow (see **Table 1** for brief descriptions of each modelling tool and framework).

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***Table 1:** Overview of CCG modelling tools and frameworks*

MAED – Model for Analysis of Energy Demand	**What will be the future energy demand of a region based on socioeconomic, demographic, and technological factors under different development scenarios?** MAED is a tool developed by the International Atomic Energy Agency (IAEA) to evaluate future energy demand in the industrial, transport, household, and services sectors based on a set of consistent assumptions on socioeconomic, technological, and demographic developments.
OnSSET – Open Source Spatial Electricity Tool	**What is the least-cost electrification strategy for a given region, considering both grid and off-grid technologies, to achieve universal energy access?** OnSSET is a geospatially explicit modelling tool developed by KTH University of Stockholm that estimates the most practical and beneficial expansion path for attaining universal access to energy. The modelling tool analyses and optimises the expansion of electricity access while considering factors such as geographical locations, energy demand, and infrastructure constraints
OnStove – Open Source Spatial Clean Cooking Tool	**What is the most cost-effective and sustainable cooking solution for a specific region, considering economic, health, and environmental factors?** OnStove is a geospatially explicit modelling tool developed by KTH to assess the costs and benefits of different cooking solutions, with a focus on clean cooking transitions. The modelling tool evaluates the impact of transitioning households from traditional cooking methods, such as wood and charcoal, to cleaner alternatives like LPG, electricity, biogas, or improved cookstoves.
OSeMOSYS – Open Source Energy Modelling System	**What is the optimal capacity expansion plan for a region that minimises costs while meeting energy demand and environmental targets over a long-term planning horizon?** OSeMOSYS, developed by KTH, is an integrated assessment and energy planning tool that performs long-term energy system planning and investment optimisation. It determines the most cost-effective energy system configuration over a long-term modelling period. For power, OSeMOSYS optimises the capacities of electricity generation and storage plants and, if desired, may also plan optimal end-use electrification and how this feeds into total electricity demand. A variation of this model, OSeMOSYS Global, is specially designed to evaluate the economics of cross-border power interconnectors and regional power pool integration.
FlexTool	**How much flexibility does a power system need to reliably integrate renewable energy while meeting demand and minimising costs?** FlexTool, created by the International Renewable Energy Agency (IRENA), is an optimiser tool that analyses short-term operational aspects of the power system, performing single-year flexibility analyses, to identify potential underlying flexibility bottlenecks. It also evaluates flexibility options, such as deploying (additional) electricity storage, electric vehicles, power-to-heat, power-to-hydrogen, and the implementation of demand response.
Mat-dp	**Which materials and in what amounts are needed for low-carbon systems? What other environmental and socioeconomic implications does this demand have?** Mat-dp, developed by the University of Cambridge, compares the bulk and critical material implications of changing energy and transport systems. Mat-dp includes 102 bulk and critical materials spread across different energy and transport technologies. Mat-dp aims to help countries to consider industrial capacity and trade pathways to meet material demand. Mat-dp is open-source and can be used alongside projections from energy systems models or Integrated Assessment Models.

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CLEWs – Climate, Land, Energy, and Water Systems	**How do land, energy, and water systems interact in a region, and what is the best way to manage them together for sustainable development?**	The CLEWs approach, developed by KTH, offers an integrated, nexus-based framework encompassing climate, land, energy, and water systems. By adopting a nexus approach, CLEWs transcends sectoral silos and recognises that these systems are deeply interconnected and interdependent, considering linkages such as water for energy, energy for water, land for energy, energy for land, land for water, land for climate.
SIBs - Social Impacts and Benefits	**What are the associated social and environmental impacts and benefits associated with an energy transition plan?**	The SIBs approach, developed by CCG, provides a comprehensive framework for assessing the social and environmental impacts related to an energy transition plan. The framework quantifies key socio-economic and environmental variables, such as job creation, air pollution, and socio-environmental costs related to global warming. By integrating these metrics, the SIBs framework offers a method for evaluating how energy transition plans can contribute to both social well-being and environmental sustainability, supporting informed decision-making for policymakers and stakeholders.
MinFin – Model for Informed National Financing	**Is a country's energy expansion plan financially sustainable and feasible for the country, considering investment requirements, financing costs and sector cashflows?**	MinFin is an emerging tool designed by CCG to support the development of financing strategies for long-term energy investment plans by computing associated financing costs and comparing them to available cashflows. Based on recent history and forward-looking projections, users can determine the viability of implementing climate transition and explore alternative mechanisms for delivering climate finance.
FinPlan – Model for Financial Analysis of Electric Sector Expansion Plans	**How should individual energy projects be financially structured to ensure profitability, attract investment, and align with the overall energy strategy of the country?**	FinPlan, created by IAEA, is a tool to assess the financial viability of projects, considering different technical and financial factors such as plant size, electricity generation, investment costs, discount rates, and so on. FinPlan uses these to calculate projected cash flows, financial ratios, shareholders' returns, and other financial indicators.
PathCalc – Pathways Calculator	**What is the estimated carbon footprint of various combinations of scenarios for reducing emissions in a region?**	Work is currently underway within CCG to develop an interactive web-based tool based on the MacKay Carbon Calculator. The tool aims to enable users to explore different scenarios for national energy consumption and production. By choosing 'levels of ambition' for decarbonising different sub-sectors of the energy sector, users can visualise the potential impacts of different energy choices on the carbon footprint and chart potential carbon trajectories.
OSeMobility	**What are the implications of alternative decarbonisation pathways for transport?**	Work is underway within CCG to develop a modular framework for transport systems modelling. OSeMobility allows stakeholders to explore credible and diverse transport futures by integrating social, technical, and economic considerations. Using a socio-technical modelling approach, and providing a direct interface with OSeMOSYS, the tool enables the quantification of these futures' impacts on broader energy, emissions, and development goals.

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Figure 1 shows how these tools interlink. The Analytical Workflow starts with energy demand projections (from MAED), energy access plans for electrification (from OnSSET), clean cooking (from OnSTOVE), and transport demand projections (from OSeMobility). Outputs from these can then be fed into OSeMOSYS to produce a capacity expansion plan, which can then be evaluated for power system flexibility (using FlexTool), as well as for broader linkages with land and water (via the CLEWs approach).

Implications for carbon emissions can be further visualised for engagement purposes (with PathCalc). Furthermore, OSeMOSYS output can be used as the basis for developing a national climate finance strategy (via MinFin), including evaluation of the financial viability of individual constituent projects (using FinPlan).

Contact Us
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Figure 1: *A visual overview of CCG's Data-to-Deal Analytical Workflow (interlinkages between the modelling tools and frameworks)*