Closure of Disputes in Assessments of Climate Change in The Netherlands

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ABSTRACT / This paper presents an analysis of the closure of visible disputes in the assessments of climate change in the Netherlands. We focus primarily on two key constituents of the assessments: the estimate of climate sensitivity and the inclusion of non-CO_2 greenhouse gases in assessment studies. For the cases studied, we identify variability in the assessment reports in the Netherlands during the pre-IPCC period. In the Netherlands arena, the assessments in this period can be seen as exponents of two different lines, a Netherlands line and an international line. We seek to identify what factors were decisive in the selection processes that resulted in the closure of visible disputes (visible in or across the assessment reports) for both cases. Our analysis reveals a remarkable difference in the adoption behavior of two Dutch assessment groups despite a large overlap in membership. We provide evidence that it is not the paradigmatic predisposition of the experts in the committee that was decisive for the closure of visible disputes, but it was the context in which the experts operated and the commitments they had made in each setting.

Anthropogenic climatic change is a relatively new area of research. In this field, experts started drafting assessment reports for policy makers when research on anthropogenic climate change was still in an early stage of development. Assessment is the analysis and review of information derived from research for the purpose of helping someone in a position of responsibility to evaluate possible actions or think about a problem. Assessment usually does not mean doing new research. Assessment means assembling, summarizing, organizing, interpreting, and possibly reconciling pieces of existing knowledge, and communicating them so that they are relevant and helpful for the deliberations of an intelligent but inexpert policy maker (Parson 1995).

The current record of assessment reports on anthropogenic climate change covers about two decades. In this period closure of visible disputes can be identified on a number of key constituents of the climate risk assessments (Jäger and others 1998). These closures appear primarily in the international climate risk assessment community that emerged in the 1980s and diffused from there to the national arenas. The emergence of an international assessment community led to an important conference on the climate change problem in Villach in 1985 and resulted in the establishment within the United Nations system of the Intergovernmental Panel on Climate Change (IPCC) in 1988. Nowadays the IPCC is the leading forum that carries out—and brings about closure in—climate risk assessment. Fourteen Dutch scientists contributed to the 1990 report by IPCC Working Group I (Houghton and others 1990). In the pre-IPCC period Netherlands expert committees carried out their own climate risk assessments. The most important pre-IPCC assessment group in the Netherlands was the CO_2 committee of the Gezondheidsraad (Netherlands Health Council). This committee had relatively weak links with the emerging international assessment community. For the elements studied, the assessments by the Gezondheidsraad differ significantly from the assessments made by the international community in that period. This situation changed with the preparation and publication of the IPCC 1990 report. Therefore the climate change assessment studies in the Netherlands constitute an excellent case by which to investigate mechanisms leading to the closure of visible disputes in science for policy.

For the purpose of this study we define closure of visible disputes as the achievement of consensus among the assessment community in the arena concerned. Funtowicz and Ravetz (1990) have designed a so-called pedigree matrix for research that contains a useful yard stick for colleague consensus. The pedigree matrix is a tool to identify the strength or robustness of science-based information in terms of social and cognitive criteria such as theoretical structure, data input, peer acceptance, and colleague consensus (Table 1). In this view, consensus is a social component of robustness.

It should be noted that the social (peer acceptance, colleague consensus) and cognitive dimensions (theo-

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Table 1. Social phase of pedigree matrix for research[a]

Code	Peer acceptance	Colleague consensus
4	total	all but cranks[b]
3	high	all but rebels
2	medium	competing schools
1	low	embryonic field
0	none	no opinion

[a]As proposed by Funtowicz and Ravetz (1990). Note that the process of closure on answers inferred from scientific research does not necessarily follow this scale linearly from low to high and that once the upper end of the scale is reached this is not necessarily the definite end-point, because closure can always be followed by reopening.

[b]''Rebels'' have some standing among their colleagues, whereas ''cranks'' have none. Who is considered a ''crank'' and who a ''rebel'' may change over time (Funtowicz and Ravetz 1990).

Table 2. Our operationalization of the Funtowicz and Ravetz scale for consensus on level of assessment reports

Code	Indicator for level of consensus
4	absence of interassessment variability
3	minority views are mentioned explicitly in the assessment reports
2	reports can be grouped as exponents of a limited amount of different views
1	ad hoc assessment-initiatives / large interassessment variabilities
0	absence of assessment reports

retical structure, data input) of robustness are not independent of each other: consensus formation clearly is facilitated by achievement of strength in the cognitive dimensions of robustness and vice versa. According to Everdingen (1988), the scientific foundations are the cornerstone of consensus formation; he also stresses the reciprocity between the actors involved in consensus formation and the consensus knowledge that is formed. Star (1988) stresses the importance of the aggregation of viewpoints in the achievement of robustness: ''Each actor, site or node of a scientific community has a viewpoint, a partial truth consisting of local beliefs, local practices, local constants, and resources, none of which are fully verifiable across all sites. The aggregation of all viewpoints is the source of robustness in science.'' Rip (1991) defines expert advice as robust if it is not easy to undermine. According to Rip, robustness is a hard-won achievement, and it is not simply the outcome of trying to be ''objective'' all the time. Rip argues that pragmatic rationality is crucial in the achievement of robustness. Robustness increase is the driving force of the hybrid social cognitive process of assessment.

In this study we have opted for an operational definition of closure on the level of the assessment reports. That is, we speak of closure if we observe the emergence of consensus over time across the various assessment reports produced in successive periods. We operationalize consensus on the level of the reports produced by the assessment communities, rather than on the level of the assessment communities as such. We identify the closure process in terms of an increase in the level of consensus, which in turn we derive from comparing statements in the existing assessment reports in succeeding time periods. We assume that the level of consensus in the assessment community is reflected in its reports. Expressed in terms of the scale of Funtowicz and Ravetz (1990), our operationalization of consensus is presented in Table 2. In terms of this operationalization, closure on an element of the assessment is reached at the moment in time when visible interassessment variability regarding that element has disappeared.

