EPRINC
formerly PIRINC

July 2008

You may be interested

EPRINC has produced the enclosed report, ***Impact of a National Carbon Emission Cap and Trade Program on the US Petroleum Industry*** .

On balance the petroleum industry is likely to be adversely affected by cap and trade for several reasons. Costs of energy-related inputs would rise, and the firms likely would not be able to pass through all of the increase, particularly if they are subject to competition from foreign sources not subject to GHG controls. In addition, a cap and trade system probably would cause energy price volatility, adversely affecting demand and hindering investment. There also could be macroeconomic harm from cap and trade, which would reduce demand for petroleum products. Under a cap and trade program, carbon allowances have value, and petroleum firms may be able to secure some of these without payment under some legislative outcomes.

Though discussion regarding the science of climate change continues, many policy makers have concluded that steps need to be taken to mitigate Greenhouse Gas (GHG) emissions. A number of regulatory and legislative initiatives have surfaced at the state and federal levels, and it appears increasingly likely that some will be promulgated or enacted into law. Prominent among these is "cap and trade," in which the nation's GHG emissions would be capped, allowances to emit these gases given out or sold by the government, and parties receiving them allowed to transfer them in organized markets. A bill containing such a cap and trade system passed the Senate Environment and Public Works Committee in December 2007 and a close substitute recently was deliberated on the floor. This paper focuses mainly on the consequences of cap and trade for the US petroleum industry.

The nation's approach to curbing GHGs will contain command and control measures as well. Recent legislation passed by Congress mandating substantial increases in the use of ethanol and other biofuels was rationalized in part by the argument that such fuels will reduce these emissions.[1] The same legislation mandates increased Corporate Average Fuel Economy (CAFÉ) standards, again in part to reduce GHGs. In addition, the state of California has mandated a Low Carbon Fuel Standard to reduce carbon emissions in that state, and a similar provision is contained in the Senate's recently debated cap and trade bill.

[1] The biofuels mandates have brought about unanticipated problems to the transportation fuels sector and these issues have been evaluated in earlier EPRINC reports. ***Energy System Limits Future Ethanol Growth***, ***November 2007*** and ***Ethanol Mandate 2008, An EPRINC-EIA Roundtable Discussion, April 2008.*** These reports are available online at http://www.eprinc.org/publications.html.

GHG emission targets contained in cap and trade proposals are likely to impose significant changes in the nation's energy makeup. For example, if the targets in S.2191 were to be met, then GHGs per capita in the US would have to drop 30% by 2020 and 50% by 2030. Barring near term viability of large scale carbon dioxide sequestration, this implies a sharp drop in the use of fossil fuels, to be replaced by nuclear power, renewable energy sources or energy efficiency measures. Further, the gap between how much fossil energy would have been consumed and what actually could be consumed would steadily grow. For example, if emissions from these fuels otherwise would have risen by 1% per year, a reduction of 10% from 2008 levels by 2020 would imply a reduction of almost 23% from what otherwise would have occurred.

Petroleum firms will be affected by a carbon emission cap and trade system in several ways. For one, their customers will be adversely affected by steadily rising prices for petroleum products. The initial price increase has been estimated at anywhere between 20¢ and 60¢ per gallon, but as allowances become ever more scarce relative to fossil fuel demand the price increase is likely to become larger. Sellers can expect demand to fall off as consumers conserve on petroleum use and as substitute products enter the market. These effects will come on top of those from recent increases in petroleum prices which already are motivating conservation and the development of substitutes.

Under cap and trade, the cost of energy used to process crude would increase to refiners, and transport costs would increase to refiners, pipeline companies, jobbers, and heating oil and LPG distributors. Also, the cost of processing chemical feedstocks into finished product would increase, as would the cost of power, particularly in areas where coal is a major feedstock for generation.

These various consequences of cap and trade would affect all petroleum firms operating in the US. However, not all countries are committed to reducing their GHGs, and US refiners could be squeezed by competitors operating elsewhere, where caps on GHG emissions are not in force.

On the other hand, a cap and trade system would create opportunities for petroleum firms. Virtually all Congressional proposals freely allocate substantial proportions of the annual allowances to private sector firms, though usually these proportions diminish over time as more of the allowances are auctioned by the government. Petroleum firms will be forced to compete with a wide variety of others to secure free allowances but one criterion for awarding them likely will be historical emissions and the firms presumably would qualify for allowances via this route. Petroleum firms also will be able to secure GHG offsets in the US and elsewhere, possibly at costs below the market price of allowances.

Congress will decide how to spend the monies raised by auctioning a portion of the allowances. Some of it likely will be spent on development of alternative energy sources, and petroleum firms who exploit these sources may benefit from some of this spending.

