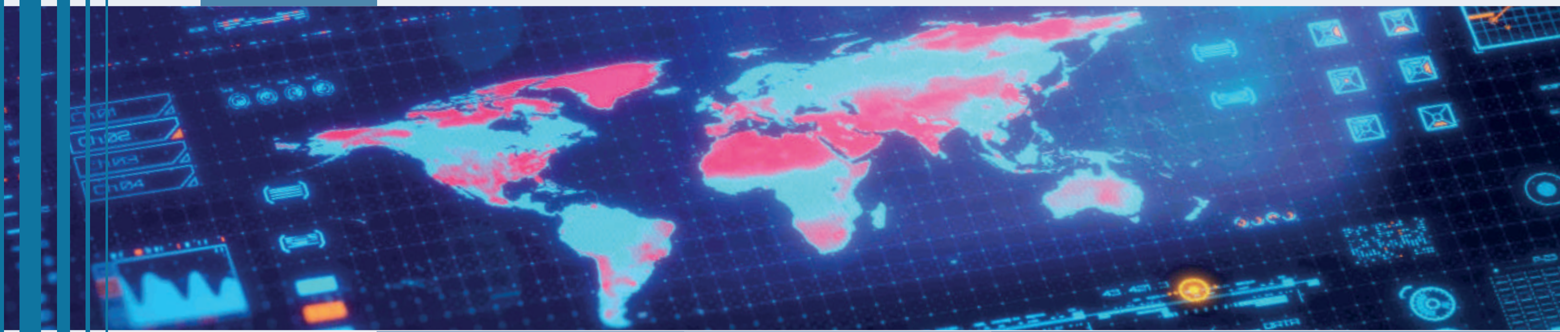

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EXCITE: The How-To Guide

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1 Purpose of This Document

The web-based tool EXCITE (EDHEC Cross-Model Climate Institute Temperature Emulator) is described in the companion document *EXCITE: The Physics and Modelling Background*. In brief, its aim is to provide a user-friendly web-hosted platform for scientists, experts, professionals, and general users to explore and visualise how global warming responds to various carbon emissions scenarios. The tool can be accessed here: EXCITE. The purpose of this document is to explain how inputs can be provided to the simulator, and how to interpret the outputs.

2 Description of the EXCITE Emulator

EXCITE has two panels:
1. the left-hand panel, which displays a trajectory of **carbon dioxide emissions** from 2020 to 2100 (in Gigatons of CO_2 per year);
2. the right-hand panel, which displays the corresponding **temperature** trajectories from 2020 to 2100 (in degrees centigrade), according to a set of climate models.

Figure 1: A schematic plot of EXICTE. The left panel displays the trajectory of emissions according to users' choice. The right panel shows the corresponding temperature anomaly projections by the temperature models. Users can further filter temperature results by selecting a sub-group of temperature models.

