

Table 1: Calibration dataset. This table shows all data sources that were used to calibrate the model to history from the period of 1980 to 2100.

Variable Name and unit in the model	Variable Name in the Database	How data was calculated	Database name
Economy.GDP (G\$/Years)	rgdpe	GDP= Expenditure-side real GDP at chained PPPs (in mil. 2017US\$) (for the World, it's sum of all countries)	Penn World Table version 10.01 (Feenstra et al. 2015)
Economy.Government spending (G\$/year)		Government spending (G\$/y) = Gov Consumption= Gov cons as share (per y)* GDP (G\$ per y)(1) Government consumption as fraction of GDP (1)= csh_g= Share of government consumption at current PPPs	Penn World Table version 10.01 (Feenstra et al. 2015)
Economy.Investment (G\$/year)		Investments= Investments as share of GDP (1) * GDP Investments as share of GDP (1) = csh_i = Share of gross capital formation at current PPPs	Penn World Table version 10.01 (Feenstra et al. 2015)
Economy.Private Consumption (b\$/year)		Consumption Share of GDP * GDP or GDP - Investment - Government Spending.	Calculated based on Penn World Table version 10.01 data (Feenstra et al. 2015)
Economy.N2O emissions (ktN2O/Year)		N2O Other (not energy and food and land use)	RCMIP (Nicholls et al. 2020)
Economy.CO2 emissions (MtCO2/year)		emissions from cement + emissions from other categories except oil, gas, coal, flaring	Global Carbon Project (Friedlingstein et al. 2022)
Economy.CH4 emissions (MtCH4/Year)		Waste + Industrial Sector	RCMIP (Nicholls et al. 2020)
Population.GDP per person (k\$/p/year)			Penn World Table version 10.01 (Feenstra et al. 2015)
Population. Aged 0 Years (Mp)	Total population by single age, both sexes combined (thousands)	Age 0 (thousands)	United Nations
Population.Aged 1 to 20 Years (Mp)		Sum of ages 1 to 19	United Nations
Population.Aged 20 to 40 Years (Mp)		Sum of ages 20 to 39	United Nations
Population.Aged 40 to 60 Years (Mp)		Sum of ages 40 to 59	United Nations
Population.Aged 60 to 80 Years (Mp)		Sum of ages 60 to 79	United Nations

Population.Aged over 80 Years (Mp)		Sum of ages 80 to 100+	United Nations
Population.Population (Mp)		Sum of all ages	United Nations
Population.Deaths 0 years (Mp/Year)	Deaths by Single Age - Both Sexes	Infant Death	United Nations
Population.Deaths 1 to 20 years (Mp/Year)		Sum of death for age 1 to 19	United Nations
Population.Deaths 20 to 40 years (Mp/Year)		Sum of death for age 20 to 39	United Nations
Population.Deaths 40 to 60 years (Mp/Year)		Sum of death for age 40 to 59	United Nations
Population.Deaths 60 to 80 years (Mp/Year)		Sum of death for age 60 to 79	United Nations
Population.Deaths over 80 years(Mp/Year)		Sum of death for age 80 to 100+	United Nations
Population.fertility (dmnl)		Total Fertility Rate (live births per woman)	
Population. Births (Mp/Year)	Birth (thousands)		United Nations
Population. Total Deaths (Mp/Year)	Total death (thousands)		United Nations
Temperature.Surface Temperature Anomaly(deg C)			Smith et al. 2023
Temperature. CO2 ERF (W/(metre^2))			Smith et al. 2021
Temperature.CH4 ERF (W/(metre^2))			Smith et al. 2021
Temperature. N2O ERF (W/(metre^2))			Smith et al. 2021
Temperature. Total CH4 Emissions (MtCH4/yr)	Emissions CH4		RCMIP (Nicholls et al. 2020)
Temperature.Total CO2 Emissions (MtCO2/yr)			RCMIP (Nicholls et al. 2020)
Temperature. CO2 Concentration (ppm)			Smith 2023
Temperature.Total N2O Emissions (ktN2O/yr)	Emissions N2O	Emissions N2O	RCMIP (Nicholls et al. 2020)
Temperature.N2O Concentration (ppb)			Chapter 7 of the IPCC's Sixth Assessment Report, Working Group 1 (Smith et al. 2021)
Temperature. CH4 Concentration (ppb)	Emissions CH4	Emissions CH4	Chapter 7 of the IPCC's Sixth Assessment Report, Working Group 1 (Smith et al. 2021)
Temperature. Total SO2 emissions (MtSO2/yr)	Emissions Sulphur	Emissions Sulphur	RCMIP (Nicholls et al. 2020)
Food and land use. N2O emissions (ktN2O/Year)	N2O MAGICC AFOLU	N2O MAGICC AFOLU	RCMIP (Nicholls et al. 2020)
Food and land use.CO2 emissions (MtCO2/year)	land use change emissions		Global Carbon Project (Friedlingstein et al. 2022)