One result of a cap and trade system will be to change the relative prices of fuels, with higher carbon content fuels becoming relatively more costly to produce and sell, and lower carbon fuels less so. Under these changed conditions, petroleum firms likely will experience a relative increase in demand for lower carbon fuels, especially natural gas in the power sector. Sales of LPG too will be relatively encouraged.

If US GHGs are to be constrained, a carbon tax would be a socially superior alternative. However, its relative impact on petroleum firms is mixed. If the proceeds from a carbon tax were used to reduce other taxes, particularly corporate income taxes, petroleum firms would share in the benefit. Petroleum firms also could benefit from government spending of some of the revenues on development of alternative energy sources. In addition, a carbon tax would avoid many of the administrative and monitoring issues imposed by cap and trade, and might be easier for firms to adjust to. However, under a tax approach, no free allowances would be available, nor would there be opportunities to use offsets. Thus, a tax would avoid many of the problems of cap and trade, but would negate some of the opportunities to profit from such a system as well.

If you have any questions or comments on the report, please contact Michael Canes at mcanes@eprinc.org, (Tel: 703 917 7201)

Other EPRINC Contacts:
Lucian Pugliaresi, loup@eprinc.org, (Tel: 202 944 5082)
Larry Kumins, larryk@eprinc.org, (Tel: 443 949 7462)
Ben Montalbano, benm@eprinc.org, (Tel: 202 944 3339)
Larry Goldstein, larryg@eprinc.org, (Tel: 631 335 9302)

July 2008

Impact of a National Carbon Emission Cap and Trade Program on the US Petroleum Industry

Introduction

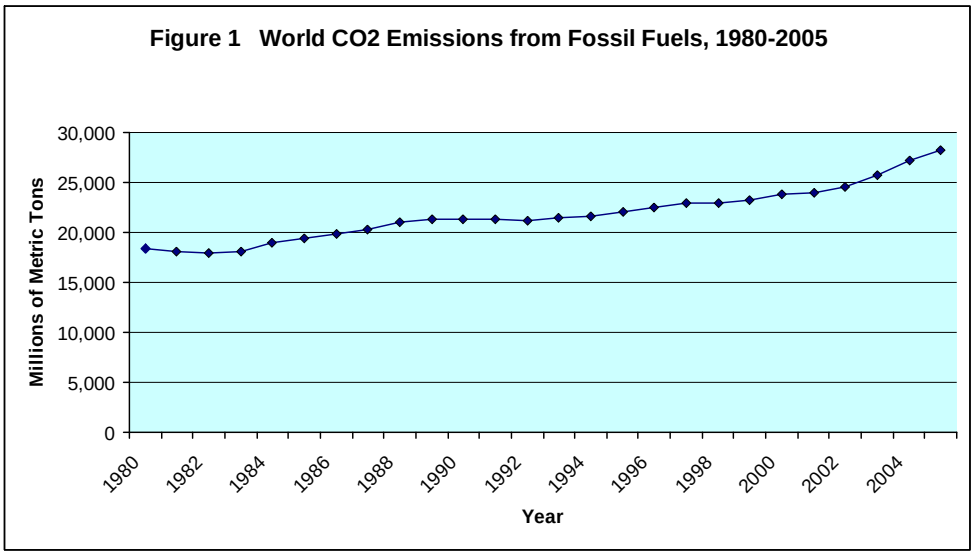
Though discussion regarding the science of climate change continues, a scientific consensus has emerged that anthropomorphic activities generating emissions of GHGs are contributing to a warming of the Earth, and many policy makers have concluded that steps need to be taken to mitigate such emissions. A number of regulatory and legislative initiatives have surfaced at the state and federal levels, the Supreme Court has ruled that EPA has authority to regulate GHGs, and it appears increasingly likely that further legislative or regulatory initiatives will be undertaken.

Though implementation of these initiatives is still in its early stages, there are increasing signs that they will have profound effects on the use of fossil fuels, and for the industries that produce and process these. In this paper we examine the most prominent of the initiatives, a cap and trade system, and its likely effects on the petroleum industry. Our conclusions are that cap and trade as well as several other initiatives to curb GHGs will adversely affect the industry, but that opportunities will be created as well.

Background

After years of international study and discussion, climate scientists have generally concluded that the Earth has been warming and that anthropomorphic activities, mainly the combustion of fossil fuels, have contributed to this warming. Though there remains considerable uncertainty regarding the magnitude of the anthropomorphic effect and only limited understanding of natural climate variation, model projections indicate that if current trends continue there are significant chances that the Earth will experience a warming climate with adverse consequences such as increased numbers of severe weather events, rising sea levels, drought and the spread of tropical diseases.

In Figure 1 below worldwide carbon dioxide (CO_2) emissions from the burning of fossil fuels are shown. Between 1980 and 2005 these emission rose from around 18 billion tons per year to about 28 billion. Since carbon dioxide emissions represent better than three quarters of worldwide GHG emissions, the trend in GHG emissions is roughly similar to that for CO_2.



