Climate Interactive

World Energy Simulation Facilitator's Guide

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This guide is intended to support your facilitation of the World Energy Simulation, a group role playing game that promotes greater understanding of the causes of climate change and the factors essential to mitigating it. It does this by enabling participants to explore the dynamics between various stakeholders and economic sectors in addressing climate change. The unique component of World Energy is that is anchored by the En-ROADS computer model, which allows for rapid assessment of the recommendations for mitigation put forth in these mock-negotiations.

Materials for the World Energy Simulation and more can be found at: https://www.climateinteractive.org/tools/world-energy

The *World Energy* Simulation complements the *World Climate* Simulation. The primary difference is that World Energy focuses on the climate impact of sectors of activity like land & agriculture and energy supply resources, while World Climate focuses on geopolitical entities' actions that affect climate—countries like the United States and China and regional blocs, like the European Union and developing nations.

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Storyline and Exercise Overview

The World Energy Simulation is premised on a fictitious conference convened by the United Nations Secretary General to address climate change. Rather than pull representatives of nations together the Secretary General has taken the extraordinary step of convening corporate CEOs and leaders of organizations, governmental and non-governmental, and stakeholders responsible for climate change and also activists and others working to mitigate it.

Participants meet first for a whole group or plenary briefing that normally includes a slide presentation followed by Q and A. This presentation provides essential background information on Climate Interactive's approach, contextual data on the effects of climate change, an introduction to the goal of the exercise, and a snapshot of the En-ROADS simulation. The main aim of the exercise, the facilitator explains, is to see if the proposed actions of all six groups can contain global temperature rise to less than 2 degrees Celsius by 2100.

Participants are then divided into 6 groups and given a briefing sheet that describes who they represent and what their group's assignment is. At this point the facilitator takes on the role of the UN Secretary General and begins the role play. The Secretary General (or perhaps a science advisor to the UN) reinforces the stakes of climate change, the role each group has in addressing it, and the goals for the exercise—limiting global temperature rise to < 2°C or 1.5°C, the agreed upon goals of the UN climate negotiations process.

Following mutual introductions and a review of their briefing sheet, group members discuss strategy and possible measures to bring global temperature rise down to acceptable levels. During this first round of negotiations and subsequent rounds as well, groups are encouraged to reach out to other groups, seek to understand their emerging positions and affect their proposals.

After the first negotiation round, each group makes a presentation to the plenary, laying out their proposals. These proposals are written on the board and then entered in the En-ROADS computer simulation to test their impact.

Following an initial discussion about the results of their efforts as reflected in the simulation, a second negotiating round proceeds, followed again by plenary speeches and entering the results into En-ROADS. After the negotiations conclude, and participants either reach the goal or run out of time, the facilitator asks everyone to step out of

their roles and reflect on the experience. (More detail on these parts of the experience below)

Purposes

As you facilitate World Energy, keep three purposes in mind:

1. **Insights and Understanding.** World Energy offers an opportunity for participants to gain insights into the carbon and climate system, as well as the social and political dynamics of the climate challenge confronting us all.

2. **Learning and Leadership.** Provides a non-directive experience that lets participants experiment in a role-playing environment how to advocate for positive action and to explore and identify for themselves a possible role in addressing climate change

3. **Diffusion.** Gives participants an opportunity to take what they learn and translate it into real-world action, including leading the exercise with another audience.

Preparation and setup

Time Required

We recommend three hours for the entire session, about two hours for the initial presentation and role-playing exercise and about one hour for the debrief. However, many variations are possible, from stretching the exercise and making it into a multi-day event to holding a consolidated version in an online webinar.

