

***Early Observations on the European Union's Greenhouse Gas
Emission Trading Scheme:
Insights for United States Policymakers***

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Overview

As of February 2006 161 countries had ratified the 1997 Kyoto Protocol, which entered into force on February 16, 2005 (United Nations 2006). The Protocol signifies broad international agreement that the developed nations should take the lead in reducing greenhouse gas emissions, the bulk of which have been emitted from the industrialized world.

The European Union's leadership in the climate change arena was evident before the Protocol formally went into force. In 2000 the European Union (E.U.) initiated the comprehensive European Climate Change Program. A cornerstone of this program is the Greenhouse Gas Emission Trading Scheme, or the E.T.S. (European Union 2003), which was launched in 2005 and is the most ambitious emissions trading system ever established.

This paper describes how the E.T.S. is working thus far and it also asks what U.S. policymakers can learn from the E.T.S.'s early implementation as they develop climate change policies in the United States. The greenhouse gas reduction plans implemented across the E.U. necessarily vary because each Member State's regulatory, historical, political, and economic circumstances are unique and because each country has a different emissions goal under the E.U.'s climate change burden-sharing agreement. These sundry approaches offer a diverse range of experiences to draw on as U.S. policymakers try to craft greenhouse gas regulatory schemes at the state, regional, and national levels.

Any evaluation of the E.T.S. must be regarded as preliminary as it went into effect little more than a year ago. Still, the E.U.'s policies represent the most ambitious effort in the world to address climate change and, as such, it makes sense for U.S. policymakers at all governmental levels to understand the practical details of the European experience to date. And to the extent that U.S. policymakers would like to link domestic market-based programs with trading opportunities elsewhere in the world, it helps to appreciate the ways in which the design of domestic programs can facilitate or hinder that end.

This paper is organized as follows: (a) background on the European Climate Change Program; (b) general observations about the E.T.S.; (c) E.T.S. National Allocation Plans; (d)

allowance trading in the E.T.S.; and (e) linking the E.T.S. with projects and programs outside of the E.U. Many sub-topics are treated within these broader categories, including but not limited to: the use of so-called “project-based” mechanisms (the Clean Development Mechanism and Joint Implementation); costs and benefits of greenhouse gas reductions; allowance price caps; non-E.T.S. greenhouse gas reduction measures; competitive effects; and, centralized vs. decentralized government control.

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This paper does not give a detailed overview of the E.T.S. Readers seeking more background information on how the program works may consult either the Pew Center’s recent paper on this topic (Pew Center on Global Climate Change 2005) or the European Commission’s internet sites on the European Climate Change Program (<http://europa.eu.int/comm/environment/climat/eccp.htm>) and the E.T.S. (<http://www.europa.eu.int/comm/environment/climat/emission.htm>).

Background on the European Climate Change Program

Under the Kyoto Protocol, the European Union has committed to reduce its greenhouse gas emissions in 2008-2012 by eight percent below 1990 levels. The European Climate Change Program, an E.U.-wide strategy to achieve that goal, started in 2000. As a first step several working groups developed reports on various topics, e.g. flexible mechanisms, energy supply, emissions trading, and transport. This was a multi-stakeholder process that involved experts, Commission staff, the business community, and non-governmental organizations (NGOs). From this work the European Commission concluded that every sector should reduce greenhouse gases to minimize the overall cost of meeting the Kyoto Protocol’s targets. Further, the Commission identified forty control measures deemed cost-effective (€20/ton CO₂eq or less) whose aggregate reductions totaled 664 to 765Mt CO₂eq, or more than twice the E.U.’s overall Kyoto target of 336 Mt CO₂eq (European Commission 2001).

Since that initial work was completed the Commission has implemented several pieces of legislation aimed at reducing greenhouse gas emissions. Much of this work has focused on

energy supply and demand. The Renewables Directive establishes the goal that renewable sources provide twenty-one percent of total electricity consumption E.U.-wide by 2010 (European Union 2001). Other Directives instruct member countries to adopt building energy efficiency standards, to impose minimum fuel taxes,¹ and to promote biofuels. A June 2005 Green Paper identifies ways in which E.U. countries can save twenty percent of energy consumption cost-effectively by 2020 (European Commission 2005c). On 13 December 2005 the European Parliament and European Council agreed upon a new Energy Efficiency Directive whose goal is for Member States to save nine percent of energy in the nine years following the Directive's entry into force.

Although this goal is not binding on the Member States, each must submit three energy efficiency plans over the nine-year period to the Commission (European Union 2005). Many Member States have already implemented energy savings programs. To cite but a few examples: district heating systems are in widespread use around the E.U.;² Germany gives a rebate on energy-efficient vehicles; Denmark reduces taxes on energy-efficient vehicles; Italy and the U.K. have created white certificate programs, which require energy efficiency improvements of energy suppliers and distributors who then earn tradable "white" certificates; and, The Netherlands has undertaken voluntary energy efficiency agreements with industry that seem to be yielding impressive reductions (European Commission 2005c; International Energy Agency 2005).

Transportation emissions have not been ignored. E.U. aviation carbon dioxide emissions grew by over seventy percent between 1990 and 2003, a period when overall E.U.-25 greenhouse gas emissions dropped by slightly greater than five percent (European Commission 2005). As a result, the European Commission has recommended bringing aviation emissions into the E.T.S. and a recent study examines various regulatory alternatives for this relatively modest (three percent of overall greenhouse gas emissions) but rapidly growing source (European Commission 2005, 2005d). Further, the E.U. has established a voluntary agreement with auto manufacturers

¹The Directive on Energy Taxation sets minimum tax levels on fuels, in order to reduce competitive imbalances and to encourage energy efficiency. The minimum tax on unleaded gasoline is 35.9 European cents (or about 43 U.S. cents, at current exchange rates) (European Union 2003(a)).

²District heating systems supply hot water to buildings in a wide area, circulating the water through insulated pipes. The energy savings in these systems, as compared with those in which each building has its own boiler, can be especially high when they use waste heat from incineration or from power generation. The Danish Board of District Heating's website provides more detailed information (<http://www.dbdh.dk/index.html>).

that, if fully implemented, will achieve an average fuel efficiency of 5.8 liters/100 km (about 42 miles/gallon) by 2008.³

The centerpiece of the European Climate Change Program is the 2003 E.T.S. Directive, which established a cap-and-trade program for greenhouse gases in the European Union. The E.T.S. is the E.U.'s main tool for reaching its Kyoto Protocol target. The E.T.S. Directive is binding legislation that was proposed by the European Commission and passed in 2003 by the European Parliament and the European Council.⁴ This cap-and-trade scheme is in its first, start-up phase, which lasts from 2005 to 2007. The second phase will last from 2008 to 2012, which coincides with the Kyoto Protocol's commitment period. Carbon dioxide emissions from selected heavy industries are the focus of the current start-up phase, with the idea that the sectors and pollutants covered will expand during the second phase. While many Member States are finding that some companies can meet the requirements of the first trading period through well-known control measures (one observer noted that "better housekeeping" on energy consumption goes a long way), many observers believe that the E.T.S. will also help drive technological innovation.

Predicting whether these diverse, ambitious efforts will bring the E.U. to its Protocol target is complicated by several factors. The E.T.S. has been under way only since January 2005, which means that the most recent (2003) emission E.U.-wide emission inventories do not account for E.T.S. reductions. Further, all twenty-five E.U. Member States and a corresponding diversity of initiatives are involved in the Climate Change Program. Finally, making predictions about the effectiveness of pollution control is an inherently uncertain process. Despite these complexities, the question of whether the E.U. is likely to succeed is important, especially since the Protocol's deadlines loom in the reasonably near future.

The European Commission reports that E.U.-15 greenhouse gas emissions overall decreased by 1.7 percent between 1990 and 2003 (European Commission 2005f), which is equivalent to the annual greenhouse gas emissions of Denmark or Bulgaria (United Nations

³This goal is expressed as a CO₂ emission standard (140 gm/km CO₂), and the Commission's goal for 2012 is even lower (120 gm/km CO₂). For more specifics see http://europa.eu.int/comm/environment/co2/co2_agreements.htm.

