



EN-ROADS

Climate Workshop

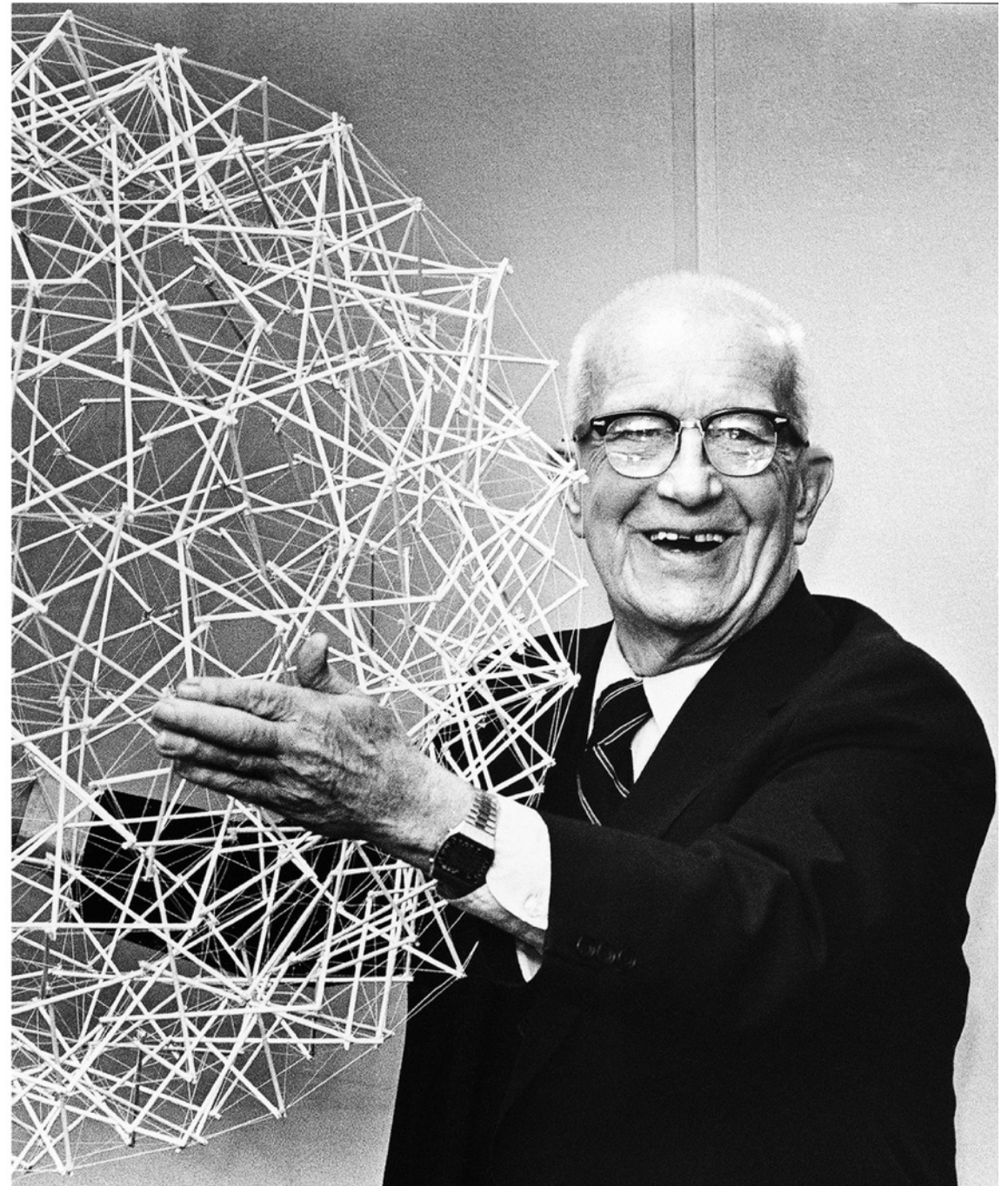
Developed by:



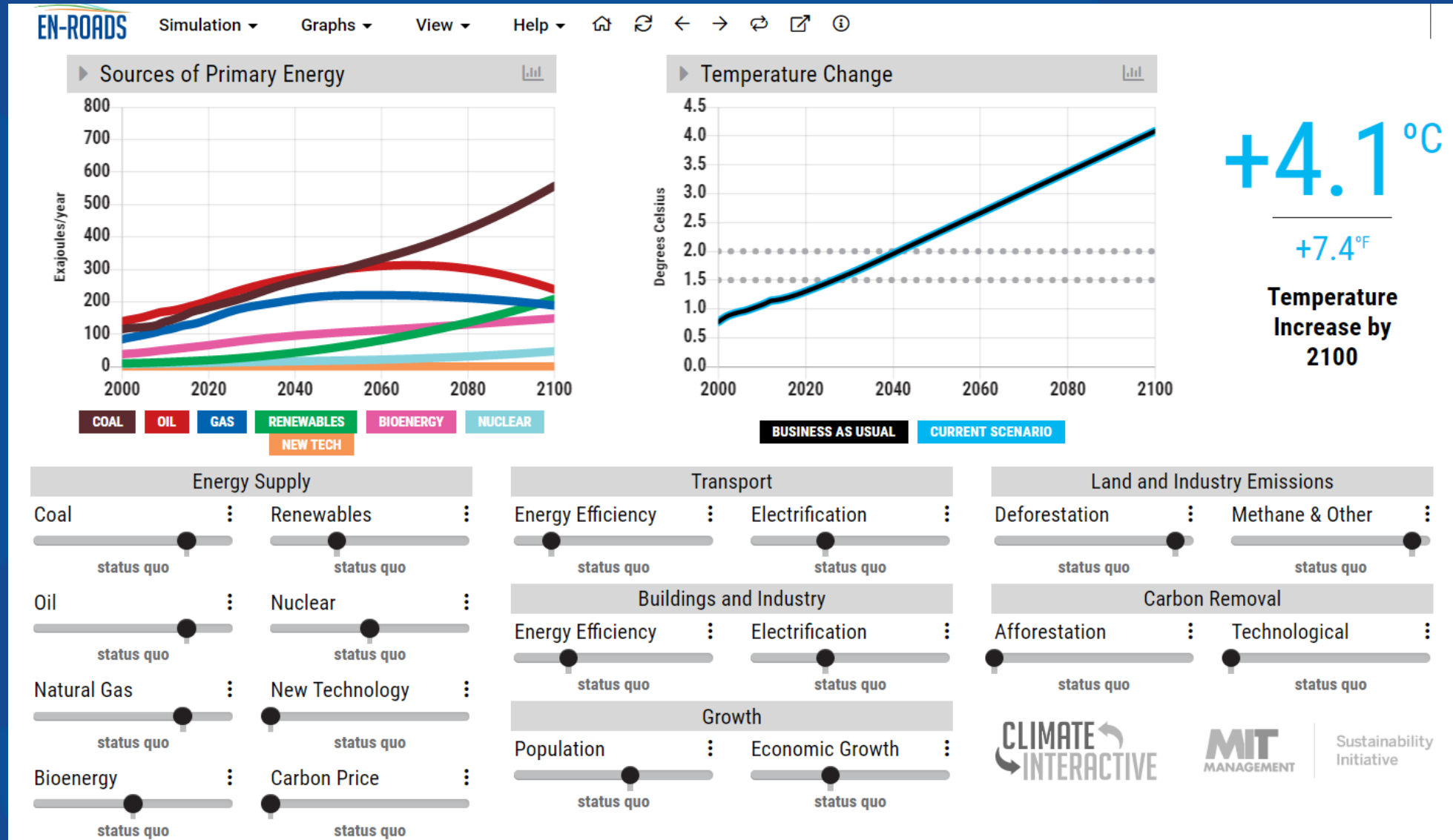
Sustainability
Initiative

“If you want to teach people a new way of thinking, don’t bother trying to teach them. Instead, give them a tool, the use of which will lead to new ways of thinking.”

**- BUCKMINSTER FULLER,
ARCHITECT, VISIONARY 1895-1983**



En-ROADS is a cutting-edge simulation model to test climate solutions and generate climate scenarios for the future.



Features of En-ROADS

- **Transparent**

All equations and structure are open source

- **Flexible**

Assumptions are adjustable

- **Highly aggregated to be fast**

Complementing, not supplanting, the EMF22 and other more detailed models

- **Supports grounding discussions to learn and strategize backed with real data & science**

However not to serve as *predictions* for the future, which is dependent on too many behavioral variables

What does +4 °C of warming mean?

- **Multi-meter sea level rise** within 50- 150 years possible
- Widespread **increase in the frequency of drought** across the globe (~60% increase)
- Desertification of Mediterranean Europe
- Intense and **frequent heat waves and floods** in many areas across the world
- Committed warming (centuries to millennia): **+ >6 °C**
- Long-term equilibrium sea level rise (millennia): **~13-15 m**
- Irreversible change

Coal

Discourage or encourage mining coal and burning it in power plants.