Food and land use.CH4 emissions (MtCH4/Year)		Peat Burning + Grassland Burning + Forest Burning + Agriculture + Agricultural Waste Burning	RCMIP (Nicholls et al. 2020)
Food and land use.SO2 emissions (MtSO2/Year)	Sulfur MAGICC AFOLU	Sulfur MAGICC AFOLU	RCMIP (Nicholls et al. 2020)
Food and land use.Forest land (Mha)	Forest land (1000 ha)		Food and Agriculture Organization of the United Nations (2023)
Food and land use. Crop Production (Mtcrop/Year)		Sum of production of different crops	Food and Agriculture Organization of the United Nations (2023)
Food and land use.Cropland (Mha)			Food and Agriculture Organization of the United Nations (2023)
Food and land use. total water withdrawal (m ³ /Year)			Global International Geosphere-Biosphere Programme (IGB)
Food and land use. Livestock Production (MKg/Year)			Food and Agriculture Organization of the United Nations (2023)
Food and land use. fraction of water withdrawal for agriculture (dmnl)			OECD 2023
Food and land use. fraction of crops for livestock (dmnl)			Food and Agriculture Organization of the United Nations (2012)
Food and land use. available water supply (m ³)			The World Bank
Food and land use. Man Made Fertilizer Use (MtN/year)			Breier (2023)
Food and land use. Manure Fertilizer Use (MtN/year)			Breier (2023)
Food and land use. Fertilizer use (MtN/year)			Breier (2023)
Food and land use. soil carbon loss cropland (GtC)			Karstens et al. 2022
Energy. Secondary Fossil Energy Output (TWh)		world; summed oil gas and coal; inverted conversion for fossil equivalent input energy	Energy Institute - Statistical Review of World Energy (2023)

energy.Renewable Energy Output (TWh)		world; summed solar, wind and hydro. and other (including bio energy and geothermal); inverted conversion for fossil equivalent input energy	Energy Institute - Statistical Review of World Energy (2023)
energy. Wind and Solar Energy Output (TWh)		world; summed solar and wind; inverted conversion for fossil equivalent input energy	Energy Institute - Statistical Review of World Energy (2023)
energy. Hydropower Energy Output (TWh)		world; hydropower; inverted conversion for fossil equivalent input energy	Energy Institute - Statistical Review of World Energy (2023)
energy.Nuclear Energy Output (TWh)		world; inverted conversion for fossil equivalent input energy	Energy Institute - Statistical Review of World Energy (2023)
energy. Other Energy Output (TWh)		world; includes bioenergy and geothermal; inverted conversion for fossil equivalent input energy	Energy Institute - Statistical Review of World Energy (2023)
energy. Total Energy Output (TWh)		world; summed above	Energy Institute - Statistical Review of World Energy (2023)
energy. Total Renewable Energy Capacity (GW)		world; summed solar wind and hydro	International Renewable Energy Agency (2023) – processed by Our World in Data
energy. Wind and Solar Energy Capacity (GW)		world; summed solar and wind	International Renewable Energy Agency (2023) – processed by Our World in Data
energy.Hydropower Energy Capacity (GW)		world; Renewable hydropower including mixed plants (excludes pumped storage)	International Renewable Energy Agency (2023) – processed by Our World in Data
energy.Other Energy Capacity (GW)		world; summed marine, bioenergy and geothermal	International Renewable Energy Agency (2023) – processed by Our World in Data
energy. Nuclear Energy Capacity (GW)		world	IAEA (2023)
energy.Primary Fossil Energy (FUEL)(zJ)		world; summed over coal, oil, and gas	Energy Institute - Statistical Review of World Energy (2023)

energy.demand for energy (TWh)		world; same as supply	Energy Institute - Statistical Review of World Energy (2023)
energy.Investments in Fossil Fuel Extraction Capital (2017\$)		world; summed over oil gas and coal adjusted for inflation	IEA-World Energy Investment (2023)
energy.Investments in Fossil Energy Capital (2017\$)		world; summed over coal and oil and gas adjusted for inflation	IEA-World Energy Investment (2023)
energy. Investments in Solar and Wind Energy Capacity (2017\$)		world; summed solar and wind adjusted for inflation	United Nations Environment Programme Frankfurt School of Finance and Management (2023)
energy. Investments in Renewables (2017\$)		World adjusted for inflation	IEA (2023)
energy. Investments in Hydropower Energy Capacity (2017\$)		World adjusted for inflation	International Renewable Energy Agency (2023)
energy.Investments in Nuclear Capacity (2017\$)		World adjusted for inflation	IEA-World Energy Investment (2023)
energy.Investments in Other Capacity (2017\$)		world; summed over all excl. hydro solar and wind adjusted for inflation	United Nations Environment Programme Frankfurt School of Finance and Management (2023)
energy.Installation Cost of S&W capacity (2017\$/kW)		adjusted for inflation	IEA-World Energy Investment (2023)
energy. share of GDP invested in fuel extraction (dmnl)		traced by hand	IEA-World Energy Investment (2020)
energy. share of GDP invested in Energy w/o fuel (dmnl)		traced by hand	IEA-World Energy Investment (2020)
energy.CO2 emissions (MtCO2/year)		Emissions from Coal + Oil + Gas + Flaring (this also includes transport)	Global Carbon Project (Friedlingstein et al. 2022)
energy. CH4 emissions (MtCH4/year)		Energy Sector + International Shipping + Residential Commercial Other + Transportation Sector	RCMIP (Nicholls et al. 2020)
energy. N2O emissions (ktN2O/year)		Total N2O- (Food and Land Use +Economy)	RCMIP (Nicholls et al. 2020)
energy.SO2 emissions (MtSO2/year)	Sulphur MAGICC Fossil and Industrial		RCMIP (Nicholls et al. 2020)

energy. conversion efficiency of fossil fuels to secondary fossil energy (dmnl)		conversion factors of primary energy to electricity in a traditional fossil fuel plant	Energy Institute - Statistical Review of World Energy (2023)
energy.Hydropower Installation Costs (2017\$/kW)		inflation adjusted	Statista (2023)
energy. Nuclear Installation Costs (2017\$/kW)		Inflation adjusted	Schlissel and Biewald (2008)
Sea Level.global sea level rise	Global mean sea level		Copernicus climate change service (C3S) (2023)