⁴The European Commission, the European Parliament, and the Council of the European Union are the three decision-making institutions of the European Union. The Council represents the Member States, the Parliament represents the citizens, and the Commission is to represent the collective European interest. Thus the Commission must not take instructions from any Member State. The Council and the Parliament share legislative power, although only the Commission may propose legislation. The Commission is divided into 26 Directorates-General and it is the E.U.'s executive arm. The Commission consults extensively when developing legislative proposals (http://europa.eu.int/comm/atwork/basicfacts/index_en.htm#comm, accessed 8 December 2005; Fontaine 2003).

2006). As indicated in Figure 1, the most dramatic decreases were in agriculture (nitrous oxide and methane), waste management (methane), and industrial processes (HFCs, nitrous oxide, and carbon dioxide). Compared with 2003 emissions (the most recent estimates available), the E.U.-15 must reduce 297 Mt CO₂eq by the Kyoto commitment period of 2008-2012 (European Commission 2005g). This seems a formidable task.

However, a December 2005 European Environment Agency report concludes that while several Member States are not on track to meet their targets under Kyoto or under the E.U.'s burden-sharing agreement, others are helping to make up those shortfalls, and the E.U. as a whole can reduce emissions to slightly over nine percent below base-year levels, in excess of its Kyoto target of eight percent (European Environment Agency 2005).⁵ To accomplish this reduction will require implementing a wide variety of existing and planned pollution control measures as well as use of the Kyoto project-based mechanisms. Meeting this goal also implies that second-round E.T.S. allocations in many Member States must be tighter than those in the first round (European Commission 2005g). Appendix B gives details on the European Environment Agency's analysis.

European Climate Change Program: Accomplishments and Challenges

E.U.-15 greenhouse gas emissions dropped by 1.7 percent between 1990 and 2003, although carbon dioxide emissions rose by 3.5 percent in this same period.

Between 1990 and 2003 carbon dioxide emissions rose much more slowly than did GDP. However, transportation-related greenhouse gas emissions, which are comprised primarily of CO₂, increased by 24 percent over that same period.

The European Environment Agency projects that the E.U. as a whole can meet—and even perhaps slightly exceed—its Kyoto Protocol commitment, although this assumes that several Member States will overreach their targets to compensate for others who are unlikely to meet their goals.

Source: European Environment Agency (2005)

⁵The Kyoto Protocol allows parties to meet their targets individually or jointly. Member States, and the European Community as a whole, have identical targets under the Protocol, but the E.U. has re-allocated the emissions under an internal burden-sharing agreement.

Overview of Emission Trading Scheme

In the E.T.S., emission allowances are issued to operators of affected installations, and they may buy or sell these allowances as long as they hold a sufficient number to cover their emissions. All Member States were to prepare National Allocation Plans by 31 March 2004 (or, for new Member States, by the date of accession into the E.U.). Despite these acute time pressures, the vast majority of Plans were submitted and reviewed on time. As of June 20, 2005 the Commission had approved all Plans for the first E.T.S. trading period (2005 to 2007), including those for the ten new Member States which, although not part of the overall E.U. Kyoto burden-sharing agreement, are still part of the E.T.S.

Six-and-a-half billion allowances have been issued to the estimated 11,400 sources in the covered categories, which are: combustion installations, oil refineries, coke ovens, iron and steel plants, cement factories, coke ovens, pulp and paper manufacturing, and glass, lime, bricks, and ceramics industries (European Commission 2005a). Each allowance confers the right to emit one tonne of CO₂. Thus the largest emissions trading program to date has been launched, largely on time.

As would be expected as this “learning” phase of the E.T.S. unfolds, some observers have expressed concerns over the program’s basic features, potential environmental outcomes, and possible economic effects. One concern goes to the omission of transportation-related emissions from the E.T.S. While the industrial sectors included in the E.T.S. account for about half of carbon dioxide emissions in the E.U. (European Commission 2005b), transport emissions are growing, thereby counterbalancing actions to reduce emissions in the covered sectors. As indicated above, the E.U. has initiated efforts to control aviation and auto emissions. But for now there is concern that decreased emissions in the E.T.S. industries will be offset by increases in the non-E.T.S. sectors.

The Commission reduced the number of proposed allocations in fourteen of the twenty-five Plans submitted. Nonetheless, some fear that many Member States have been overly generous with their initial allocations and that to meet their national emission targets they will depend too heavily on reductions achieved in the non-trading sectors or through flexible mechanisms. The Member States must take care not to violate the principle of complementarity, which is set forth in the Marrakesh Accords and states that “the use of mechanisms [International Emissions Trading, CDM, JI] shall be supplemental to domestic action.” This limit has been interpreted to mean that fifty percent of emission reductions must be met through domestic action (Climate Action Network 2005). The European Commission has cautioned in its recent guidance

for the E.T.S.'s second round of National Allocation Plans that many Member States must close the gap between current emissions and Kyoto Protocol commitments by combining the following strategies: lowering total E.T.S. allocations in the 2008-2012 trading period; implementing additional measures in non-E.T.S. sectors; and, government purchase of Kyoto unit credits (European Commission 2005g).

Interviewees raised other concerns about the environmental integrity of the program. Comprehensive emissions databases had to be generated very quickly in some countries, raising some questions about the data's validity. And there are reservations about whether all countries—especially those with limited administrative resources—can implement effectively the strict reporting and monitoring guidelines. Even though many countries are “off-target” when 2003 emissions are compared to Kyoto goals, the majority of Member States have allowed emissions increases in the E.T.S. trading sectors during the learning period of 2005-2007 (Centre for European Policy Studies 2005). In its recent guidance document for the second round of National Allocation Plans, the European Commission has hinted that it will use the low carbon intensity rates achieved between 1990 and 2000 as a benchmark for second-round E.T.S. allocations (European Commission 2005g). The Commission has also indicated that Member States that are “off track” must reduce allocations in the second round. Enforcing strict allocation caps seems a vital step in ensuring that the E.U. can meet its ambitious Kyoto emissions goal.

Among the economic concerns is that there might be “leakage” of business capacity (and emissions) to the U.S. (referred to by some as a “Kyoto-free area”) and to the developing nations. Many observers from N.G.O.s, businesses, and government agencies also strongly advocate greater harmonization across member countries for the second phase of the E.T.S. so as to minimize adverse competitive effects. Some of the areas in which harmonization has been suggested are as follows: the definition of combustion installations, new entrants, and closure rules (Centre for European Policy Studies 2005; Climate Action Network 2005; UNICE 2005). (More details on the issue of harmonization are given below under the section covering National Allocation Plans.) There is sentiment for eliminating the smallest sources (the 2004 Directive includes all combustion sources with a rated thermal input larger than 20 MW), which make up a large fraction of the number of installations but which contribute a small fraction of overall emissions (Centre for European Policy Studies 2005; UNICE 2005), and for including more gases and sectors (UNICE 2005). Energy-intensive sources complain that they are paying twice for emission reductions because they must hold enough allowances to cover their facilities' process

emissions and they must also pay higher rates to utility companies (Egenhofer 2005).⁶ Finally, the fact that carbon has been trading between 20 and 30€/tonne CO₂ worries some in the business community (Shah 2005). Carbon prices are treated in greater detail below in the Allowance Trading section.

National Allocation Plans

E.T.S. participants recognized from the start that the process of allocation would be complicated, contentious, and time-consuming. These predictions were realized. A 2003 report for the European Commission (PriceWaterhouseCoopers 2003) outlined the following basic questions for government officials writing National Allocation Plans: Should allowances be given away or auctioned? How many allowances should be allocated to the covered industries? How should those allowances be divided up within the covered industrial sectors? For any given facility, should historical emissions serve as the basis for allocations or is it better to use a benchmark level reflective of best practices in that sector? The E.T.S. Directive settled one of these issues by specifying that most allowances would be given away: in the first trading period (2005-2007), at most five percent of allowances can be auctioned and in the second trading period (2008-2012), at most ten percent can be auctioned (European Union 2003). This decision is not surprising. Handing out free emission allowances creates new assets, thus easing the transition to a new regulatory regime with new pollution control liabilities, and in the E.T.S. it also lowers the potential for adverse competitive effects with non-E.U. nations.