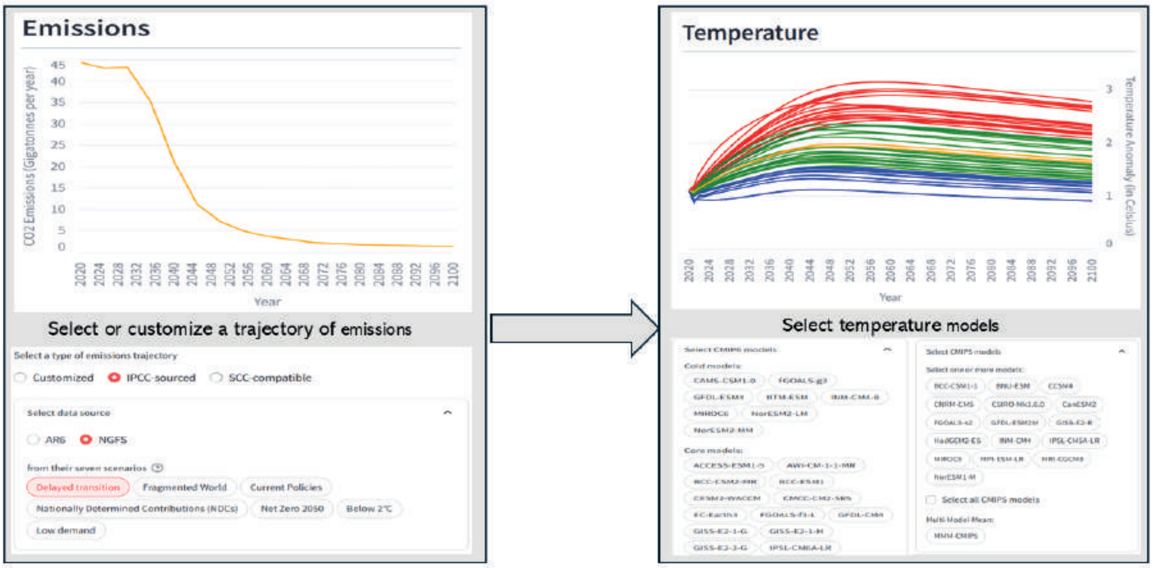


Fig. 1 is a schematic plot of EXICTE. To run the simulation, users should pick an emissions scenario, namely a trajectory of CO_2 emissions. The emissions data is passed on to the climate emulator embedded in EXCITE, and a profile of temperature projections is generated by a set of temperature models.

In the companion document (*EXCITE – The Physics and Modelling Background*), we have provided the modelling details of the climate emulator embedded in EXCITE and the generation of emissions scenarios. In this note, we focus on explaining step-by-step how to use the functionality provided by EXCITE.

3 Emissions

The input emissions can be provided in three ways, by choosing from the menu the options labelled:
1. **Customised:** Users can design a trajectory of emissions by specifying the shape parameters of the trajectory;
2**. IPCC-sourced:** Users can choose the emissions data from the public dataset under the climate scenario framework of IPCC;

3. **SCC-compatible:** Users can specify a value of social cost of carbon (USD/ton CO_2) as a proxy of transition policy; the corresponding trajectory of emissions will be automatically generated.

More precise descriptions, including the parameters that can be customized, are given below. An illustration of each option is given in Fig. 2.

3.1 Customised

If the selection **Customised** is chosen, the menu in the bar **Select Parameters** asks the user to choose (by sliding the red cursors on the left of the dialogue box)
1. by which year the user believes emissions will peak;
2. by which year the user believes emissions will stabilize to an asymptotic level.

On the right of the dialogues box the user then specifies
1. at what level (expressed as percentage of current emissions) the user believes emissions will reach a maximum (eg, 130% of current emissions);
2. at what level (expressed as percentage of current emissions) the user believes emissions will stabilize (eg, 50% of current emissions)

The emulator then produces a smooth emission profile using this information. See Fig. 2a.

Figure 2: The right panel lists three ways to specify a trajectory of emissions and the left panel shows the corresponding emissions.

3.2 IPCC-sourced

If the selection IPCC-sourced is chosen (Fig. 2b), the menu in the bar Select Parameters asks the user to choose from two sources of public climate scenarios: the climate scenarios described in the IPCC's Sixth Assessment Report (AR6) or the climate scenarios designed by the Network for Greening the Financial System (NGFS). Fig. 3 provides basic information of the two public sets of climate scenarios.

