Abstract

Perhaps like no other country, Germany has radically changed its policies towards regulating air pollution in the European context. Acting originally as a dragger in the 1970s to regulate transboundary air pollutants due to pessimism about the relationship between causes and effects, Germany responded very decisively to its own damage assessment in the early 1980s. In particular the adverse effects to forests ("Waldsterben" or forest decline) led to the formulation of strict air pollution regulations in the domestic context, efforts to spread the regulatory system within the European Union, and activities within the United Nations Economic Commission for Europe to foster stronger, continent-wide emission reductions. Using three conceptual models (rational actor, domestic politics, and social learning), we show that Germany deviated strongly from the ideal policy cycle consisting of (i) domestic policy formulation, (ii) international negotiations, as well as (iii) implementation and compliance with the provisions of international environmental agreements. Both national policy-making as well as partial implementation have been well on the way towards compliance even before Germany entered international negotiations on substantive protocols. Therefore, one may conclude from this country study that push countries may use the results of their national policy processes to influence the policy of *other* countries.

1. Germany and Acid Rain[1]

Perhaps like no other country, Germany has radically changed its policies towards regulating air pollution in the European context. Acting originally as a dragger in the 1970s to regulate transboundary air pollutants (TAP) due to pessimism about the relationship between causes and effects, Germany responded very decisively to its own damage assessment in the early 1980s. In particular the adverse effects to forests ("Waldsterben" or forest decline) led to the formulation of strict air pollution regulations in the domestic context, efforts to spread the regulatory system within the European Union, and activities within the United Nations Economic Commission for Europe (UNECE) to foster stronger, continent-wide emission reductions. Thus, Germany turned from a dragger state of the 1970s to an international leader on air pollution regulations in the mid-1980s (Sprinz/Vaahtoranta 1994).

This article summarizes the domestic foundations of Germany's air pollution policy in the national, European, and UNECE context and explains why Germany switched from dragger to leader by building on the conceptual lenses advanced by Underdal (1994).

2. The Problem as Seen by Germany[2]

The damaging effects of air pollution in general have been known in Germany for several centuries. Already in 1341, the blacksmiths were forbidden to use anthracite whose smoke damaged vegetation (Klein 1984, 32). And in 1883, the first book about environmental damage to forests by air pollutants - the main concern in the modern acid rain debate in Germany - was published in Germany (Schröder/Reuss 1883). After World War II, air pollution was mainly an issue of the heavily industrialized areas especially in North Rhine-Westphalia and posed a health problem, and already by the late 1960s, the problem of *long-range* transport of air pollutants and resulting damages to forests was, at least in principle, known in Germany.

For Germany, the problem of transboundary air pollutants is largely an issue of protecting German forests and advancing the state of technology (best available technology) to reduce emissions. Thus, protecting a vital part of Germany's (managed) nature and building on long-standing engineering traditions go hand in

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1 This article is based on Sprinz, Oberthür, and Wahl (1995).

2 Throughout this study, the notion of Germany has a consistent meaning. First, the term "Germany" can always be interchanged with the legal entity "Federal Republic of Germany" (FRG) in its respective borders. Until the fall of 1990, this included what is often considered "West Germany." By 03 October 1990, the former "German Democratic Republic" (GDR, or "East Germany") joined the constitutional order of the FRG. Therefore, beginning with this date, Germany (or the FRG) consists of West and East Germany.

hand. While the economic damages are hard to quantify exactly (see Section 6), the *abatement* costs have normally been comparatively low. Once massive damages were systematically documented in the forest sector in the early 1980s in Germany and elsewhere, Germany was able to respond to the challenges while building on its regulatory history on air pollution (see Section 3). However, as compared to many other countries, domestic effects of air pollution had to first enter the domestic political process, and subsequent international policies largely served to influence other countries to follow its lead. The German situation shows a slight reversal of the ideal policy cycle: Domestic damages initiated substantial changes in domestic laws, aspects of domestic laws influence the position in international regulations, and domestic implementation and compliance is largely determined by the original German domestic laws - rather than being a response to international negotiations and the obligations stemming from international environmental agreements.

3. Domestic Policy and Regulations Prior to International Negotiations[3]

Since the 1950s, regulation of air pollutants has periodically appeared on the German policy agenda and led to a series of public statements and actual regulations. By 1957, the Federal Parliament (Bundestag) had received a report from the federal government concerning the problems originating from air pollution, and in 1960, the Association of German Foresters passed a resolution at a meeting in Stuttgart targeted at those responsible to combat air pollution. However, the problem was viewed, in principle, to be of a *localized* nature. The Technical Instruction for the Purification of Air ("TA-Luft") entered into force in September 1964 and assisted the executive branch in implementing legislation. It specified the best available technology (BAT) for granting authorization to build an industrial installation or plant. The first German flue gas desulfurization plant followed in 1971. Already by 1967, the Federal Health Ministry pointed to the problem of the *long-range* transport of air pollution with emphasis on SO_2 - while also mentioning that the forests may be in danger. An early criticism of the policy of high smokestacks - which were used to solve the problem of *local* air pollution - was already issued in October 1967 at a general meeting of the Federation of European Agriculture by Dr. Wenzel who was responsible for Nature Conservation and Protection of the Countryside of the State (or Land) Government of Hesse. Referring to the adverse effects of SO_2, the Federal Interior Minister Höcherl pointed out in April 1968 that 0.8% of German forests were already harmed. In the middle of the following year, Federal Minister of Health Strobel also drew attention to the dangers of air pollution.

Parliamentary responses followed suit. In June 1971, a hearing on the "Preservation of Clean Air" took place in the Federal Parliament. By amending the Basic Law ("Grundgesetz" which serves as the German equivalent of a federal

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3 For an assessment of the impact of political actors, see Section 6.2.

constitution) in 1972, the responsibilities for the well-established divisions of air pollution, noise pollution, and waste disposal were put under the prerogative of *federal* regulation (as opposed to the Länder) (Article 74, No. 24 Grundgesetz). Since then, the foundation of air pollution control measures lies with the 1974 Federal Clean Air Act (Bundesimmissionsschutz-Gesetz). More specific regulations can be grouped into plant-related regulations (TA-Luft, Ordinance on Large Combustion Plants, etc.), area-related provisions to control local problems (clean air plans), and product-related regulations (which specify quality standards for substances and products such as the Ordinance on the Sulfur Content of Fuel Oil and Diesel Engine Fuels or the Ordinance on Fuel Labeling and Fuel Quality). Originally, only *new* plants were affected by these regulations. With the amendment of the Technical Instructions for the Purification of Air in the 1980s and the Ordinance on Large Combustion Plants, regulations were also applied to *existing* plants.