The E.T.S. Directive articulated eleven “criteria” (requirements) to be followed as Member States developed their Plans, and the Directive also specified the source categories that would be covered (European Union 2003). Among these eleven criteria were: consistency with the Member State’s Kyoto obligations; consistency with other E.U. legislation; non-discrimination among companies or sectors; a list of installations covered and the quantity of allowances allocated to each installation;⁷ and, public access to the decision-making process. Each Member State could decide—subject to European Commission approval—how many

⁶The German cartel office has initiated an investigation into whether members of the Germany energy market have overcharged their customers for costs incurred through the E.T.S. (Dr. Thomas Fuhr, Becker, Buettner, Held, Berlin, personal communication, 28 October).

⁷Companies owning many installations may centrally manage their allowances, which can be moved easily between installations in the electronic registries (Peter Zapfel, European Commission, personal communication, 16 August 2005).

allowances to distribute and how to allocate carbon dioxide emission allowances among and within the covered industrial sectors. Among the differences across nations are choices in:

- base year period (these choices spanned various recent intervals, e.g., 1998 to 2002 for Denmark and 2001 to 2002 for The Netherlands);
- methods for allocating among and within sectors (the techniques employed included permutations of historic, projected, category-wide average, and installation-specific emissions, with some countries accounting for production levels as well);
- “grandfathering” (basing allocations on facility-specific emissions or production levels) vs. “benchmarking” (applying a benchmark based on, for example, average emission rates or rates associated with best available technology);⁸
- presence or absence of auctioning (most countries are giving away their entire allocations,⁹ although Denmark, Hungary, Ireland, and Lithuania will conduct auctions, and the U.K., The Netherlands, and Portugal intend to auction unused allowances from the new entrants reserve);¹⁰
- treatment of new entrants (all countries have new entrant set-asides that will be distributed for free);
- rewards for early action (for example, Germany gives explicit bonuses to early actors while the U.K. does not);
- use of “opt-in” provisions, which allow Member States to include in the trading system smaller installations than the Directive requires (several countries have used this provision) and, after 2008, to extend trading to additional activities or gases;
- definition of installations covered (a prominent ongoing issue concerns how broadly to define “combustion” installation) (IVL Swedish Environmental Research Institute 2004); and,
- public access procedures (there have been complaints in some countries about lack of transparency in decision-making rules).

⁸Benchmarking is most commonly used for new facilities.

⁹In Germany an entirely new, 90-person administrative unit (the Deutsches Emissionshandelsstelle, or DEHSt) oversees the E.T.S. DEHSt is supported entirely by source fees and thus businesses argue that these allowances are not strictly “free.”

¹⁰Ireland’s auction proceeds will be used to cover administrative costs. Denmark and Lithuania have not yet indicated what will happen to their auction proceeds.

The flexibility designed into the E.T.S. is proving a source of concern. Many E.T.S. participants are concerned over disparate allocation methods and over the perception that each country favored certain industries over others, which could lead to adverse competitive impacts within the E.U. Special exemptions or elaborate allocation schemes can hamper emissions trading markets, which work best when least interfered with. In Germany the final allocation of allowances provoked more than 700 separate appeals (out of 1,849 installations covered) about an overly elaborate, sometimes confusing allocation scheme that the Bundestag codified in an overarching law and that gave very little discretion to German administrative authorities. Some policymakers and industry representatives believe that a three-year allocation is too short and that the prospect of new allocations for the second trading period introduces too much uncertainty into the E.T.S.

Business representatives have protested what they regard as a perverse prohibition on domestic offsets: companies may not use domestic offsets from sectors outside of the specified E.T.S. categories. The response to this objection is that the required emission reductions should be had solely from the first set of E.T.S. categories, thereby “saving” emission reductions from other source categories for the second trading period. As of 2008 Member States can “opt in” other source categories and greenhouse gases and there may also be an E.U.-wide extension along these lines. Implementing a new system of domestic offsets would require new E.U. legislation and infrastructure, and as of this writing there are no formal plans to embark on this path.

The widespread perception of uneven playing fields for affected industries has driven public and private parties alike to advocate harmonization in the second round of National Allocation Plans, which are due in June 2006. Climate Action Network-Europe, which serves as an N.G.O. focal point on climate change policy in Western Europe, and the Centre for European Policy Studies, writing on behalf of a seventy-five-member task force comprised primarily of (and chaired by) business representatives, agree that the E.T.S. will be more effective and credible if the Commission forces more consistency across allocation methods in the next round of Plans (Climate Action Network-Europe 2005; Centre for European Policy Studies 2005). These same organizations also point to benchmarking as one way to reduce the perception of unfair treatment across countries. Many observers have suggested that National Allocation Plans be made more consistent and transparent in the next round (Centre for European Policy Studies 2005; UNICE 2005). The European Commission’s recent Guidance Document agrees that the second round of National Allocation Plans should be simpler, more transparent, and better harmonized, while leaving the question of benchmarking to individual Member States. The

Commission has also specified a definition for combustion installations that will bring into the E.T.S. many more installations and help to eliminate competition distortions caused by variable definitions (European Commission 2005g).

U.S. policymakers should contemplate carefully the lessons of these debates for climate change programs in the U.S., where similar questions about consistency have arisen many times in environmental law. Because of the United States' large geographic extent and because of a well-established dedication to federalism, American laws often combine strong national oversight with delegation of important decisions to state legislatures and administrative entities. The Clean Air Act's program for ambient air quality standards exemplifies this approach, as it relies on the states for implementation and on the federal government to set national health and environmental standards. In the climate change arena this same regulatory model may be the appropriate choice, for two reasons. First, it is likely that any reasonably ambitious national program will include a huge number and variety of sources, as does the ambient air quality standards program. Second, many states are entering the climate change policy arena and, having taken the initiative, they may be unwilling to cede an overwhelming measure of control to the federal government. The latest entry into this realm is the Regional Greenhouse Gas Initiative (RGGI), which consists of seven Northeastern states that have agreed to cut greenhouse gas emissions from power plants (http://www.rggi.org/docs/mou_rggi_overview_12_20_05.pdf).

By way of contrast to the ambient air quality standards program, U.S. cap-and-trade programs provide precedent for a great deal of centralized control. In the Clean Air Act's sulfur dioxide cap-and-trade program to mitigate acid rain, the federal government specified formulas for electric utility allowance allocation, leaving no discretion to the states.¹¹ For the regional program to reduce nitrogen oxides emissions in the Eastern United States (the "NO_x SIP Call") the federal government specified overall state pollution budgets and the states then allocated those budgets among power plants and industrial combustion sources (U.S. Environmental Protection Agency 2005). In these cases the federal government reduced (with NO_x) or eliminated (with SO₂) any uncertainty about, or sense of unfairness over, allowance allocations and, in so doing, simplified program implementation.

¹¹Sulfur dioxide allowances were decided on the bases of fuel input and specified emission rates. For further explanations see EPA's Acid Rain Allowance Fact Sheet (<http://www.epa.gov/airmarkets/arp/allfact.html>).

Allowance Trading in the Emission Trading Scheme

Cap-and-trade regulatory systems succeed when the emissions cap is reached cost-effectively. Of course, it is still too early to evaluate whether the E.T.S. trading system will prove environmentally effective and cost-effective. What we can do now is describe how the trading system has been designed to accomplish its environmental and economic goals and to describe the system's performance in its start-up phase.