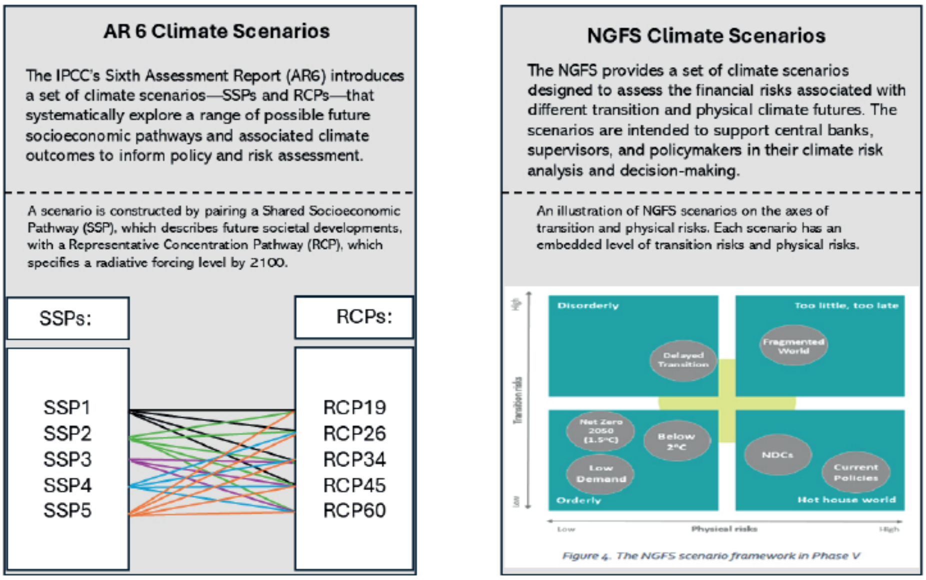
- **AR6:** Under this option, users can choose a public climate scenario included in the IPCC's Sixth Assessment Report (AR6). Each climate scenario is constructed by pairing a Shared Socioeconomic Pathway (SSP) with a Representative Concentration Pathway (RCP), e.g., SSP2-45. There are five SSPs describing five potential future pathways with various assumptions on the economic growth and technological development. Each RCP specifies a particular radiative forcing level (in Watt/m^2) by 2100, e.g., RCP45 means that the radiative forcing by 2100 is 4.5 Watt/m^2. A higher value of RCP indicates a warmer global temperature. In addition to the climate scenarios shown in Fig. 3, some scenarios are labeled as SSP-Baseline, e.g., SSP2-Baseline. Such a scenario does not have a constrained RCP level by 2100. Instead, the physical risk (or the global warming level) is determined by the socioeconomic assumptions in its SSP. Detailed descriptions of the five SSPs can be found in Appendix A.

- **NGFS:** This option offers users the climate scenarios developed by the Network for Greening the Financial System (NGFS). There are seven scenarios:
  - **Below 2°C, Net Zero 2050, Low Demand**
  - **Current Policies, Nationally Determined Contributions (NDCs)**,
  - **Delayed Transition and Fragmented World**.

These scenario share the same socioeconomic assumptions as in SSP2.[1] The scenarios differ in timing and ambition of their transition policies. Consequently, the resulting physical risks are different across scenarios. The emissions data used in EXCITE are sourced from the NGFS REMIND-MAgPIE model output. Appendix B provides detailed descriptions of the NGFS scenarios.

1 - Part of the technological assumptions in Low Demand are from SSP1.

Figure 3: This plot provides basic information about the two public sets of climate scenarios, from AR6 and NGFS. The illustration of the NGFS scenarios is taken from Page 18 in the NGFS Climate Scenarios Technical Documentation V5.0 (2024).



3.3 SCC-compatible

The selection **SCC-compatible** allows users to specify a value of social cost of carbon (USD/ton CO_2) as a proxy of transition policy. Then, the corresponding emissions trajectory is automatically generated via the EDHEC scenario simulator based on the work done by Rebonato et al. (2023) and (2025). The **Select Parameters** bar opens a dialogue, in which the user can input the social cost of carbon ("carbon tax") expressed in $ per ton of CO_2 (Figs. 2e and 2f). Within the model, the choice for the social cost of carbon uniquely selects an effective "abatement speed". See Rebonato et al (2025) for details. For simplicity, **SCC-compatible** is implemented in a deterministic version of the EDHEC scenario simulator with pre-defined parameters.

This concludes the presentation of the CO2 emissions part of the emulator. Next, we move to the temperature part.

4 Temperature

For a given emission schedule chosen in the previous part, the emulator outputs one temperature profile (from 2020 to 2100) for each of the temperature models chosen.

4.1 CMIP5 and CMIP6

The climate models emulated can be selected from the dialogue bars (**Choose CMIP6** or **Choose CMIP5**) – the Coupled Model Intercomparison Project – Phase 6 or 5.[2]. Fig. 4 shows the available climate models from CMIP5/6 in EXCITE.

For the general user, the recommended option is to choose **Select All Models**. This produces a full set of temperature profiles, and gives a comprehensive picture of the uncertainty associated with the projection of temperatures produced by state-of-the-art climate models even when the emission profile is perfectly known. Researchers or advanced users can select individual models, and explore how the chosen climate model projects temperature for the chosen emission profile. Fig. 5 provides one example using the emissions from SSP2-45 as input.

2 - The WCRP (World Climate Research Programme) Working Group on Coupled Modelling (WGCM) oversees the Coupled Model Intercomparison Project, which is now in its 6th phase.

