

7. THE BRAZILIAN PROPOSAL ON RELATIVE RESPONSIBILITY FOR GLOBAL WARMING

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Introduction

This chapter examines the policy implications and future potential of the Brazilian Proposal for establishing limitations on greenhouse gas emissions. Considerable confusion surrounds this Proposal, in part because the term “Brazilian Proposal” has two meanings. One refers to the specific proposal introduced in the United Nations Framework Convention on Climate Change (UNFCCC) negotiations prior to the 1997 adoption of the Kyoto Protocol (UNFCCC 1997b). Like other proposals put forward during Kyoto negotiations, the Brazilian Proposal offered a concrete option for structuring the Protocol’s emission limitation requirements. The other meaning refers to elements of the Brazilian Proposal that have persisted since the Protocol’s adoption. The most notable of these is the burden-sharing scheme, which apportions greenhouse gas (GHG) emissions targets according to each country’s historical responsibility for the global temperature increase. As such, the burden-sharing scheme can be understood as a general methodological framework for determining emission limitation commitments among states. This aspect of the Brazilian Proposal is very much still alive; research and analysis continues (MCT 2000; UNFCCC 2001).

This chapter has three sections. Section I describes the basic features of the original Brazilian Proposal as presented in the Kyoto negotiations. It also explains the proposal’s political significance in the negotiations. Section II discusses the Brazilian Proposal’s methodology in a policy context, including various ways of determining historical responsibility. Section III analyzes the future implications of adopting the proposal’s methodology under the Climate Convention and, in particular, the pros and cons of

using its burden-sharing scheme to establish emission targets for the Kyoto Protocol's second commitment period and beyond. This section suggests some modifications to the Brazilian Proposal that could make it more feasible in the future.

I. The Context and Features of the Original Brazilian Proposal

In 1995, the first Conference of the Parties (COP 1) to the Climate Convention adopted the Berlin Mandate, which stated the need to establish GHG emissions reduction targets for industrialized and transition (Annex I) countries and affirmed the implementation of the Convention's commitments for developing (non-Annex I) countries. The negotiation process aimed to adopt a protocol to the Climate Convention at COP 3, in Kyoto, Japan, in 1997. In the run-up to Kyoto, the process invited proposals from all Parties on how to shape "quantified emission limitation and reduction objectives" for Annex I Parties. Many proposals included indicators—or a combination of indicators—such as per capita emissions, gross domestic product, and energy intensity, among others (UNFCCC 2000c). The idea of a Brazilian proposal was developed between 1996 and 1997 by experts from the government and the national scientific community and, particularly, by Luiz Gylvan Meira Filho and José Domingos Miguez from Brazil's Ministry of Science and Technology, in consultation with Luiz Pinguelli Rosa, professor at COPPE/UFRJ.¹ In July 1997, the Brazilian government presented its proposal to base emission reduction requirements on an industrialized country's relative responsibility for the global temperature rise (currently about 0.6° C higher than pre-industrial levels).

Specifically, the Brazilian Proposal called on Annex I countries as a bloc to reduce their GHG emissions 30 percent below 1990 levels by the year 2020. The proposed reduction target covered the three main GHGs (carbon dioxide, methane, and nitrous oxide) and extended from 2001 to 2020 (using a succession of 5-year commitment periods).

The Proposal's most innovative feature was the method used to distribute emission reduction burdens among countries—according to each country's relative responsibility for the global temperature increase. The Proposal included a complex methodology for determining this responsibility for individual Annex I countries, as well as for determining the associated targets (the target methodology was *not* applied to developing countries in the Brazilian Proposal). It also suggested the need for an "agreed

climate-change model” for estimating each country’s contribution to global temperature increase and, as an illustration, included a “policymaker model” for estimating country targets (UNFCCC 1997b).

One consequence of the Brazilian Proposal’s approach and methodology was that countries that industrialized earlier tended to incur the largest emission reduction requirements in percentage terms. For example, in the original Brazilian Proposal, the indicative target for the United Kingdom was a 66 percent reduction below 1990 levels by 2010, while the targets of the United States and Japan were about 23 and 8 percent, respectively, reflecting the fact that they industrialized more recently than the United Kingdom (UNFCCC 1997b). However, these targets and others presented in the original Proposal were illustrative only and were later shown to have some methodological shortcomings (see Section II). The Proposal incorporated flexibility into targets by allowing individual targets to be negotiated among Annex I countries. In other words, Annex I Parties would be bound by the collective target and could trade individual targets among themselves.

