

The Art of a Deal: A Kyoto Protocol Simulation

By Richard Cowlshaw, Charles Hunter, Jason Coy, and Michael Tessmer

In this case study, groups of students represent countries as they negotiate an agreement to limit greenhouse-gas emissions. While initially developed for and used in an environmental-science course for first-year college students, the case could be applicable to other courses dealing with conflict resolution such as public policy, international relations, and certain business courses.



The case

In this simulation, you will represent one of several countries attempting to barter an international agreement to lower global carbon dioxide (CO₂) emissions. For simplicity, there will be only three countries (A, B, and C) that need to lower their CO₂ emissions. To add a bit of realism, there will be one developing country (Country D) that is exempt from any reduction agreement.

The goal of each country is to maximize its score as computed below. At the end of the simulation, each member of the highest-scoring country will have their name thrown into a hat for a \$50 campus-bookstore gift certificate.

Rules

1. Countries A, B, and C will begin the simulation with 100 CO₂ units and \$100 per country. Country D has 50 CO₂ units for sale and \$20 to start.
2. An agreement must be reached that lowers global CO₂ emissions of Countries A, B, and C by 100 CO₂ units. The 100 could include CO₂ purchased from Country D. If an agreement is not reached, no names go in the drawing for the gift certificate.

3. Countries A, B, and C must approve any agreement unanimously. Country D has no vote.
4. Each country will designate two representatives who may speak to any other country or address the countries as a whole.
5. Country D has 50 CO₂ units available for sale. Any country can purchase these units with their dollars. These 50 units can be sold in smaller blocks to separate countries. Any money used to purchase CO₂ units is given directly to Country D.
6. Any CO₂ unit sales or reductions must be done in whole units.

Scoring: Determining the winner Countries A, B, and C

At the beginning of the simulation, Countries A, B, and C all have 200 points (\$100 + 100 CO₂ units). However, at the end of the simulation if the CO₂ units of A, B, or C are below 100, their economies suffer. If the CO₂ emissions are below 100, the economy loses a dollar amount equal to half the number of CO₂ units below 100. For example, if Country A ends up with 80 CO₂ units and \$100, their economy will end up at \$90. Their

total score will then be 170. (For the example described, the score of 170 comes from: $100 + 80 - (20/2) = 170$)

Country D

The final score will be three times the economic size in dollars. Your starting economy size is \$20, for a starting score of 60. No credit will be given for unsold CO₂ units.

Teaching notes

This case study was developed as part of a course named “Planet Earth” that is taught each fall at Southwestern College. The course is part of the college’s general education curriculum and is geared toward first-year students with minimal science backgrounds. The overriding philosophy of the instructors is to focus on the process of science using environmentally based case studies. The course includes a lab component that is a mixture of project-based work at an outdoor field station and several indoor labs. There are usually about 70 students in the course who are split into four sections for the Kyoto Protocol simulation. The course has traditionally been team-taught by two faculty members. It is currently taught by a biologist and a chemist, although social-science faculty have been involved in the past.

The Kyoto Protocol simulation concludes a unit on global warming that follows the sequence of steps listed below. In its initial two years it was used in the middle of the unit, but the instructors have found that it best serves as a conclusion because it discusses something that is part of a comprehensive solution. The simulation itself is not strictly dependent on the other four parts of the unit and could be done independent of them, although some background material on

TABLE 1**A typical class.**

Time	Activity
10–15 minutes	Initial class discussion.
10 minutes	Group formation and rules explanation.
5–10 minutes	Groups get together to discuss strategy and designate representatives.
15–20 minutes	Negotiation and discussion among the countries with an instructor status report at some point.
10–15 minutes	Continued negotiation and discussion with instructor-imposed deadline. In some cases, no agreement will be reached by Countries A, B, and C.
10 minutes	Computation of scores and wrap-up. Common discussion questions: Who are the winners? Who are the losers? Why might one country choose not to be involved?

global warming would be required. A follow-up assignment wrapping up the global warming unit is also given out at the end of the simulation (online at www.sciencecases.org/kyoto_protocol/assignment.asp).

Overview of the five-part global-warming unit

1. Students are given an introduction to greenhouse gases and the greenhouse effect.
2. They then participate in a lab focusing on the analysis of temperature and carbon dioxide ice-core data and the building of a model atmosphere where the carbon dioxide level is altered.
3. A class discussion is conducted on the lab results and what scientists think might happen in the future.
4. Further discussion on potential effects of global warming takes place. An attempt is made to make the discussion current and relevant. The discussion in 2005, for example, focused on the potential connection between hurricane intensity and climate change.
5. The case study on the Kyoto Protocol wraps up the unit.

Objectives

- Examine issues related to a potential worldwide solution to greenhouse-gas emission increases.
- Teach students some details of the Kyoto Protocol.
- Show students the challenges associated with making an agreement involving numerous groups with different interests.

Based on the objectives and content

of the case study, we feel that this case would be effective in an environmental-science course or any course that deals with conflict resolution. These courses range from public-policy courses to international-relations and certain business courses. Many of the lessons described here apply to several areas.

Classroom management

The simulation was first tried during a 50-minute lecture period, but that was found to be too short. The 50-minute period allowed just enough time for students to complete the simulation and left no time for discussion and reflection. A class period of 60–80 minutes is recommended for the case study. We have also found that an incentive is helpful and a \$50 campus-bookstore gift certificate has worked better than extra-credit points. Individual instructors may edit the Kyoto rules as they see fit, based on course dynamics and budgets. A typical class breakdown is presented in Table 1.