4.2 Hot, Cold, and Core CMIP6 models

The climate models used by the emulator from CMIP6 may suffer from the “hot model” problems identified by Hausfather. The emulator bundles the CMIP6 models in three groups: “hot”, “core” and “cold” according to the literature recommendation. Advanced users have the possibility to edit the parameter choices governing these groupings as detailed in Fig. 6 and explained in the scientific paper. A reset button brings back the parameters to their default values.

Figure 4: This figure i llustrates t he a vailable c limate m odels f or t emperature p rojections i n E XCITE. EXCITE provides 16 models from CMIP5 and 43 models from CMIP6. Notably, some climate models in CMIP6 exhibit a “hot model” issue. By default, the models in CMIP6 are categorised as core models, cold models, and hot models.

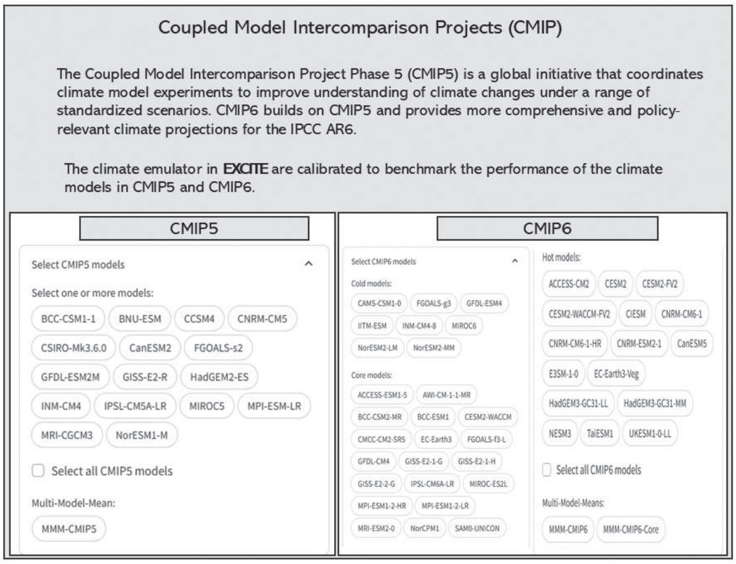


Figure 5: Take the emissions under SSP2-45 as an example. If the users select all CMIP5 models, the temperature projections are displayed on the top right panel. Each gray line corresponds to a climate model output. Note that the climate models in CMIP5 do not exhibit the “hot model” issue and thus we do not distinguish the climate models. If the users select all CMIP6 models, the temperature projections are automatically displayed in blue (by the cold models), green (by the core models) and red (by the hot models). The average across climate models (Multi-Model-Mean) is always shown in yellow.