The U.S. experience with emissions trading demonstrates that some important variables inevitably remain outside of policymaker control. For example, the acid rain program in the United States was helped by railroad industry deregulation, which happened prior to passage of national acid rain legislation and which lowered the costs of transporting low-sulfur coal from the American West to the East. Control costs and allowance costs were much lower than expected because of this important non-programmatic factor. Similarly, we are witnessing now the effect on E.T.S. carbon trading of uncontrollable circumstances in that natural gas prices worldwide have risen dramatically, causing many E.T.S. installations to switch to coal and increasing the demand for (and price of) carbon allowances. Drought conditions in Spain have caused many hydroelectric generators to switch to burning fuel, which also creates additional demand for carbon allowances (McCrone 2005).

Fortunately, policymakers can control many variables in their attempts to achieve emissions caps and to allow the market to find the least-cost path. Accomplishing these twin goals is most likely to happen under the following interconnected conditions: (1) reporting and monitoring deter cheating; (2) allowance banking is permitted; (3) trades can happen easily, thereby minimizing transaction costs; and (4) there are stiff penalties for non-compliance (Ellerman et al. 2003; Thomson and Roach 2004). The following section touches on all four of these program design features.

E.T.S. participants must be confident that reported emission reductions are real, because environmental effectiveness is the program's core value and because cheating undermines markets generally. Much attention has been devoted to establishing a robust monitoring and reporting system for the E.T.S., which drew on the GHG Monitoring Protocol developed by the World Resources Institute and the World Business Council on Sustainable Development. The Commission published a 75-page Decision and Guidelines that specified closely the methods for computing indirectly or measuring directly carbon dioxide emissions from each of the industrial categories covered under the E.T.S. (European Commission 2004). These monitoring, computation, and reporting requirements become part of each individual facility's E.T.S. permit,

and third-party verifiers ensure that the requirements and procedures are followed. The requirements are tiered: they are most stringent for the largest installations and least strict for the smallest facilities.

Reliable allowance tracking is absolutely necessary so that government officials will know exactly how many allowances an installation owns at annual reconciliation (which happens by April 30 in the E.T.S.). Each Member State will have its own national registry containing accounts which will hold the allowances. These registries interlink with the Community transaction log, operated by the Commission, which will record and check every transaction. Careful attention is being given to these registries, so that they can all communicate with one another and with the Community transaction log. The U.K. and France have developed registry software that has been sold to other member countries.

Programs that permit allowance banking encourage firms to regard allowances as real assets. In the U.S. acid rain program the affected utilities banked allowances very early, thereby signaling that they viewed allowances as assets whose value would probably rise over time. We cannot judge yet whether similar patterns will be realized with the E.T.S. Firms affected by the E.T.S. cannot bank allowances between the first and second trading periods, with the exception of credits earned through the Clean Development Mechanism program (Ehrhart et al. 2005).¹² However, international accounting standards dictate that E.T.S. allowances must appear on company balance sheets, a decision that should reinforce the idea of allowances as assets (Pfeifer 2005).¹³

An important indicator that trading can happen easily is the increasing activity of the E.T.S. allowance market. PointCarbon consolidates trading data from several brokerage firms and, while those data are proprietary and cannot be reproduced here, they show carbon prices rising from a low of around 7 €/tonne of CO₂ in early February 2005 to a high of 29 €/tonne in early August and falling once again to the low to mid-20s by the end of 2005. Current prices are hovering around 28 €/tonne (www.pointcarbon.com). Daily trading volumes have tended to be in the range of a few hundred thousand and the overall volume traded in the first ten months of 2005

¹²While the rationale for forbidding banking between periods is nowhere explicitly stated, it seems likely that Member States felt that the use of banked allowances might cause emissions to exceed Kyoto targets.

¹³One E.T.S. expert interviewed for this report observed that allowances may be viewed as financial instruments under the meaning of the Markets in Financial Instruments Directive (MiFID). If that is the case, many provisions of MiFID may apply to emissions trading contracts, thereby complicating—and increasing the costs of—these transactions (Dr. Thomas Fuhr, Becker, Buettner, Held, personal communication, 28 October 2005).

was 220 million (Arvanitakas 2005; Hasselknippe 2005), a modest amount when one considers that there are 6.5 billion allowances in the E.T.S. (European Commission 2005a). However, the market has become much more active in early 2006: the leading carbon exchange firms reported a combined trading volume of almost 60 million tonnes by 24 February (http://www.europeanclimateexchange.com/index_noflash.php).

Close observers believe that the early performance of the market is healthy and that it is responding appropriately to policy decisions by the European Commission, which lowered the allocation amounts requested in many National Allocation Plans, and to market changes, which have involved fuel-switching to coal, which emits more carbon per unit of heat (Arvanitakas 2005; Saltmarsh 2005). While excessively high carbon prices might make it costly for firms to acquire needed allowances in a pinch, high prices give firms every incentive to reduce emissions and they signal that initial allocations were not overly generous. One PointCarbon analyst suggested in February 2005 the possibility that prices might well rise to 20 €/tonne, so the price level we witness today falls well within the realm of expert expectations (Mulvey 2005).

On balance it is simply too early to evaluate the market's performance and it would be premature indeed to use trading prices to draw conclusions about potential control costs. Companies are only now deciding how to respond to the first phase of allocations. Further, many potential allowance sellers in Eastern Europe have not yet started to trade (Harvey and Morrison 2005), probably because of uncertainty over how the E.T.S. works, a natural reluctance to plunge too quickly into a new, untested market, and the absence of completely functioning registries (Lecocq and Capoor 2005). One projection indicates that, once mature, the market will generate billions of dollars of business for affected companies and financiers (Cohn 2005). However, some observers are concerned that a changing field of regulatory decisions may ripple through the market, making firms less willing to trade (Ahmad 2005).

The carbon market's early behavior thus far is not inconsistent with other emissions trading experiences that ultimately lowered emissions at reasonable cost. During the first year or so of the sulfur dioxide emissions trading program there were very few trades. For example, in 1995, the first year of the sulfur dioxide emissions trading program, there were 8.7 million allowances available for trading (U.S. Environmental Protection Agency 2004), but only 750,000 were traded in the first six months (U.S. General Accounting Office 1997).¹⁴ Trading picked up considerably over time. Analysts who have watched the U.S. acid rain program have concluded

¹⁴This estimate is approximate as it had to be interpolated from Figure 1 (U.S. General Accounting Office 1997).

that it takes some time for emissions markets to mature and for firms to figure out how best to manage their new allowance assets (Carlson et al. 2000). Even after some time, however, sulfur dioxide allowances prices can change unpredictably and inexplicably (Ellerman et al. 2000). Market fluctuations seem to be a natural trait of emissions trading programs.

Stiff penalties are at the core of the E.T.S.'s program design. Participating firms may not simply pay the penalty and exceed their caps, much as happened with the Los Angeles RECLAIM cap-and-trade program in the late 1990s (Ellerman et al. 2003). Rather, E.T.S. firms running short of allowances at the annual reconciliation must not only pay the 40 €/tonne¹⁵ penalty for their excess emissions, they must also proportionately reduce by this excess their emissions in the following year. Public humiliation is added to the financial penalties: the names of the operators of these installations are to be published (“naming and shaming”).

E.T.S. participants place a high premium on attaining the E.T.S.'s emission reduction goals and at present there is widespread opposition to price caps, in part because the Commission believes that there are many cost-effective control opportunities available. While the European Climate Change Program was under development the Commission formed several working groups comprised of government officials and representatives from business and N.G.O.s. One of their tasks was to enumerate ways of reducing greenhouse gas emissions. These groups identified forty-two measures that were considered cost-effective—achieved at a rate of 20€/tonne or less—and that, in total, might reduce CO₂ equivalent emissions by twice that required in the Kyoto Protocol (European Commission 2001a). Finally, when E.T.S. participants talk about the costs of greenhouse gas programs, they also consider the social costs of *not* controlling them. While recognizing the difficulties in assessing the damage costs, which depend heavily on many unpredictable and unknowable variables, the U.K. uses 70 £/Mg C as a benchmark (Clarkson and Deyes 2002) and the European Commission has recently published a document indicating that the social cost ranges from 14 to 80 €/tonne of CO₂ “and very possibly much higher” (European Commission 2005e, 20).¹⁶

¹⁵Penalties rise to 100 €/tonne in the second commitment period of 2008-2012.