At the start of the class period there is a short discussion with several PowerPoint slides (text below) that serve as a lead-in to the topic. Each point in the slides is brought in one at a time, with class discussion after each point in Slide 1.

Slide 1: What can be done about global warming?

- Working alone, determine two things you can do as individuals to reduce greenhouse-gas emissions.
- Working in a small group, generate a list of three or four ideas.

- As a group, what are two things that society can do to limit greenhouse-gas emissions?

Slide 2: The Kyoto Protocol

- An international plan to slow global warming
- An attempt to reduce global greenhouse-gas emissions to 5.2% below 1990 levels
- 156 countries involved in the initial drafting
- Agreement went into force in February of 2005
- Not ratified by only two developed countries: United States and Australia
- As a class, you will try to reach an agreement similar to the Kyoto Protocol

Following the class discussion, students are assigned to one of four countries for the case study and the guidelines are handed out to each person. We have found it easiest to have students count off A, B, C, or D to be assigned to the different countries. Because students are split up into four groups, a class size of 20 is the largest recommended. It is generally not advisable to have students form their own groups.

Students in A, B, and C are considered the developed countries and have large economies, but are also responsible for making voluntary reductions of their CO₂ emissions at an economic cost. Country D has a small initial economy, but has the advantage of having CO₂ units for sale on the open market. The key for the developed countries is to try to purchase the CO₂ units at the lowest price as a means to offset the economic impact of any agreement they make to reduce their CO₂ emissions.

The rules may initially seem complicated to students, but they can be distilled into a few major points. Students can keep track of money and CO₂ units on a piece of paper or using the templates (online at www.sciencecases.org/kyoto_protocol/kyoto_protocol.doc) con-

TABLE 2

Rules with instructor explanations.

Rule	Instructor explanation
Countries A, B, and C will begin the simulation with 100 CO ₂ units and \$100 per country. Country D has 50 CO ₂ units for sale and \$20 to start.	Countries A, B, and C are the developed countries and D is the developing country.
An agreement must be reached that lowers global CO ₂ emissions of Countries A, B, and C by 100 CO ₂ units. This 100 could include any CO ₂ purchased from Country D. If an agreement is not reached, no names go in the drawing for the gift certificate.	Countries A, B, and C are the only countries involved in the negotiation to lower global CO ₂ levels. At the start of the simulation each has 100 CO ₂ units, for a total pool of 300. In that case, the total needs to go from 300 to 200. Any CO ₂ purchased from Country D increases the total pool of CO ₂ available for reduction. For example, if 40 CO ₂ units are purchased from D, then the total needs to go from 340 units to 240 units.
Countries A, B, and C must approve any agreement unanimously. Country D does not vote.	A unanimous agreement is not part of the actual Kyoto Protocol ratification process, but has been found necessary for the classroom simulation.
Each country will designate two representatives who may speak to any other country or address the countries as a whole.	
Country D has 50 CO ₂ units available for sale on the open market. Any country can purchase these units with their dollars. These 50 units can be sold in smaller blocks to separate countries. Any money used to purchase CO ₂ units is given directly to Country D.	Countries A, B, and C must decide independently what they are willing to pay for the CO ₂ units of Country D. When the simulation begins, each country is given 5–10 minutes to sort through the information and come up with a strategy. Once the simulation starts, representatives from the countries talk with each other and move about the room. The important point for students to discover is that the CO ₂ units from Country D are worth no more than \$0.50 based on the scoring system. Some groups determine this, while others do not and pay too much.
Any CO ₂ unit sales or reductions must be done in whole units.	This keeps the math simplified.

taining money and CO₂ units. The authors have had the best success giving each group an envelope with money and CO₂ units and having students keep track of any reduction-agreement attempts on paper. Table 2 contains the rules from the handout with some more detailed instructor notes.

The winning country of the simulation is the one that maximizes its score based on the formula in the handout. If students work together and discuss the scoring system, they will realize that the CO₂ units from Country D are worth \$0.50 each. Our past experience has been that one or more of Countries A, B, and C will initially overpay for some of the units during an initial rush to purchase the units. For example, when we taught this case in 2005 the first 10 units were sold for \$30. Our experience has been that near the end of the simulation the price offered is very low and the last CO₂ units go cheaply or not at all.

Final thoughts and caveats

After the simulation has been completed, we have a short discussion of the case study. One discussion point that may be pursued is the consequences of not coming to an agreement (the United States and Australia have not ratified the final agreement). Second, the fairness of the clause that exempts developing countries from emission reductions can be debated. There are several differences between the real workings of the Kyoto Protocol (see Resources) and the simulation used in this case study. For example, emissions trading would occur between Annex I countries such as Russia and Canada. Despite these differences, we believe that the simulation is a useful tool because it shows the complexity of forging an agreement such as this and shows who potentially has more to lose than others.

The PowerPoint slides described above, along with the follow-up assignment and answer key, are available on the National Center for Case Study Teaching in Science website at www.sciencecases.org/kyoto_protocol/

[kyoto_protocol_notes.asp](#).

Acknowledgment

This case was developed with support from the National Science Foundation under CCLI Award #0341279. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

Resources

United Nations Framework Convention on Climate Change (UNFCCC). Kyoto Protocol. http://unfccc.int/essential_background/kyoto_protocol/items/2830.php.

Richard Cowlshaw is an assistant professor and Charles Hunter is a professor in the biology department at Southwestern College in Winfield, Kansas. Jason Coy is an assistant professor in the history department at the College of Charleston in Charleston, South Carolina. Michael Tessmer (mtessmer@sckans.edu) is an associate professor in the chemistry department at Southwestern College in Winfield, Kansas.