Dividing Participants

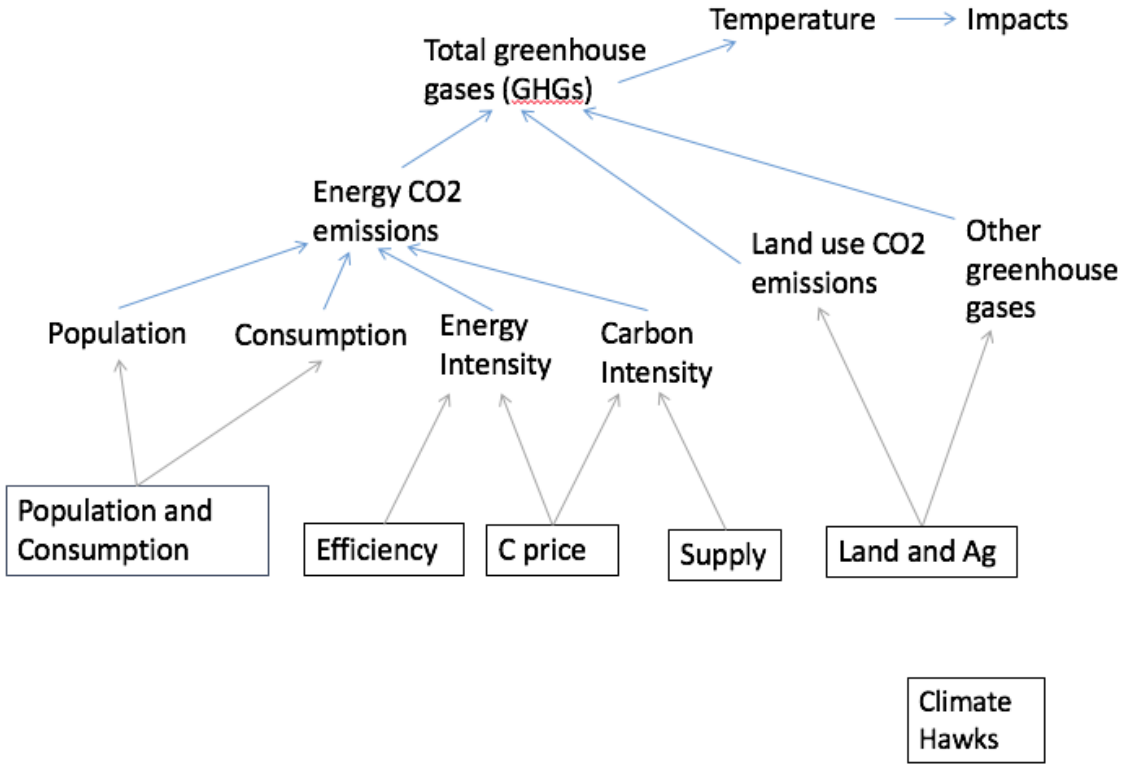
Participants are divided into 6 groups and given briefing statements describing their respective group.

The groups are:

1. **Energy Supply** – representatives of energy producers (fossil fuel, nuclear and renewables).
2. **Energy Efficiency** – representatives of energy consuming interests, primarily companies of energy intensive consumer products (e.g., automobiles, heavy industry, electricity).

3. **Land and Agriculture** – representatives of interests concerned with land use and conservation (e.g., farmers and forest managers).
4. **Population and Consumption** – representatives of organizations and government bodies that advise on economic policy and public health choices.
5. **Carbon Pricing** – representatives of major economies with the ability to set a global carbon price.
6. **Climate Activists** – advocates seeking the best possible outcome to address climate change and ensure minimum climate impacts.

The diagram, below, shown in the PowerPoint deck, shows the impacts that all teams have on the overall climate system.



Facilitation Roles

World Energy works best when participants as well as facilitators actively take on a role other than themselves. As the primary (or sole) facilitator, you will be playing the role of the UN Secretary General. If possible, enlist co-facilitators to assist you to lighten your load and give them an opportunity to learn how to facilitate. You may also find it helpful to co-facilitate with someone who has knowledge and skills that complement your own (e.g., a scientist or science educator may want to co-facilitate with someone who is more familiar with policy, economics, or business).

For example, you could have technical advisors who are colleagues that have experience with the exercise and advise groups on how best to fulfill various aspects of their assignment including lobbying other groups, or are people who run the computer and explain model output and climate science.