Another important element of the proposal was the Clean Development Fund (CDF)—a punitive and financial mechanism to be managed by the Global Environment Facility. Failure on the part of industrialized countries to achieve their required reductions would result in a fine, payable to the CDF. The value attributed to the fine was set at US\$10 per ton of carbon emissions exceeding the target. The distributive criterion for the fund corresponded to the Brazilian Proposal’s rationale of proportionality: Non-Annex I countries could apply for funds according to their relative contributions to atmospheric warming. The funds would finance GHG abatement projects, and up to 10 percent would be used for adaptation projects. The primary objective of the proposed fund was to promote climate protection, including through the transfer of clean technologies and allowing for the participation of non-Annex I Parties.

With these features, the Brazilian Proposal addressed two key issues that pre-Kyoto negotiations were attempting to address (UNFCCC 1997b, 9). First, it addressed the issue of “the future level of emissions to be tolerated from the Annex I Parties” (i.e., the “cap”). Second, the Proposal suggested a “criterion for the sharing of the burden” among industrialized countries (i.e., by historical responsibility for temperature increase). The Proposal also dealt with the issue of developing-country participation in a manner consistent with the Berlin Mandate (which called on industrialized countries to take the first quantitative commitments). Accordingly, the Brazilian Proposal did not call for developing-country commitments, but rather

for developing countries to share the CDF's proceeds in order to implement "clean development" projects.

The COP in Kyoto did not adopt the Proposal. Industrialized countries considered the methodology for estimating past emissions to be biased (see Section II)² and insisted on negotiating targets in a bottom-up, pledge-based fashion. Some industrialized-country Parties felt that the Brazilian methodology unfairly punished countries for actions in the past, when the consequences of emitting GHGs were unknown.

The CDF was rejected because, among other reasons, it was a punitive instrument entailing financial penalties, making it an unlikely instrument in an international treaty. The allocation of resources from the CDF to developing countries was also considered questionable. As noted above, the resources would be distributed to non-Annex I countries in proportion to their relative contribution to global temperature increase. In other words, the higher their contribution, the more resources they would receive. According to the simulation undertaken in the Proposal, China would receive the largest share of the funds, about 32 percent (UNFCCC 1997b). In light of these shortcomings, the Kyoto Protocol negotiations subsequently modified the CDF into what is now known as the Clean Development Mechanism (CDM), which earned widespread support from industrialized and developing countries alike.

Over and above the CDM, the Brazilian Proposal played a significant role in the Kyoto negotiations, and it should be understood within that historical context. Despite the fact that the 1995 Berlin Mandate called for quantitative commitments for industrialized countries only, the United States and some other developed countries were pressing hard in the Kyoto negotiations for such commitments from developing countries. The Brazilian Proposal helped defuse the arguments posed by the United States and others that developing countries should adopt emission limits. In a highly political debate, the Proposal used scientific considerations, the well-established polluter-pays principle, and the Climate Convention principle of responsibility to argue, if implicitly, against developing-country commitments.

Moreover, the Proposal helped to further engage developing countries in the debate over the emission commitments of Annex I. The analysis included in the Proposal illustrates that developing countries have an important stake in precedent-setting quantitative commitments adopted by Annex I (UNFCCC 1997b). Given the imbalances in negotiating power between industrialized and developing countries, the Brazilian Proposal framework held the potential to inject transparency and objectivity in

target setting, which might improve the future likelihood of developing countries receiving fair treatment.

II. Defining Responsibility for Climate Change

The Brazilian Proposal is more than a proposal presented in the Kyoto negotiations, it is a framework for allocating emission reduction burdens across countries and a subject of continued debate and analysis. After COP 3, the Brazilian Proposal was referred for further methodological analysis to the Subsidiary Body for Scientific and Technological Advice (SBSTA). The SBSTA review includes an effort by the Secretariat of the UNFCCC to promote debate and information sharing.³ The Secretariat has organized expert meetings to review the Proposal, aiming to “identify issues relating to the scientific and methodological aspects of the Brazilian proposal, including those that need further consideration and areas of future work” (UNFCCC 2001). Although this assessment does not directly address policy implications, the Brazilian Proposal is currently the only such proposal being officially considered by the Parties.

