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Making Cap-And-Trade Work: Lessons From The European Union Experience

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With a new administration in Washington and a new consensus that carbon dioxide emissions are causing catastrophic climate change, it is becoming clear that the United States will soon adopt some form of market-based regulation scheme. Though many would argue that the United States should have instituted a regulatory scheme years ago, the country will reap one distinct advantage from having a late start: the ability to learn from the European Union's ambitious efforts to tackle the problem of industrial carbon emissions for nearly five years.

There are many ways that governments and other regulating bodies can regulate and control industrial carbon emissions, but two of the main methods are the traditional “command and control” strategy in which government sets unwavering limits on how much carbon each business can emit, and a system of “tradable emissions permits” —sometimes called cap and trade—in which a government sets an emissions limit, or cap, for each business or industry and issues permits that correspond to the allowed emissions amounts. Businesses within the system can buy and sell emissions permits to each other, enabling those who need and can afford to emit more carbon to do so without the overall limit being exceeded.

Under most circumstances, the cap and trade system is considered superior to the command and control approach because cap and trade, in theory, is more cost-effective for businesses and society. Cap and trade encourages businesses to develop more efficient technologies and allow businesses that can most cheaply reduce their emissions to do so, while businesses with high costs of emission reduction do not have to reduce emissions and can instead purchase permits on the market. Carbon dioxide is generally considered an ideal pollutant to be addressed by cap and trade, because it does not matter where the emissions reductions occur.

That is indeed the theory, but the European Union cap and trade experience has shown the reality to be much more nuanced. It will be vitally important to future efforts in the United States, as well as in Japan and Australia, which also seem poised to institute cap and trade, to understand why the system worked better for some industries and businesses than for others. In order to understand this, I interviewed 25 representatives of individual businesses, industry trade groups, and government agencies. The results of the interviews reveal that different businesses in diverse industries react diversely to cap and trade, and these reactions have to do with varying capacities, organizational structures, and overall characters of the businesses.

Why Cap and Trade? The Theory Behind the Practice

The market-based tradable emissions permit system, cap and trade, is theoretically the most cost-effective, technology-encouraging, and environmentally effective strategy for reducing carbon emissions.[1] Cap and trade allows businesses that need to emit more carbon in order to function, or for which it is more expensive to abate emissions, to abate less, while businesses that have lower emissions needs or abatement costs can abate more and sell their excess emissions permits on the market. If the permit market were to reach a cost-effective equilibrium, the marginal abatement costs of each emitter would equal the permit price. In theory, each emitter will reduce carbon until the price of reducing carbon emissions is equivalent to the price of purchasing an emissions permit on the market. Even if the cost-effective equilibrium is not reached, cost savings result from emissions trading.[2]

Cap and trade systems are expected to induce technological change because they allow emitters to generate income if they can abate emissions for lower costs than the permit price. Thus, businesses have incentives to research and develop innovative emission control technologies. Unfortunately, there is limited evidence that cap and trade has induced technological change, but this may be due to difficulty in proving causal relationships between the two.[3] There is, however, anecdotal evidence of innovations within emissions markets.[4]

Because cap and trade contains a system-wide cap on carbon emissions that is lowered each year, environmental effectiveness is assured, in contrast to carbon taxes, in which firms can increase carbon emissions and pass costs of the tax along to consumers. However, the real-world situation deviates significantly from theory. Markets are characterized by imperfections such as transaction costs, and there is market volatility resulting from uncertainty over future supply and demand. These factors, combined with the different decisions that businesses choose to make regarding cap and trade based on their different capacities, structures, and corporate cultures, cause results to vary significantly from theoretical models.[5]


ISTOCKPHOTO/F.O.N.

Caption: Shop of hot and cold rolling of pipes.