Room Setup

The room should be set up with:

- Tables and chairs for the teams. Each table should have:
    - A label with the group's name (table tent),
    - Briefing Statements for the team (one per team member),
    - 2-3 Proposal Forms.
- A computer with access to the En-ROADS simulation and PowerPoint slides, a projector, and a screen in the center of the room in the front.
- A white board (or flip chart paper) with a large grid for participants to write their proposals that everyone can read from their seats.
- Somewhere out of sight, such as outside the room or in the back, store your more formal clothes or accessories for acting as the UN Secretary General, *e.g.*, a man could store a tie and coat or a woman a jacket and scarf.

Handouts for each individual:

1. Briefing Statement (specific to their group)
2. Graph Sheet with background data

Handouts for each group:

1. World Energy proposal forms
2. Table card

Write on board:

1. Grid for everyone's inputs
2. Sketch of possible temperature outcomes **(see image at right)**

In addition to these materials you might consider using some props to help participants get into their roles and set the context of the group discussions and the dynamic between the groups. Here are some ideas:

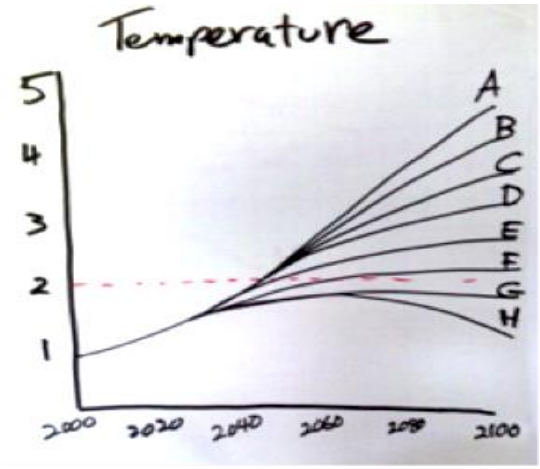


Figure 1

Optional Props for each group

Group	Props	Symbolism
Energy Supply	Individual bags candy or more sumptuous treats	Wealth, near term benefits, graft
Energy Efficiency	Consumer brochures focusing on efficiency attributes of companies	Potential benefits and opportunities from energy efficiency (educational tool)
Land and Ag		
Population and Consumption	Population graph – a single piece of paper (print out from World Climate slide deck)	
C pricing	Money if a C price gets enacted	Revenue
Climate Activists	Sign-making equipment; poster boards and markers; costumes; handcuffs	

Access to En-ROADS:

- Online En-ROADS access: https://www.climateinteractive.org/en-roads-online/
    - Username and Password: ciguest01 through ciguest10
- Provide computers or invite participants to bring their own computers in order to access the simulation during the second round of negotiations

Facilitation Steps

Opening presentation

Begin by briefly introducing background information on what is about to happen, climate change impacts, the use of the En-ROADS Simulation, and the challenge the group faces as a special UN Task Force. There are PowerPoint slides available on the Climate Interactive website to support this introduction, but pick and choose what suits your audience and needs. Limit this segment to about 15 minutes maximum. Hand out briefing statements, if they haven't been handed out in advance.

Step away for a minute while participants review their briefing statements (if they weren't able to read them in advance). Put on your official dress (e.g., tie/scarf and blazer). Then graciously welcome the group of leaders (participants) to a global summit that will advise the United Nations on how to attain climate and energy policy goals.

Example of facilitator's opening comments*:*

> *"You are gathered here today as leaders of the key sectors that influence the energy system and the greenhouse gas emissions that threaten our climate. In December, 2015, 190 countries reiterated a goal of limiting global warming to well below 2 ˚C over preindustrial levels and asserted the desire to stay within 1.5 ˚C. You represent the sectors that have the power to meet this objective.*
>
> *At the same time, the commitments put forth by these nations failed to deliver the deep cuts in emissions needed to meet this goal. The UN therefore has brought together multinational corporations, government ministers with shared expertise, and leaders of citizens groups and NGOs to reach across political boundaries and work within their spheres of action and influence.*
>
> *Your role is to demonstrate to government leaders and heads of state that there is a feasible, actionable path to stay below 2 ˚C of warming and to give those leaders a roadmap for achieving it. Time is short. You are charged with providing world leaders with a plan they can support. Given that political will in their home countries for climate action is mixed, your plan should be compelling and give government leaders what they need to advocate for action without losing their political standing.*
>
> *You have the capacity to take substantive measures to move nations towards a low-carbon world. I have brought you here today to give you an opportunity to work both within and across your sectors and to negotiate the best possible outcome. You are well aware of what is at stake. We are beyond a time of half-measures and incremental*