Two policy-related questions are important to the ongoing review and study of the Brazilian Proposal methodology. First, how well does the Brazilian Proposal methodology capture the relative contributions to warming? Second, are relative contributions to warming the appropriate measure of country “responsibility?” The remainder of this section examines these two issues in detail.

Methodology of the Brazilian Proposal

In response to scientific and technical concerns raised by experts, the Brazilian government revised the calculation method that accompanied its original proposal in 1999. The latest calculation methods for the Proposal (dated January 2000) are available on the websites of the Brazilian Ministry of Science and Technology and the Climate Convention Secretariat.⁴ In its review of the Proposal, SBSTA is systematically investigating scientific and methodological issues. A background paper by the UNFCCC (2001) Secretariat identifies a host of scientific and methodological considerations worthy of consideration.

The Brazilian Proposal has already been the subject of considerable scientific study.⁵ A landmark report by the Dutch research institute RIVM (Elzen et al. 1999) reviewed both the original and revised versions of the Brazilian Proposal. The study found that the revised version was “a major improvement with respect to the original version but still contains a few

Table 7.1. Regional Contribution of Greenhouse Gas Emissions to 1990 Temperature Change, *percent of total*

Country or Region	CO ₂ from Fossil Fuels Only	Methane, Nitrous Oxide, and CO ₂ including CO ₂ from Land-Use Change
Canada	2.3	2.0
United States	31.2	21.7
Western Europe	21.7	16.3
Eastern Europe	5.8	5.0
Commonwealth of Independent States	14.8	11.9
Japan	4.2	2.8
Latin America	4.3	10.9
Africa	2.5	5.7
Western Asia	1.8	2.6
India	1.9	6.9
China	7.0	10.8
Oceania	1.2	1.7
Annex I	81.2	61.1
Non-Annex I	18.8	38.9

Source: Elzen et al. 1999.

Note: Results are derived from the EDGAR-HYDE data set and the meta-IMAGE model, not the Brazilian policymaker model.

shortcomings. The revised model still ignores the terrestrial part of the carbon cycle, and only focuses on the slow (oceanic) carbon dynamics” and contains some other characteristics that “seem to differ from those of other climate models.” The overall effect, according to the RIVM study, is “an overestimation of the contribution of Annex I countries to temperature increase. These deficiencies can all be improved by corrections or by importing techniques and processes already available in other models.”

In this regard, Elzen and colleagues analyzed the Brazilian Proposal with respect to the sensitivity of incorporating various GHGs and sources. Because of limited data availability, the original Brazilian Proposal considered only CO₂ emissions from fossil fuel sources. Table 7.1 shows that the relative responsibilities of countries and regions can change significantly when all sources of CO₂ (including from land use changes) as well as two other GHGs (methane and nitrous oxide) are included. The incorporation of all sources of CO₂, methane, and nitrous oxide reduces the collective responsibility of Annex I countries for temperature increase from 81

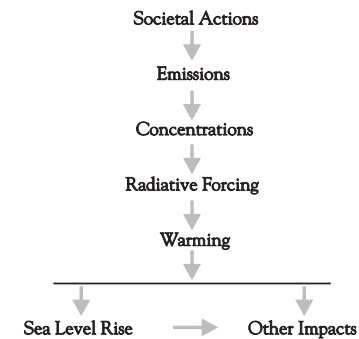
to 61 percent. Scientific and model uncertainties can also strongly influence relative responsibilities (Elzen and Scheaffer 2002). Interestingly, however, Elzen and Schaeffer show that if the relative responsibilities are calculated for *Annex I countries only* (consistent with the original Brazilian Proposal), the results are remarkably insensitive to modeling uncertainties and the inclusion of gases and sources beyond CO₂ from fossil fuels. This is partly due to the fact that developing countries have a much larger share of CO₂ emissions from land use changes and non-CO₂ emissions than from fossil fuel-related CO₂ (where industrialized countries dominate).