In this paper we analyze the closure process in the Netherlands arena for two cases: the estimate of climate sensitivity (namely the range 1.5–4.5°C) and the inclusion of non-CO_2 greenhouse gases in the assessments. For this purpose we investigated the time series of Netherlands climate risk assessments against the background of the closures in the international time series of assessments. The construction of the estimate of climate sensitivity in the international series of assessments has been analyzed by Van der Sluijs and others (1998, see also Van der Sluijs 1997). The inclusion of non-CO_2 greenhouse gases in the international assessments has been analyzed by Jäger and others (1998).

For the international arena, the successive reports of interest are the assessments produced by the US National Academy of Sciences (US NAS) from 1979 and 1983; the report of the 1985 Villach ''Conference on the Assessment of the Role of Carbon Dioxide and of Other Greenhouse Gases in Climate Variations and Associated Impacts,'' the reports by the German Enquete Kommission from 1988 and 1990 and the report by Working Group I from the Intergovernmental Panel on Climate Change (IPCC) from 1990 and its supplements from 1992 and 1994, and finally IPCC's Second Assessment Report of 1995 (US NAS 1979, 1983, Bolin and others 1986, Deutsche Buntestag Enquete Kommission 1988, 1990, Houghton and others 1990, 1992, 1995, 1996). All these reports had an international impact and have been cited in policy documents.

For the scientific history of the greenhouse problem we refer to Victor and Clark (1991), Jones and Henderson-Sellers (1990), Handel and Risbey (1992), Victor (1995) and Hecht and Tirpak (1995).

In the Netherlands arena six different advisory groups have issued assessments of the climate problem: the Scientific Council for Government Policy (WRR), the National Steering Group Environmental Research (LASOM), the Gezondheidsraad (GR), The Netherlands Advisory Council for Research on Nature and Environment (RMNO), the National Institute of Public Health and Environmental Protection (RIVM) and the Central Council for Environmental Hygiene (CRMH) (see Table 3 below). The assessments by the Gezondheidsraad[1] of 1983 and 1986, and the assessment by the RMNO[2] of 1984 have explicitly been used in Dutch policy documents (see also Van Eijndhoven and others 1998).

The central question in this paper is how the closure on the estimates of climate sensitivity and on the inclusion of non-CO_2 greenhouse gases in the assessments of climate change took place in the Netherlands arena. We will show that closure occurred in the Netherlands arena by diffusion of the closure reached in the international arena. This diffusion process took several years. In the transition period interassessment variability was observed. For the two cases studies, the most important assessment reports constructed in the Netherlands (the ones by the Gezondheidsraad of 1983 and 1986) deviated significantly from the international line and from another influential Netherlands assessment (by the RMNO 1984) which did adopt the results from the international arena.

The second part of this paper will address why it took significantly longer to reach closure in the assessments in the Netherlands arena than in the international arena and what we can learn from the different modes of conduct of the committees of the Gezondheidsraad and the RMNO, respectively. To answer these questions, we analyzed how the Gezondheidsraad assessment reports were constructed. In addition we extended our analysis of the assessment reports with an analysis of the minutes of the meetings of the committee that wrote the Gezondheidsraad reports and gathered additional information from interviews and personal communication with several experts who were involved in the assessments.

Results

Table 3 presents the closure time lines for the estimate of climate sensitivity in the assessments in the international arena and in the Netherlands arena. Note that all international assessments played a role in the Netherlands arena, whereas none of the Netherlands assessments played a role in the international arena. This holds despite the fact that the findings of the first report of the Gezondheidsraad were summarized in an article in *Ambio* (Hekstra 1986), and the second report of the Gezondheidsraad was translated into English (Gezondheidsraad 1987).

Climate sensitivity is a key quantity in the assessments. It indicates the global mean equilibrium temperature rise associated with an instantaneous doubling of atmospheric CO_2 concentration and acts as a highly aggregated simplified quantitative summary of the outcome of complex scientific studies (Van der Sluijs and others 1997). Table 3 shows that closure took place in the international arena in 1983 with the US NAS 1983 assessment (see also Van der Sluijs and others 1997). In the Netherlands closure was not reached until 1990.

In the pre-IPCC period we observed interassessment variability. The assessments of climate sensitivity in this period can be divided into two lines: the line of the Gezondheidsraad and the line of the international community on climate change. The international line superseded the Gezondheidsraad line in 1990 when the first IPCC assessment report was issued.

Table 4 presents the closure time lines for the inclusion of non-CO_2 greenhouse gases (non-CO_2 GHGs) in the assessments. The non-CO_2 GHGs, such as CH_4, N_2O, and chlorofluorocarbons (CFCs), started to get attention in the assessments from the mid-1980s on. In scientific publications, the non-CO_2 greenhouse gases showed up significantly earlier. In 1975, V. Ramanathan discovered the greenhouse effect of CFCs (Victor and Clark 1990). The first WMO statement on the greenhouse effect of CFCs dates from 26 November 1975 (WMO 1975). The significance of the greenhouse effect of anthropogenic CH_4 and N_2O was recognized in 1976 (Jäger and others 1998). It was also known that human activities influenced the atmospheric concentrations of these gases. It took more than ten years for the non-CO_2 GHGs to get a place in the assessments. Table 4 lists the non-CO_2 GHGs that were mentioned in the assessment reports analyzed.

The US NAS study of 1979 dealt with CO_2 only. The

[1]The Gezondheidsraad is an influential standing advisory body that was set up under the 1956 Health Act to assist the Netherlands government. Its function is to provide the Netherlands government with objective information on scientific developments on all matters relating to health and environmental protection. Reports are made by ad hoc committees of experts, appointed by the President of the Council.

[2]The RMNO was set up in 1981 and is one of the so-called ''sector counsels'' (in Dutch: ''sectorraden'') that were formed in the Netherlands in the 1980s. Sector councils are advisory bodies dealing with the programming of research for a medium-term period. They advise the government and the relevant ministries. The RMNO focuses on research on nature and environment. In contrast to the Gezondheidsraad, committees of the RMNO are composed not only of scientists but also of policy makers and representatives of NGOs.