Cap and Trade in the EU: Design and Performance

The European Union's Emissions Trading Scheme, as it is called, began in 2005 as a mandatory trading program targeting approximately 12,000 installations.[6] The Emissions Trading Scheme, or ETS, functions through trading periods. In the first and second trading periods (2005–2007 and 2008–2012), National Action Plans were devised to allow each member state to allocate emissions permits covering about 40 percent of carbon dioxide emissions in the EU across covered industries and combustion activities. Covered sectors include power stations and other combustion plants, oil refineries, coke ovens, iron and steel plants, and factories making cement, glass, lime, bricks, ceramics, pulp, paper, and board. Emissions allowances for each country correspond to Kyoto Agreement targets, and allocations vary among individual countries and installations.[7]

While the permit allocation process varies greatly from country to country, most emissions permits have been allocated freely to facilities based on historical emissions. In Germany, for example, each facility is subject to an emissions reduction factor, which dictates the percentage of historical emissions for which a facility does not receive freely allocated permits. In general, large utilities have high reduction factors, meaning that these firms do not receive as many free permits as their historical emissions, while small utilities and industrial producers have low or no reduction factors. This allocation process means that without trading, nearly all reductions would be required of the large utilities, while small utilities and industrial producers could continue business as usual. National Allocation Plans are approved by the ETS and must demonstrate a variety of criteria, including an aim to meet national Kyoto targets, as well as to create carbon market stability. As a whole, the EU-15 (the fifteen states that share a legally binding agreement for joint compliance) must abate 8 percent of 1990 baseline emissions by 2012 and 20 percent by 2020. After an initial allocation of credits is set, businesses may trade their emissions permits across borders; trading is monitored and registered by the ETS in Brussels, as well as by national country registries.

The first trading period of the ETS had a variety of difficulties. National Action Plans and emissions registries were developed late, causing significant confusion in initial permit trading. Emissions permits were over-allocated, allowing for an increase in the amount of emissions during the first period. Because of the over-allocation of carbon permits and uncertainty regarding the allocation process, many businesses did not engage in trading, and prices of carbon were highly volatile. The price of a ton of carbon reached a high of nearly 30 Euros per ton in 2006, and dropped to 0 by the end of 2007.[8]

Experience in the first trading period also led the EU to recognize windfall profits that can result from freely allocated permits. In the electricity sector, the percentage of the CO_2 permit prices that were passed along to consumers varied between 60 percent and 100 percent of CO_2 costs in the Netherlands and Germany. Because permits were freely distributed and firms did not have to pay for these permits, this led to substantial windfall profits by electric generators.[9]

While the 2008–2012 trading period maintains many of the design flaws included in the initial trading period, the 2013–2020 trading period will see substantial changes to the ETS. In particular, emissions allocation, reporting, and verification will be centralized through the EU and will focus on compliance, in contrast to the current system, which focuses on goals and implementation.

Because of the windfall profits in initial stages of the ETS, the 2013–2020 trading period will incorporate fully auctioned allowances, where firms purchase emissions allowances at periodic auctions, for electricity generators, and 20 percent auctioned allowances for other industrial firms in 2013, increasing to 70 percent auctioned allowances in 2020. Firms in energy-intensive sectors that are subject to international competition will continue to receive freely allocated permits based on benchmarking, and utilities in Eastern Europe will receive a greater percentage of freely allocated allowances. In addition, there will be a re-examination of the Clean Development Mechanism and Joint Implementation offset provisions.[10]

Under the current ETS, businesses can choose from among six basic strategies to comply with and/or profit from ETS regulation.

1. Secure electricity from wind, solar, gas, combined cycle, and biomass projects in order to phase out coal powerplants.

2. Improve energy efficiency, and invest in improved boilers and combined heat and power plants.

3. Offset emissions through participation in clean development mechanisms or joint implementation, which allows firms to invest in projects that reduce emissions abroad, and earn offset credits, which can be used similarly to allocated emissions permits.

4. Shift the generation load to plants that are less emission intensive and switch fuels to minimize emissions. (This is only possible for businesses with multiple plants.)

5. Purchase permits from other firms, including offset credits, in order to cover emissions.

6. In addition to selling excess permits on the market, actively speculate and engage in permit trading in order to hedge against other energy positions, making permit trading a potentially profitable strategy.