¹⁶One unit of carbon dioxide is equivalent to 0.2727 units of carbon (U.S. Environmental Protection Agency 2005a).

Linking the Emission Trading Scheme with Projects and Programs

Outside of the European Union

Emissions trading markets benefit from having many participants spread across a wide geographic area. A large market with many participants increases the kinds of possible emissions reductions, makes prices more competitive, and broadens the range of marginal abatement costs, all of which make trading more efficient. Climate change seems optimally suited for a global emissions trading scheme because it does not matter environmentally where emission reductions occur. Controls undertaken in a developing country will have the same effect as equivalent controls imposed in a developed country, where the control costs are likely to be much higher. Echoing the Kyoto Protocol's structure, the E.T.S. Linking Directive recognizes the benefits of a broad trading market by letting Member States use the Kyoto Protocol's so-called "project" mechanisms, the Clean Development Mechanism and Joint Implementation (European Union 2004).

The Clean Development Mechanism allows companies and governments in industrialized nations to support sustainable projects in developing countries and thereby to earn "Certified Emission Reductions," or C.E.R.s. The credits earned in this fashion must be issued by the Clean Development Mechanism Executive Board and they may be used in either the first or second E.T.S. trading periods. C.E.R.s can be traded (United Nations 2005). Joint Implementation (J.I.) provisions apply to projects undertaken jointly between countries that have ratified the Kyoto Protocol and that have emission reduction targets. In essence, J.I. credits (Emission Reduction Units, or E.R.U.s) are transferred from one country to another. This exchange cannot commence until the E.T.S.'s second trading period and much effort will be devoted to ensuring that emission reductions are not double-counted. Certain kinds of projects (e.g., nuclear power) may not be used to generate credits under the Clean Development Mechanism and Joint Implementation programs. All Member States have forbidden the banking of E.T.S. allowances from the first to the second periods, but Clean Development Mechanism credits can be banked and thus they are likely to be a popular hedge for the 2008-2012 trading period (Ellinghaus et al. 2004).

Several countries will rely on project-based credits to meet their E.T.S. and Kyoto commitments and, by implication, they are relying on the Clean Development Mechanism Executive Board to approve Clean Development projects in timely fashion. As of this writing, over 150 projects were either officially registered or were under consideration for registration with the Clean Development Mechanism Executive Board (<http://cdm.unfccc.int/Projects>). A few illustrative examples are given here. The Netherlands has undertaken projects in developing

countries (India and China) and in other industrialized countries (New Zealand) and, in so doing, has devoted public funding to the purchase of these credits (European Commission 2005b). Italy has entered into an agreement with the World Bank to start the Italian Carbon Fund, whose purpose is to purchase emission reductions through project-based mechanisms. Many other Member States have also established carbon funds.¹⁷ Denmark accepted an aggressive goal (a twenty-one percent reduction) and plans to apply public funding toward the purchase of Clean Development and Joint Implementation credits, which Denmark believes are likely to cost less than 13 €/tonne (Danish Environmental Protection Agency 2003). These cost assumptions are predicated on the assumption that the U.S. will not enter into the Kyoto Protocol, thereby leaving a huge potential competitor out of the market.

Many E.T.S. participants have expressed interest in the idea of linking with U.S. programs, whether at the national, regional, or state levels, as it would broaden the market for trading on both sides of the Atlantic and it would reduce the possibility of economic activity “leakage” to the U.S. However, substantial legal modifications at the E.U. level would be necessary before this could occur. At a minimum, the E.T.S. Directive would have to be changed, as it currently restricts linking to the Annex B countries that have ratified the Kyoto Protocol.¹⁸ The E.T.S. Directive’s linking provisions (Article 25) also specify that an international agreement must be established with any non-E.T.S. trading partner. Further, it appears that the Kyoto Protocol would have to be modified in order for credits generated in the U.S. to be sold into the E.T.S., because the treaty limits the assignment of credits to the Protocol’s signatories (Bodansky 2002).

Many states in the U.S. have initiated climate change programs, but it would be unconstitutional for a State government to enter into a treaty with the European Union.¹⁹ Despite this prohibition, E.T.S. participants could still recognize as legitimate trading partners U.S. businesses affected by sub-national programs like the Regional Greenhouse Gas Initiative, as long as those programs are properly structured. Even if allowances originating in the U.S. cannot be sold to E.T.S. companies, business participants in American regional or state programs could

¹⁷ More information on the Italian Carbon Fund—and those of other countries as well—can be found at <http://carbonfinance.org/router.cfm?Page=html/icf.htm>.

¹⁸ Annex B countries are nations with developed or “in transition” economies that have accepted emission targets under the Kyoto Protocol.

¹⁹ Article I, Section 10, Clause 1 of the U.S. Constitution says: “No State shall enter into any Treaty, Alliance, or Confederation.”

be allowed to purchase E.T.S. allowances, thereby accomplishing a one-way linkage. Direct E.T.S. trades with U.S. businesses, rather than with the states, would likely pass legal muster in the U.S.

It is important to consider how U.S. programs might be optimally designed so as to leave open the possibility of such linkages. Monitoring, reporting, and verification procedures must be as stringent as those of the E.T.S. to avoid undermining confidence in the U.S. emission credits. This qualification was mentioned repeatedly in discussions with E.T.S. participants. Programs with allowance price caps are unlikely to be attractive linking partners for the E.T.S. In the view of E.T.S. participants, price caps imply a willingness to violate environmental goals and they also indicate an unwillingness to let the market find the best, least-cost solution. In this view, flexible mechanisms provide a sufficient cost safety valve. Price caps are precluded by the current E.T.S. Directive and they have not been under serious discussion. Links between the E.T.S. and a system with price caps would probably be feasible only if limits were placed on the number of allowances that could flow into the E.T.S. from the price-cap system (International Energy Agency 2004).²⁰

By contrast, U.S. programs that differed in scope (i.e., that included different types of sources or gases) or in allocation strategies (e.g., upstream vs. downstream allocation) from the E.T.S. could still be possible linking partners. Care would need to be taken that credits are not double-counted (for example, by both consumers and producers of electricity), that differences in allocation schemes do not encourage counter-productive responses in the regulated community, that banking rules are harmonized, that “leakage” does not occur (e.g., that electricity demand is not simply shifted to power plants outside a trading region), and that there is clarity about which trading units are included in the overall scheme (International Energy Agency 2004). These considerations would not be new to the many U.S. businesses that, by virtue of their European operations, are already subject to the E.T.S.’s requirements (Eizenstat and Kraiem 2005).

²⁰ The Draft Model Rule for the Regional Greenhouse Gas Initiative includes two price triggers. One expands the market for offsets and allows covered entities to use a higher percentage of offsets to comply with their caps. The second price trigger allows the purchase of allowances from international trading programs if market prices rise above \$10/ton CO₂ twice in two consecutive 12-month periods (Regional Greenhouse Gas Initiative 2005).

Summary and Conclusions

The European Union's Emission Trading Scheme is off to a strong start. All twenty-five E.U. Member States have approved National Allocation Plans for the first trading period of 2005-07. Six-and-a-half billion carbon dioxide allowances have been issued to an estimated 11,400 sources, making this the largest emissions trading scheme attempted to date. Recent analyses indicate that the E.U. can accomplish its Kyoto Protocol target of eight percent below base year emissions, although this cautious optimism is tempered by the recognition that some Member States will find it difficult to achieve their individual goals. Many Member States will have to rely on the Kyoto Protocol's flexible mechanisms, notably C.D.M. and J.I., to meet their commitments. Trading has grown steadily in volume and, while trading has been relatively thin relative to the number of allowances issued and while carbon prices initially rose steeply, the young market seems appropriately responsive to policy decisions and to energy market conditions. It will take time for the market to mature and for holders of allowances to decide how to use their assets to best advantage.