Furthermore, in 1976, more incidents of dying pine trees in Bavaria were reported, and led to increased scientific research in 1977 and, in the following year, the Federal Environmental Agency arranged a hearing on the damage to forests and long-range transport of air pollutants in preparation for the negotiations which ultimately led to the UN ECE Convention on Long-Range Transboundary Air Pollution in 1979.

Despite the suggested threats posed by air pollutants to forests, air pollution regulations were mainly geared towards the protection of human health. Particular emphasis was placed on large combustion plants and the domestic energy sector. The oil price shock of the 1970s gave rise to a domestic coal and nuclear energy strategy in order to further national independence of the energy sector. In 1975, Chancellor Schmidt met leading members of industry and trade unions at Schloß Gymnich. Because Germany was experiencing a decline in economic growth and a subsequent rise in unemployment (resulting from the oil price shock), the focus was put on "pro-industry" environmental policies. In addition, the trade unions agreed on giving preference to economic issues over ecological ones. Therefore, no further environmental legislative initiative was taken until 1978. Even the first meeting of the Chancellor with representatives of the environmental NGOs in 1979 led to no tangible results regarding environmental policy. Because of these developments, there had not been a national target on reducing sulfur emissions - the major air pollutant considered by the end of the 1970s. Instead a policy of "more research" was pursued.

Until the early 1980s, the Federal Republic was a dragger in international negotiations on emission reductions. Especially the *transboundary* aspect of air pollution was not much attended to. Consequently, until the end of the 1970s, the regulations in the field of air pollution led only to higher smoke stacks to solve local and regional air pollution problems by way of dispersion (Hartkopf 1984; Schärer 1992, 192).

Forest death ("Waldsterben") is not new to Germany, but forest decline in so-called "clean air areas" (Reinluftgebiete) posed a new challenge to research, because only flue gas-related damage in the vicinity of sulfur emitters were well-known until the early 1980s in Germany. Most importantly in 1979, Prof. Ulrich (a soil scientist)

and colleagues published research results which suggested strong links between the dying of forests and SO_2 emissions (Ulrich et al. 1979).

Much of the policy process to follow was characterized by the interplay of science, public attitudes, and the mass media. The Council on Environmental Quality (Rat von Sachverständigen für Umweltfragen) published a special report on "Energy and the Environment" in 1981 and concluded that even minor concentrations of SO_2 could damage vegetation. In the same year, the Federal Ministry of Agriculture and Forestry began with its annual forest surveys. In November 1981, a very influential three-part series about dying of forests and its causes appeared in "Der Spiegel" (Der Spiegel 1981, No. 47 - 49) and made forest death a major issue for the mass public and policy makers alike - in Germany *and* beyond. By autumn of 1982, the Federal Government and the "Committee for Protection Against Immissions [for Air Quality] or Depositions" of the states (Länder) presented a report which concluded that 7.7% of the forest area was damaged. Air pollutants were highlighted as a major cause, especially SO_2, NO_x, heavy metals, photooxidants, as well as natural causes such as drought, frost, disease, etc. Scientifically conclusive proof could not be produced, but the report focused political attention on the issue. In March 1983, the Council on Environmental Quality presented an extensive, specialized report about "Forest Damage and Air Pollution" (Sachverständigenrat für Umweltfragen 1983). This report contained recommendations which were similar to the draft regulations of the Ordinance on Large Combustion Plants. The results of the second survey of forest damage published in 1983 concluded that 10% of the forest area of the Federal Republic should be classified as "medium ill" to "seriously ill" (forest damage classification categories 2 - 4). By the third forest survey in 1984, 17% of the forests were classified as damaged (categories 2 - 4) (Bundesministerium für Landwirtschaft, Ernährung und Forsten 1985, 12).

Around 1983, a large research program was launched on forest death. It was coordinated by the Inter-Ministerial Working Group "Damage to Forests/Air Pollution" convened by the federal government in the same year. As the name indicates, it focused on the link of acidifying pollutants and forest decline. Together with its scientific advisory committee and its office (which was established by the Federal Environmental Agency - UBA), the working group spent about 250 million DM on ca. 660 different research projects between 1982 and 1988 (Gregor 1990, 139). The fundamental conclusion that forest death is caused by a multitude of factors rather than by air pollution alone has remained unchanged.

In response to the environmental (and political) problems caused by forest death (see also below), Germany began to upgrade its air pollution regulations over time. For example, the second amendment of the Federal Clean Air Act of 1985 dropped the clauses on economic viability (which influenced the definition of BAT until then). In May 1990, a third amendment of the Federal Clean Air Act was enacted. And on 1 July 1990, the environmental regulations of the FRG were extended to the (then barely existing) GDR, the latter being a major emitter of sulfur to the European airshed. By way of the unification treaty of 23 September 1990 it was finally stipulated for the Eastern Länder of the FRG that

- all installations and plants had to comply with the best available technology standards and
- *existing* plants had to attain the standards of new ones within five years - or otherwise be shut down (see Art. 67A Federal Clean air Act, in Hansmann 1995).

The periods of implementation of the regulations for reaching the targets of the Ordinance on Large Combustion Plants on the territory of the former GDR were extended by one to three years longer as compared to Western plants.

German policy on transboundary air pollution changed considerably over time. Beginning with a long history of scientific research into the causes and effects in the vicinity of emitters (in the past century), Germany began to develop air quality regulations which were health-based and technology-driven. However, with the advent of the international dimension of long-range transboundary transport of air pollutants and focused research on its vulnerable forests, Germany has shifted from an international dragger in the late 1970s to become a persistent pusher since the early 1980s. Thus, the basic framework of air pollution policies existed long before acidification and forest death became major issues. By radically strengthening an existing regulatory framework, Germany was able to respond decisively to the new problem (Schärer 1992, 192). In effect, German domestic regulations have been leading international regulations, both in terms of timing and in terms of stringency.