Indicators of Responsibility

Conceptually, the Brazilian Proposal is built on the “common but differentiated responsibilities” and “polluter pays” principles. These are important principles enshrined in the 1992 UNFCCC. Although these principles are widely accepted, the Brazilian Proposal is not without controversy. Responsibility is a normative concept with competing viewpoints.

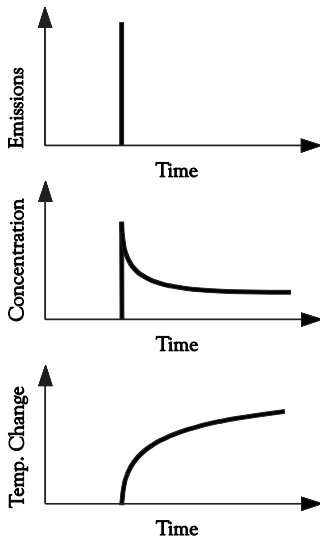
To illustrate, Figure 7.1 shows a representation of the chain of causality linking emissions to climate change and impact (Enting and Law 2002). Each stage of the chain involves some degree of *delay*; thus, the farther down the chain one goes, the greater the delay between actions and their effect. Indicators of responsibility could be considered at different points along this chain. Locating responsibility farther down the chain (e.g., sea-level rise) will differ considerably from locating it on the top part of the chain (e.g., emissions). It is important to realize that industrialized countries will show a larger share of responsibility using indicators late in the chain—such as temperature change and sea-level rise—mainly because of the longer average “age” of their emissions in the atmosphere. Countries with more recent emissions will therefore show smaller shares of responsibility late in the chain because their

Figure 7.1. A Chain of Causality in Global Warming



Source: Enting and Law (2002).

Figure 7.2. Temporal Relationship between Emissions, Concentrations, and Temperature Change



Source: Adapted from Höhne and Harnisch (2002); Elzen et al. (1999).

emissions have quite some time before reaching their full global warming potential.

These time delays are shown in Figure 7.2. The top frame shows a hypothetical “pulse” of emissions at a given point in time (with no emission before or after this pulse). This emission pulse leads to an immediate increase in atmospheric concentrations (middle frame), which declines over time as the gas is slowly removed from the atmosphere (e.g., through decay out of the atmosphere). Finally, the temperature change (bottom frame) resulting from the pulse continues into the future, even as the concentration is declining. Understanding these delays is essential to understanding the Brazilian Proposal and how it relates to other indicators of responsibility.

Time lags explain why the Brazilian Proposal has such different consequences than measuring responsibility with emissions or concentrations.

To illustrate, Table 7.2 shows the relative responsibilities of Annex I and non-Annex I countries using three different indicators. The first is *annual emissions* (1990) and the second is contributions to increases in CO_2 concentrations, which is a function of historical emissions over time. Finally, the contribution to *temperature increase* (i.e., actual warming) is shown for 1990 and projected for 2010 and 2020.⁶ Each of these indicators shows that industrialized countries are primarily responsible for climate change. However, industrialized country responsibility is largest when expressed in terms of temperature increase, due to the long atmospheric residence time of CO_2 and the past warming influence of CO_2 that is no longer in the atmosphere. Even though most emissions from 100 or more years ago are no longer present, their influence on global temperature lingers.

Under these different indicators of responsibility, the date at which developing- and industrialized-country responsibilities reach parity varies dra-

Table 7.2. Relative Contributions of Annex I and Non-Annex I Countries to Global Climate Change
Percentage Shares

Indicator of Contribution	Annex I	Non-Annex I
Emissions in 1990	75	25
Concentrations in 1990	79	21
Temperature increase:		
in 1990	88	12
in 2010	82	18
in 2020	79	21

Source: Adapted from Pinguelli Rosa et al. (2001).

