1.2.4. Do Uncertainties Play a Role in the Context of Verification?

Uncertainties must be considered as a matter of principle. Without uncertainty estimates, no verification can occur. The Kyoto Protocol also mentions uncertainty. However, it does not put uncertainty – thus, verification – at the center of its efforts to slow global warming (Nilsson *et al.*, 2001, 2002). So far, the number of countries that have made their uncertainty assessments available is limited to Austria (Jonas and Nilsson, 2001; Orthofer *et al.*, 2000), Netherlands (van Amstel *et al.*, 2000), Norway (Rypdal and Zhang, 2000), Poland (Gawin, 2002), Russia (Nilsson *et al.*, 2000), and the United Kingdom (Charles *et al.*, 1998; IPCC, 1998), of which only two countries have done this on the basis of FCA: Austria and Russia, with Austria being the only one where uncertainties have been studied from two distinct perspectives: accounting and (diagnostic and prognostic) modeling.[1]

Several ways exist to graphically visualize the need of introducing and evaluating uncertainties in terms of verification. Figure 1 motivates this need from a credibility viewpoint, while Figure 2 directs attention to the scientific shortcomings of insufficient temporal verification.

---

[1] Charles, D., B.M.R. Jones, A.G. Salway, H.S. Eggleston and R. Milne (1998). Treatment of Uncertainties for National Estimates of Greenhouse Gas Emissions. Report AEAT-2688-1. AEA Technology, Culham, United Kingdom. Available on the Internet: http://www.aeat.co.uk/netcen/airqual/naei/ipcc/uncertainty.

Gawin, R. (2002). Level and Trend Uncertainties of Kyoto Relevant Greenhouse Gases in Poland. Interim Report IR-02-045. International Institute for Applied Systems Analysis, Laxenburg, Austria. Available on the Internet: http://www.iiasa.ac.at.

IPCC (1998). Managing Uncertainty in National Greenhouse Gas Inventories. IPCC/OECD/IEA Programme on National Greenhouse Gas Inventories, Meeting Report, 13 – 15 October, Paris, France.

Nilsson, S., A. Shvidenko, V. Stolbovoi, M. Gluck, M. Jonas and M. Obersteiner (2000a). Full Carbon Account for Russia. Interim Report IR-00-021. International Institute for Applied Systems Analysis, Laxenburg, Austria. Available on the Internet: http://www.iiasa.ac.at. Study also featured in: *New Scientist*, **2253**, 26 August 2000, 18–19.

Orthofer, R., E. Gebetsroither, F. Strebl, H. Schwaiger, B. Schlamadinger, G. Jungmaier, J. Spitzer, L. Canella, G. Hintermeier, A. Windsperger and F. Schneider (2000). The Austrian Carbon Balance Model (ACBM). Final Project Report OEFZS-S-0107. Austrian Research Centers Seibersdorf, Seibersdorf, Austria.

Rypdal, K. and L.-C. Zhang (2000). Uncertainties in the Norwegian Greenhouse Gas Emission Inventory. Report 2000/13. Statistics Norway, Oslo, Norway.

van Amstel, A.R., J.G.J. Olivier and P.G. Ruyssenaars (eds.) (2000). Monitoring of Greenhouse Gases in the Netherlands: Uncertainties and Priorities for Improvement. Report 773201 003. National Institute of Public Health and the Environment, Bilthoven, Netherlands.

