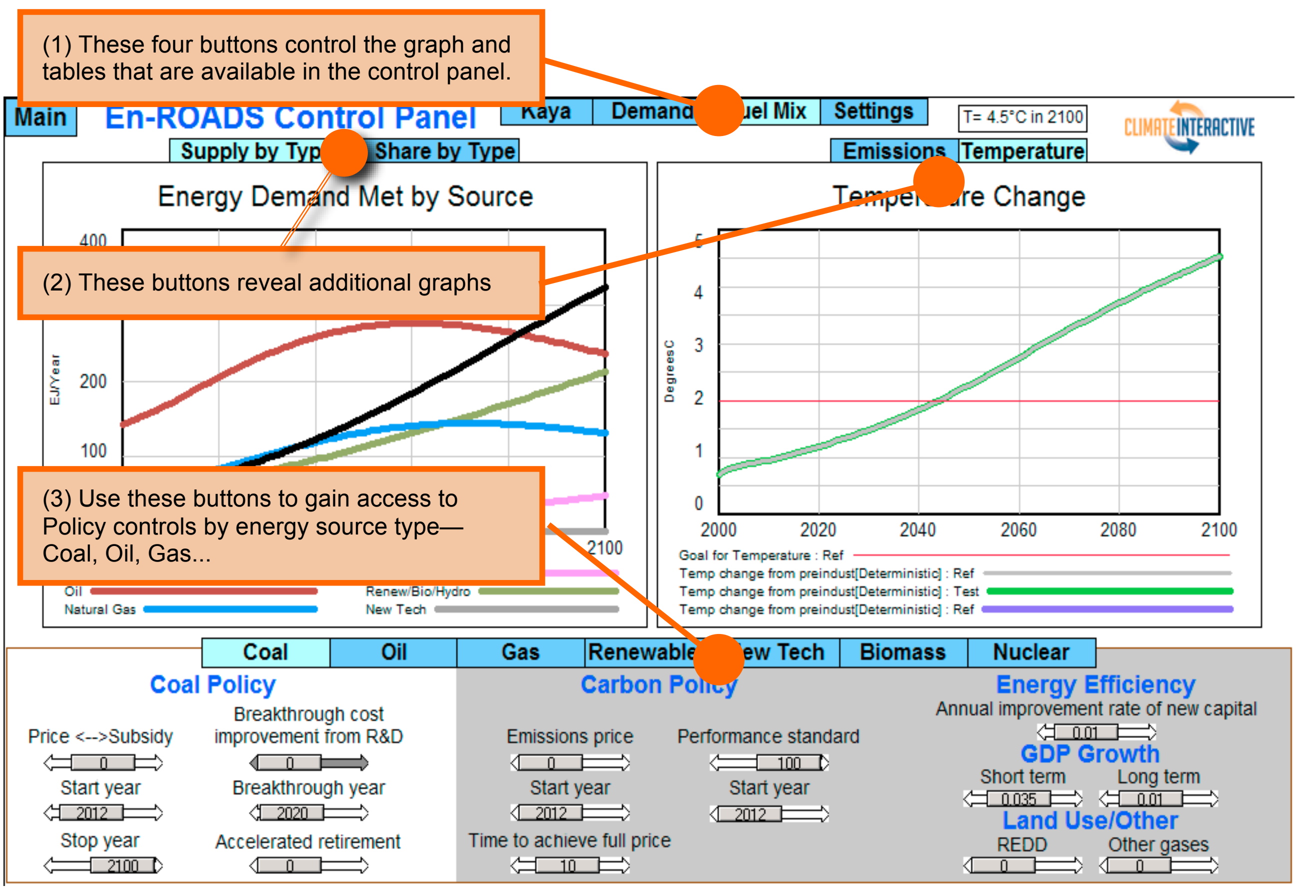
Guide to the En-ROADS Control Panel

Climate Interactive

Control panel basics

The buttons at the top of the Control Panel screen (1) control the output graphs or tables that are visible. When there are buttons associated with graphs (2), they allow you to view an additional graph. The seven buttons above the control slider area (3) switch the Energy-specific Policy levers on the left portion of the control region.



The following is a summary of the key levers in the En-ROADS (Energy – Rapid Overview and Decision Support) simulator. Many others are accessible.

Energy Supply Types

Below the graphs in the control panel (on the left side) is a set of levers that are fuel-type specific. They change from Coal Policy to Oil Policy to Gas Policy to Renewables Policy, and so on. Click on the blue buttons above the control section to change energy type.

Coal. In the reference scenario, coal use grows steadily through the century. Coal has the highest carbon density of the sources (96 tons CO2/TJ).

Oil. In the reference scenario, oil use gets more expensive in the middle of the century. Oil has a somewhat lower carbon density than coal (75 tons CO2/TJ).

Gas. Many are calling natural gas a “transition” fuel or “bridge” fuel to a low carbon world. Natural gas has a lower carbon density than coal (50 tons53 kg CO2/TJMMBTU versus 96 for coal).

Renewables. In the main graph, Renewables are bundled with Bio-energy and Hydropower, but the levers in the control panel for renewables policy are exclusively wind, solar photovoltaic, concentrated solar thermal, etc. Renewables have close to zero carbon density.

New Tech. As promoted in the technology press, a research team could emerge from a lab with a zero-carbon energy supply technology (e.g., cold fusion or thorium-based nuclear fission) and then commercialize and grow it. One should specify a breakthrough year. The delay between the breakthrough year and a commercial-ready plant is 12 years. *To have the new tech cost at approximately half the price of coal, choose .98 for the breakthrough cost reduction. (98% reduction from an arbitrarily high starting value.) New tech is assumed to have zero carbon density.*

Biomass. With much lowering carbon density (but there is a good bit of debate of what it is, when you consider lifecycle emissions—we assumed 42 tons CO2/TJ), biomass can contribute to mitigation. Note—it is lumped with Renewables and Hydro on many of the main graphs.