change. The best available science shows that greenhouse gases emitted by human activity have already increased global temperature by .8 degree Celsius, and that the risks of further climate change to our economy and to human welfare are serious. Yet avoiding the worst impacts is possible. You must balance the need for action with the realities of your own and your stakeholders' needs. I have the utmost confidence that you can do this. Good luck."

First round of negotiations

Give groups 20-30 minutes to:

- review their briefing sheet and supplemental information,
- review the decisions they need to make and begin formulating their positions and strategy,
- Determine their initial proposal and plenary speech

Gently encourage groups to:

- Use their props,
- Reach out to other groups to discover their positions and lobby them to change them if their in conflict with the groups own positions,
- Ask questions of the facilitator(s).

Remind them that they will need to appoint a representative to deliver at the first plenary session a two-minute presentation of their proposals and the main themes in their group's discussion.

First plenary session

- Each group is invited to make its presentation (Energy Supply, Energy Efficiency, Land and Ag, Population and Consumption, Climate Activists, Carbon Pricing).
- Facilitators enter decisions on board, but not yet in En-ROADS.
- After all groups have presented ask the participants to think about what outcome on temperature the sum of the proposals that have been put forward will have (i.e., to mentally simulate the temperature outcome). Have them select A, B, C, D, E where they think the result will be (see figure 1).
- Simulate the groups' proposals in En-ROADS (with suggested order of simulation as follows – Energy Supply, Energy Efficiency, Land and Ag, Population and Consumption, Carbon Pricing).
    a. More specifically we suggest you enter new tech/breakthrough cost reductions in renewables first, if there is one.

b. Each group's recommended distribution of revenue from the proposed carbon price should be recorded and saved for later discussion.

- If the sum total of the groups' proposals do not reach the <+2 ˚C goal, drive home the consequences (see slides for support information – e.g., if they reach +3.2 ˚C, show impacts at +3-4 ˚C).
- Explain the "bathtub dynamics" of CO_2 accumulation, to help participants understand why stabilizing emissions does not stabilize global temperatures or CO_2 concentrations. You can do this by using the familiar example of a bathtub and how when the inflow into the tub is at a higher level than the outflow out of the tub the stock (the amount in the tub) with rise. You can demonstrate this by pouring water into a glass (representing inflow and stock).
- As it is unlikely that the groups' initial proposals will produce a satisfactory result offer them another negotiating round, urging that they come closer to or attain the goal of <2 degrees C.

Second round of negotiations

- Encourage teams to talk and lobby each other to advance the agreement.
- Remind the Climate Hawks if they have been quiet that they should think creatively about how to influence the negotiations.
- If there are computers with access to En-ROADS available to participants, encourage groups to select one or two team members to use the En-ROADS simulation and provide policy advice to the group, while other team members work on negotiating deals with participants from other groups
- After ~20 minutes, invite each group to provide inputs on the board as before.

Second plenary:

- Each group offers its second round proposals along with the rationale for it. This can be done without inviting representatives to the front of the room to save time.
- Enter inputs into En-ROADS and determine outcome.

Debrief and closing (30 min-1 hour):

A good debrief enables participants to reflect on the experience they just had and consider what insights they are taking away. It comprises three areas of inquiry:

- What happened?
- What are the implications?
- What are potential applications?

In World Energy this translates into:

- What were the results of your efforts and the reasons for those results?
- What are the implications of what you achieved for the planet and its inhabitants as well as the various interests you were representing?
- What might you or others you could influence do to achieve the best possible results?

Begin the debrief by first congratulating the negotiators on their success. Then ask them to step out of their negotiating roles. Sometimes having everyone stand up and switch seats or moving to another room can help participants "reset."

Then facilitate a discussion by asking:.