Note: Includes only CO₂ from the energy sector.

matically. Using *annual* emissions, the IS92a scenario of the Intergovernmental Panel on Climate Change (IPCC) suggests that developing and industrialized countries will reach parity at about 2037. Yet, under the original Brazilian Proposal methodology, Annex I and non-Annex I responsibilities reach parity in 2147⁷—a delay of more than 100 years compared to calculations based on annual emissions. More recent estimates using different models and data sets suggest different dates. Analysis by Elzen and Schaeffer (2002) suggests convergence of Annex I and non-Annex I contributions in 2015 for CO₂ emissions, 2045 for CO₂ concentrations, and 2055 for temperature increase. Austin et al. (1998) estimate annual emissions parity at 2015 and concentration parity at 2057 (or 2038 if CO₂ emissions from land use are included). As explained in the previous section, if emissions from land use changes (e.g., deforestation) and all gases are included in the analysis, the date at which industrialized and developing countries reach parity under any indicator moves closer to the present.

Proponents of the Brazilian Proposal (UNFCCC 1997b), however, argue adamantly against formulating responsibility using annual emissions:

It is often implied that...most of the responsibility for climate change in the future will tend to be attributed to non-Annex I Parties, the year when the non-Annex I emissions equals those of Annex I Parties being taken as the year when the respective responsibilities become equal. This approach for implicit differentiation of responsibilities overestimates the non-Annex I Parties share of responsibility, as it does not take into consideration the different historical emission path resulting from very different industrialization process and consumption patterns in time of both groups.

Because climate change is caused not by *emissions* but by the rising *concentration* of GHGs in the atmosphere over time, the argument against using annual emissions as an indicator of responsibility is a strong one.

Nevertheless, the Brazilian Proposal's representation of responsibility is not without controversy. The Proposal takes into account only the temperature increase that has *already occurred*. It does not consider the extent of future warming that the present increase in atmospheric concentrations has committed us to. For this reason, the Brazilian Proposal weights past emissions significantly more heavily than emissions in recent years. Yet, recent emissions will undoubtedly have an effect on future warming. In this regard, Höhne and Harnisch (2002) suggest that an appropriate indicator for responsibility should be not only *backward-looking* (such as the Brazilian Proposal) but also *forward-looking*. Similarly, according to Elzen et al. (1999), "It might make sense to include some form of 'forward-looking' assessment in the analysis of countries' responsibility for global mean temperature increase. In such an approach, not only would the current effect be evaluated [as in the Brazilian Proposal], but also the future effect of greenhouse gases emitted in the present and the past."

III. The Future Potential of the Brazilian Proposal: The Burden-Sharing Scheme

This section analyzes the future implications of possibly adopting principles of the Brazilian Proposal within the UNFCCC framework, with particular attention as to whether its burden-sharing scheme could be used to set emission targets in subsequent rounds of the negotiation process for the Kyoto Protocol.

Continued Validity and Usefulness

Like most proposals made before the Kyoto Protocol's adoption, some parts of the original Brazilian Proposal are no longer applicable to the current negotiations. For example, the adoption of the CDM and the non-compliance procedures (through the 2001 Marrakesh Accords) suggest that the CDF will have little applicability in the future negotiations.

The Brazilian Proposal's burden-sharing scheme, however, continues to be a useful idea and could offer an approach to bring non-Annex I countries aboard the emission control system. So far, negotiations on developing-country emission limitations under the Climate Convention have been deadlocked. Developing countries insist on establishing a connection between the Climate Convention goals and sustainable development through

mechanisms that transfer financial resources and technology from North to South. In contrast, Annex I countries focus on their economic losses due to mitigation of GHG emissions and emphasize the need for developing countries to come aboard to achieve the Convention's objective of preventing dangerous climate change. The Brazilian Proposal supplies a starting point to break this deadlock. While focusing on the main goal of stabilizing the global climate, it quantifies the different individual contributions of each Party to the existing global temperature increase and, consequently, to the required efforts to solve or minimize the problem.

The proposed approach is science-driven. This is good news, as it avoids a burden-sharing scheme based solely on the bargaining power of Parties sitting at the negotiations table. Arrangements driven by sheer negotiating power are subject to all kinds of asymmetries and imperfections, as illustrated in the process leading to the establishment of Kyoto targets. However, it should be noted that the Brazilian Proposal's approach to establishing responsibility is not free of dissension, as discussed above.