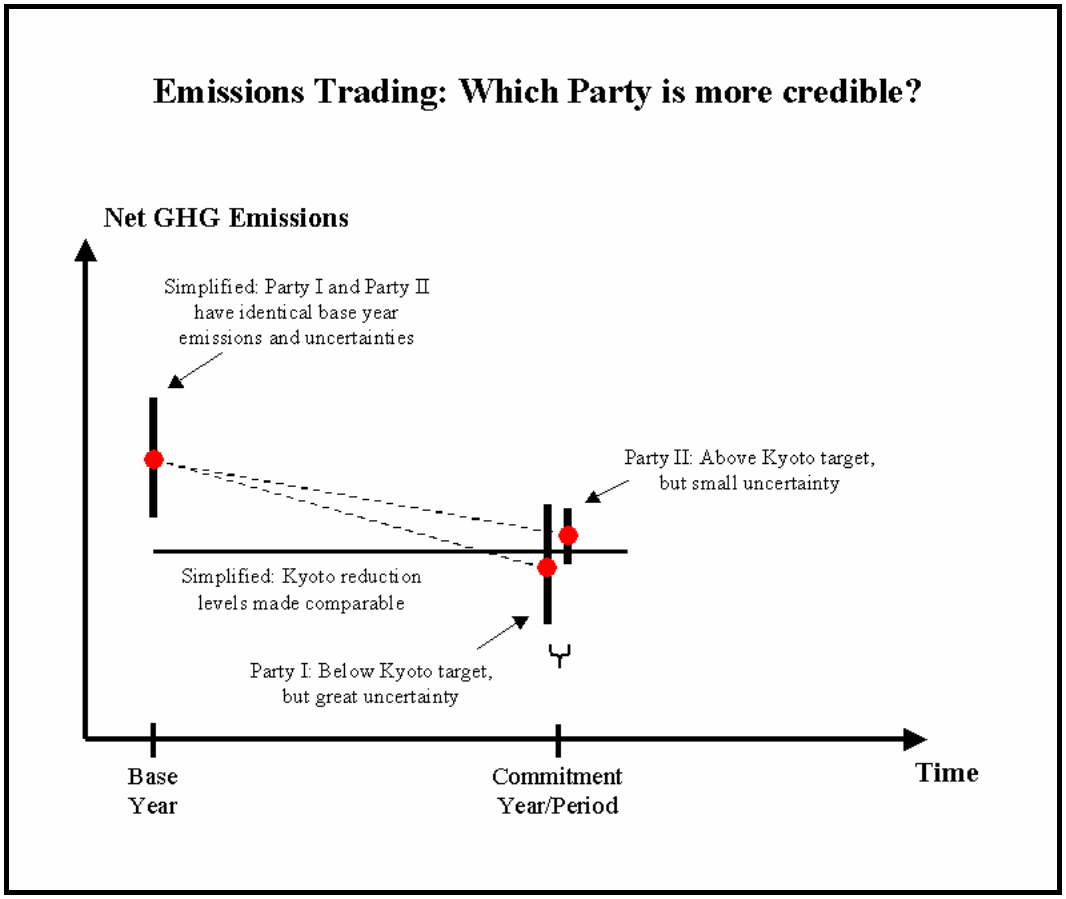

Figure 1: Simplified graphical representation to illustrate the importance of uncertainty and verification in the context of the Kyoto Protocol, here addressing the crucial question of credibility (IIASA, 2002; modified).[2] The uncertainty intervals of both Party I and Party II encompass the same Kyoto target, but which Party is more credible for emissions trading? Party I reveals a greater uncertainty interval, the mean of which undershoots the Kyoto target, while Party II reveals a smaller uncertainty interval, the mean of which, however, does not comply with the Kyoto target.

[2] IIASA (2002). The IIASA/FOR Workshop *GHG Accounting: Uncertainty – Risk – Verification*. Compendium, International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria.

