The Art of a Deal: A Kyoto Protocol Simulation

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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.

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

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
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.

**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 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.

<table>
<thead>
<tr>
<th>Rule</th>
<th>Instructor explanation</th>
</tr>
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<tbody>
<tr>
<td>Countries A, B, and C will begin the simulation with 100 CO₂ units</td>
<td>Countries A, B, and C are the developed countries and D is the developing country.</td>
</tr>
<tr>
<td>and $100 per country. Country D has 50 CO₂ units for sale and $20 to</td>
<td></td>
</tr>
<tr>
<td>start.</td>
<td></td>
</tr>
<tr>
<td>An agreement must be reached that lowers global CO₂ emissions of</td>
<td>Countries A, B, and C are the only countries involved in the negotiation to lower global</td>
</tr>
<tr>
<td>Countries A, B, and C by 100 CO₂ units. This 100 could include any</td>
<td>CO₂ levels. At the start of the simulation each has 100 CO₂ units, for a total pool of</td>
</tr>
<tr>
<td>CO₂ purchased from Country D. If an agreement is not reached, no</td>
<td>300. In that case, the total needs to go from 300 to 200. Any CO₂ purchased from</td>
</tr>
<tr>
<td>names go in the drawing for the gift certificate.</td>
<td>Country D increases the total pool of CO₂ available for reduction. For example, if 40</td>
</tr>
<tr>
<td></td>
<td>CO₂ units are purchased from Country D, then the total needs to go from 340 units to</td>
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