Policy Briefing

The Study of IIASA's Forestry Project produced a full carbon account of Austria, including (level or total) uncertainties, using data from around 1990. However, the Study focuses on conclusions that are not specific to Austria, but that are valid for other countries as well. Based on their deductive and inductive research, the IIASA scientists conclude that, more than ever, the Kyoto Protocol and the way in which national emissions are inventoried urgently need fundamental methodological improvements. Their deductive research directly leads the scientists to the following five straightforward conclusions, which will help guide the Protocol toward success

1. A robust full carbon accounting (FCA) system (embedded in a proper *full greenhouse gas* accounting [FGA] system) that permits the quantification of uncertainties within this wider context is required. Only such an accounting system can form a solid basis for accounting emissions and removals of greenhouse gases under the Kyoto Protocol.
2. The biosphere must be treated as a single system and must not be split into a *Kyoto* and a *non-Kyoto biosphere*.
3. The concept of uncertainty put forward by the Intergovernmental Panel on Climate Change (IPCC), which is defined with regard to two pre-defined points in time but disregards how the signal evolves dynamically in time, must be replaced by a verification concept that is sufficient in terms of temporal verification.
4. Bifurcated rules (actually, Protocols) are needed that treat the more easily verified fluxes (especially fossil fuel CO_2) differently from those that are more uncertain (notably CO_2 sinks).
5. An understanding of what the environmental criteria under the Kyoto Protocol should be must be developed. Environmental objectives (e.g., sustainability criteria) need to be introduced as a *condicio sine qua non* before economic measures are permitted to take effect.

The scientists' inductive research with reference to national emission inventories complements conclusions 1 and 4 above. With respect to conclusion 1, the additional conclusions of the IIASA scientists are as follows:

- The generation of a full carbon (or greenhouse gas) account for a country—which ultimately should be based on material flow analysis (MFA) because of its more direct link to the country's socioeconomic activities—is not an easy task, but it is one that needs to be tackled. An instruction manual with clear guidelines on how to accomplish this is not yet available, nor is one expected in the near future. Major data limitations and inconsistencies will occur for many countries.
- The application of relative uncertainty classes as a common good practice measure is recommended. They constitute a robust means to get uncertainties under control. In light of the aforementioned data limitations and inconsistencies, the reporting of exact relative uncertainties is not justified.
- To assess the uncertainties of national emission inventories, the IIASA scientists suggest using a simplified calculational procedure—in addition to applying Monte Carlo analysis for scientific safeguard reasons—that makes use of the law of uncertainty propagation as well as arising approximations, but that is more accessible for external verification.
- Austria is a *data-rich* country, making even *two-sided* statistics available in a number of cases. These are most interesting because they generally disagree, offering expert review teams the rare opportunity to scrutinize the quality of their work and ask themselves what they would not be able to adequately review if countries were to provide them with only *one-sided* statistics. The IIASA scientists suspect that, in the short-term, increased data richness will uncover more such predicaments rather than confirm existing understanding.
- PCA, as under the Revised 1996 IPCC Greenhouse Gas Guidelines or the Kyoto Protocol, does not ensure that the physical law of conservation of matter is rigorously preserved in deriving biospheric sink (or source) strengths. Compliance with this physical boundary condition can lead to greater uncertainty to be considered in the accounting. This shortcoming must be remedied. The accounting of biospheric sink (or source) strengths as required under the Kyoto Protocol is the least trustworthy, revealing uncertainties

potentially greater than 100%, with implications that may be crucial with respect to the implementation of Articles 3.3 and 3.4 of the Protocol.

With respect to conclusion 4, the additional conclusions of the IIASA scientists are as follows:

- The consideration of forest (as well as other biospheric) sink strengths in the total national CO_2 emissions increases the overall relative uncertainty of the combined CO_2 emissions (potentially also in terms of classes, depending on the magnitude of the sink strength). A greater relative uncertainty induces a greater verification time (VT), which is the time until a signal begins to outstrip its underlying uncertainty.
- Superimposing the highly uncertain emissions of the non-CO_2 greenhouse gases on the less uncertain CO_2 emissions can also induce the aforementioned effect. The overall emissions carry a greater relative uncertainty and thus result in a greater VT.
- Of all the modules, the ENERGY module's CO2 emissions exhibit the smallest relative uncertainty class, a situation we consider typical for many countries. In combination with the two previous conclusions, this supports the aforementioned request for bifurcated rules (actually, Protocols) needed to treat the more easily verified fluxes differently from those that are more uncertain.