Inefficiencies in the ETS Market: Transaction Costs and Uncertainty

Achieving cost savings in greenhouse gas abatement and developing innovative abatement technologies in a permit trading market depend on the fluid functioning of that market. Transaction costs are a fact of life in every market; those that are incurred in the emissions market include legal fees, lost time, staff costs, and consultant costs. These costs result from the need to acquire information, seek out contract partners, negotiate trades, choose from among alternative options, and monitor and enforce outcomes.

Trading will cease when transaction costs exceed the cost savings that would be incurred from continued trading.[11] In addition, transaction costs can inhibit the development of a liquid market, leading to uncertainty regarding the availability of permits in the future and a preference among businesses for self-sufficient compliance with emissions limits.[12]

Uncertainty in the emissions trading market is the result of several factors, including unclear rules and ongoing changes in the system's institutional design, inherent market uncertainty, and technical uncertainty regarding the benefits of emissions abatement investments.

Unclear rules and procedures, as well as the potential for changes in policy design, generate considerable uncertainty in permit trading. The ETS in particular is plagued by this type of uncertainty due to its international character, which has always involved political negotiation.[13]

Uncertainty regarding medium- or long-term aggregate abatement targets prevents businesses from anticipating the long-term price of carbon, which makes it difficult for them to decide which technologies to pursue or to formulate a long-term carbon strategy.[14]

Uncertainty regarding future price trends is inherent to any kind of market system. Future emissions permit prices may be influenced by technological innovation, economic growth, input and output prices, and political responses to new findings on global warming.[15] In this market, as in any other in its initial phases, uncertainty leads to high volatility. Cap and trade systems require a learning curve, which necessarily hinders their effective functioning in its early stages.

Finally, uncertainty may result from monitoring techniques of production processes and abatement measures. In the ETS, permits created through clean development mechanism projects have been traded at a far lower price because of the political and technical uncertainty surrounding these projects.[16] Because clean development mechanism projects are subject to monitoring and verification by inspectors, uncertainty exists as to whether anticipated emissions reductions will materialize.

Uncertainty from any of these factors can dissuade businesses from making effective investment and technology decisions.

Caption: Large petrochemical oil refinery.

Businesses Are Not Rational Actors

According to the neoclassical economic model of tradable permits, rational businesses estimate the long- term cost of carbon emissions as well as their own marginal abatement costs.[17] If they expect the cost of abatement to be less than the cost of emissions, they should seek to abate emissions and sell excess emissions permits. If abatement is more expensive than emission permits, then they should acquire permits via the trading market.[18]

In practice, however, businesses do not always behave rationally.[19] Several characteristics of business behavior interact with transaction costs and uncertainty, and lead businesses to "satisfice" (meet only minimum requirements) and to prefer business-as-usual outcomes.

Businesses that have only a poor understanding of the carbon trading system and how it will affect their business, and/or an inability to optimize under uncertain conditions will tend to satisfice and opt for business-as-usual operations as opposed to alternative strategies.[20]

In addition, some businesses may use information inefficiently and gauge risk and uncertainty poorly, preventing the optimization of profits. This inefficiency may be due to lack of foresight and a simple inability among managers to solve complex problems.[21] Businesses that satisfice rather than maximize and that prefer business-as-usual over making operational changes may have trouble adapting to price signals.

Further, some businesses are not set up to minimize costs. In regulated industries, for example, government commissions place constraints on profits and allow firms to pass along cost increases to consumers. But even in non-regulated industries, organizational complexity and alternative goals may hinder profit-maximizing behavior.[22] When faced with reductions, these businesses prefer to abate carbon internally rather than participate in permit trading, especially when the abatement costs can be passed on to consumers.[23]

Finally, some businesses take a long time to incorporate carbon costs into pricing models and have a hard time processing the uncertainty surrounding climate change legislation and carbon prices. Most businesses are "cautious planners" and are unlikely to quickly take concrete actions to adapt to climate change regulation.[24]

What's Really Happening

Based on all that has been discussed above, we can expect carbon abatement and emissions strategies to vary based on individual firms' capacities and the complexity of their production processes. Large firms possess considerably greater capacity and the ability to take advantage of the variety of opportunities presented through the ETS. Firms that have greater capacity will be more likely to weigh costs and benefits, invest in joint implementation and clean development mechanism projects abroad, and take advantage of the permit trading market for profitable purposes. In contrast, smaller firms will rely more on a business-as-usual strategy and seek to meet compliance requirements internally or by purchasing permits on the market.