Nuclear. Close to zero carbon density and, thus, the potential to mitigate carbon emissions, but some concerns about other environmental effects (which are not captured quantitatively in the simulation). Go to “Main” to find a graph of the number of power plants that would need to be sited.

[Energy Type] Policy – Coal Policy, Oil Policy …

Other than "Accelerated Retirement" for Coal, all the views have the same levers.

Price <–> Subsidy. An increase would represent a subsidy (a reduction in the cost of energy from the energy type), while a decrease would represent a tax, measured in $/GJ. For example, 5 would indicate a subsidy of $5 per GJ and bring a decrease in cost, while -7 would indicate a tax and bring a $7 per GJ increase in cost. The subsidy/tax begins in the **Start year** and ends in the **Stop year**. While it is difficult to compare to current subsidies, $6-8 would be a large tax or subsidy.

Breakthrough cost reduction. What if breakthroughs in R&D and industry reduce the cost of the supply suddenly and not slowly via the learning curve governed by the progress ratio? Change this number to simulate a long-term boom in gas, renewables, or other supplies, for example. The number represents the reduction in the cost from the price of energy from the source when the breakthrough occurs, e.g., 0.6 would mean a 60% decrease. A 40-60% drop would be enormous (except for New Tech, where 95-98%, while arbitrary, is required). One can specify a **Year of breakthrough.**

Accelerated retirement. Following the lead of China in recent years, one can boost the rate of retirement of old coal plants. Each percentage adds to the annual rate of retirement. A boost of 5% would be significant. This control is only available as a coal policy.

Carbon Policy

Some strategies would put a price on carbon or give an economic disincentive to using the fuel based on its carbon density. We suggest you choose **one** of the two approaches below, not both at the same time. Also, note that the model keeps track of the aging of energy-using capital such as buildings, motors, vehicles, and appliances.

Emissions price. You can add a cost to energy supplies, based on the amount of CO_2 emitted per EJ produced, in $/ton CO_2. Use this to simulate a Carbon Tax or extensive cap-and-trade markets. The price begins increasing in the **Start year** and grows linearly to the specified price over a number of years, the **Time to achieve full price**. Some Scandinavian countries have a price of $20-30/ton. Some climate activists call for prices well over $75.

Emissions performance standard. These standards restrict the use of energy supplies based on their carbon density. A lower standard disincentives higher-emitting sources. Measured in Tons CO_2 per TJ. The default is 100, which is above the C-density of all supplies. Costs will show up at lower levels: 91 for coal, 71 for oil, and 50 for natural gas. The standard begins in the **Start year**. Could be used as an alternative to an Emissions price.

Energy Efficiency

The model keeps track of the aging of energy-using capital such as buildings, motors, vehicles, and appliances, with its installation and (after an average of 15 years) its retirement, plus early discards and retrofits. The average energy intensity of GDP is already falling ~1% per year in the "Reference" scenario.

Annual improvement rate of new capital. Boosting this value increases global energy efficiency. It changes the energy intensity of the **new** capital, which slowly replaces the existing capital stock. A 7% per year improvement of the **new** capital gives a 3.5% per year drop to the average energy intensity from 2010-2050, a rate that some energy experts believe is possible.

GDP Growth

Growth of GDP (actually GWP—Gross World Product) drives energy demand and is specified for both the **Short term** (primarily the next 30 years) and the **Long term** (after that). In the "Ref" scenario, GDP grows in the short term at 3.5% per year, slowing down to 1% per year in the long term, over 50 years. The simulation includes feedback from energy price to GDP growth and from climate impacts to GDP, but their impact is initially set to zero. One can imagine how redefining metrics of well-being could lead to prosperity without maintaining the same levels of GDP growth.

GWP growth has hovered around 3-4% per year over the last decade (except in 2008-2009). To explore a lower growth world, lower it to 2.5 – 3.0% per year.

Land Use/Other

REDD. Reduction of Emissions from Deforestation and Forest Degradation is a 0 to 1 slider, where 1 is the maximum that these emissions could be reduced. A value of .9 would be very ambitious, but possible.

Other gases. This is an index of other non-CO_2 greenhouse gas emissions reductions. You can change emissions from other well-mixed greenhouse gases such as methane, N2O, and the f-gases (not including emissions of methane from permafrost and similar sources). It works as a 0 to 1 slider, where 1 is the maximum that could be reduced through 2100. Values considered ambitious are around 0.8 or 0.9.

Notes on Additional Graphs

Click on the “Main” button in the top left corner to view other graphs and on "Control Panel" to return.

Compare your scenario against other energy models: **EMF** under “Comparisons”

View other impacts such as cumulative emissions: **Cumulative Emissions** under “Annual Emissions”

See how our simulation compares to actual historical data since 1990: **Calibrations** under “Historical Calibrations”

Compare your scenario for the future growth in renewable energy or New Tech against the actual growth of Coal, Oil, Gas, Nuclear and Rewewables since their inception: **New Tech** or **Renewables** under “Transition Comparisons”

See the gap between your fuel mix and the one in the initial “Reference Scenario”: **Supply Comparisons** under “Supply”

“Open the hood” and explore the structure of the simulation: “En-ROADS Structure.”

For advanced sensitivity testing, change core assumptions in the model: under “Full Control Panels” see **Assumptions and Conditions.**

Other Resources

The full 100+ page Reference Guide, including assumptions, equations, and references, is available through the Climate Interactive website: http://www.climateinteractive.org/simulations/en-roads/en-roads