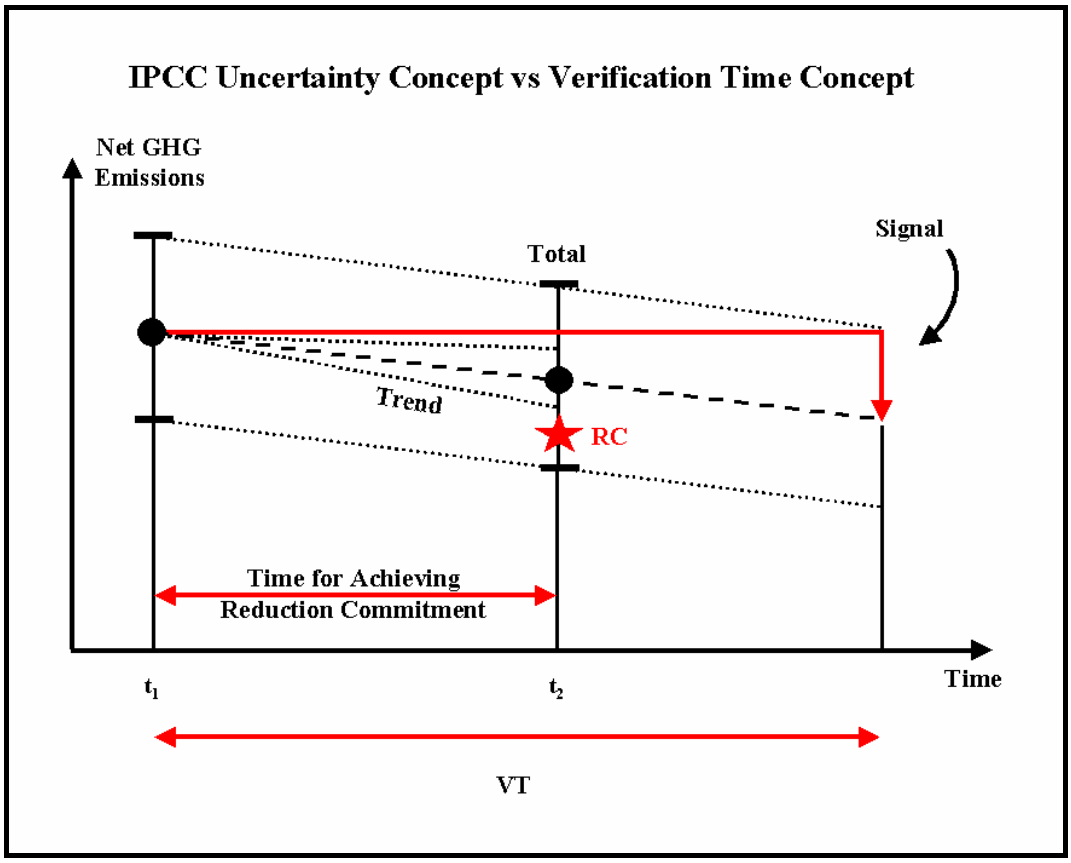

Figure 2: Simplified (linear) graphical representation to contrast static versus dynamical temporal verification. The figure shows: (1) the two-points-in-time uncertainty concept (here: with respect to t_1, t_2), i.e., the two uncertainties, which are currently discussed in accounting carbon under the Kyoto Protocol (IPCC, 2000a: Chapters 6 and 7; IPCC, 2000b: Sections 2.3.7 and 2.4.1): level (or total) uncertainty and trend uncertainty[3]; and (2) a dynamical verification concept, termed verification time **(VT)** concept, which takes the past (here: linear) dynamics of a country's emission signal into consideration to decide whether or not the net emissions of the country differ detectably from its committed Reduction Target **(RC)** (Jonas *et al.*, 1999, 2000; Jonas and Nilsson, 2001: Section 3.1.2). In this example, the VT – the time until the emission signal begins to outstrip its underlying uncertainty – is greater than the time for achieving the reduction commitment (t_2-t_1), confirming that: (1) the realized emission reduction is not verifiable at all at the time point of commitment (the emission signal has not yet outstripped level uncertainty), and (2) the interpretation of the country's realized emission reduction in terms of the two-points-in-time (total or trend) uncertainty concept must be rejected.

[3] The total uncertainty reflects our real diagnostic capabilities, that is, the uncertainty, which underlies our past as well as our current observations (accounting) and which we will have to cope with in reality at some time in the future (e.g., commitment year). By way of contrast, trend uncertainty reflects the uncertainty of the difference in net emissions between two points in time (here: t_1 and t_2).