4. Role of Germany in LRTAP and EU Negotiations

The international negotiations concerning air pollution began in 1972 with the UN Conference on the Human Environment at Stockholm. At this conference, Sweden presented scientific evidence regarding the long-range transboundary transport of air pollutants. The Organisation for Economic Cooperation and Development (OECD) was then used as an early forum for discussion and scientific work among its member countries. Two main results of OECD´s activities include the gathering of data and the recognition of *transboundary* exchange of harmful air pollutants (OECD 1979).

Since the late 1970s, negotiations took place at the UNECE (United Nations Economic Commission for Europe). The Federal Republic of Germany has been actively involved in these negotiations since the beginning. Until 1982, the FRG was one of the most forceful *draggers* regarding SO_2-emission reductions as a result of assuming low damages to its ecosystems (see Section 3 as well as Sprinz/Vaahtoranta 1994). This changed in the early 1980s when news of the dying forests were reaching the public and the Green Party has began enjoying electoral success at the state and federal levels. Since 1982, the Federal Republic has become a pusher for strict international environmental agreements in alliance with the Nordic countries. In parallel to the UNECE negotiations, Germany used the institutions of the European Union to reduce emissions of air pollutants.

All major political programs on transboundary air pollution have been initiated and decided upon by the German authorities *prior to* signing the respective

protocols - with the exception of the LRTAP Convention of 1979. Originally, the Federal Republic was one of the major *opponents* of agreements to reduce acidifying pollutants. The warnings and calls for help from the Scandinavian countries as well as their demand for a 30% reduction of SO_2 emissions had no impact on the policy of the Federal Republic. Given the resistance against any specific pollution reduction by the U.K. and the FRG, the LRTAP Convention (1979) contained no binding obligations on emissions limitations. The text stated only, inter alias, that the signatory countries should "endeavor to limit and, as far as possible, gradually reduce and prevent air pollution, including long-range transboundary air pollution," and therefore "use the best available technology that is economically feasible" (United Nations Economic Commission for Europe 1979, Articles 2 and 6). Although this early international environmental agreement contained no binding obligations on emissions reductions, it still formed the starting point for subsequent negotiations.

The international negotiations on reducing sulfur emission ultimately resulted in two international environmental agreements, namely the Helsinki (1985) and Oslo (1994) Protocols (United Nations Economic Commission for Europe 1985; United Nations Economic Commission for Europe 1994). At the first session of the Interim Executive Body for the Convention in June 1983, the Nordic countries renewed their demands for a 30% reduction of SO_2 emissions. Because of the forest decline and domestic political attention (see above), Germany now actively supported this proposal. The proposal of the Federal Republic, Austria, and Switzerland demanded additional regulations, namely to limit the content of sulfur in diesel and light fuel oil to 0.3%.

At the International Ministerial Conference in Ottawa in March 1984, the Federal Republic signed a declaration which required signatories to reduce their SO_2 emissions between 1980 and 1993 by 30%. This group, consisting of the Nordic countries, Switzerland, Austria, Canada, France, and the FRG was often coined the "30%-Club." Later that year, the "Multilateral Environmental Conference on the Causes and Prevention of Damage to Forests and Waters by Air Pollution in Europe" was hosted by the German federal government at Munich. On this occasion, many Eastern European countries declared their intention to reduce sulfur emissions or their transboundary fluxes by 30%. This enlarged coalition of like-minded countries was needed to conclude the first Sulfur Protocol which requires signatories to reduce national emissions of sulfur or their transboundary fluxes by 30% from 1980 levels until 1993 (United Nations Economic Commission for Europe 1985, Art. 2).

When the deadline for implementing the Helsinki Protocol began to approach in the early 1990s and in view of the substantial emission reductions under way, many countries wished to go beyond the regulations of the Helsinki Protocol. The international negotiations began in February 1990, when the UNECE Working Group on Strategies prepared documents which shaped the international negotiations on a second sulfur protocol. The Federal Republic supported (i) 60% emission reductions of SO_2 based on BAT (best available technology) and (ii) the critical loads "gap closure" approach. The Federal Republic was one of the states which initiated the negotiations, in alliance with the Nordic countries, the

Netherlands, and Austria. In November 1993, Germany announced a 84% emission reduction goal to be accomplished by the year 2000. At the end of the negotiations, the targets for the Federal Republic agreed to a 83% reduction by the year 2000 and a 87% reduction by the year 2005 (United Nations Economic Commission for Europe 1994, Annex II). In parallel to its policy within the UNECE, the Federal Republic of Germany also pushed the issue of sulfur emissions by way of the EC's Large Combustion Plant Directive - thereby narrowing the competitive burden of Germany with its most important trading partners (see below).

Equally determined as in the case of sulfur emission reductions, Germany pursued reductions of nitrogen oxide (NO_x) emissions since the mid-1980s. Already on occasion of the Conference in Ottawa (1984), the Federal Republic stated its intention to reduce NO_x emissions substantially. By June 1984, at the Munich Conference, the Federal Republic supported the proposal, that the Executive Body should include the reduction of NO_x emissions in its working program. Perhaps unsurprisingly, the UNECE Task Force on NO_x was chaired by the Federal Republic.

Parallel to the UNECE forum, the NO_x issue was pursued within the European Union (EU). After the domestic policy process led to the introduction of passenger cars with catalytic converters, Germany used the European Community (EC) as a forum to spread its regulations on the European scale. These efforts resulted, inter alias, in the Luxembourg compromise of 1985 - which regulated NO_x and hydrocarbon emissions for larger passenger cars. Ever since then, the scope of additional emissions regulations was broadened to include all types of passenger cars and, ultimately, trucks. Within the UNECE domain, the Sofia NO_x Protocol was concluded in 1988 (United Nations Economic Commission for Europe 1988), and the Federal Republic of Germany committed itself not to exceed its 1987 emissions by the year 1994 and to introduce unleaded petrol. The latter was already mandated by the Luxembourg compromise within the European Union as a result of German pressure. The Sofia NO_x Protocol was signed by 26 countries and came into effect on 14 February 1991.