- What surprised you, if anything, about the results you achieved and the difficulty of achieving them?
- To what extent did your proposals taken together produce the result you expected, or hoped for? Why or why not?
- If <2 ˚C goal was not ultimately reached, what might you have proposed that would have produced a better result – use the model for a couple of rounds of speculation
- Note that energy efficiency, price on C, GDP, other greenhouse gases are all 'high leverage' for reaching the goal.
- How did final energy demand, or other key parameters, respond to your proposals?
- If time allows, run sensitivity tests in En-ROADS, in which all levers are reset and individual levers are adjusted one by one to see their individual impact. Note that because En-ROADS is a nonlinear model, policies will have less impact if other policies impacting that part of the system have already been put in place.

Ask participants to address the following sorts of open-ended questions. Better if they discuss their responses first with a partner, then share with the whole group.

- What impact do you envision the result you achieved (in either round) will have on climate stability, on the earth's livability? On the interests you were representing in the exercise?
- To what extent is the result you achieved (in either round) feasible? From an economic standpoint? A political standpoint? A social or cultural standpoint?
- What do you see as the different benefits and values expressed in the varying approaches to the distribution of revenue from carbon pricing?

Invite participants to let go of their analytic perspective for a moment and think about how the exercise made them feel. Possibly ask participants to stand and go to a part of the room that best describes their feelings at this point. Designate different parts of the room for *anger*, *despair*, *hope*, *mixed feelings*. After participants sort themselves accordingly ask for comments on why they chose the place they are in.

What do you see as your unique contribution to producing a desirable result? You needn't make specific commitments at this juncture, just cite the kinds of positive actions individual citizens can undertake. Who else would you need to involve to make achieve a more favorable outcome?

Background on En-ROADS dynamics

Facilitators will often be asked to explain why the En-ROADS simulation is behaving as it is. Most all questions can be answered by these explanations:

1. Delays and capital stock turnover

New energy technologies (e.g., renewables, nuclear, "New Tech", biofuels), take a long time (decades, not years) to grow and compete with fossil-fuel-based fuels. There are two main sources of delays:

A. New supply capacity doesn't show up until old, long-lived capacity is retired (e.g., coal-fired power plants and oil refineries, which can survive for ~30 years).
B. Commercialization, permitting, financing, and construction all take time. Similarly, non-electrified end uses (e.g., cars and industry) can be electrified, but not instantaneously. Because of the time associated with building new energy infrastructure and retiring the old, the scale-up of energy technologies is much slower than the spread of many other technologies that we are familiar with, like smart phone apps or information technologies.

Addresses questions such as:

- "Why do renewables grow so slowly?"
- "Why does New Tech take so long to achieve its market share?"

To illustrate this point: Point to the graph of energy supply from various sources and show that, even as zero-carbon sources grow, it takes several decades before fossil capacity retires away.

2. Imperfect substitution

Growth in zero-carbon energy supplies such as wind, solar, nuclear, and "New Tech" don't reduce CO_2 emissions on their own. They reduce carbon dioxide emissions *only if* they take the place of burning coal, oil, and gas. In many scenarios, zero-carbon energy is inexpensive, but so are fossil alternatives, so they continue to be burned and emit CO2.

Use this idea to point participants toward policies that directly keep coal, oil, and gas in the ground – e.g., carbon prices, fuel taxes and energy efficiency.

Addresses questions such as:

- "Why doesn't the growth in renewables reduce temperature more?"

To illustrate this point: Point to the graph of energy supply from various sources and show that the world continues to burn coal, oil, and gas for the next 20-40 years.

3. Success builds success

Costs of energy supplies such as renewables fall as cumulative experience is gained through the "learning loop" and economies of scale. Every doubling of cumulative installed capacity of renewables reduces costs by around 20%, creating a reinforcing loop.