Table 3. Closure time lines for climate sensitivity[a]

Assessment	Corresponding reference	Arena	Estimate of climate sensitivity (°C)	Estimate adopted from	Level of consensus (codes: see Table 2)	
					I	NL
WRR 1978	Schuurmans (1978)	NL	—			1
US-NAS 1979	US NAS (1979)	I/NL	1.5–4.5		1	1
LASOM 1979	LASOM (1979)	NL	2–3			1
US-NAS 1983	US NAS (1983)	I/NL	1.5–4.5		4	1
GR 1983	Gezondheidsraad (1983)	NL	2			1
RMNO 1984	RMNO (1984)	NL	1.5–4.5	US-NAS 1983		2
Villach 1985	Bolin and others (1986)	I/NL	1.5–4.5		4	2
GR 1986	Gezondheidsraad (1986)	NL	2–4			2
RIVM 1987	De Boois and others (1988)	NL	1.5–4.5	Villach 1985		2
DBEK 1988	Deutscher Bundestag Enquete Kommission (1988)	I/NL	1.5–4.5		4	2
CRMH 1988	CRMH (1988)	NL	1.5–4.5	RIVM 1987		2
IPCC 1990	Houghton and others (1990)	I/NL	1.5–4.5		4	4
DBEK 1990	Deutscher Bundestag Enquete Kommission (1988)	I/NL	1.5–4.5		4	4
IPCC 1992	Houghton and others (1992)	I/NL	1.5–4.5		4	4
IPCC 1994	Houghton and others (1995)	I/NL	1.5–4.5		4	4
IPCC 1995	Houghton and others (1996)	I/NL	1.5–4.5		4	4

[a]The estimates for climate sensitivity in assessment reports in the international (I) and the Netherlands (NL) arenas. Note that the indicated level of consensus in the right-hand columns is a metameasure of the period in which the reports were drafted rather than a measure of the individual reports.

US NAS 1983 report included a small chapter on "Effects of Non-CO_2 Greenhouse Gases." The Villach Conference in 1985 was the first assessment that comprehensively addressed the non-CO_2 GHGs. This conference brought closure regarding the inclusion of non-CO_2 GHGs in the assessments into the international arena. In the IPCC assessment of 1990 and its supplements of 1992 and 1994 and in the SAR, the non-CO_2 greenhouse gases have a prominent place within the assessments.

In the Netherlands, closure in the non-CO_2 greenhouse gas debate follows a similar pattern to that of the climate sensitivity case. In the pre-IPCC period we observe interassessment variability. Again the assessments in that period can be divided into the Gezondheidsraad line and the international line. Closure occurred because the international line superseded the Gezondheidsraad line after 1990 when the first IPCC assessment report was issued.

In the Netherlands, the major user of the assessments was the Netherlands Ministry of Housing Physical Planning and the Environment (VROM). In the period studied, VROM issued three policy documents that were entirely devoted to the climate problem. Table 5 presents the estimates of climate sensitivity and the non-CO_2 greenhouse gases given in these three policy documents. The table also shows what assessments they were based upon. The three policy documents are described briefly below.

In 1984 a working group of the Interdepartmental Coordination Committee Environmental Hygiene/Coordination Committee Concerning International Environmental Affairs (ICMH/CIM) of VROM issued the policy document "Carbon Dioxide, Signalling a Policy Issue." The scientific part of this document was based on the GR 1983 and RMNO 1984 assessments (Ministry of Housing, Physical Planning and the Environment 1984).

In 1987 the Minister of VROM presented a memorandum to parliament on "Climate Change by CO_2 and Other Trace Gases." This is the official government reaction to the second report of the Gezondheidsraad (1986). This reaction adopted the Villach 1985 estimate rather than the GR 1986 estimate of climate sensitivity (Table 5), whereas it also deals with the non-CO_2 greenhouse gases, despite the focus of the Gezondheidsraad on CO_2. Chapter 2 of VROM 1987 gives a scientific review of the causes and consequences of the greenhouse effect, based mainly on the Villach 1985 report rather than on the GR 1983 and 1986 reports. (Ministry of Housing, Physical Planning and the Environment 1987).

In 1991 the Minister of VROM issued the "Memorandum on Climate Change." This government paper explicitly adopts the IPCC 1990 assessment as the scientific starting point for policy development, and opted explicitly for a (greenhouse) gas-by-gas approach (Ministry of Housing, Physical Planning and the Environment 1990, 1992).

Table 5 shows that for the non-CO_2 greenhouse gases, VROM had already adopted the all-gases ap-

Table 4. Closure time lines for inclusion of non-CO_2 GHGs[a]