Simple production processes, such as electricity generation, where decisions on fuel use and output are closely linked, allow businesses to seamlessly integrate the costs of carbon permits into daily production decisions. In contrast, manufacturing and other industrial processes are more complex, and fuel use is not directly related to output decisions. These firms are more likely to view carbon management issues in terms of compliance and continue to focus primarily on their core business model.

Data Collection and Research Design

In order to explore the role of capacity and organizational structure on business decision-making, I conducted interviews with 25 companies representing industry and the electric utilities in Germany between July 2006 and October 2008.[25] While the number of interviews is not particularly large, the interviews covered entities responsible for over 50 percent of the emissions in Germany. Companies were coded as to whether each has a high capacity or low capacity, based on the size of the company. Firms with over 100 employees were considered to be companies with high capacity, firms with less than 100 employees were considered to have low capacity.

Companies were also coded based on whether they managed carbon through a trading office, which would allow them to have dedicated carbon or commodities traders, and would allow them to consider the marginal cost of carbon when making production decisions. In contrast, firms that managed carbon through compliance officers and general management might be less likely to consider marginal costs of carbon in production decisions.

Findings

The interviews revealed a remarkable range of behaviors, ranging from companies that behave very similarly to the "rational" economic model, to those that deviate very far from this model. I categorize these businesses based on two dimensions: capacity and complexity. The summary of strategies and tactics employed by firms is summarized in Table 1 below.

Table 1: Firm Strategies Under Cap-and-Trade Regulation

	Low Complexity	**High Complexity**
Low Capacity	• Purchase of Permits for Compliance • Investments in Wind and Biomass • Efficiency and Combined Heat and Power Investments	• Purchase of Permits for Compliance
High Capacity	• Joint Implementation / Clean Development Mechanism Investments • Permit Trading for Profit • Fuel Switching • Efficiency and Combined Heat and Power Investments	• Purchase of Permits for Compliance • Efficiency and Combined Heat and Power Investments • Joint Implementation / Clean Development Mechanism Investments

High Capacity, Low Complexity

Large utilities have a simple production process (turning fuel into electricity), have significant capacity, and are responsible for the vast majority of carbon emissions in Germany and in the EU. Large utilities have hired several traders to deal exclusively with carbon, as well as employees to deal with monitoring, clean development mechanisms, and joint implementation. Individual companies may hire between three and fifteen dedicated carbon traders as well as a person dedicated to monitoring each plant. They also must hire an external verifier for about 10,000 Euros each year, per plant. In order to participate directly with the carbon market in Leipzig, an initial five-digit investment, plus an annual fee of 20,000 Euros is required, in addition to staff fees.[26]

These businesses break their carbon-related decisions into three major areas. First, large energy utilities base daily energy production decisions on the costs of fuels and carbon permits. Each day, models that include carbon costs determine which power plants should be operated.[27] In these businesses, traders are responsible for carbon permits and aim to profit from carbon trading.

Second, these companies aggressively pursue clean development mechanism and joint implementation projects in order to strengthen their strategic advantage, and because they view them as profitable investments. These projects are operated by a separate department and are judged based on their prospects for profitability, given the riskiness of clean development mechanism project approval.[28]

Third, investment and energy efficiency decisions are made independently of each other, and they attempt to formulate a long-term carbon strategy, given a variety of scenarios. Investments in projects must be robust across both short-term and long-term models, and they must not exclusively focus on climate change. However, they must incorporate fuel costs and carbon risks (valued at about 20 Euros per ton), attempting to follow a no-regrets strategy.[29] These investments generally are based on short-term projects, as companies find it difficult to anticipate long-term carbon prices given the political environment surrounding carbon trading. Firms report small improvements such as optimizing the power generation mix and small efficiency gains with power plants that become cost-effective at 20 Euros/ton. Medium and long-term uncertainty hampers longer-term investments: for example, investments in high-efficiency lignite coal plants require between eight and nine years from initial planning and licensing until a plant begins generating power.[30]