Renewables

Encourage or discourage building solar panels, geothermal, and wind turbines.



Transport Energy Efficiency

Increase or decrease the energy efficiency of vehicles, shipping, air travel, and transportation systems.



Transport Electrification

Increase or decrease purchases of new electric cars, trucks, buses, trains, and ships.



Methane & Other Gases

Decrease or increase greenhouse gas emissions from methane, nitrous oxide, and the f-gases.



Oil

Discourage or encourage drilling, refining, and consuming oil for energy.



Nuclear

Encourage or discourage building nuclear power plants.



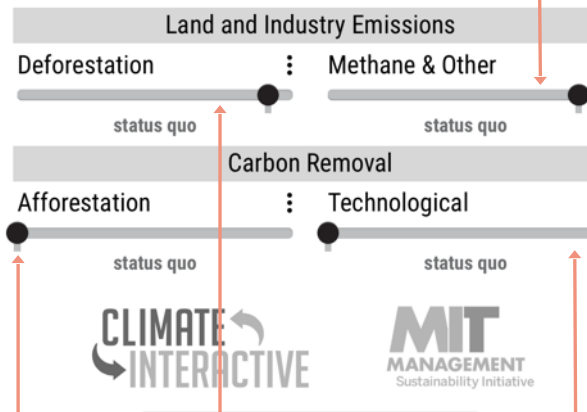
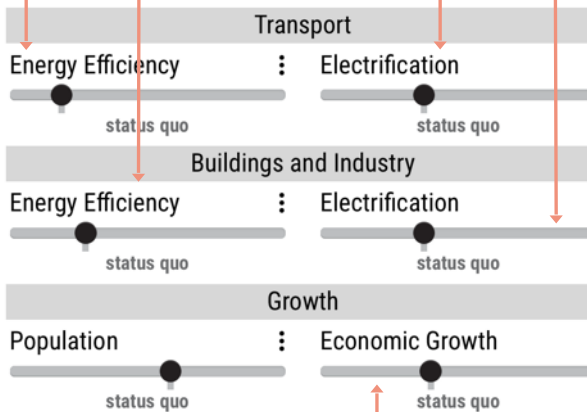
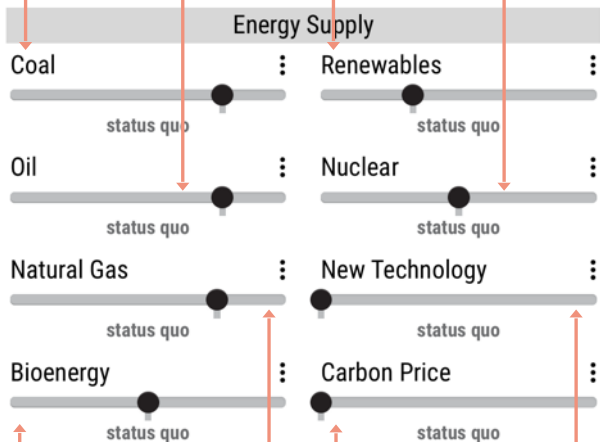
Buildings & Industry Energy Efficiency

Increase or decrease the energy efficiency of buildings, factories, appliances, and other machines.



Buildings & Industry Electrification

Increase or decrease the use of electricity in buildings, appliances, motors, and other machines, instead of fuels like oil or gas.



Natural Gas

Discourage or encourage drilling and burning natural gas for energy.



New Technology

Discover a brand new, cheap source of electricity that does not emit greenhouse gases.



Economic Growth

Assume higher or lower growth in goods produced and services provided.



Afforestation

Plant new forests and restore old forests.



Deforestation

Decrease or increase the loss of forests for agricultural and wood product uses.



Bioenergy

Discourage or encourage the use of trees, forest waste and agricultural crops to create energy.



Carbon Price

Set a global carbon price that makes coal, oil, and gas more expensive depending on how much carbon dioxide they release.