Given its ambitions to go further than a freeze, Germany played an active role as part of a group of twelve countries to substantially reduce NO_x emissions. A Sofia Declaration was signed by those countries to reduce their NO_x emissions by about 30% until 1998 at the latest. Any year between 1980 and 1986 could be chosen as the reference year and Germany selected 1986 - close to its maximum emissions in this period.[4]

Considerably less is known about the German participation in the negotiations on non-methane volatile organic compounds (VOCs). In accordance with the work plan of the Executive Body for the Convention on Long-Range Transboundary Air Pollution, the UNECE Working Party on Air Pollution Problems established a task force on "emissions of volatile organic compounds from stationary sources and possibilities of their control" under the leadership of the Federal

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[4] The NO_x Declaration was only signed by the Federal Republic of Germany, not the German Democratic Republic. Nevertheless, the obligation to reduce its NO_x emissions by 30% now applies to all the Länder (states) of the Federal Republic.

Republic and France (Umweltbundesamt 1991, 2). The national position in the international negotiations of the Federal Republic was a 30% reduction (base year 1988) of the annual VOC emissions which are to be accomplished by 1999 and signed the Geneva Protocol on VOCs (United Nations Economic Commission for Europe 1991). As a result, the Federal Republic is obliged to cuts its emissions by 30% between 1988 and 1999 once the Protocol enters into force - an obligation which is fully in line with the national position.

After a comparatively slow start due to questioning the scientific evidence presented in the 1970s, the Federal Republic embarked on ambitious national and international environmental policies after discovering substantial environmental (and national political) damage in the early 1980s. Since then, Germany qualifies as a lead country across air pollutants by pushing international environmental negotiations, trying to convince other countries to subscribe to more stringent rules on emissions of pollutants, and by sponsoring relevant research and (co-)heading relevant working groups within the UNECE as well as by parallel structure within the European Union.

5. Implementation and Compliance Record

Given its change in perspective on the LRTAP regime, Germany has been a country which undertook comparatively swift implementation of its obligations under the various LRTAP Protocols - because most of the substantive implications were already embedded in national German air pollution laws by the mid to late 1980s (see Section 3). The transfer of international obligations normally took 2-3 years (see Table 1). Furthermore, from the latest available data, it seems prudent to conclude that the Federal Republic, despite its enlargement of jurisdiction in 1990, either fully complies with its international obligations, or, where the target year has not yet been reached, shows good progress in complying with its international obligations (see Table 2).

In most cases, national implementation did not mandate substantive upgrading of national pollution laws. The LRTAP Convention itself did not require more than national ratification. For the Helsinki Sulfur Protocol, the Federal Republic could rely on the amendments of the Federal Clean Air Act as amended on 4 October 1985 and the Technical Instructions Air (TA-Luft) as amended on 1 March 1986. The German Ordinance on Large Combustion Plants acted as the major regulative instrument for combating air pollution and reaching the national targets. As a result of the national regulations, the sulfur emissions had decreased by *more than* 30% as compared to the base year 1980 already by 1986. And by 1993, Germany had already reduced 58% of its 1980 sulfur emissions - exceeding the requirements of the Helsinki Protocol within the enlarged territory. And while the Oslo Sulfur Protocol has not yet been transferred into national law, these data also indicate that Germany has made reasonable progress towards compliance with its obligations under this international environmental agreement.

Table 1: **International Signatures and National Ratification**

	Date of Signature*	Date of National Ratification*	Entry into Force (internationally)
LRTAP Convention	13 November 1979	15 August 1982	16 March 1983
Helsinki (First) Sulfur Protocol (1985)	09 July 1985	03 March 1987	02 September 1987
Sofia NO_x Protocol (1988)	01 November 1988	16 November 1990	14 February 1991
Geneva VOC Protocol (1991)	19 November 1991	08 December 1994	not yet in force
Oslo (Second) Sulfur Protocol (1994)	14 June 1994	not yet ratified	not yet in force

Source: (United Nations Economic Commission for Europe/Convention on Long-Range Transboundary Air Pollution 1995, 135).
* Refers to the Federal Republic in its respective borders at each point in time.

Table 2: **German Emission Reductions**

	Sulfur Emissions (1,000 t SO_2)	NOx Emissions (1,000 t NO_2)	VOC Emissions (1,000 t hydrocarbons)
Base Year (Sulfur: 1980 NOx: 1987 VOCs: 1988)	7,517	3,598 (1986: 3,683)	3,167
Target Year (Sulfur: 1993 NOx: 1994, VOCs: 1999*)	3,156	2,872	2,405*
Change in % of Base Year	-58%	-20% (-22% compared to 1986)	-24%*

Source: United Nations Economic Commission for Europe (personal communication, 02 June 1997)
Note: All data for the Federal Republic also contain the territory of the former German Democratic Republic.
* Data are for the year 1994.

Regulating NO_x emissions is likely to be substantially more difficult since the transport sector has to be regulated. While the obligations of the Sofia Protocol could be easily accomplished, it will be more difficult to reach the 30% reduction goal until 1998. Already by way of the Lead in Petrol Act of 18 December 1987, lead in regular gasoline was forbidden. On 1 January 1990, the financial incentives for low emission vehicles entered into force, and the introduction of catalytic converters was subsidized so as to assure emission reductions, and leaded gasoline has been taxed more heavily as compared to lead-free gasoline.

As a result of the measures taken, NO_x emissions decreased by 20% between 1987 and 1994 (Sofia Protocol) and by 22% between 1986 and 1994. Thus, the Federal Republic is well on the way towards reaching the stricter goal of 30% of NO_x emission reductions, although the final increments may be harder to achieve than the initial gains in emission reductions to create incentives to switch to lead-free gasoline.

In order to achieve the goals set out in the Geneva VOC Protocol, the Ordinance on Surface Treatment and Dry Cleaning (2nd Federal Clean Air Ordinance, last amended on 10 December 1990) and the Ordinance on the Filling and Storage of Otto-Engine Fuel (20th Federal Clean Air Ordinance) and the Ordinance on the Refueling of Motor Vehicles (21st Federal Clean Air Ordinance) were both passed on 07 October 1992. In view of a 30% reduction goal for VOCs between 1988 and 1999, the Federal Republic has made progress by already achieving a reduction of 24% by 1994.

