The Future of the Climate Change Regime: A Strategic Analysis

Extended Abstract #

Luai Hamouda[1,3], D. Marc Kilgour[2,3], Keith W. Hipel[3], and Jesse L. Thé[1]

[1] Lakes Environmental Software Inc., Waterloo, Ontario, N2L 3X2, Canada
[2] Department of Mathematics, Wilfrid Laurier University, Waterloo, Ontario, N2L 3C5 Canada
[3] Department of Systems Design Engineering, University of Waterloo, Waterloo, Ontario, N2L 3G1, Canada

CLIMATE CHANGE CONFLICT

The graph model for conflict resolution is employed to analyze systematically the current strategic conflict over the future of the Climate Change Regime (CCR). Beginning at the Eighth Conference of the Parties (COP 8) in New Delhi in 2002, parties to the Kyoto Protocol have failed to reach agreement on post-2012 commitments and other key issues. While delegates at the 2005 Montreal meeting (COP 11 and COP/MOP 1) agreed to hold future discussions of the CCR under both the Convention and the Kyoto Protocol, there is no assurance of future commitments[1].

Most signatories to the Convention and the Protocol can be classed as Developed or Developing. The Developed Countries, or Annex I Parties, agreed to specific emissions reduction targets and support broader commitments and mitigation. The Developing Countries, on the other hand, face no immediate reduction targets under either the Convention or the Protocol, and focus on adaptation, poverty eradication, and sustainable development[2].

The Developed and Developing Countries of the CCR are further organized into political coalitions based on their interests, economies, and culture. The main political alliances are the *EU,* the *Umbrella Group*, and the *Group of 77/China*[2]. The *EU*, which comprises 25 member states plus the European Community, seeks ambitious emission reduction objectives and opposes "loopholes" in the implementation of the Kyoto Protocol. The *Umbrella Group*, which includes Australia, Canada, Iceland, Japan, New Zealand, Norway, Russia, Ukraine and the US, aims to establish a cost-effective Kyoto system, and promotes flexibility in emissions targets and rules. The *Group of 77/China* includes 132 developing countries and China – all non-Annex I Parties. Its main objectives are to achieve sustainable development in the Developing Countries, enabling them to overcome poverty and attain wealth at the level of the Developed Countries[3]. In addition, there is a worldwide network of over 340 *Environmental Non-Governmental Organizations (ENGOs)* from 80 countries, which works alongside the Parties to limit anthropogenic climate change to ecologically sustainable levels[4].

The Developed Countries can also be divided into groups according to their attitude to their commitments under the Protocol in the first period (2007-2012). In the *EU*, there are 13 countries that can meet their commitments and 12 whose emissions are projected to exceed the EU's target[5]. The *Umbrella Group* can be divided into four groups: the US and Australia, which have high

emissions and have rejected the Protocol because it will harm their economies and because of the lack of "meaningful participation" by large-scale polluters including India and China[6]; Canada which has a substantial projected violation[5] but opted to pursue the Protocol regardless of cost[7]; Iceland, Japan, New Zealand and Norway which have moderate emissions and can meet their reduction targets at low cost[3]; and the Russian Federation and Ukraine which have surplus emission allowances, enabling them to profit from selling "hot air"[3].

Although Developing Countries are not subject to emissions targets, they are committed to set of actions and programs under the Convention Article 4 and the Protocol Article 10, and fall naturally into three groups. The Developing Countries with growing economies, in particular China and India, argue that their commitments under the Convention are conditional upon the Developed Countries' fulfilling their commitments regarding financial resources and technology transfer, and oppose negotiations that might quantify targets[3]. The *Organization of Petroleum Exporting Countries (OPEC)* is strongly opposed to measures to reduce carbon dioxide emissions, and is concerned about measures that would affect OPEC economies[3]. Finally the *Least Developed Countries (LDCs)* and *Alliance of Small Island States (AOSIS)* pollute the least, but are the poorest (the *LDCs*) or the most vulnerable (*AOSIS*). They support high emission reduction targets for industrialized countries, but depend on them for help to manage the adverse impacts of climate change[3].

However, new groups of environmental economists opposed to the *ENGOs* have emerged recently. They describe Kyoto as a case of "misplaced priorities", and argue that, while global warming is real, paying $150 billion a year ($100 trillion/1^{o}C) to postpone warming for a mere six years in 2100 is unjustifiable. This level of funding could meet other priorities such as provision of safe drinking water, prevention of communicable diseases, and elimination of hunger[8,9].

Thus, the CCR exists in a hostile setting characterized by the incompatible environmental and economic values of competing Parties. The future of the CCR is now analyzed using the graph model for conflict resolution.

STRATEGIC ANALYSIS

Graph Model

The graph model technique involves three key steps: modeling, stability analysis, and output interpretation. The following summary assumes only two decision makers; see Fang et al. (1993) for a comprehensive discussion[10].

A graph model, developed in the modeling stage, consists of a set of decision makers (DMs), a set of states representing the possible outcomes, and for each DM a set of arcs between states representing the unilateral moves (UIs) controlled by the DM, plus the DM's preferences over the states. Preferences are ordinal, so for any states s_m and s_n for any DM *i*, either DM *i* strictly prefers s_n to s_m, denoted $s_n \succ_i s_m$, or DM *i* is indifferent between s_n and s_m, denoted $s_n \sim_i s_m$. A move from state s_m to state s_n by DM *i* is a *unilateral improvement* (UI) for *i* if $s_n \succ_i s_m$. If

subsequent moves by *i*'s opponent, DM *j*, from state s_n to state s_p result in a state not preferred to the initial state s_m for DM *i*, i.e. $s_p \succ_i s_m$, then the unilateral move by DM *j* is a *sanction*.