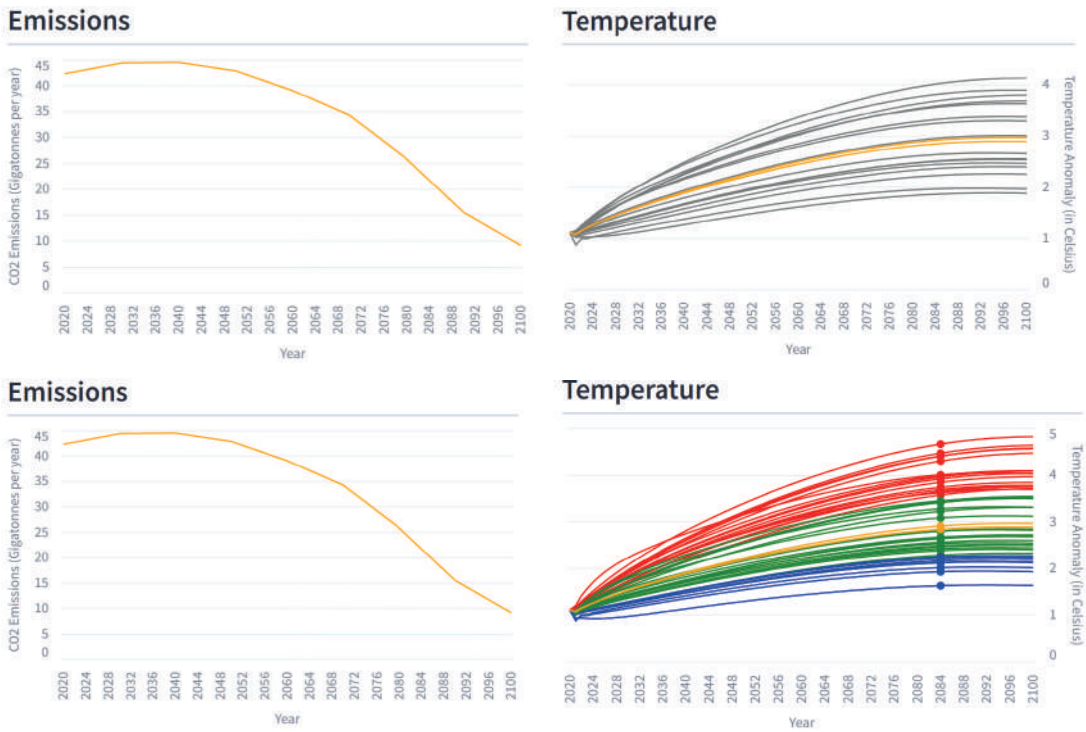


Figure 6: The choice of parameters governing the groupings of CMIP6 models.

The resulting sets of CMIP6 models are presented in a 3-color scheme (blue for "cold", green for "core", and red for "hot") as shown in Fig. 5.

APPENDICES

A Description of the SSP Scenarios

Scenario	Description
SSP1	**Sustainability – Taking the Green Road (Low challenges to mitigation and adaptation)** • The world shifts toward a more sustainable path, emphasising more inclusive / environmentally aware development. • Educational and health investments accelerate the demographic transition, and the emphasis on economic growth shifts toward a broader emphasis on human well-being. • Inequality is reduced both across and within countries. • Consumption is oriented toward low material growth and lower resource and energy intensity.
SSP2	**Middle of the Road (Medium challenges to mitigation and adaptation)** • Social, economic, and technological trends do not shift markedly from historical patterns. Development and income growth proceeds unevenly, with some countries making progress while others do not. • Global / national institutions make slow progress in achieving sustainable development goals. • Intensity of resource and energy use declines but environmental systems experience degradation. • Global population growth is moderate and levels off in the second half of the century. • Income inequality persists; challenges to reducing vulnerability to societal and environmental changes remain.
SSP3	**Regional Rivalry – A Rocky Road (High challenges to mitigation and adaptation)** • A resurgent nationalism, concerns about competitiveness and security, and regional conflicts push countries to increasingly focus on domestic or, at most, regional issues. • Countries focus regionally (e.g., on achieving energy and food security) rather than broader-based development. • Investments in education and technological development decline. • Economic development is slow, consumption is material-intensive, and inequalities persist or worsen over time. • Population growth is low in industrialised and high in developing countries. • Low international priority for environmental concerns leads to significant degradation in some regions.
SSP4	**Inequality – A Road Divided (Low challenges to mitigation, high challenges to adaptation)** • Highly unequal investments in human capital and increasing inequality both across and within countries. Social cohesion degrades and conflict and unrest become increasingly common. • The world 'separates' into an internationally-connected society that contributes to knowledge- and capital-intensive global economy, and a fragmented collection of lower-income, poorly educated societies that work in a labor intensive, low-tech economy. • Technology development is high in the high-tech economy. The globally connected energy sector diversifies, with investments in both carbonintensive and low-carbon energy sources. • Environmental policies focus on local issues around middle and high income areas.

SSP5	**Fossil-fuelled Development – Taking the Highway (High challenges to mitigation, low challenges to adaptation)** • Significant global development predicated on more competitive markets, innovation and greater investment in human and social capital. Global markets are increasingly integrated. • Predicated on the exploitation of abundant fossil fuel resources and adoption of resource intensive lifestyles worldwide. • All these factors lead to rapid growth of the global economy, while global population peaks and declines in the 21st century. Local environmental problems like air pollution are successfully managed. There is faith in the ability to effectively manage social and ecological systems, including by geo-engineering if necessary.

B Description of the NGFS Scenarios

The following narratives are based on the NGFS Climate Scenarios Technical Documentation V5.0 (2024).