Overall, the Federal Republic of Germany created its major legal framework for air pollution regulations in the mid-1980s and has been quite successful in implementing and complying with the provisions of international environmental agreements so far.

6. Explaining National Policy Formation and Implementation

Three models were introduced by Underdal (1994) to explain national policy formation and implementation, namely the rational actor model, the domestic politics models, and the social learning model. We will turn to each of these perspectives in this Section.

6.1 The Rational Actor Model

The rational actor model relies on the logic of marginal abatement and damage costs being equal for determining optimal emission reduction levels. Thus, both types of data are needed. Regrettably, it appears impossible for existing studies to differentiate between the damage costs by type of pollutant (SO_2, NO_x, and VOC). Furthermore, it is not at all clear which fraction of damage costs is to be attributed to *other* causes. In particular, damage to forests has multiple causes. Estimates of damage costs of several billion DM per year caused by air pollution have been given. For example, Wicke estimated in the mid-1980s that the overall damage of air

pollution in Germany was 48 billion DM per year (Wicke 1986, 56). Given the methodological limitations of most studies, this estimate has to be regarded as a rather crude indicator of the damage costs caused by acid rain. Reliable estimates exist for damage to materials which has been assessed as amounting to 3-4 billion DM annually since the 1980s (Heinz 1985; Bundesministerium des Inneren 1984; Isecke et al. 1991; Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit 1992). While these figures have been characterized by the respective authors as lower bounds of actual damage, they are thought to be rather crude "guesstimates." Apart from any quantifiable costs, between ca. 15% and 20% of West German forests were assessed as being seriously ill (categories 2-4 for forest damages) in the second half of the 1980s, whereas this figure has risen to ca. 25% *after* the enlargement of the Federal Republic in 1990.

With respect to abatement costs for the 30% reduction of SO_2 emissions demanded by the first Sulfur Protocol, estimates based on the RAINS model give the costs for Western Germany as 1.4 billion DM (equivalent to ca. 0.05% of GDP) per year until the year 2000 (Amann/Kornai 1987; Sprinz 1993). For the Oslo Sulfur Protocol, RAINS 6.0 puts the costs of compliance for the enlarged Germany by 2000 at 4.81 billion DM (equivalent to ca. 0.14% of 1994 GDP) annually. By modernizing the East German electricity generation sector and enhancing energy efficiency, SO_2 emissions will be reduced as a side-effect at no extra cost. This may account for the fact that less than one third of the costs of compliance with the Oslo Protocol is expected to arise in Eastern Germany despite its relatively high emission level. Furthermore, in order to reduce NO_x by 30% (base year: 1980), RAINS 6.0 computes abatement costs of 0.525 billion DM (equivalent to ca. 0.02% of GDP) per year in the Western part of Germany (Amann 1989; Sprinz 1993), while compliance with the obligation under the Sofia Protocol to freeze NO_x emissions at 1987 levels by 1994 should cost the enlarged Federal Republic 0.1 billion DM. The abatement costs have been influenced in two different ways by the enlargement of the Federal Republic. To the extent that NO_x emissions stem from stationary sources (electricity generation), it has to be emphasized that as in the case of SO_2, general technological modernization led to inexpensive pollution reduction. Consequently, less than 10% of the costs of NO_x emissions stabilization is expected to occur in the Eastern part of the Germany. However, a substantial increase in individual mobility has occurred in East Germany since 1990. Therefore, abatement costs for major emission reductions may become quite high because the sector consists of many independent actors.

The decision to accept the abovementioned abatement costs had essentially been taken *before* the international protocols were concluded, most importantly by passing the Ordinance on Large Combustion Plants in 1983. Thus, the German Federal Government was able to state that it expects to comply with its international obligations under the Oslo Sulfur Protocol because of prior domestic legislation - without new, additional measures (Umwelt No. 7-8/1994, 281).

In conclusion, taking the German case by itself, the rational actor model does not provide a precise explanation of the extent of German regulatory ambitions. Nevertheless, the rational actor model provides a reasonable directional prediction: high emission reduction goals by international comparison.

6.2 The Domestic Politics Model

The domestic politics model rests both on the demand for and supply of policies to improve environmental quality. Thus, this model extends the rational actor model outlined before by going beyond purely economic factors to be included in decision-making. Environmental protection has been perceived as important or very important by 80 to 90% of the West German population since the early 1970s (Sachverständigenrat für Umweltfragen 1978, 440-455; Eurobarometer, various surveys since 1981). At the end of the 1980s/beginning of the 1990s, 74% of the German population regarded the environment to be in deep crisis, and more than 70% responded that environmental protection would be a very important political task (see Wahl 1994, Tables 2-4). More specifically, in 1980/82 air pollution was among the issues that were regarded as one of the most serious environmental problems (Kessel/Tischler 1984). Taking the number of media reports as an idicator, public concern about acid rain rose during 1982, at a time of economic recession, and peaked in 1983-85 (Cavender Bares et al. 1995). While media attention declined afterwards, Eurobarometer surveys still showed strong public concern about acid rain, with 26% (1986) and 29% (1988) of the population selecting acid rain as one of the top three environmental issues (Sprinz 1992). In 1989 and 1991, nearly 75% of the population of the Federal Republic mentioned acid rain as a very serious problem, while more than 20% still believed it to be a fairly serious problem. At the end of the 1980s/beginning of the 1990s, a great majority of Germans in the Western as well as in the Eastern parts of Germany expressed great concerns about air pollution (81-95%). When the German population was asked about the most important environmental problems of the future in 1992, air pollution ranked second with 36% of respondents mentioning this problem (Wahl 1994, Tables 2-5). In 1988, 24% of the West German population complained about air pollution, while in 1993 this figure had declined to 21%. In the Eastern parts, 28% complained about air pollution in 1993, a pronounced decline from 56% in 1990 (probably due to advances in combating local air pollution) (Statistisches Bundesamt 1995, 568-569). In conclusion, while no time series data are available, public concern about acid rain appears to have risen sharply in the early 1980s despite the economic recession. It has declined somewhat since 1986, but, to the extent that it can be equated with concern about air pollution in general, it has stayed high on the public agenda of environmental problems.

