Back to the Holocene

Modelling Global Technology Deployment Pathways to a Future of Abundant Renewable Energy and a Safe Climate

Our world has a problem: Policymakers have been focused, since the Paris Agreement of 2015, on trying to limit the increase in global average annual surface temperature well below 2.0°C and as close to 1.5°C as possible compared to the late 19th century average (right now we are already at 1.2°C). The implicit assumption has been that 1.5°C is "safe enough." Unfortunately, it turns out it is not safe enough:

- New evidence from climate science clearly shows that **stabilising at 1.5°C would entail extremely disruptive consequences, including long-term loss of the world's coastal cities to >10 m sea level rise** as Greenland and West Antarctic ice sheets melt. In addition, stabilising at 1.5°C will entail more extreme heatwaves, droughts, and forest fires; heavy rains, floods, and typhoons; destabilisation of the jet stream; and the northward spread of insect vectors of tropical diseases, among other damages.
- The planetary boundary and therefore a safe climate is at **CO_2 levels around 350 ppm** (it is ca. 420 ppm today), which corresponds to a temperature increase of about **1.0°C** relative to the pre-industrial age. Thus, CO_2 must be removed from the atmosphere, the energy needed to do so must be provided from renewable sources.

With the "Back to the Holocene" research project, we offer a **key piece of the solution:** an advanced tool for specifying carefully calibrated technological pathways back to safety from the brink of disaster.

- These pathways would, if implemented, see the world exceed 1.5°C for as few years as possible, and enable a return to atmospheric CO_2 concentrations within planetary boundaries later this century, while **delivering energy prosperity in every region by drawing on abundant renewable energy resources.**
- Global, regional, and local implementations of LUT-ESTM 2.0 will generate detailed quantitative estimates, calculated in five-year time-steps, of **cost-optimised combinations of more than 140 technologies** in **power, energy storage, heating, transport, industry, seawater desalination, and carbon dioxide removal (CDR) sectors** that can achieve these climate-science-driven carbon targets.
- These technologies will identify pathways to future energy-industry-CDR infrastructure that deliver **sustainable energy abundance as well as net negative emissions** in **any given region.**
- LUT-ESTM features **hourly resolution** (hourly matching of energy supply and demand), **sector coupling** (energy flows between sectors), and **inclusion of Power-to-X technologies** that allow use of sustainable electricity to synthesise fossil-free e-fuels and e-chemicals.
- As part of the project, we will make our modelling software and data sets available as **tutorial-supported Open Science** freeware tools, enabling local and regional researchers and energy planners around the world to **join in the urgent task of exploring and preparing such pathways.**
- Our research aims are guided by the **UN Sustainable Development Goals**, in particular SDG 7, access to modern sustainable energy for all, and SDG 13, climate action.

We believe this project will have game-changing impact. Our research to date has shown that highly renewable energy-based pathways to global or regional net-zero annual emissions can be achieved at cost parity or better, compared to business as usual. Our next research phase can show us the least-cost path to climate safety even as it generates much more geographically detailed pathways to sustainable energy prosperity, region by region.

- This energy-industry-CDR infrastructure transition pathway optimisation tool, LUT-ESTM 2.0, and the results it generates will help shape international energy, climate, and industrial policy and planning discourse. Among other things, this research will **provide key input to future IPCC Reports** exploring pathways to climate safety. Ambitious climate goals become more feasible when we know in advance, the **dimensions and costs of the challenge before us** – and see it's **fundable and manageable.**
- The tool's **impact will be multiplied** by creating and disseminating a tutorial- and training-supported **Open-Source version,** so that other research groups can join in implementing and refining the model for 800+ local regions, in accordance with local priorities, and in contributing to the global dataset.
- LUT-ESTM 2.0 will be **very useful to national and regional energy system planners** because the development of **regional technology deployment scenarios** using LUT-ESTM's freeware version can help **improve the coordinated targeting of hundreds of billions of euros in spending** on clean electricity generation, heat, transport, industry, seawater desalination, and CDR infrastructures.

To learn more: visit our webpage and contact us

We are looking forward to finding funding partners who share our passion for and commitment to the **grand challenge** of **bringing into being a win-win pathway to both climate safety and energy prosperity.**

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