Assessment	Arena	Non-CO_2 greenhouse gases mentioned	Level of consensus (codes: see Table 2) M, A	I	NL
WRR 1978	NL	none			1
US NAS 1979	I/NL	none			1
LASOM 1979	NL	H_2O[b], O_3 (stratospheric, indirect)[c]	M		1
US-NAS 1983	I/NL	N_2O, CH_4, O_3, CFCs	M (A)	1	1
GR 1983	NL	none			1
RMNO 1984	NL	CH_4, N_2O, CFC-11, CFC-12, CFC-22, CCl_4, CF_4, CH_3Cl_3, CH_2Cl_2, $CHCl_3$, CH_3CCl_3, C_2H_4, SO_2, NH_3, O_3 (tropospheric), H_2O (stratospheric)	A		1
Villach 1985	I/NL	CH_4, N_2O, CFCs, O_3, (tropospheric)	A	4	2
GR 1986	NL	CH_4, N_2O, CFCs, O_3, (tropospheric)	M		2
RIVM 1987	NL	CH_4, N_2O, CFCs, O_3, (tropospheric)	A		2
DBEK 1988	I/NL	CH_4, N_2O, aerosols, O_3 (tropospheric), CO, H_2O (stratospheric), CFC-11, CFC-12, CFC-13, HCFC-22, CFC-113, CFC-114, CFC-115, CH_3CCl_3, CFC-116, CCl_4, CH_3Cl, Halon-1211, Halon-1301, CH_3Br.	A	4	2
CRMH 1988	NL	CH_4, N_2O, CFCs, O_3, halons	A		2
IPCC 1990	I/NL	CH_4, N_2O, halocarbons, O_3 (both stratospheric and tropospheric) and the ozone precursors CO, non-Methane Hydrocarbons, Reactive Nitrogen Oxides.	A	4	4
DBEK 1990	I/NL	CH_4, N_2O, O_3 (tropospheric), CFC-11, CFC-12, CO, stratospheric H_2O, aerosols, CFC-113, CFC-114, CFC-115, CCl_4, CFC-14, H-CFC-22, CH_3-CCl_3, CFC-116, CH_3Cl, Bromocarbons, Halon-1211, Halon-1301, CH_3Br.	A	4	4
IPCC 1992	I/NL	CH_4, N_2O, halocarbons, O_3 (stratospheric and tropospheric) and the ozone precursors CO, non-Methane Hydrocarbons, Reactive Nitrogen Oxides.	A	4	4
IPCC 1994	I/NL	CH_4, N_2O, CFC-11, CFC-12, CFC-13, CFC-113, CFC-114, CFC-115, HCFC-22, HCFC-123, HCFC-124, HCFC-141b, HCFC142b, HCFC-225ca, HCFC-225cb, CCl_4, CH_3CCl_3, CF_3Br, HFC-23, HFC-32, HFC-43-10mee, HFC-125, HFC-134a, HFC-152a, HFC-143, HFC-143a, HFC-227ea, HFC-236fa, HFC-245ca, $CHCl_3$, CH_2Cl_2, SF_6, CF_4, C_2F_6, c-C_4F_8, C_6F_{14}, O_3 (both stratospheric and tropospheric) and the ozone precursors CO, non-Methane Hydrocarbons, Reactive Nitrogen Oxides.	A	4	4
IPCC 1995	I/NL	CH_4, N_2O, CFC-11, CFC-12, CFC-13, CFC-113, CFC-114, CFC-115, HCFC-22, HCFC-123, HCFC-124, HCFC-141b, HCFC142b, HCFC-225ca, HCFC-225cb, CCl_4, CH_3CCl_3, CF_3Br, $CBrClF_2$, $CBrF_2CBrF_2$, HFC-23, HFC-32, HFC-41, HFC-43-10mee, HFC-125, HFC-134, HFC134a, HFC-152a, HFC-143, HFC-143a, HFC-227ea, HFC-236fa, HFC-245ca, HFOC-125e, HFOC-134e, CF_3I, $CHCl_3$, CH_2Cl_2, SF_6, CF_4, C_2F_6, C_3F_8, C_4F_{10}, C_5F_{12}, c-C_4F_8, C_6F_{14}, CH_3Cl, CH_3Br, O_3 (both stratospheric and tropospheric) and the ozone precursors CO, non-Methane Hydrocarbons, Reactive Nitrogen Oxides, industrial dust, soot, sulphate aerosols, nitrate aerosols.	A	4	4

[a]The inclusion of non-CO_2 GHGs in assessment reports. I = international, N = the Netherlands. M means that the gases were mentioned without providing numbers, A means that the effects of non-CO_2 GHGs were assessed quantitatively (fourth column). Note that the indicated level of consensus in each arena is a meta-measure of the period in which the reports were drafted.

[b]The LASOM considered that if in the future H_2 were to be used on a large scale for electricity generation, emissions of water vapor might influence the climate.

[c]They mention the possibility of climate change by stratospheric ozone depletion by CFCs, supersonic transport, and NO_2.

proach in its first policy document on the climate issue. It also follows that the GR 1983, RMNO 1984, and GR 1986 were the Netherlands assessments that were explicitly used in the policy documents. The Gezondheidsraad reports had the greatest impact in getting the climate problem on the Netherlands political agenda (Dinkelman 1995), and it is more interesting that they constitute a line that significantly deviates from the internationally achieved closure.

Construction of Gezondheidsraad Assessments

In the following we analyze how the Gezondheidsraad constructed its estimate of climate sensitivity and how it dealt with the non-CO_2 greenhouse gases. In

Table 5. Estimates of climate sensitivity and mention of non-CO_2 greenhouse gases in Netherlands policy documents

Policy document	Assessments used	Estimate of climate sensitivity (°C)	Estimate adopted from	Non-CO_2 greenhouse gases mentioned
VROM 1984	GR 1983 RMNO 1984	not given		same as RMNO 1984 + CO[a]
VROM 1987	Villach 1985 GR 1986 GR 1983	1.5–4.5	Villach 1985	same as Villach 1985
VROM 1991	IPCC 1990	1.5–4.5	IPCC 1990	same as IPCC 1990

[a]The document refers to the RMNO 1984 report for a list of relevant trace gases, and adds CO, making reference to a ''recent publication by Khalil and Rasmussen in *Science*.''

particular we consider the scientific and other underpinnings of choices made in each case, against the background of the competing international assessments. We seek to identify factors that accounted for the difference in the adoption behavior of the Gezondheidsraad committee and another important assessment group, the committee of the RMNO.

In 1980 the Gezondheidsraad established a CO_2 Committee. At the beginning the CO_2 Committee consisted of nine experts (later 11), including one representative from the Ministry of Health and Environmental Affairs (the precursor of VROM) and one secretary from the Gezondheidsraad. In 1983 the Gezondheidsraad issued the first assessment: ''Partial Advice Concerning the CO_2 Problem'' (Gezondheidsraad 1983). This report is focused on the scientific aspects of the CO_2 problem, and recognized it as an important problem for the Netherlands. In 1986 the Gezondheidsraad issued its second assessment: ''CO_2 Problem, Scientific Opinions and Impacts on Society.'' This report focused on the social and economic impacts of climate change for the Netherlands.