Population

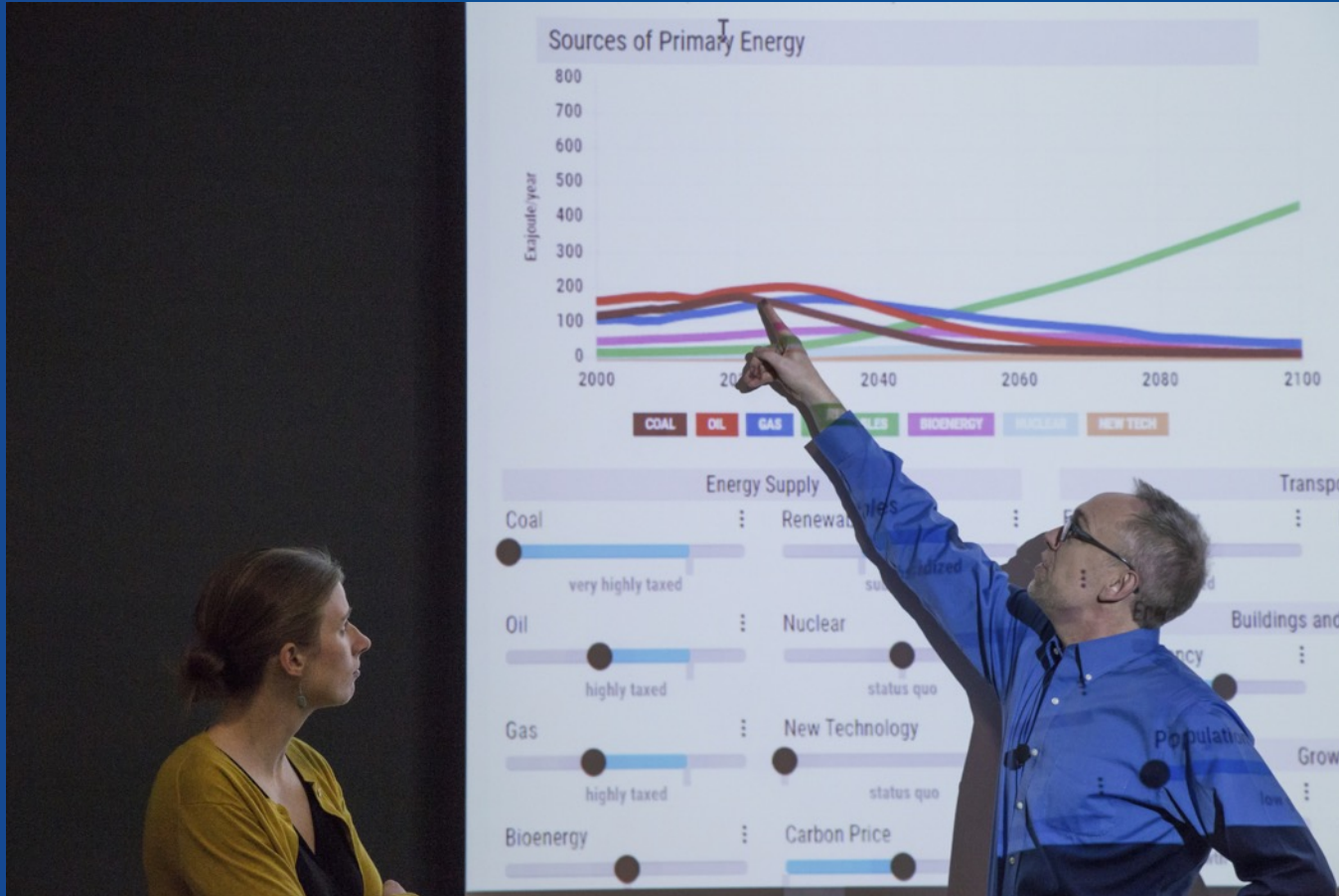
Assume higher or lower population growth.



Technological Carbon Removal

Pull carbon dioxide out of the air with new technologies that enhance natural removals or manually sequester and store carbon.





Thank You!

Visit:
climateinteractive.org

Insights from En-ROADS

1. There is no silver bullet.
2. To achieve ~2 degrees requires “silver buckshot” – success with most everything.
3. Highest leverage: Keeping fossil fuels in the ground.
4. Even when low-carbon supply is encouraged and thrives, we still burn fossil fuels.
5. New technologies grow via reinforcing “learning” feedback loops.
6. Energy efficiency starves growth in renewables.
7. When energy becomes inexpensive (e.g., renewables, nuclear, new tech breakthroughs), energy demand increases via a modest “rebound effect.”
8. Accelerated growth in natural gas (e.g., via subsidy) absent a carbon price starves renewables and mitigates little greenhouse gases.
9. A brand new tech is too delayed to contribute much on its own.
10. The transition from high-carbon to low-carbon takes decades due to long lifetime of fossil fuel capital infrastructure.
11. In a hi-mitigation scenario, more nukes/new-tech/renewables just displaces the other low-c sources.
12. “Other gases” reduction mitigates a good bit.
13. GDP changes are high leverage.
14. A carbon price is high leverage because it changes fuel mix and reduces energy demand.
15. Reducing deforestation is lower leverage in long term than most expect.

En-ROADS Core Structure