This first phase of the E.T.S. is considered a "learning" phase and there will be adjustments during the second trading period. Following the recommendations of public and private stakeholders, the European Commission will enforce greater harmonization and transparency in the second round of National Allocation Plans. Because some Member States are "off track" with respect to meeting their targets, the European Commission has signaled its resolve to require tighter allocations in the second round of National Allocation plans.

Despite the fact that the E.T.S. is only a year old, there are already some useful lessons for U.S. policymakers to consider as climate change programs are developed on this side of the Atlantic:

Allocation Decisions Making allocation decisions at the federal level is expedient in that it avoids the need for debate across all fifty states. However, states should have an active role in any national climate change regulatory program, given this country's geographic extent, the number of sources that are likely to be affected, and the fact that many states are already undertaking their own greenhouse gas reduction programs. The national government could minimize adverse competitive impacts and reduce claims of unfairness by making category-wide or state-wide allocation decisions, while letting the states decide how to allocate allowances to individual installations (or groups of installations). Auctioning a small proportion of overall allowances would be consistent with the E.T.S. and with the acid rain and NO_x cap-and-trade

programs in the U.S. Giving away large numbers of allowances may be politically desirable because free allowance allocation creates assets that counterbalance the new liabilities created by cap-and-trade programs. “Benchmarking” allocations against a best-technology standard rewards industry leaders and penalizes industry laggards. If a national or regional governmental body selected the benchmarks, this could help reduce the possibility for adverse competitive impacts among states.

Linking with the E.T.S. To enhance the prospects for two-way linkages with the E.T.S., U.S. cap-and-trade greenhouse gas programs should avoid allowance price caps and they should adopt reporting and monitoring schemes as stringent as those in the E.T.S. Many E.T.S. participants have expressed interest in linking with U.S.-based programs, but U.S.-based credits could flow into the E.T.S. only if a number of legal modifications are made to the E.T.S. Directive. Linking with U.S. programs or companies would demand changes in the Kyoto Protocol so that credits from the U.S.—which has not ratified the Kyoto Protocol—could be legitimately counted against an E.U. Member State’s overall Kyoto burden. On the other hand, state or regional programs in the U.S. could allow one-way trades in which U.S. businesses purchased E.T.S. allowances. The newly signed Regional Greenhouse Gas Initiative, an agreement to reduce emissions from power plants in the northeastern United States, allows for this latter possibility if allowance prices rise above \$10/ton CO₂ twice over two consecutive 12-month periods.

Developing World Projects E.U. companies and Member States have moved quickly to establish emission reduction projects in developing nations. To the extent that U.S. companies face emission constraints but do not have access to such reductions, either through the Kyoto system or a parallel U.S.-based crediting system, it seems likely that they will miss out on many of the cheapest emission reduction opportunities.

Transport Emissions The E.T.S. excludes transport from the initially regulated sectors. Even though the E.U. and its Member States have imposed fuel and vehicle registration taxes that are high by U.S. standards, and despite a voluntary agreement with auto manufacturers to reduce CO₂ emissions, it appears that some additional regulation of this sector will be necessary, at least to counteract transport emissions growth. U.S. policymakers must decide how to address transport emissions in any climate change regulatory program, so as to avoid the appearance of unfairness toward stationary sources and to ensure the program’s environmental effectiveness.

Public Access The U.S. is justifiably famous for its tradition of procedural openness in public administrative processes. Involving interested parties at all points in the decision-making process is clumsy and time-consuming and, of course openness does not guarantee problem-free solutions, as the German government discovered when 700 appeals were filed protesting allowance allocation decisions. But consulting widely before adopting programs helps to forestall complaints of exclusivity and to ensure that all views have been heard.

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Appendix A
Emission Trading Scheme Interviewees and Commenters

Belgium

European Commission, Environment Directorate

Olivia Hartridge

Madeleine Infeldt

Stefaan Vergote

Peter Zapfel, Administrator, Climate Change and Energy

Centre for European Policy Studies

Christian Egenhofer, Senior Research Fellow

Noriko Fujiwara, Research Fellow

Louise van Schaik, Research Fellow

(This visit included observing a CEPS Task Force meeting attended by about 40 members. This group, primarily comprised of business and industry representatives, was formulating a report on ways to improve National Allocation Plans in the second round.)

Climate Action Network Europe

Matthias Duwe, Policy Officer

Karla Schoeters, Director

Germany

Umweltbundesamt, Deutsche Emissionshandelsstelle (DEHSt)

Dr. Hans Juergen-Nantke, Director, DEHSt

Dr. Juergen Landgrebe

Dr. Simon Marr

Dr. Wolfgang Seidl

Becker, Buettner, Held

Dr. Thomas Fuhr

Alexander Handke

Dr. Ines Zenke, Partner

Ecologic

Benjamin Goerlach, Fellow

R. Andreas Kraemer, Director

Helen Lueckge, Researcher

Italy

Fondazione per l'Ambiente, Turin

Franco Becchis, Director (also Professor, University of East Piedmont)

Franco Molteni

Daniele Russolillo

Italy (cont.)

Ministry of Environment, Rome

Daniele Agostini

Mariano Morazzo

Legambiente (Italy-wide NGO), Rome headquarters

Daniele Calza Bini, Climate change expert

The Netherlands

Ministry of Economic Affairs

Jeroen Brinkhoff, Directorate General Competition and Energy

United Kingdom

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Appendix B

Description of the European Environment Agency's Analysis Projecting that the European Union Will Meet its Kyoto Target

The European Environment Agency's analysis (European Environment Agency 2005) assumes that several Member States (Austria, Belgium, France, Greece, Luxembourg, the Netherlands, Sweden, and the U.K.) will reduce emissions more than required, to make up for the possible inability of five Member States (Denmark, Ireland, Italy, Portugal, and Spain) to meet their targets.²¹ It is instructive to examine closely the actual emissions gaps faced by these latter five Member States. The combined emissions of Denmark, Ireland, Portugal, and Spain comprise only eleven percent of the E.U.-15's base year emissions. So with the possible exception of Italy, the shortfalls involved are all relatively small, although their combined effect is not insubstantial.

Denmark—which adopted an aggressive target of twenty-one percent below baseline levels—and Ireland have yet to analyze the reductions possible with the application of further domestic measures. Currently, Denmark intends to use flexible mechanisms to close its emissions gap, which ranges from 13 to 17 Mt CO₂eq. Ireland's gap is 7 Mt CO₂eq, even after the use of flexible mechanisms is included. Portugal's projected shortfall is 9 Mt CO₂eq and an as yet unspecified part of that gap is to be made up through Kyoto mechanisms. Italy's potential emissions gap is by far the largest (54 Mt CO₂eq). However, Italy's emissions shortfall could be much lower, on the order of 14 Mt CO₂eq, when the planned use of Kyoto mechanisms is taken into account (European Environment Agency 2005, Annex 8). And the Italian government recently announced a late revision to its National Allocation Plan that reduces allocations by 10 Mt CO₂eq (Anonymous 2005). Spain's gap drops to 7 Mt CO₂eq when “additional measures” and Kyoto mechanisms are taken into account.²²

Thus, the projected total shortfall of these five Member States ranges from 37 (assuming current best-case targets) to 84 Mt CO₂eq (assuming current worst-case targets), as compared with the E.U.'s overall emission reduction target of 336 Mt CO₂eq. However, the efforts of only a few other Member States may suffice to counterbalance all of—or the bulk of—these deficits.²³

²¹ Several of these countries (Austria, Belgium, Luxembourg, and the Netherlands) project compliance with their Kyoto targets through application of additional domestic measures plus use of Kyoto mechanisms. Predicted domestic reductions are itemized by source category in the detailed annexes to the European Environment Agency's December 2005 report.