Construction of Gezondheidsraad Estimate of Climate Sensitivity

Climate sensitivity usually refers to the long-term (equilibrium) change in global mean surface temperature following a doubling of atmospheric CO_2 (or equivalent CO_2) concentration (Houghton and others 1996). According to the GR 1983 assessment, a doubling of CO_2 would lead to a 2°C rise in temperature. This number was based on the outcome of one single general circulation model (GCM) calculation by Manabe and Stouffer (1980). In GR 1986 this estimate was widened to 2–4°C, although the committee suggests that its earlier estimate had not changed: ''The conclusions with respect to climate reactions to a CO_2 increase have not changed since the publication of the first advice in 1983: after a doubling of CO_2 the global mean surface temperature will rise by 2°C to 4°C, the strongest increase being near the Poles (about 6°C)'' (Gezondheidsraad 1987, p. 25). In the following we show that the Gezondheidsraad was familiar with the international assessments and hence with the 1.5–4.5°C estimate.

For the members of the committee, the representative of the Ministry of VROM, Mr. Hekstra, produced summaries of the US NAS 1979 report and the US NAS 1983 report. It is striking that neither of the Gezondheidsraad reports makes an explicit reference to the US NAS reports. However, the GR 1983 report contains an appendix with a list of recommended literature. This list does include the US NAS 1979 and the US NAS 1982 report (of which the US NAS 1983 report is a revised version).

In the Gezondheidsraad report references are made to the draft report of the Villach conference. From the minutes we also found that at least two members of the Gezondheidsraad committee (Mr. Goudriaan and Mr. Hekstra) attended the Villach 1985 conference. Furthermore the minutes of the 27th meeting (26 March 1986) mention that Hekstra was of opinion that the draft advice makes too little use of the results of the Villach 1985 conference. One of the main conclusions from Villach was the 1.5–4.5°C range for climate sensitivity. As a response to Hekstra's criticism, the chairman (Mr. Schuurmans) asked all participants to closely review the text of the draft report in the light of the results of Villach. However, after a comprehensive discussion the committee decided to maintain the range of 2–4°C for CO_2 doubling. No details of the discussion are given in the minutes. Consequently, the reasons why the committee decided not to adopt the Villach estimate remain unclear.

In the minutes of the meetings of the CO_2 Committee one can find additional evidence to show that the committee was aware of the 1.5–4.5°C estimate: During the 19th meeting of the committee (10 December 1984), the US Environmental Protection Agency (EPA) high scenario for sea-level rise was discussed. This high scenario is based on the US NAS high estimate of a 4.5°C temperature increase for CO_2 doubling. The chairman of the committee, Mr. Schuurmans[3] was of the opinion that a temperature increase of 4.5°C cannot be ruled out since it falls within the existing uncertainty range. It is all the more surprising therefore that the Gezondheidsraad 1986 report presents a range of only 2–4°C.

According to Schuurmans the Gezondheidsraad committee made limited use of the US NAS reports and the Villach conference because they had a preference for original journal articles (C. J. E. Schuurmans, personal communication, 23 January 1996).

In the same period as the Gezondheidsraad made its assessments, the Ad Hoc Working Group CO_2 of the RMNO issued an inventory of climate research in the Netherlands (RMNO 1984). In this report a sketch of the state of the art of the climate problem is given, based almost completely on the US NAS 1983 report, including the 1.5–4.5°C estimate of climate sensitivity. The composition of the ad hoc working group of RMNO and the CO_2 committee of the Gezondheidsraad overlapped to a large extent: Table 6 shows that six of the ten experts in the Gezondheidsraad committee were also members of the RMNO working group. It is remarkable that two groups with such a large overlap in composition produced different figures in the same period.

Despite closure on the level of the assessment reports, in the scientific community in the Netherlands the 1.5–4.5°C temperature change is still a subject of debate. A workshop of Dutch scientists on the IPCC 1990 report provided a deviating figure. In a lecture that summarized the results of the workshop, Prof. Turkenburg said: ‘‘The uncertainty in the projected temperature increase of 0.3°C/decade has a broader range than indicated by the IPCC. According to the IPCC, in the case of business as usual, the temperature increase will range from 0.2 to 0.5°C/decade. There are good reasons for arguing that the temperature increase might be 0.1°C/decade, or 0.6–0.7°C/decade’’ (Turkenburg 1991). The figure of 0.2–0.5°C/decade is derived directly from the 1.5–4.5°C values for climate sensitivity combined with the so-called ‘‘business as usual’’ emission scenario (Houghton and others 1990), so the workshop did in fact provide a wider range for climate sensitivity. Another example is a paper by Slanina and Kieskamp (1994) in the Dutch journal *Energie en Milieuspectrum*. In this paper they suggest that a doubling of

Table 6. Membership overlap in 1983 between CO_2 Committee of the Gezondheidsraad and Working Group CO_2 of RMNO

Member	Gezondheidsraad	RMNO
E. C. van Ballegooyen	X	
A. P. M. Baede		X
H. de Boois	X (from 1984 on)	X
M. Booij		X
A. Dop		X
J. Goudriaan	X	X
G. P. Hekstra	X	X
P. Ketner	X	
J. J. Hofstra		X
W. G. Mook	X	X
R. Mureau	X	
H. Postma	X	X
P. G. Schipper	X	X
C. J. E. Schuurmans	X	
H. Weyma		X
F. C. Zuidema		X

CO_2 would lead to a 2–7°C rise in temperature. This apparent disagreement is not reflected at the level of assessment reports. This is, however, partly due to the fact that the intergovernmental IPCC assessments made the continuation of domestic assessment efforts superfluous.

CO_2 Focus of Gezondheidsraad

The first advice report of the Gezondheidsraad focused entirely on CO_2 (Gezondheidsraad 1983). Other gases were not mentioned. In its second advice report, issued in 1986, the Gezondheidsraad still focused primarily on CO_2, but a very small section dealt with the effects of other trace gases. In this section the committee wrote: ‘‘Although the committee will restrict itself in this advice to the CO_2 increase and its causes, one must account for the amplification (possibly a doubling) of the climate effect by the increase of other trace gases. Even if the CO_2 increase would not occur, then there may still occur climate effects as a result of the increase in other trace gases.’’ Furthermore the 1986 conclusions state explicitly that in addition to the 1983 conclusions: ‘‘The CO_2 problem is not an isolated problem. The concentration of other trace gases, that cause similar climate effects as CO_2, increases as well.’’