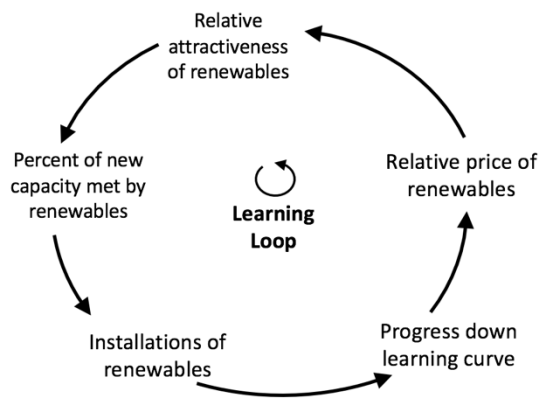


Figure 2.

Addresses questions such as:

- "Why should we have hope?"
- "How can we afford a transition to a low carbon economy?"
- "Aren't the costs of renewables prohibitive?"

To illustrate this point: Show and explain the diagram in Figure 2.

4. Supplies compete for market share

Many assume that if the world promoted several long term zero-carbon energy supplies such as nuclear, wind, solar, and some new technology ("New Tech"), their contribution to carbon mitigation would be additive. Instead, in the simulation one can see that they compete. More of one; less, the other.

Addresses questions such as:

- "Why didn't it help to add nuclear to this renewable-dominant scenario?"

To illustrate this point: Show energy supply by source with and without subsidies to zero carbon energy.

5. Fossil fuel growth has long term constraints

Rising costs due to scarcity of coal, oil, and gas materials put limits on the pace of growth of many energy supplies. This creates a balancing effect that is evident in the 2060s-2080s for coal, oil, and gas in the reference scenario when they begin to level off.

Addresses questions such as:

- "Why does this curve level out?"

To illustrate this point: Show energy supply by source post 2060.

6. Price, demand and supply are linked

Energy demand falls if energy prices rise, and demand increases if prices fall. The first is evident when carbon prices increase. The second, when zero-carbon energy such as renewables or New Tech are either subsidized or experience a breakthrough cost improvement. Often called the rebound effect or the Jevons paradox. In En-ROADS, the strength of this effect is governed by a parameter called "Price Sensitivity of Demand."

Addresses questions such as:

- "Why do subsidies for New Tech or renewables not help as much as I thought?"

To illustrate this point: Show energy demand relative to the Reference Scenario. You could also show overall average energy price as well.

7. Population and GDP/cap growth drive emissions

Perhaps the biggest challenge to limiting future warming in this simulation is the powerful growth in global GDP, which is population times the gdp/person. Energy efficiency and changes to the fuel mix can help reduce energy emissions, but their success is dampened by the overall ~2% per year growth in GDP. Recognizing this fact leads many game players to explore different futures for population (for example, by empowering women in developing countries, which could lower

population growth) and GDP/capita (for example, by finding ways to meet economic needs without increasing consumption).

Addresses questions such as:

- "We've done a lot in energy efficiency and clean energy – why haven't we solved the climate crisis?"

To illustrate this point: Show the "Kaya Identity" graphs and point to GDP over time.

8. Non-CO_2 emissions affect temperature a lot

Methane, N_2O and the f-gases are controlled by the "other gases" lever in En-ROADS. Adjusting this has a large impact on temperature. This implies changes in livestock management and consumption, waste management, fertilizer use, and industry to make a difference.

Addresses questions such as:

- "We've done a lot in energy – why haven't we solved the climate crisis?"

To illustrate this point: Show emissions of "Other gases" and move the "Other gases" slider.

9. Temperature and CO_2 Concentrations seem weakly responsive to CO_2 emissions

Emissions must fall significantly just to change the growth in temperature and CO_2 concentrations slightly. This counterintuitive dynamic is an important feature of the carbon and climate system. A short explanation for this dynamic would include the fact that the momentum in the carbon cycle and the climate lead to long delays between emissions and temperature. A long explanation is below, in Appendix A, and involves the powerful lesson of the carbon bathtub.

Addresses questions such as:

- "Emissions are stabilized, so why is temperature or CO_2 concentration still going up?"

To illustrate this point: Show the "Bathtub Graphs" view in En-ROADS comparing Emissions and CO_2 Concentration then talk through the Bathtub dynamics. More detail in Appendix A.