²² The data described here were taken from European Environment Agency 2005, Annex 1, and individual country analyses in Annex 8. Spain's projections to date apply only to CO₂.

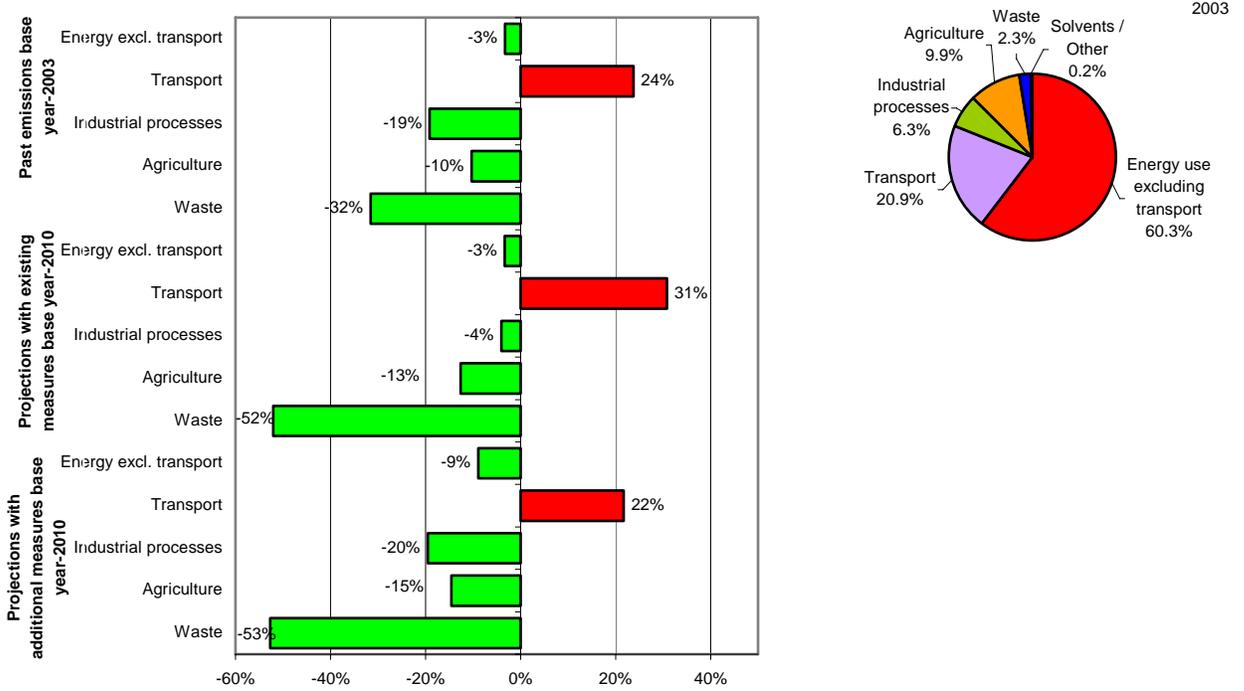
If the U.K. can reach its domestic target of twenty percent below baseline emissions by 2010 it would exceed by 59 Mt CO₂eq its Kyoto target of 12.5 percent (European Environment Agency 2005; Institute for Public Policy Research 2005). Sweden's projected 2010 surplus is 4 Mt CO₂eq and that figure would increase if, as the United Nations reports, Sweden's greenhouse gas policies result in a twenty percent reduction in 2010 (as compared with a Protocol target of a four percent increase) (United Nations 2006). With additional measures France is projected to exceed its target by 9 Mt CO₂eq. This means that under current projections the combined surplus of the U.K., Sweden, and France (72 Mt CO₂eq) either completely or almost completely counterbalances the deficits predicted for Denmark, Ireland, Italy, Portugal, and Spain.

These cautiously optimistic projections are tempered by recognition of the challenges that lie ahead. Two forms of energy production—combined heat and power and renewables—have yielded fewer emission reductions than originally hoped (Keay 2005; European Environment Agency 2005). Further, even as E.U.-15 greenhouse gas emissions decreased by 1.7 percent between 1990 and 2003, carbon dioxide emissions increased by 3.4 percent over the same period (European Commission 2005f). Transport-related emissions are expected to rise substantially—by twenty-two to thirty-one percent between 2003 and 2010—despite a recent fall in the average CO₂ emissions per vehicle (Figures 1, 2, and 3) (European Environment Agency 2005). The U.K.'s Revised Climate Change Programme, published in March 2006, showed the country falling short of its goal of reducing carbon dioxide emissions 20% by 2010 (DEFRA 2006), although this was anticipated and a recent analysis indicates how the U.K. might fill its emissions gap (Institute for Public Policy Research 2005).

Other indicators are more encouraging. Carbon intensity (emissions per unit of G.D.P.) between 1990 and 2000 declined slightly (0.3 percent decrease) in the E.U.-25 and stayed almost level (0.1 percent increase) in the E.U.-15 (European Commission 2005g). E.U.-15 carbon dioxide emissions from fossil fuel consumption (including transportation) between 1990 and 2003 grew much more slowly than did E.U.-15 G.D.P. (Figures 4 and 5). In the non-transport sector, energy demand grew faster than energy-related greenhouse gas emissions in every Member State except Finland (European Commission 2005f), and current projections indicate that non-transport energy-related greenhouse gas emissions (which consist primarily of carbon dioxide) will decrease by three to nine percent between now and 2010 (Figure 1).

Figures 1 through 5

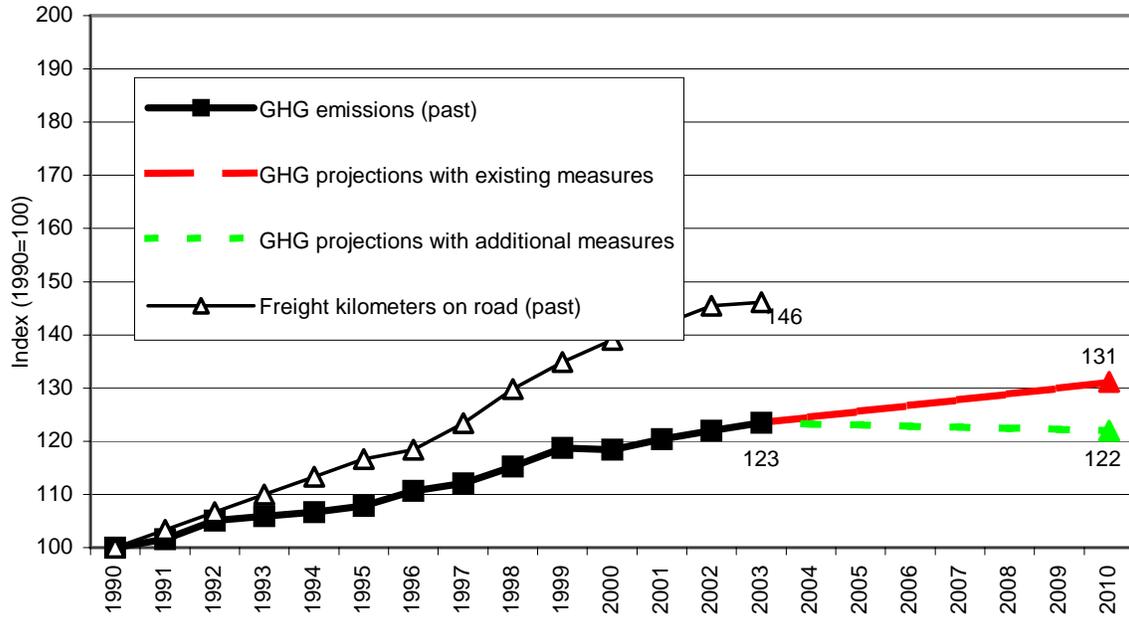
Figure 1 Change in EU-15 greenhouse gas emissions by sector base year to 2003, sector projections with existing and 'with additional measures' base year to 2010, and share of sectors in 2003. (Source: European Environment Agency 2005)



Note: Several Member States did not report projections for all sectors/scenarios. Therefore, the information on projections has to be interpreted with care.