The fact that the CO_2 Committee of the Gezondheidsraad in 1983 and in 1986 hardly paid any attention to non-CO_2 GHGs contrasts with scientific publications of individual members of the committee in the period 1980–1986. In these articles the other trace gases were mentioned from 1979 onwards. Therefore from the beginning, at least some experts in the committee were aware of the significance of non-CO_2 greenhouse gases. In a seminar in Ljubljana, Hekstra (1979) presented a

[3] C. J. E. Schuurmans is a climatologist and a prominent member of the Royal Dutch Meteorological Institute (KNMI) and of Utrecht University.

table compiled from three different sources with the estimated temperature change due to changes of the concentrations of N_2O, CH_4, $CFCl_3$, CF_2Cl_2, CFC-11, CFC-12, CCI_4, CH_3Cl NH_3, C_2H_4, SO_2, and O_3. Another case of the early consideration of non-CO_2 GHGs is the KNMI 1980 report ''Anthropogenic Climate Change, State of the Art Review'' (Reiff and Schuurmanns 1980). Schuurmans, the chairman of the CO_2 Committee of the Gezondheidsraad, was one of the editors. This review included a WMO statement on the greenhouse effect of CFCs (WMO 1978). In this statement it was recognized that CFCs are strong GHGs and that: ''It has been estimated that a continued release of chlorofluoromethanes at the 1977 rate, taken in isolation of other factors, could in this way produce an average temperature rise at the surface of 0.5°C. Such a change in the mean temperature may well be of significance.'' In another publication (Schuurmans and others 1980), CH_4, NH_3, N_2O, and Freon were mentioned as non-CO_2 anthropogenic GHGs. It is also interesting to note that the Working Group on CO_2 from the RMNO paid more attention to non-CO_2 GHGs in its 1984 report than the Gezondheidsraad did in its 1986 report. They even presented a table, based on seven different sources, providing quantitative estimates of the temperature effect of a doubling of the concentrations of 16 different trace gases. There is no doubt that this was known to the Gezondheidsraad committee as well: as we found in the previous section, six members of the CO_2 Committee of the Gezondheidsraad were also members of the RMNO working group (see Table 6).

The reasons why the committee of the Gezondheidsraad paid relatively little attention to non-CO_2 GHGs become clear when we take a closer look at the minutes of their meetings. The first time the effects of non-CO_2 GHGs were mentioned in the minutes of the committee was before the first report was issued: at the 7th meeting (8 June 1982), Goudriaan gave an account of an American Association for the Advancement of Science (AAAS) conference, where Hoffman (US EPA) had stressed that other gases, such as N_2O and chlorofluorocarbons can enhance the greenhouse effect of CO_2 by 20%–40%. At the 11th meeting of the Committee (28 March 1983), while discussing the incoming correspondence, Hekstra stressed that from an article (no specification was given) it can be concluded that the influence of trace gases enhances the CO_2 temperature effect by a factor between 1.5 and 2. He also referred to a conference in Osnabrück where this subject was discussed. In Osnabrück it was stressed that the feedbacks in favor of other trace gases should get more attention. Although the minutes are not clear on this point, our impression is that this refers to feedbacks such as the release of methane from the thaw of permafrost. Van Ballegooien reacted by stating that in quantifying these things, prudence is desirable since negative feedbacks occur as well.

During the 14th meeting (19 December 1983), the possible contents of the next advice were discussed. Mr. Hekstra suggested that the second advice should start with new insights, including positive feedbacks in favor of other trace gases. When, at the 20th meeting (14 January 1985), the detection of the CO_2 effect was under discussion, the chairman stressed that for detecting the CO_2 effect the effect of other trace gases and aerosols should be taken into account. Van Ballegooien responded that the committee could not pay much attention to these gases because the committee had a lack of expertise. Schuurmans suggested expressing the effect of other gases as an enhancement factor of the CO_2 effect, and Hekstra said that this factor would probably amount to 2. Van Ballegooien responded that if the effect was indeed comparable in magnitude to the CO_2 effect, more attention should be paid to the trace gases. Schuurmans stressed that the consequences of a given enhancement factor should be considered, and suggested that a separate study into trace gases might be advisable. Goudriaan added that the relative importance of trace gases might change in the future, in the light of expected future emissions and residence time of the trace gases in the atmosphere. Schipper noted that this underlines the necessity of further study on this point.

During the handling of the incoming correspondence at the 21st meeting (25 February 1985), the article ''Doubling of Atmospheric Methane Supported'' was discussed. Schuurmans remarked that this article concludes that methane is responsible for 38% of the total effect and that the effect of all trace gases together is of the same order of magnitude as the CO_2 effect itself.

Schuurmans stated that in the second recommendation attention will be paid to the effect of the other trace gases. Hekstra thought that the committee could not go into details, and he proposed using as a starting point a report of the Coordination Committee on the Ozone Layer (CCOL, an international committee).

At the 22nd meeting it was decided to consult P. Crutzen to get more information about the other trace gases. This indicates the awareness of the committee that there was a lack of expertise within the committee regarding the non-CO_2 GHGs. The plan to consult Crutzen was not realized.

At the 27th meeting (26 March 1986), Hekstra made a case for including the non-CO_2 GHGs in the Gezondheidsraad study. He announced that the government would issue an indicative multiyear program (IMP) on air around September 1986. He also referred to the work of the Inter-Departmental Committee Environmental Hygiene (ICMH) and said that both the IMP and the ICMH would not be restricted to CO_2 but would pay attention to the other trace gases as well.

Later, during the same meeting, a discussion evolved about the moment at which CO_2 doubling would be reached. Hekstra stressed that the committee should consider the other trace gases. After a comprehensive discussion, the committee decided not to treat the trace gases in more detail than the draft report did then. The main argument was that the committee had no insights in the future concentrations of these gases. The only thing the committee could do was to refer explicitly to the report by the Coordination Committee on the Ozone Layer.