In this context, the special attitude of many Germans towards their forests has to be taken into account in addition. Although Germany has been a largely deforested area some 400 years ago and many of today's forests are monocultures planted within the last one hundred years, there is a strong tradition in Germany to regard forests as an important part of German culture, history, and identity. Thus, when the link between forest death and acid rain was established and made public in the early 1980s by the media (Cavender Bares et al. 1995), the issue easily achieved major public attention (on the special importance of forests to Germans

see, inter alias, Cavender Bares et al. 1995; Boehmer-Christiansen/Skea 1991, 61, 191).

On the industrial side, potential "negative" demand for strict air pollution control by the three most important German industries in terms of contributions to GDP ("fabricated metal products, machinery and equipment," "wholesale and retail trade," and "real estate and business services") or employment (the same as above, but "real estate and business services" is replaced by "construction") has to be considered as basically non-existent. Although the top three industries accounted for about 30-35% of overall GDP or employment, none of them belongs to the sectors of the economy which are usually considered the main victims of acid rain (forest-related industries and inland fisheries) or the main polluters (electricity generation, cars, solvent industry). In principle, the degree of exposure to damage as well as abatement costs of the top three industries has to be considered very low.

Only to the degree that the automobile industry is part of the category of "metal products," one of the top industries is partially affected by abatement measures. However, it has to be noted that compensation was provided by the federal government to car owners/purchasers by granting special tax exemptions and subsidies for low-emissions passenger cars between 1985 and 1991. Taxes on vehicles without catalytic converters were increased at the same time. Also, unleaded gasoline was granted a tax reduction in 1985, while taxes on leaded fuel were increased. Moreover, subsidies of 13.5 million DM were given to independent petrol stations to support introduction of unleaded gasoline during 1985-87 (Bundesregierung 1985; 1987; Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit 1992). Otherwise, the government supported abatement measures by granting subsidies to those actors of the economy who have to bear significant parts of the burden (but did not belong to the top three industries). Until the end of 1990, the government granted particularly favorable conditions for writing off environmental protection investments in general. Furthermore, industry could apply for low-interest credits for the support of maintaining clean air (total volume 1983-1990: 1.65 billion DM). Direct subsidies for investment in environment-friendly production amounted to 690 million DM until 1990, only part of which can be attributed to clean air investments.

In addition, technological development facilitated the implementation of far-reaching abatement measures. Industry made decisive progress in adapting foreign (in particular Japanese) technology to European and German conditions and in developing its own abatement technologies (Weidner 1986; Prittwitz 1984). This technological progress comprised desulfurization, denitrification, and catalytic converters. Germany is believed to have positioned itself ahead of most other nations, thus giving German industry special advantages as regards the export of abatement technology and catalytic converters (especially the lambda measuring device used in conjunction with catalytic converters). Thereby, Germany was able to reap a special benefit from international regulation of air pollutants (Sprinz 1992, 121).

Industries which could be particularly affected by acid rain, namely forestry and inland fishery, do not play any significant role in the German economy. The costs of damage to materials correspond to a share of GDP of ca. 0.1-0.2% per year.

Five possible (groups of) actors relevant for articulating societal demand for stringent acid rain policies have been identified:

(i) environmental NGOs,
(ii) green parties,
(iii) representatives of regions particularly affected by acid rain,
(iv) industries producing abatement technologies, and
(v) industries selling environment-friendly production methods (Sprinz/Wahl 1995).

To the extent that these actors have influenced German policy-making on acid rain, they have mainly concentrated on *national* legislation and regulation. Thus, international obligations agreed upon later have (to a great extent) been internally "agreed" upon and partially implemented beforehand. Therefore, supporting relatively strong international policies and accepting strict obligations posed little problems to German negotiators and made the international process itself relatively irrelevant to national environmental NGOs and the other groups.

Under these circumstances, it appears to be most appropriate to focus on the national political process regarding national regulations in order to account for the influence of relevant political actors on German acid rain policies. The most important of the national measures were the Ordinance on Large Combustion Plants of 1983, the amendment to the TA-Luft of 1986, the Ordinance on Small Combustion Plants of 1988 (all relevant to SO_2 and NO_x), the introduction of the catalytic converter (relevant to NO_x and VOCs), and the 20th (Ordinance on the Filling and Storage of Engine Fuel) and 21st (Ordinance on the Refueling of Motor Vehicles) Federal Clean Air Ordinances in 1992 (both relevant to VOCs).

The most important regulation of SO_2 is the Large Combustion Plant Ordinance of 1983 by which essentially even the emissions reductions of the Oslo Protocol will be achieved. In order to reduce NO_x emissions, the introduction of catalytic converters was the most relevant policy measure besides the Ordinance on Large Combustion Plants. In both cases, environmental NGOs have been active and can be assessed as influential. By climbing smoke stacks, collecting signatures in support of stringent regulation, organizing information campaigns, distributing leaflets etc., environmental NGOs were able to put considerable political pressure on decision-makers. However, NGOs were neither the first ones to put the issue on the public policy agenda (because this was done by the media; see Cavender Bares et al. 1995) nor were they the only ones articulating societal demand: NGO influence can be assessed as high, but not as extremely important. Their activism peaked in 1983/84, but declined thereafter (Cavender Bares et al. 1995).

On the Länder level, the Bavarian state government, representing a region particularly affected by forest damage, was quite active by pursuing acid rain policies in the early 1980s. It influenced the process in two ways. On the one hand, it used its representation in the Bundesrat, which had to agree to the laws and regulations passed, to form coalitions which led to a tightening of the draft regulations. On the other hand, the conservative Christian Social Union (CSU), as the ruling party in Bavaria, became part of the federal government in 1982. A

member of the CSU, Friedrich Zimmermann, became Minister of the Interior and was responsible for environmental protection at that time. He fought very hard for the Ordinance on Large Combustion Plants and, in particular, for the mandatory introduction of the catalytic converter. However, since other members of the ruling coalition, in particular officials of the liberal Free Democratic Party (FDP), were also committed to stringent clean air policy, the influence of the CSU/Bavaria can be assessed as high, but not extraordinary high.