A variety of factors have contributed to a business-as-usual mentality among power generators. First, medium to long-term uncertainty has led to many shifts in the short-term production and optimization, mainly leading to shifts in electricity generation, but this uncertainty has not led to the significant change in new investment that was anticipated by models.[31] Second, with nuclear energy scheduled to be phased out, firms expect coal to play an increased role in handling base-loads. Third, due to fears regarding future permitting of coal plants, there has been a rush to replace old coal plants with new coal plants. Fourth, increasing fuel prices of alternative fuels, such as natural gas, continue to make coal an affordable alternative.

Low Capacity, Low Complexity

The medium (three to four plants) and small (one to two plants) utilities are unable to take advantage of the same opportunities as the large utilities due to a lack of capacity. Initially, these firms had little understanding of carbon trading. Past experiences with trading have primarily involved fuel purchase for plant operation. These businesses are not interested in energy trading, but simply in retail electricity generation and sales. While they have built up some of their trading capacity, a medium utility operation of 70 employees is likely to have 25 energy traders, of whom two to three will be dedicated to carbon. Small utilities are unlikely to have dedicated carbon traders, and they lack understanding of permit markets. At first, these firms were over-allocated and could continue business-as-usual operations; however, the third trading period includes auctioning for these companies, and it remains unclear if they will be able to perform the necessary early valuations of carbon.[31]

Small and medium-sized utilities do not have clean development mechanism capacity like the larger firms. Instead, they rely on new wind and biomass projects, gas projects, combined cycle plants, combined heat and power plants, and energy efficiency improvements. They also combine efforts to build newer and more efficient plants and are much more likely to purchase permits in order to meet reduction requirements.[33]

Despite some subsidies and advantages for small-scale plants, these businesses perceive themselves as having a huge disadvantage: “It's like sitting down for a game of poker where your opponent starts with 10 times as many chips as you ... you don't have much of a chance.”[34]

High Capacity, High Complexity

Large manufacturers have a high degree of capacity, but they often support complex production processes and have managerial barriers that prevent them from mimicking the large utilities. While large manufacturers pursue clean development mechanisms and joint implementation, and they allocate permits to a trading desk, several important differences between industry and utilities exist. First, because industry is primarily generating electricity for its own use, it does not have the flexibility that the utilities have regarding the operation of their power plants. Further, energy costs are the primary factor in any change in behavior. Any savings from carbon permits is just “the cherry on the cake.”[35] Due to high, long-term CO_2 regulatory uncertainty, carbon dioxide may not be taken into account for long-term decisions. One company reports that energy efficiency investments average a two-year return on investment, and no projects are considered that have a return of longer than five years.[36] Another company reports that carbon prices are considered in investments up until 2012; however, after 2012, there is too much uncertainty and carbon implications are not considered.[37]

> *… many large industrial firms … have no desire to change behavior, regardless of possible profits from selling carbon permits.*

In industrial businesses, in contrast to major utilities, energy efficiency improvements are suggested from the bottom-up—from the plant managers, rather than by traders or firm strategists. For example, in one company, the traders inform the plant managers of the monthly price for carbon, and the managers make suggestions or decisions based on this information. In another, permit trading is of secondary interest. Nine months into a year, energy consumption is forecasted for the last three months, and permit trading decisions are made then.[38]

Barriers exist in the optimization of production processes. Due to the nature of the manufacturing process, the generation of one output in one plant leads to an input in another plant, and this complexity makes perfect optimization impossible.[39]

One company also notes a change in its strategy that has led to a more efficient management of carbon. Initially, carbon permits were managed in the corporate sustainability department. Under this system, trades were conducted internally, but the company took a wait-and-see approach toward external trades. The company's focus was much more geared toward compliance and continuing business-as-usual operations. The company decided to shift carbon management to the traders, and this has been more efficient; however, the manager notes clashes between the environmental specialists and the traders. While the traders are interested in the profitability of trading, the environmental specialists are highly concerned with emissions reductions, compliance, and corporate sustainability.