This reconstruction shows that the explicit reasons for not paying much attention to the non-CO_2 GHGs—despite the recognition of the significant contribution to the enhanced greenhouse effect of these gases—were lack of insight into future concentrations of these gases, lack of expertise on these gases within the committee, and lack of initiative to fill up this gap.

Discussion and Conclusion

For the cases studied we identified closure of visible disputes in the assessments in the Netherlands arena after 1990, mainly because the Netherlands expert committees on climate were superseded by the IPCC. In the pre-IPCC period we identified interassessment variability in the Netherlands for both the estimate of climate sensitivity and for the inclusion of non-CO_2 greenhouse gases in the assessments of climate change. In the Netherlands arena, the assessments in this period can be grouped as the line constituted by the Gezondheidsraad assessments and the assessments adopting international closure.

In the policy-makers' summaries of the successive international assessment reports, the 1.5–4.5°C estimate of climate sensitivity has not changed since 1979 (Van der Sluijs 1997, Van der Sluijs and others 1998). The assessments by the Gezondheidsraad show different quantitative representations for climate sensitivity: 2°C in the 1983 report and 2–4°C in the 1986 report, although the Gezondheidsraad was familiar with the international quantitative representation. In the same period in which the Gezondheidsraad drafted its second assessment, another Dutch advisory body (the RMNO) did adopt the international quantitative representation for climate sensitivity, that is the temperature range 1.5–4.5°C, rather than the Dutch 2°C (Gezondheidsraad) representation. This difference is surprising, considering the large overlap in the membership of the two expert committees. Although we showed that in the period after the first IPCC report Netherlands scientists advocated broader ranges of climate sensitivity than the IPCC estimate, this was not visible in the assessment reports, because since 1990 the IPCC assessments have been the only official ones in the Netherlands (that is, drafted by a scientific body and endorsed by the government).

Our analysis regarding the inclusion of the non-CO_2 GHGs in the assessments of climate change shows that it took about ten years for the scientific knowledge to reach the assessments. In the international line of assessment reports, the non-CO_2 GHGs were first mentioned in 1983, and acquired a substantial place in the assessments after the 1985 Villach conference. The main reports in the Netherlands line of assessments (namely, the Gezondheidsraad reports of 1983 and 1986) were in essence focused on CO_2.

Our analysis of the minutes of the Gezondheidsraad reveals that it was aware of the scientific evidence indicating effects of other gases. Lack of scientific expertise within the committee with respect to the future trends of these other gases explains the inertia that the Gezondheidsraad showed with respect to the inclusion of these gases in its reports. Again, almost the same group of experts, but in another context, did include the non-CO_2 GHGs in the assessment of the RMNO committee. In the RMNO context, the experts closely followed international developments.

We seek to identify what factors are decisive in the selection process: Why did the RMNO take the US NAS 1983 assessment as a starting point for its state of the art sketch rather than the comprehensive 1983 state of the art report by the Gezondheidsraad, whereas those persons sitting on both committees, when in the context of the Gezondheidsraad committee, seemed to ignore the US NAS 1983 assessment and the Villach '85 assessment and instead built further on its own 1983 assessment. Why did the RMNO committee adopt the international innovation of including the non-CO_2 GHGs, whereas those persons sitting on both committees, when in the context of the Gezondheidsraad committee, remained focused on CO_2 almost exclusively. What can we learn from different modes of conduct of both committees?

In the classical view on controversies in science, actors are assumed to be paradigmatically predisposed to preserve their former interpretation as long as possible. According to that view experts represent a specific viewpoint that is left unaltered as long as the scientific evidence allows it (e.g., Kuhn 1962, Collingridge and Reeve 1986). This view contrasts with our finding that at the same time two expert committees with a large overlap in membership put forward different interpretations and performed significantly different patterns of adoption. Our analysis gives several indications that it was not the (dominant views of the) experts in the committee that were decisive in the adoption process, but it was the context in which the experts operated and the commitments they had made in each setting.

The phenomenon we observe here has much in common with the findings of Van Eijndhoven and Groenewegen (1991). They argue that in studies of the advisory practice, little attention is paid to the amount of flexibility an expert may introduce into the argumentative strategy when new scientific data or new practical situations arise. They show that despite the availability of scientific data that calls for a change in the assessment, the context can drive experts to stick to their former conclusions, whereas different conclusions can be drawn from the same data, if the context changes. Regarding the assessments in the international arena, Van der Sluijs and others (1998) identified sources from which the assessors acquired flexibility in maintaining the 1.5–4.5°C estimate of climate sensitivity without ignoring changing scientific ideas. There, we argued that expert interpretations are ''underdetermined'' by any given scientific knowledge thanks to the repertoire of interpretive possibilities existing at each link in the argumentative chain. Often, new data introduce more flexibility, although negotiated interpretive links, once made, are consolidated as if naturally determined by the subtle redefinition of ancillary linkages and meanings. Van der Sluijs and others (1998) have introduced the concept of ''anchoring devices'' for actively maintained expert interpretations that preserve consensus by an unstated social contract among the diverse scientists and policy specialists involved, which allows the same portion of information to accommodate tacitly different local meanings.

The repertoire of interpretive possibilities of scientific evidence gives experts the flexibility to deconstruct and reconstruct argumentative chains that connect scientific data, expert interpretation, and policy meaning. This notion implies that, vice versa, in a different setting with other commitments, the same experts can construct different conclusions from the same information. This is what we may observe when we compare the modes of conduct of the Gezondheidsraad committee and the RMNO committee.