In contrast, the influence of the Green Party, according to most accounts, has to be given an extremely high score. In the early 1980s, when the Green Party organized itself at the federal level, it constituted a threat not only to the Social Democratic Party (SPD) but also to the Christian Democratic Union (CDU/CSU) because, in these times, it also included conservative factions. Thus, all parties felt the need to amend their party and election programs in the late 1970s and the early 1980s so as to take account of the environmental challenge. When the Green Party managed to win seats in the German Bundestag in early 1983 for the first time, the threat to the established parties became even more obvious. In the Bundestag, the Green Party fought hard to strengthen acid rain legislation and fulfilled the role of the voice for people concerned about environmental issues (Boehmer-Christiansen/Skea 1991, 90-91 and 198).

While the availability of abatement technology and, to a lesser extent, environment-friendly production methods certainly played a role in political decision-making (Sprinz 1992; 1993; Sprinz/Vaahtoranta 1994), little is known about the actual participation of the relevant industries in the decision-making process. The car industry was of some importance insofar as it ultimately did *not* oppose the introduction of the converter, at least if conducted at the European Community level. The pan-European introduction of catalytic converters held the promise for the German car manufacturers to gain a competitive advantage because it had developed effective converter technology (Boehmer-Christiansen/Weidner 1992; Sprinz 1992, 121).

When policy-making turned to combating VOC emissions in the second half of the 1980s, attention of political parties, NGOs and others had declined dramatically. Interviews revealed that environmental NGOs did not influence the decision-making process to a great extent. Very little is known about the actual participation of the other relevant actors in the related political decision-making process. If existent at all, their influence on the political output and outcome has to be assessed as small.

On the institutional supply side of environmental policy, the Federal Republic has benefited from high political continuity of chancellors and cabinets. There was only one change of government during the period under investigation here (1975-94). In the 1970s, the government was formed by the Social Democratic Party of Germany and the FDP under former Chancellor Helmut Schmidt (SPD). He was succeeded by Chancellor Helmut Kohl (CDU) who has lead a coalition of the sister parties CDU and CSU with the FDP since October 1982.

With respect to the institutional capacity of the environmental branch of the federal government, few changes can be observed until the Ministry of the Environment (BMU) was established in 1986. Until then, obtainable data on the

budgetary share of the environmental branch of the Ministry show figures fluctuating between 0.09 and 0.3%, while the share of the expenses for personnel increased steadily from 0.05 to 0.08% between 1975 and 1986.[5] Because of their relatively low level, they point to a rather weak environmental branch of government until 1986, especially vis-à-vis other ministries. The budgetary situation has improved somewhat after 1986 with the share of the Federal Ministry of Environment of the federal budget rising from 0.17% in 1987 to 0.29% in 1995 and its share of expenses for personnel even increasing from 0.19% to 0.44% during the same period. This development certainly improved the power of the Federal Ministry of Environment within the cabinet as it took over the role of the leading actor in drafting legislation and interdepartmental decision-making from the environment department of the Federal Ministry of the Interior. However, the overall judgment is not as clear-cut as it may seem: While the Minister of the Interior has a senior standing in the cabinet that he could bring to bear for the environment, the Minister of the Environment has a junior institutional standing within the government. This may have been, at best, compensated to a certain degree by the personal skills of the former Ministers of the Environment Klaus Töpfer (1987-94).

Decision-making authority on issues of air pollution control in Germany is neither highly centralized nor very decentralized. It rests mainly with the federal government, but subject to relatively strong influence of the states as exercised mainly through the Bundesrat. By a constitutional amendment passed in 1972, air pollution control became part of the section on "competitive legislation" in the constitution. Thus, the federal government received the authority to pass laws and regulations, while the states only retained the power to pass legislation if federal law did not exist. However, decisions of the Bundestag have to gain majority support in the Bundesrat for passing laws and issuing regulations in this field. Furthermore, implementation and enforcement of laws and regulations on air pollution control is conducted by the states *on behalf of* the federal government (Weidner 1986).

The strength of the federal government is not enhanced by any direct financial dependence of the main target groups of acid rain policy on the executive. The main target actors in Germany are the electricity generating sector (SO_2 and NO_x), the transport sector (NO_x and VOCs), and the solvent industry (VOCs). The combined share of these target groups amounts to 75% or more of the overall emissions of any of the pollutants regulated internationally (United Nations Economic Commission for Europe/Convention on Long-Range Transboundary Air Pollution 1995, 74, 82, and 96). However, none of these actors has received subsidies from the government on a regular basis such that it would have made them dependent on the executive to any substantial degree (Bundesregierung 1985; 1987).

In terms of the domestic political process of curbing air pollutants, there was some disagreement within the government on air pollution control in the late 1970s and early 1980s which is difficult to attribute to *party* positions. Instead,

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5 In the latter figures only the items "expenses for environmental protection" (including nuclear safety) and the budget of the Federal Environmental Agency (UBA) are included.

disagreement appears to have been dependent on organizational roles. This is supported by the fact that the main conflict within the SPD/FDP government (until fall 1982) occurred between the Ministry of Economics, which acted as a dragger, and the environmental branch of the Federal Ministry of the Interior - at last supported by the Ministry of Agriculture and Forestry (Cavender Bares et al. 1995). This conflict, though, cannot be linked to specific parties, since at the time all three ministries were led by members of the FDP. After 1983, no information is available regarding major differences between ministries or governing parties. Some conflicts arose on transport policies in the 1980s and 1990s as regards cars, the prescription of catalytic converters, a general speed limit on German highways, and alternative transport concepts. As mentioned before, however, air pollution control policy, in general, has been characterized by a high level of consensus among the relevant parties and actors in Germany since the second half of the 1980s.

This also holds with regard to the major opposition parties. At best, the opposition parties have even requested tighter air pollution controls. For example, the Green Party and parts of the SPD have advocated a general speed limit on German highways and a faster introduction of the catalytic converter technology. To conclude, political consensus on governmental policies and measures, seen as the lowest common denominator, can be considered to be very strong. This correlates well with the constant implementation progress regarding air pollution regulations since the early 1980s.

Germany experienced an era of relative political stability since the 1970s, measured in terms of the number of governments in power. The respective ruling parties commanded a quite comfortable majority between 1980 and 1994. Governing parties held between 54.2% and 56.2% of the seats in the Bundestag from 1980 to 1990. In 1990, the CDU/CSU/FDP government even won 60% of the seats, while the same government can only count on the support of 50.7% of the members of the German Bundestag since the fall of 1994. In terms of their power basis in the German Bundestag, the respective governments should have enjoyed fairly favorable conditions in the 1980s, whereas the situation became even more favorable in the early 1990s.