Finally, the adoption of the Brazilian Proposal's burden-sharing scheme would be compatible with the Kyoto flexibility mechanisms, allowing for the deployment of market forces to help the scheme become easily operational. In fact, the Brazilian Proposal mainly addresses the establishment of targets for limiting the emissions of the UNFCCC Parties (i.e., the burden-sharing scheme) and can leave delicate implementation issues, such as compliance and limits to emissions trading, open for future negotiations.

Main Difficulties of Application and Possible Adaptations

The Brazilian Proposal's burden-sharing scheme faces some major difficulties that hamper its capacity to be immediately operational in the Climate Convention negotiations. These obstacles are discussed here, together with some possible adaptations that could improve the overall feasibility of adopting the general principle of the Brazilian Proposal in the next Kyoto rounds.

Complexity

As pointed out by Depledge (Chapter 2), "complexity can kill even the most intellectually brilliant proposal." This is a challenge for the Brazilian Proposal's burden-sharing methodology, which would require an agreement that incorporates complex scientific models and other technical considerations. One way to simplify would be to use the *cumulative GHG* emissions of individual countries from some given year in the past (to be nego-

tiated). This would avoid the need to use, and agree on, a particular climate model. The scientific rationale for doing so is based on the literature findings and recent IPCC work (IPCC 2000a), which has shown that cumulative emissions supply a reasonable “proxy” for the relative contribution to global warming of different Parties to the Climate Convention, when considered in a time period limited to a few decades. Actually, the Annex I/non-Annex I crossover dates for GHG concentration in the atmosphere (a function of cumulative emissions) and temperature increase are relatively close (e.g., only 10 years apart, 2045 and 2055, according to Elzen and Schaeffer (2002)).

Outreach and education efforts could also be used to overcome the complexity barrier. A systematic strategy is needed to better explain the methodology in terms accessible to wider audiences. This would include building on sparsely available previous attempts (e.g., La Rovere 1998). Through workshops and materials, the strategy would then disseminate the “user-friendly” information via an outreach campaign to stimulate public education and international awareness in a few target audiences in particular.

Data

Going back to the 19th Century presents serious problems because of the need for reliable GHG emissions data from individual countries to serve as a basis for negotiating future targets. CO₂ emissions from fossil fuels would be the least controversial data set to agree on. Elzen et al. (1999) show Brazilian Proposal calculations using three different fossil-fuel CO₂ data sets. The resulting sensitivity analysis shows relatively small differences in results. Even so, it may be difficult to reach a consensus on figures for the distant past. Experience with in-depth reviews of emission inventories has shown a number of difficulties in estimating emissions even for recent years. (See, for example, UNFCCC 2000a.) Furthermore, the Kyoto Protocol negotiations illustrate the political need to base decisions on official data supplied by each government rather than on the estimates of international organizations or research institutes or on the worldwide estimates of single government agencies.

The data challenges would be greatest for CO₂ from land use change and emissions of non-CO₂ GHGs. Again, the inclusion of these sources and gases will have a considerable impact with respect to attributing responsibility for warming at the global level (Elzen and Schaeffer 2002). Here, it seems difficult to even reach an agreement on accurate data for current years (see IPCC 2000b), and insurmountable obstacles might arise

in determining what figures to use for the 18th and 19th Centuries. One possible remedy to this difficulty would be to conduct extensive sensitivity analyses for different historical data sets of CO₂ from land use change and non-CO₂ gases. These analyses might identify the most significant discrepancies and enable analysts to develop estimates for use in the negotiations. Currently, however, very few historical data sets exist for these sources and gases at the country level. In any case, substantial improvement in the quality of land use change and forestry data, as well as non-CO₂ data, would be required at the national level.

Of course, data reliability problems would be reduced if the starting year for the accounting of cumulative emissions were established in the 20th Century: the closer to the present, the higher the quality of data. From 1990 on, this problem can be solved through proper review of inventories presented as part of national communications to the Climate Convention. However, the acceptability of such a late starting year for accounting of cumulative emissions remains to be proved at the negotiations table (see La Rovere 2002). Finding a balance to these data issues seems a daunting challenge.