We found a difference in barriers of adopting the international estimate of climate sensitivity within each committee. The difference was related to differences in setting, context, origin, and orientation. In the following we will analyze these differences. The Gezondheidsraad committee had already completed half its second impact assessment study when the results from Villach became available. The first assessment report was a state-of-the-art report on scientific insights regarding the CO_2 problem. The second report was primarily an impact assessment of climate change, explicitly addressing the impacts for the Netherlands. The climate sensitivity is an important indicator and is used as a key input parameter for calculating impacts of climate change such as sea-level rise. The second assessment was drafted in the period 1983–1986. If the Gezondheidsraad had changed its estimate of climate sensitivity by adopting the 1985 Villach estimate, this could have changed its impact assessment. For instance, the figures for sea-level rise would have been somewhat different. This means that if, following the Villach results, they would have replaced its 1983 estimate (2°C) by the 1985 Villach estimate (1.5–4.5°C), they would have had to redo part of the impact assessment calculations. In other words, if they had changed two major fundamentals of the impact study—the estimate of climate sensitivity and the restriction to one greenhouse gas, CO_2—this could have caused a delay in the process. The RMNO committee was in that sense somewhat more free to adopt the international line.

According to Schuurmans, who was the chairman of the Gezondheidsraad committee, the barrier argument did not play any significant role: the impact assessment by the Gezondheidsraad was not intended to be quantitative in such a way that the calculations would have to be redone if new climate data were to be used (Schuurmans, personal communication 23 January 1996). However, the 1986 report did present scenario calculations and provided quantitative figures for sea-level rise. The calculations were not complex. Even if we agree with Schuurmans that the barriers of adopting the 1.5–4.5°C international estimate would have been low for the Gezondheidsraad, they would still have been higher than the barriers for the RMNO committee. Regarding the inclusion of non-CO_2 GHGs, we identified another type of barrier: expertise was lacking in the Gezondheidsraad committee, so the committee would have had to recruit a non-CO_2 GHG expert or the expertise have had to be acquired otherwise if the committee were to adopt the innovation.

Another difference is in the terms of reference, the assignment, and the genesis of both committees. The CO_2 committee of the Gezondheidsraad proceeded from the ''Philosophy Committee on Radiative Protection.'' The motive for setting up the CO_2 committee was closely related to the nuclear energy discussion. This origin of the committee and its assignment to assess the CO_2 problem led automatically to a focus on CO_2. Schuurmans confirmed this bias-by-appointment, stating that ''If the GR report from 1986 had the greenhouse problem as such as the topic, the non-CO_2 greenhouse gases would presumably have got more attention'' (Schuurmans, Personal communication 21 March 1996). Schuurmans further explains the focus on CO_2 by the notion that in terms of the impacts it is not important whether the climate change is caused by CO_2 or by other GHGs. There is, however, no scientific consensus regarding the latter claim (Van der Sluijs 1997).

Originally, the assignment of the committee also focused on the health effects of CO_2. According to Goudriaan ''This question [the health effects of CO_2] was answered within one hour. Then the committee continued with an inventory of knowledge of and questions about an increased CO_2 concentration and the greenhouse effect'' (Jan Goudriaan, personal communication). It should be noted that nowadays there is an increasing interest in the health effects of global warming, especially regarding the spread of tropical diseases.

In the context of the Gezondheidsraad committee, the rationale for starting the assessment was primarily connected with concerns about adverse effects of large-scale fossil fuel use rather than concerns about the risks of climatic change. The RMNO was interested in the climate problem from a research perspective and hence was biased towards existing climate research in the Netherlands, rather than towards the risks of fossil fuel use focused on CO_2. This difference in bias made it somewhat easier for the RMNO to investigate the non-CO_2 GHGs.

The RMNO committee had the task of designing a research agenda for Dutch climate change research. Its advice was built partly on the Gezondheidsraad 1983 report, but in total much more use was made of the assessments by the US NAS. Further, in their multiyear plan from 1983 the RMNO explicitly stated that one of their objectives was to seek alignment with the international research community (RMNO 1983).

We have also seen that in the diffusion of innovations from the international arena to the Netherlands, the representative of the Ministry of VROM on the two committees, Gerrit Hekstra, played a special role. Our analysis shows that it was Hekstra who, time and time again, made a case for the use of international assessments: He attended the first World Climate Conference in 1979. He distributed summaries of both US NAS reports to all members of the Gezondheidsraad committee. He attended the Villach 1985 conference and pleaded for the use of the Villach results in the second assessment report of the Gezondheidsraad. He was involved in the influential assessments by the German Enquete Commission on the climate issue. He undertook several unsuccessful attempts to convince the Gezondheidsraad committee to include the non-CO_2 GHGs in the assessment study. But he did succeed in having adopted the international estimate of climate sensitivity and the all-gases approach in the government reaction to the Gezondheidsraad reports.

The Gezondheidsraad line of assessments and the international line of assessments can, to some extent, be viewed as competing schools in climate risk assessment in the Netherlands. Beauchamp (1987) distinguished five ways in which competition among schools of thought comes to an end: sound argument closure, consensus closure, procedural closure, natural death closure, and negotiation closure. The estimate of climate sensitivity established in the international assessment community of the climate problem (1.5–4.5°C) can be viewed as a mixture of sound argument closure and consensus closure (Van der Sluijs and others 1998). The diffusion of this estimate to the Netherlands, where it replaced the quantitative representations presented in the Gezondheidsraad assessments, is an example of natural death closure. Natural death closure occurs if some of the main protagonists die or grow old. Our analysis shows another scenario: it is not the protagonists who die, but the context that ''dies'' and gets replaced by another. We even saw that the same scientists operating in another context (RMNO instead of Gezondheidsraad) start acting as protagonists of the other line. The Gezondheidsraad line ended when its assessments were succeeded by the assessments of the IPCC.

Rip (1992a,b) argued that the increase in robustness is a driving force in science for policy. The anchoring function of maintained consensus brings about robustness (Van der Sluijs and others 1998). In the period analyzed, a situation arose where anchoring of the Gezondheidsraad interpretations became dysfunctional because the intergovernmental assessment community (IPCC and its precursors) was taking over. In terms of robustness increase, it became more opportune to join the international club. A natural death of the Gezondheidsraad committee and its line of assessments was the inevitable consequence, which made closure occur in the official assessments (which we defined here as those assessments that are drafted by a scientific body and endorsed by the government).

We have shown that in the Netherlands in the preclosure period, the context in which the experts operated and the commitments they had made in each setting were more decisive for the selection of one of the two interpretations that coexisted than the paradigmatic predispositions of the experts involved.

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