Appendix A: Explaining the Carbon Bathtub Insight

One of the best opportunities for teaching carbon dynamics may occur when the groups achieve a leveling of emissions or fall short of their goal by doing too little too late, i.e., when total CO_2 emissions stop growing and stay roughly level for the rest of the century. This is a good moment to teach the Bathtub analogy.

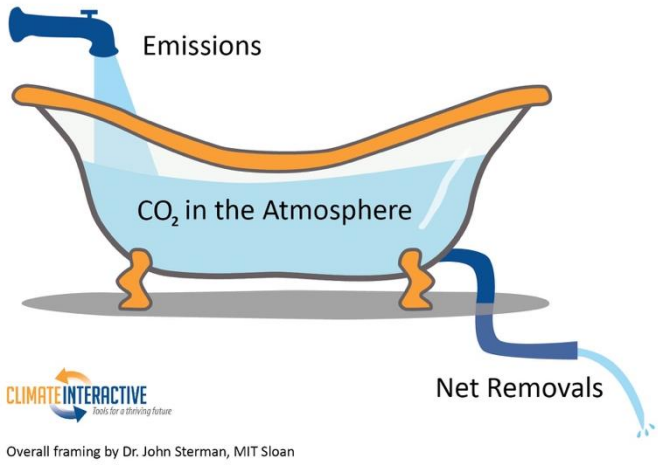


Figure 3.

There are several resources for you as you prepare to make this point.

- Climate Interactive's bathtub simulation and resources
- Dr. Juliette Rooney-Varga's video on systems thinking to understand climate.
- Drew Jones' video as part of the "Climate Leader" MOOC, which teaches about "stocks and flows" and uses the Carbon Bathtub as a main example.

Note – during this time you are acting less like the UN chair and more like a technical advisor. Open a graph of Total CO_2 emissions (it should be somewhat flat).

First, make sure the participants understand the basics of the biogeochemistry of the carbon cycle. Say something like:

"This graph shows the behavior of total global emissions of CO_2, which is {point at the spigot} *analogous to the inflow—marked "Emissions"—to a bathtub. These emissions come from where?"* {elicit from the group – burning coal, oil, and gas, and deforestation}.

"The emissions are measured in tons per year, a rate over time. Emissions build up the concentration of "CO_2 in the atmosphere," which is analogous to the amount of water in the bathtub. What is the current concentration of CO_2?" {elicit from the group: over 400 ppm}.

"*Does anyone know the goal that most scientists have proposed for the concentration below which we avoid the most damaging effects of climate change?*" {elicit from the group – less than 450 ppm}.

"*CO_2 also leaves the atmosphere through "Net Removals," analogous to this drain in the bathtub. Where does the carbon in CO_2 end up when it*

leaves the atmosphere?" {elicit from the group – trees, plants, and soils, and oceans}. "*It says 'net' because a large amount of carbon is constantly moving between the biomass, oceans, and atmosphere naturally.*"

Second, elicit participants' mental models about how the system behaves – i.e., given a graph of flattening emissions (and removals), ask them to draw the resulting graph of atmospheric CO_2 concentrations and temperature trends. Most people use a correlation heuristic and draw a line with the same shape as the emissions trend.

Third, illustrate the actual system behavior using the bathtub analogy. With inputs to En-ROADS that result in flattening emissions, navigate to the "Bathtub graphs" view and draw attention first to the emissions trend, then to the concentration trend (which continues to rise). Using the bathtub analogy, point out that emissions are an inflow, while removals make up the outflow. As we know, in a bathtub, as long water is coming into the tub faster than it is draining from it, water accumulates. Similarly, as long as emissions of CO_2 into our finite atmosphere are higher than net removals, CO_2 accumulates. Therefore, reductions in emissions are needed to stabilize concentrations. In addition, CO_2 accumulates at an even higher rate as long as action is delayed, requiring steeper rates of decline to meet the same concentration or temperature targets.

Fourth, encourage participants to use this insight to improve the outcome of their negotiation, i.e., "*Okay, now you see that we need significant reductions in emissions. Meet with your teams and determine the next round of action.*"

Good luck. Experiment to find what works.

And don't hesitate to let us know how you have found it useful
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