Scenario	**Description**
Low Demand	**This scenario includes significant behavioural changes in energy generation and consumption activities to ensure an orderly, Paris-aligned transition** • Global CO_2 emissions reach or approach net zero in 2050. Countries with a political commitment to a net zero target defined before end of March 2024 meet this target before or after 2050. • Some jurisdictions such as the US, EU, UK, Canada, Australia, and Japan reach net zero for all GHGs. • Additional levers in end-use sectors (e.g., behavioural changes, reducing energy demand, inducing faster electrification, and substitution through renewables) mitigate the pressure on carbon taxes to induce the transition and are the distinguishing feature of this scenario compared to the Net Zero scenario by 2050.
Net Zero 2050	**Global warming is limited to 1.5 °C (with a 50% change) through stringent climate policies and innovation, reaching global net zero CO_2 emissions around 2050.** • Global CO_2 emissions reach or approach zero in 2050. Countries with a political commitment to a net zero target defined before end of March 2024 meet this target before or after 2050. • Some jurisdictions such as the US, EU, UK, Canada, Australia, and Japan reach net zero for all GHGs.
Below 2°C	**The stringency of climate policies is gradually increased, giving a 67% chance of limiting global warming to below 2°C by the end of the century.** • Global CO_2 emissions evolve such that the end-of-century temperature goal of 2°C warming is reached (with a 67% chance). • Countries who have net zero targets follow through on 80% of them, others follow less ambitious trajectories.
Delayed Transition	**Annual emissions do not decrease until 2030. Strong policies are needed to limit warming to below 2°C.** • Countries stick to current policies until 2030 and experience a "fossil recovery", after which they transition such that the end-of-century temperature goal of 2°C

	warming is reached. This change of regime in 2030 is unanticipated and therefore disruptive. Countries with net zero policy target commitments are assumed to follow-through on 80% of them. Negative emissions are limited.
Nationally Determined Contributions (NDCs)	**All pledged targets are assumed to be implemented, even if they are not yet backed up by effective policies.** • Countries implement pledged policies in addition to current policies and keep their level of ambition beyond the NDC horizon. The cut-off date for targets being considered here is those published by the UNFCCC until end of March 2024.
Current Policies	**Only current implemented policies are preserved, leading to high physical risks.** • Existing climate policies remain in place but there is no strengthening of ambition level of these policies.
Fragmented World	**A delayed and divergent climate policy response among countries globally leads to high physical and transition risks.** • Only currently implemented policies are maintained until 2030 (delayed transition); thereafter, countries that have set themselves a net zero target only reach an 80% reduction by 2050, while others continue with current policies (divergent transition).

About EDHEC Climate Institute

Institutional Context

Operating from campuses in Lille, Nice, Paris, London and Singapore, EDHEC Business School is ranked in the top ten European business schools. With more than 110 nationalities represented in its student body, some 50,000 alumni in 130 countries, and learning partnerships with 290 institutions worldwide, it is truly international.

EDHEC Business School has been recognised for over 20 years for its expertise in finance. Its approach to climate finance is founded on a commitment to equipping finance professionals and decision-makers with the insights, tools, and solutions necessary to navigate the challenges and opportunities presented by climate change. EDHEC has developed a significant research capacity on the financial measurement of climate risk, which relies on the best researchers in climate finance, and brings together experts in climate risks as well as in quantitative analysis.

The DNA of EDHEC's work has also resided, since its origin, in the ability to generate business ventures, by encouraging spin-offs based on the research work of its teams. EDHEC is currently involved in three ventures: Scientific Portfolio, Scientific Infra and Private Assets, and the soon-to-launch Scientific Climate Ratings.

Mission and Ambitions

The EDHEC Climate Institute (ECI) focuses on helping private and public decision-makers manage climate-related financial risks and make the most of financial tools to support the transition to a low-emission economy that is more resilient to climate change.

It has a long track record as an independent and critical reference centre in helping long-term investors to understand and manage the financial implications of climate change on asset prices and the management of investments and climate action policies.

The institute has also developed an expertise in physical risks, developing proprietary research frameworks and innovative approaches. ECI is also conducting advanced research on climate transition risks, with a focus on supply chain emissions (Scope 3), consumer choices, and emerging technologies.

As part of its mission, ECI collaborates with academic partners, businesses, and financial players to establish targeted research partnerships. This includes making research outputs, publications, and data available in open source to maximise impact and accessibility.

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