Not all firms have embraced the rational model. A market intermediary notes that many large industrial firms he works with have no desire to change behavior, regardless of possible profits from selling carbon permits. Further, he argues that the idea that business both large and small are aware that their marginal abatement costs “only exist in theory.” He pointed to one large industrial producer who said, “I don't really care about making money from carbon permits. I'm a brick-producer, I want to produce bricks.”[40] Interviews demonstrate that the preference for business-as-usual is quite common, especially when companies do not operate a trading office, and carbon permits are allocated to a compliance officer—usually an engineer—who has little experience in trading.

Low Capacity, High Complexity

Small industrial producers occupy the opposite end of the spectrum from large utilities. These players are characterized by little capacity to deal with trading and little understanding of the trading system. Participation in carbon trading is simply a huge burden—even if they do not have to purchase any permits for compliance, and these companies generally have a compliance officer or general manager who is also responsible for ETS compliance.

Businesses like these do not behave in any manner similar to the rational economic model. They do not optimize their energy efficiency or perform cost-benefit analyses regarding additional investments in energy efficiency. One company, which installs and operates small boilers for other small industrial consumers, notes that it is extremely difficult to get businesses to see the benefits of energy efficiency. Even in energy-intensive businesses, there appears to be a general ambivalence toward energy savings, and a mindset toward continuing operations as usual, at whatever necessary cost.[41]

One company noted its lack of capacity to deal with the ETS. It described difficulty connecting with the national registry system. The company required new computer systems, and several weeks were needed to get the systems set up. They described a "book" of monitoring and verification requirements that were geared toward large utilities, not toward a small industrial producer with one boiler. In addition, the complexity of interlocking rules from the EU Directive and from the German government was considered highly burdensome.6 The company also said it was confusing, challenging, and time consuming to become familiar with the regulations. With regulations changing every few years, the company states that it still does not fully comprehend them and fears future changes in the system. This company is interested only in compliance: "We see this completely as a compliance issue. We are not interested in speculating in energy or with carbon. We simply want to continue our business operations as we did before."[42] Firm representatives noted difficulties in participating in the trading market as well. The amount they wanted to purchase (3,000 tons) was so small that no banks would work with them. They described frantic calls until finally they were able to draw a favor from an energy supplier, who sold them the needed credits.

Discussion and Conclusions

With the United States and other industrialized countries seeking to design and implement climate change policy, they can learn much from the EU experience. The EU experience emphasizes the importance of not only the design of the cap-and-trade system, but understanding how individual actors within the system will respond and react to regulation. Allocation mechanisms, in particular, can have drastic distributional consequences on businesses and consumers. Other rules, such as which companies are subject to regulation and how they interact with the regulatory system, have significant impact on the efficiency of a cap-and-trade system.

The EU has responded well by revising the allocation mechanisms, exempting the smallest emitters of carbon, and centralizing the allocation, monitoring, and verification of permits.

Nevertheless, EU governments and industry associations could increase efforts to help firms adapt to new regulations. Further, as the U.S. and other industrialized countries proceed with climate change regulations, policymakers should carefully consider the experience in the EU and seek to minimize the extent to which mistakes are repeated.

The results of this study provide several lessons for policy design, as well as for implementation and management of policy. A cap-and-trade system is a highly complex policy tool, and many companies do not have the capacity to easily adapt to this type of regulation. Small firms and utilities may require capacity assistance or should be excluded from regulation. In addition, complex production processes and managerial barriers may inhibit the functioning of a cap-and-trade system.

Company behavior in practice varies dramatically from company behavior predicted by cap-and-trade theory. Companies exhibit a strong preference for business-as-usual operations, especially under conditions of high uncertainty. Businesses with simple production processes, such as the electricity utilities, are more likely to be able to incorporate carbon costs into short-term production decisions. Uncertainty in the regulatory future of carbon impedes long-term investment decisions. Manufacturers and other industrial players are hesitant to consider carbon in production decisions and prefer to continue business as usual operations. While these companies consider energy efficiency projects, these investments are considered only in the short term.