Sources: Information submitted under the EC GHG monitoring mechanism and in third national communications.

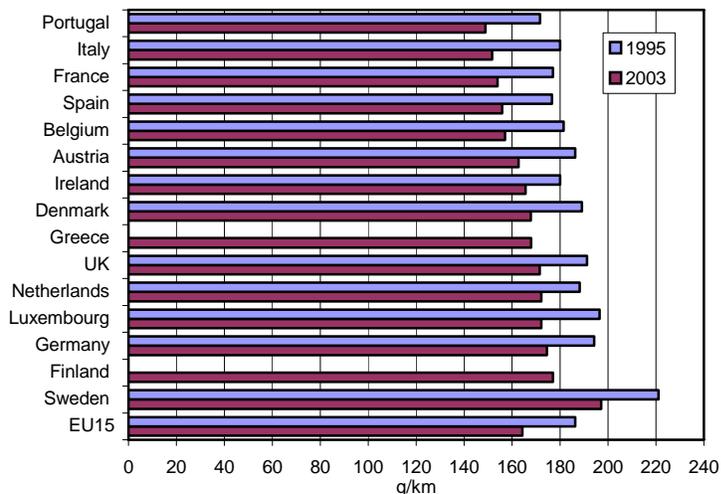
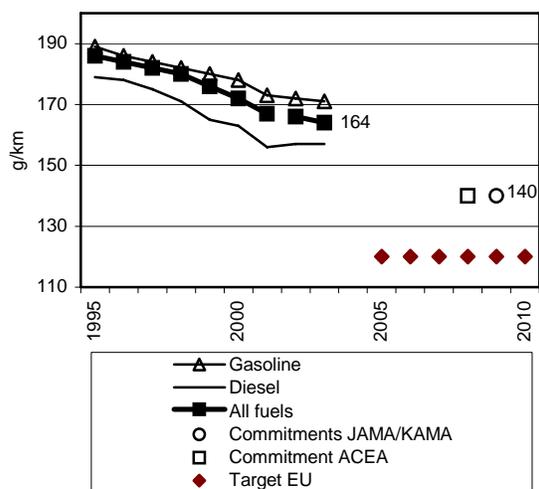
Figure 2 EU-25 past and projected greenhouse gas emissions from transport and freight kilometres on road and share of the sector in total GHG emissions (Source: European Environment Agency 2005)



Note: GHG projections for the EU-25 are calculated on the basis of projections reported by 18 Member States. The percentage change 2003–10 of those 18 Member States is applied to the EU-25. Sectoral emission projections with existing measures are missing for Germany, Cyprus, Czech Republic, Estonia, Hungary, Malta and Poland, sectoral emission projections with additional measures were not reported by Denmark, Germany, Ireland, Luxembourg, Sweden, United Kingdom, Cyprus, Czech Republic, Estonia, Hungary, Lithuania, Malta and Poland.

Sources: EEA, 2003c; EEA, 2005; Eurostat.

Figure 3 Average specific CO₂ emissions of new passenger cars per fuel type, and targets (Source: European Environment Agency 2005)



Note: The time series 1995–2003 is slightly inconsistent because in 2002, for the first time, official EU CO₂ monitoring data are used for calculating the 2002 figures. Previous to this, the associations provided the underlying data.

Source: European Commission, 2005b.

Figure 4 EU-15 CO₂ emissions from fossil fuel combustion compared with GDP (1990-2003) (Source: European Environment Agency 2005)

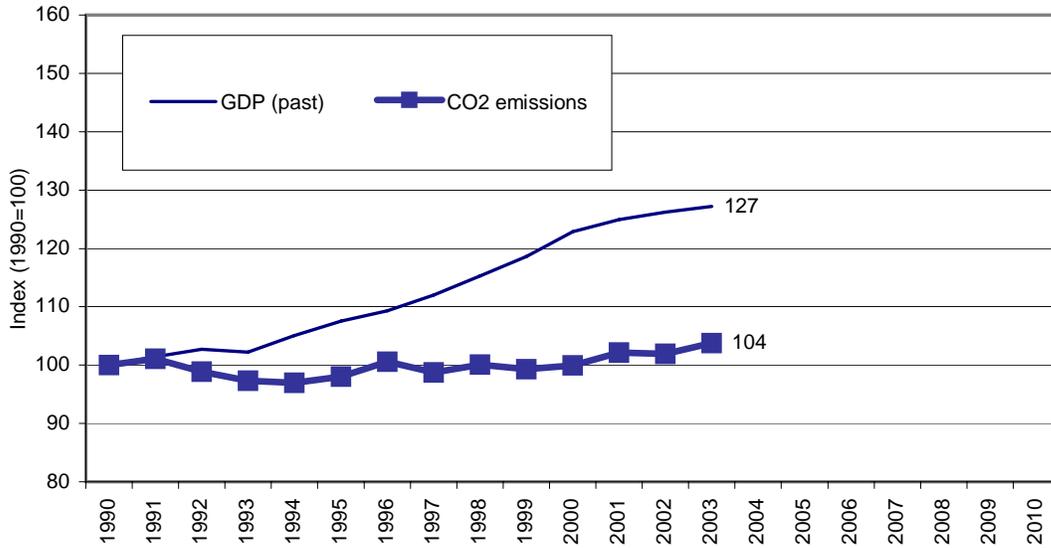
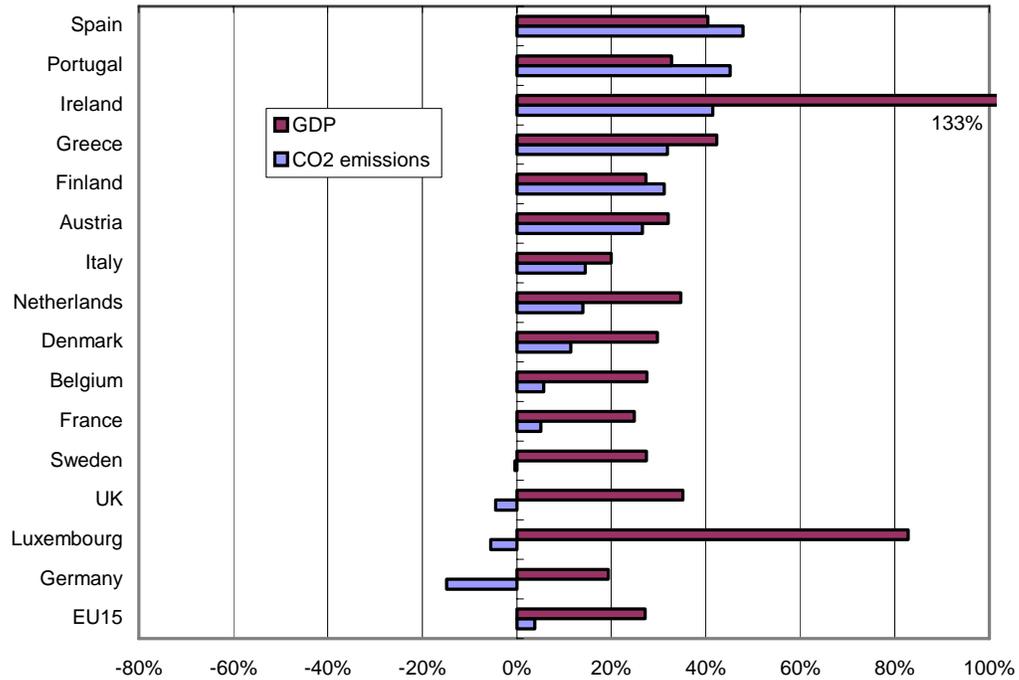


Figure 5 EU-15 Member States CO₂ emissions from fossil fuel combustion compared with GDP (1990-2003) (Source: European Environment Agency 2005)



Sources: EEA, 2005; Eurostat.