The political situation does not look as comfortable for the respective government, if public support for the ruling parties (as expressed in public surveys) is taken as an indicator. Before negotiations on the Geneva Convention started in July 1978, the ruling SPD/FDP coalition was supported only by about 48-49% of the electorate. Due to the German political system, ca. 48% of the votes are needed to win federal elections; hence, the federal government was politically vulnerable in 1978. The situation was better for the CDU/CSU/FDP government when negotiations on the Helsinki and Oslo Sulfur Protocols started in September 1984 and February 1990 respectively, because 52.2 and 53.4% of the electorate had expressed their support only a few months earlier. During the preparation of negotiations on the NO_x and VOC Protocols in 1985 and late 1988, the position of the government apparently was weaker, since only about 48% of the voters expressed their intention to vote for its parties

Taking the German case study by itself, it appears that the explanatory power of the factors investigated on the "supply-side" of formulating and implementing

acid rain policies in Germany is rather limited. The pusher position taken by Germany in the international negotiations since the early 1980s as well as the drastic reductions of SO_2 emissions and comparatively high reductions of NO_x and VOC emissions which have been accomplished so far are in line with the governments ideologically moderate position. The relatively high consensus that was reached during the 1980s in the ruling coalition as well as within the political system at large, the relatively stable legislative support of governments as well as the duration of the governing coalitions should all have worked in favor of effective acid rain policies. Finally, times of relative political vulnerability immediately prior to international negotiations on the NO_x and the VOC Protocols should have supported a progressive stance in the international arena.

However, some of the variables investigated appear to be unfavorable to stringent German acid rain policies. The institutional capacity of the environmental branch of government, if measured in terms of its share of the federal budget, can hardly be said to be impressive. Also, the medium degree of centralization of decision-making on matters of air pollution control in Germany is not believed to work towards stringent acid rain policies. Finally, even the most important target groups of controls for SO_2, NO_x and VOC emissions are not dependent financially to any significant degree on the federal government.

6.3 The Social Learning Model

The damaging effects of air pollution in general have been known in Germany for several centuries (see Section 2). After World War II, air pollution arose as a political issue mainly in the heavily industrialized areas as a response to health problems. Despite the accumulation of knowledge over time, the German Federal Cabinet initially decided not to support Swedish claims of transboundary effects, and the transboundary issue was kept off the political agenda (Cavender Bares et al. 1995).

Ministerial experts are reported to have been aware of the link between tall smokestacks and long-distance transport of pollution as well as soil acidification by the late 1970s (Müller 1986). However, until the early 1980s, no specialized research efforts were undertaken on acid rain. This changed, however, when in the 1980s, the Council on Environmental Quality published several reports on acid rain and forest death, and in 1982/83, a large research program on forest death invested 250 million in ca. 660 different research projects between 1982 and 1988. Intensive research and policy efforts were pursued in parallel during this period.

A special contribution to knowledge and learning in the German context has been made by the German Society of Engineers (Verein Deutscher Ingenieure, abbreviated "VDI"). The VDI plays an important role in defining best available technology (BAT), which is one of the most important legal norms in German air pollution control law (Boehmer-Christiansen/Skea 1991, 169-170) and which influenced the technical annexes to several international environmental agreements on transboundary air pollution.

While international conferences and the activities of international organizations did not seem to play a very significant role in the scientific process, a

consensus among German scientists developed after the publication of the research results of Ulrich et al. in the 1980s that SO_2, NO_x as well as ground-level ozone were major *contributors* to the problem of "Waldsterben." However, agreement could not be reached within the scientific community as to the *relative* importance of any of the pollutants. It was generally acknowledged that forest damage was a complex phenomenon which might have multiple causes, including anthropogenic emissions of air pollutants, but also pests, storms and climatic conditions (Boehmer-Christiansen/Skea 1991, 189-191, 199).

7. Conclusions

Germany has been a push country in terms of acid rain policies. This led to a strong deviation from the ideal policy cycle suggested by Underdal (1994): Both national policy-making as well as partial implementation have been well on the way towards compliance even before Germany entered international negotiations on substantive protocols. Therefore, one may conclude from this country study that push countries may use the results of their national policy processes to influence the policy of *other* countries. Given the transboundary nature of acid rain policies, this lets them reap additional benefits from international policies to lessen their own ecological vulnerability.

Three explanatory routes were assessed. The *economic* rational actor model pointed into the correct direction, but the missing damage costs of acid rain do not permit a narrowing of the predictive range of the model. Focusing purely on German forests and associated industries, the study shows that they do not constitute a major share of German GDP, and it seems unlikely that damage costs are extremely high for these industries. In addition, the abatement costs for the international environmental agreements (excl. VOCs) are of medium magnitude compared with other domestic social programs. Given the lack of specificity of economic damage cost data for each of the various pollutants involved, the economic rational actor model can only hint towards a generally ambitious policy of Germany. In the political actor model, we turn to a *political* demand and supply model for IEAs. On the demand side, environmental NGOs, the emergence of the Green Party, as well as media attention on environmental damages led to a strong domestic push in favor of demanding regulations, whereas the governmental supply side shows a mixture of enhancing factors (e.g., long duration of cabinets, partial electoral vulnerability) and unfavorable factors (e.g., low budgetary shares of the Federal Ministry of the Environment, junior standing of this ministry within the cabinet, little public sector control of emitters). Therefore, the domestic political actor model sheds partial light on the strong emission reduction program which Germany planned and has been implementing. Knowledge and learning explanations are particularly hampered by the (scientific) inability of attributing air pollution to be *the* major cause of forest dieback - the major environmental aspect in this policy domain. However, Germany has had a long history of regulating *local* air pollution which may have been a particular advantage once these policies were put into the international context.

Overall, Germany has been a committed pusher internationally, and it had the domestic backing needed for ambitious national and international policies. It embarked on strict emission reduction strategies domestically and endeavored to make others join it or at least tried to induce other countries to upgrade their ambitions. Taken by itself, the domestic incentive structure made the execution of Germany's international obligations self-enforcing which accounts for full or overcompliance with the obligations accepted under international environmental law.

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