Acceptance of responsibility for pre-1990 GHG emissions

The issue of responsibility for past emissions was first raised by a group of Indian scientists, under the leadership of the late Anil Agarwal, during preliminary discussions on the creation of the Climate Convention. Annex I countries then dismissed this argument, maintaining that they could not be blamed for their past GHG emissions' negative impact on world climate when they did not know about the consequences of burning fossil fuels at the time. According to this view, the first year to be taken into account would be 1990, when the IPCC published its First Assessment Report warning that GHG emissions could have been contributing to global warming. On the other hand, many countries have laws and regulations embracing the legal principle of "objective responsibility"; for example, in the United States and Brazil, a polluter cannot escape a penalty by claiming unawareness of the environmental damages caused.

Once again, a possible solution to this problem would be to use contributions to cumulative emissions from 1990 to the present, with a continuous update. Of course, this approach would favor Annex I countries, compared to the burden-sharing approach currently espoused in the Brazilian Proposal. Alternatively, a compromise could be reached if an earlier starting year were established, based upon previous warnings about the gravity

of the climate change menace from the scientific community or government reports (e.g., the 1960s report to the U.S. government from a commission of scientists chaired by R. Revelle et al.).

Bringing aboard developing countries

The Brazilian Proposal was originally devised as a burden-sharing scheme to be applied solely to Annex I countries. An important characteristic of the approach is that it yields emission targets in terms of absolute *reductions*. The Proposal does not currently allow for growth targets. This is problematic for any global application of the methodology. As outlined in Chapter 1, developing-country emissions will need to grow to meet economic development needs. Moreover, these countries' emissions are historically low and have contributed to climate change only in a small way. Imposing emission *reduction* targets on most (if not all) developing countries in the near and medium terms would be viewed as unfair and politically impossible.

One remedy might limit the application of the methodology to Annex I countries and shape commitments for developing countries on other bases (policies and measures, for example). Another possibility might be to use contribution to temperature increase or to global cumulative emissions as the starting point for negotiating targets for reducing emissions relative to a dynamic baseline (of the business-as-usual kind), rather than to a base year (this idea is illustrated in Chapter 9 of this volume). Additionally, individual or collective (non-Annex I countries as a whole) thresholds can be negotiated, below which countries would not need to commit to emission targets. Along these lines, Berk and Elzen (2001) examine a "participation threshold" based on income per capita.

Through these modifications to the Proposal, annual GHG emissions from Annex I countries as a whole would be required to decline continuously, while those from non-Annex I countries would be allowed to increase during an initial period, eventually stabilize, and finally decline until the end of the century. This kind of "safe-landing" analysis can build on the recent IPCC reference scenarios (IPCC 2000a) and the corresponding stabilization scenarios (IPCC 2001c). Informed by these scenarios, the duration of the grace period for non-Annex I countries to be free from mitigation targets would be negotiated.

Another option is to delay the participation of all developing countries until the relative responsibility of developing countries exceeds that of the industrialized countries. Prior to this date, the developing countries

would have a grace period. The IPCC Special Report on Emission Scenarios (IPCC 2000a) estimated the dates when *cumulative* CO₂ emissions since 1800 from non-Annex I countries as a whole would overtake those from Annex I countries, according to different global reference scenarios. The results cover a wide range of possible pathways and outcomes, with the cross-over dates varying from the year 2040 (under the A1 scenario) to 2050 (A2 and B1 scenarios) and 2110 (B2 scenario). Similar analyses could be easily undertaken for cumulative GHG emissions since 1990, and the corresponding dates could be anticipated. When cross-over occurred, emission-reduction commitments could be established for non-Annex I countries on the basis of each country's relative contribution to cumulative GHG emissions since 1990. This approach could also provide an incentive to Annex I countries that are taking the lead, as the sooner they start implementing mitigation actions, the sooner non-Annex I countries will be brought aboard.

Alternative approaches are also possible. For example, before Annex I/non-Annex I cross-over occurs, some individual non-Annex I countries (those that really matter in terms of contribution to climate change) might reach a given threshold of relative responsibility. Such a threshold could mark the end of the individual grace period to which they are entitled. Once a country reaches such a threshold, it would then be required to take a mitigation target, provided that a corresponding financial compensation is established under the Convention. The specific level of such a threshold could be negotiated and settled according to different criteria. Again, the analysis of long-term global and national GHG emission scenarios would provide useful inputs to this discussion.