At the stability analysis stage, at least four stability definitions (or solution concepts) that depict different patterns of human behavior are introduced. For a DM *i,* a state is Nash stable, or R, if it has no UIs, it is General Metarational, or GMR, if all of *i*'s UIs are sanctioned, it is Sequential Stable, or SEQ, if all of *i*'s UIs are sanctioned by *j*'s UIs, and it is Symmetric Metarational, or SMR, if *i* cannot escape the sanctions by a subsequent UI. A state that is stable under a specific solution concept for all DMs represents an equilibrium of the model, and is interpreted as a possible resolution.

At the interpretation stage, stability analysis results are cross-checked against the real-world conflict under study. Implausible stabilities usually are linked to faulty input data; new information can usually revise the model beneficially. Moreover, different model parameters can be altered to check the robustness of the conclusions; this process is called sensitivity analysis.

Analyzing the Future of the Climate Change Regime

Decision Makers (DMs) and Feasible States

To produce a simple but useful model, the Parties to the CCR are divided into two groups: Proponents of the CCR (P) and Opponents of the CCR (O). Each DM controls two options. P may put higher priority on maintaining the CCR – labeled MC – or on economic growth – labeled EG. DM O has the same two options. Since each DM must select one and only one option, there are four feasible states, which are shown in Figure 1 as circles. The first option listed in a circle belongs to P, and the second to O, so that at (MC, EG), P has opted for maintaining the CCR while O has chosen economic growth. Note that P moves vertically only, while O moves horizontally only, as indicated by the arcs.

State Rankings

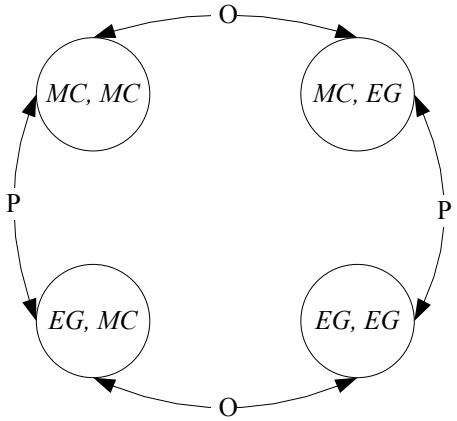
In this model, the rankings of states by the two DMs reflect current preferences – P is environmentally motivated while O is oriented to economic growth. The ranking for P, (*MC*, *MC*) $\succ_P$ (*MC*, *EG*) $\succ_P$ (*EG*, *MC*) $\succ_P$ (*EG*, *EG*), is interpreted as follows: P most prefers that both DMs maintain the CCR (*MC*, *MC*), followed by P supporting the CCR even if O pursues economic growth (*MC*, *EG*); next that O supports the CCR while P prefers economic growth (*EG*, *MC*); P's least preferred state occurs when both DMs pursue economic growth (*EG*, *EG*). Similarly, the state ranking for O, (*EG*, *EG*) $\succ_O$ (*MC*, *EG*) $\succ_O$ (*MC*, *MC*) $\succ_O$ (*EG*, *MC*), indicates that economic growth outweighs environmental values for this group.

Stability Analysis

At this stage, the stability of each of the four feasible states for every DM for all solution concepts can be calculated. A state is an equilibrium under a specific solution concept if neither DMs has an incentive to move away from it unilaterally. In this model, there is a single

equilibrium, (*MC*, *EG*), which is stable for both DMs under all four of the stability definitions: R, GMR, SMR and SEQ.

Figure 1: Graph model of the climate change conflict



Output Interpretation

The analysis confirms that the current situation is a unique equilibrium. In other words, the current tug of war between opponents and proponents of the CCR has no winner, and it is unlikely that any DM can be induced to shift from the current initial position.

A sensitivity analysis is carried out to ascertain the robustness of this conclusion to P's preferences. Specifically, suppose that the cost of implementing the CCR is found to be prohibitive. P would still most prefer to protect the environment, but if and only if O would do the same. P's next most preferred state is now assumed to be either state in which P chooses option EG (i.e., pursues economic growth), and P's least preferred states is that P commits to preserving the CCR while O pursues economic growth. Thus, P's preference order changes to $(MC, MC) \succ_P (EG, EG) \succ_P (EG, MC) \succ_P (MC, EG)$. Note that O remains oriented toward economic growth, so its ranking of the states remains the same as in the original model.

Repeating the stability analysis under the new preference ordering for P shows that the unique equilibrium under R, GMR, SMR and SEQ is (*EG*, *EG*). At this state, the high cost of implementation has shifted P's priorities. This calculation seems to reflect the views of the US and Australia which, even though they remain Parties to the Convention, claim to have been forced outside the Protocol by the enormous economic costs of implementation.

CONCLUSIONS

The graph model for conflict resolution has been utilized to analyze the future of the CCR. The primary conclusion is that the current stalemate between supporters and opponents of the regime will continue for some time – at least until the end of the first commitment period, when many Parties can be expected to be in default of their commitments. If at that time it becomes clear that implementation will be extremely costly, Parties without quantified emissions targets and non-Parties to the Protocol will make it impossible for the proponents of the CCR to support it, bringing about its collapse. This outcome is predicted by the sensitivity analysis conducted above,

and is consistent with the alarming projections for the emissions of many Parties to the Protocol, the desperation of the Developed Countries (especially Russia at COP 11) over the lack of voluntary participation by Developing Countries[1], and the emergence in 2005 of the Asia-Pacific Partnership on Clean Development, which promotes "clean coal," nuclear, and renewable energy as opposed to emissions targets and timetables. While this partnership emphasizes that its aim is not to replace the CCR, it has already attracted the participation of several Developed Countries, including Japan[11]. We conclude that, in the long run, only a cost-effective cooperative climate change regime that is consistent with economic growth will achieve success.

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