The United States has a rich history of small business compliance assistance with environmental and labor regulations. The costliness and burden of carbon regulations on the smallest players should be carefully considered (especially considering that many of these businesses may not have a reduction factor). Few carbon reductions are achieved from these companies, and the costs of their compliance are passed on to society.

It may make sense to write guidelines specifically for small industry, and also provide assistance for meeting those regulations and participating in trading. If companies hoard permits, refuse to trade, and dump excess permits at the end of the trading period, it creates uncertainty as well as market failure for the rest of the system. A major obstacle in the effectiveness and efficiency of carbon trading is a lack of understanding and a preference toward business as usual. It is possible that by educating companies regarding the economics of the system and encouraging firms to allocate permits to traders and finance officers, improved management will translate to improved performance of the system.

This research also highlights the best practices for the implementation and management of carbon emissions at the firm level. Firms report the least amount of difficulties with the ETS when they manage their permits through trading officers, rather than through compliance officers, and treat carbon as they would any other commodity. These firms balance their carbon trading strategy with carbon reduction strategies, treating each business unit separately. Smaller firms ought to consider balancing cost-effective efficiency investments with other compliance-driven strategies. The expected costs of carbon permits in the long run ought to be considered when making energy efficiency investment decisions.

Uncertainty in the system provides an obstacle toward efficient management. Governments need to work hard to send a long-term price signal. While this is politically difficult, it is unlikely that firms will make adequate long-term investment decisions until government can set rules. Few companies even reported any long-term strategy regarding carbon, with most making decisions for the time period in which rules are set. This behavior emphasizes the need for government to set long-term rules and long-term price signals, which should allow for businesses to make more efficient long-term decisions. Without companies investing in energy efficiency improvements and in renewable sources of energy, the costs of carbon reduction will be far greater than necessary and will be shouldered by society. It is important for policymakers and businesses to work together to create a system that is fair to industry and consumers, sets a long-term price signal, and achieves carbon abatement at the lowest possible cost to society. Inefficiencies and a poorly designed or implemented carbon trading system do not just impact firm profits; rather, these inefficiencies are shouldered by consumers in the form of higher electricity rates and higher prices for products.

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25. Due to institutional review board requirements and the need for confidentiality, interviewees, firms, and organizations cannot be identified in this publication. Interviewees are referred to as a representative of a large or small firm from industry or from a utility. Research notes are available upon request.

26. Trader at large utility, in interview with author, Germany, 17 Sept 2008.

27. Manager at large utility, in interview with author, Germany, 22 Sept 2008.

28. Manager at large utility, in interview with author, Germany, 8 September 2008.

29. Manager at large utility, in interview with author, Germany, 8 September 2008.

30. Industry association representative, in interview with author, Germany, 30 September 2008; Manager at large utility, in interview with author, Germany, 8 September 2008.

31. Industry association representative, in interview with author, Germany, 30 September 2008.

32. Industry association representative, in interview with author, Germany, 29 September, 2008; Interview with industry association representative, 30 September 2008.

33. Industry association representative, in interview with author, Germany, 29 September, 2008; Interview with industry association representative, 30 September 2008.

34. Industry association representative, in interview with author, Germany, 29 September, 2008.

35. Manager at industrial firm, in interview with author, Germany, 20 October, 2008

36. Manager at large industrial firm, in interview with author, Germany, 20 October, 2008.

37. Manager at large industrial firm, in interview with author, Germany, 1 October, 2008.

38. Manager at industrial firm, in interview with author, Germany, 20 October, 2008; Manager at large industrial firm, in interview with author, Germany, 1 October, 2008.

39. Manager at large industrial firm, in interview with author, Germany, 1 October, 2008.

40. Manager at market intermediary, in interview with author, Germany, 16 October, 2008.

41. Manager at small industrial firm, in interview with author, Germany, 13 October 2008.

42. Manager at small industrial firm, in interview with author, Germany, 8 October 2008.