The Need for Further Research

Taking the Brazilian Proposal's burden-sharing methodology as a starting point, further research could explore long-term global GHG emissions scenarios to illustrate the combined effects of different trajectories of Annex I and non-Annex I GHG emissions. This analysis would supply useful insights to the negotiations on the initial date of non-Annex I countries' commitment to mitigation targets, according to different targets for long-term stabilization of GHG concentrations in the atmosphere. The comparative modeling effort sponsored by the UNFCCC already provides an appropriate framework to explore this research agenda.

IV. Summary and Conclusion

The Brazilian Proposal was a positive influence on Kyoto Protocol negotiations. Although it was not adopted, the Proposal continues to influence the debate over the contentious issue of developing-country commitments and the shape of what has become the CDM. Moreover, its burden-sharing principle—a core element of the original Proposal—is the subject of continuing review and study by experts under the direction of SBSTA.

This chapter suggests several adaptations to the Brazilian Proposal approach that might increase its acceptability and effectiveness. First, expressing responsibility in terms of *cumulative emissions* over time would reduce the need for complex scientific models and associated uncertainties. Complexity and uncertainty are likely to be major barriers to adoption. Second, governments might consider reducing the time frame during which responsibility is assessed. One option is to begin assessing responsibility in 1990, the date of the first IPCC Assessment Report. This could also address some of the political challenge of agreeing on data sets (especially non-CO₂ data and CO₂ from land use changes) from distant time periods that are not gathered or verified by governments. Third, to become operational on a global scale, an approach such as the Brazilian Proposal needs adapting to allow for growth targets. This need might be accommodated by shaping reduction commitments relative to a business-as-usual projection, rather than from a base year. Fourth, because many developing countries contribute little to global warming, it might be prudent to adopt a threshold for participation. For example, until a country reaches a certain level of responsibility or level of income, it would not be required to adopt emission limits.

Overall, these changes would preserve the original spirit of the Brazilian Proposal while making it more acceptable to Climate Convention Parties. These suggested changes would deliver a strong incentive to non-Annex I countries, which would be rewarded by any early action toward a lower-carbon development profile, as they would face milder mitigation targets in the future, no matter when such commitments came into force. Linking the end of non-Annex I Parties' grace periods to the emission reductions achieved by Annex I Parties could also provide an incentive for Annex I leadership.

Notes

1. Instituto Alberto Luiz Coimbra de Pós-Graduação e Pesquisa de Engenharia/ Universidade Federal do Rio de Janeiro – Universidade do Brasil.
2. Bert Metz, personal communication, 2001.
3. The Secretariat has assembled a wide range of materials relating to scientific and methodological aspects of the Brazilian Proposal on the Internet (<http://unfccc.int/sessions/workshop/010528/documents.html>).
4. The updated Proposal (Ministry of Science and Technology 2000) expands Appendix I of the original Proposal, adding new components to the formulas to reflect the climate system more accurately, but also retaining the simple version, the “policymaker model,” as “the Brazilian Proposal.” In addition, it includes a discussion of the concept of global warming potentials (UNFCCC 2001). Hard copies of the updated calculation methodologies may be obtained from Ministério da Ciência e Tecnologia, Gabinete do Ministro, Esplanada dos Ministérios, Bloco E - 3 Andar - Sala 398, 70067-900 Brasília, Brazil.
5. See <http://unfccc.int/sessions/workshop/010528/> for documents and other materials related to the Brazilian Proposal.
6. The scientific justification for the variables chosen in terms of projections and scenarios is based on the Intergovernmental Panel on Climate Change’s (IPCC’s) Second Assessment Report.
7. The original version of the Proposal (still located on the UNFCCC website as of late 2002) states that parity would be in 2162. After submitting the Proposal in May 1997, the authors realized that some of the calculations needed revision and asked the Secretariat to change this part of the document after the deadline. They sent the corrected version, but only the chart was included, not the table and the text with the new results. The new calculations demonstrate this parity date to be 2147 (José Domingos Míguez, personal communication, 2002).