Policy maker concern over rising GHG emissions has led to a series of international meetings and the formation of the UN-sponsored Intergovernmental Panel on Climate Change (IPCC) to study the science and report its findings. The IPCC has made four assessments over several years, each increasingly confident that anthropomorphic activities are having a significant effect on climate.

A first international call to action occurred at the Earth Summit which took place in Rio de Janeiro, Brazil, in June 1992. The Rio Climate Treaty came into force in March 1994, calling for individual countries to return their aggregate GHG emissions to 1990 levels by the year 2000. The US was a signatory to the Treaty. However, the targets set at Rio were treated as goals, not mandates, and few countries outside of the former Soviet bloc (whose economies were collapsing in the 1990s) arrested the upward trend in their GHGs.

A second call to action was agreed to in December 1997 in Kyoto, Japan. The Kyoto Protocol binds developed countries to reduce their GHG emissions by about 5% below 1990 levels as of 2008-2012. In this case, the US signed the agreement but did not submit it for Senate ratification, and hence its binding targets do not apply to this country. Instead, the US has relied

on voluntary means to reduce its GHG emissions, and President Bush set a target of reducing the GHG intensity of GDP (GHGs/GDP) by 18% over the ten year period 2002-2012.

Figure 2 shows the trend in US GHGs since 1990. The absolute level of GHGs increased steadily in most years between 1990 and 2000 but has increased only slightly since. Overall, between 1990 and 2006 US GHGs increased by about 15%.

Figure 2 Annual US GHGs

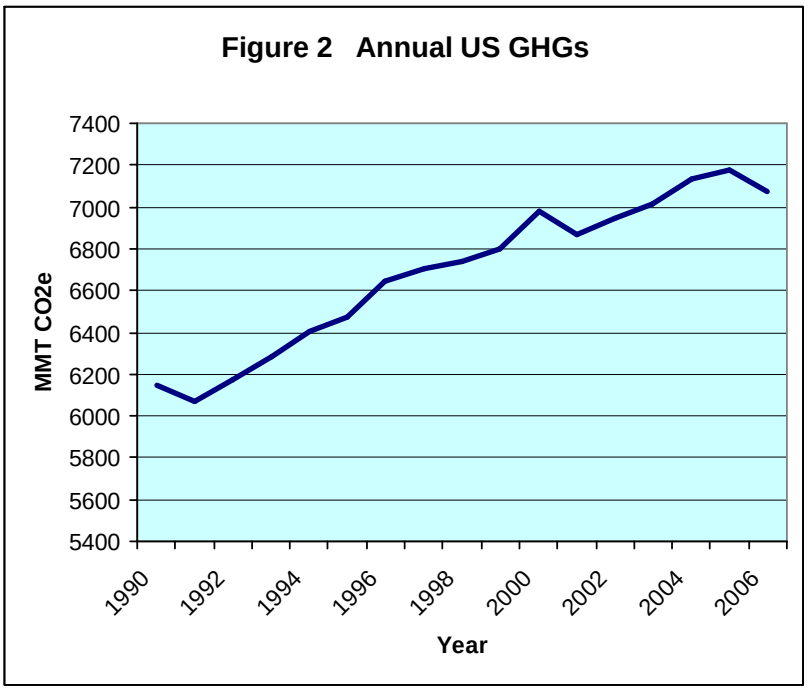
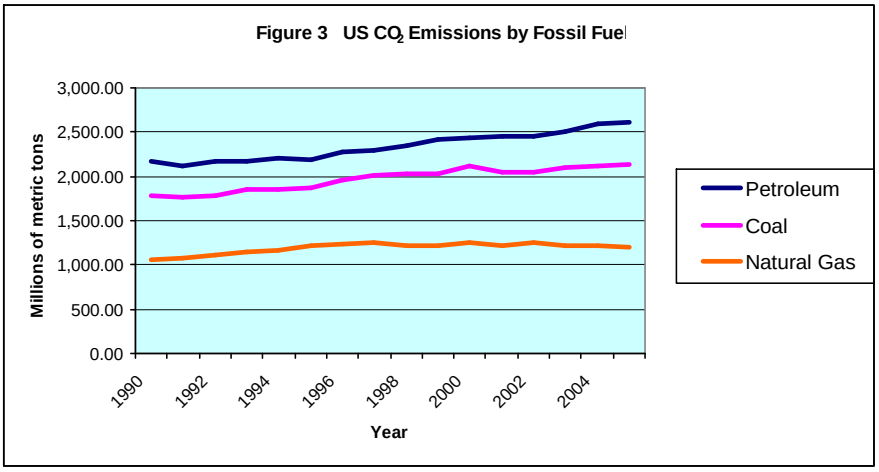
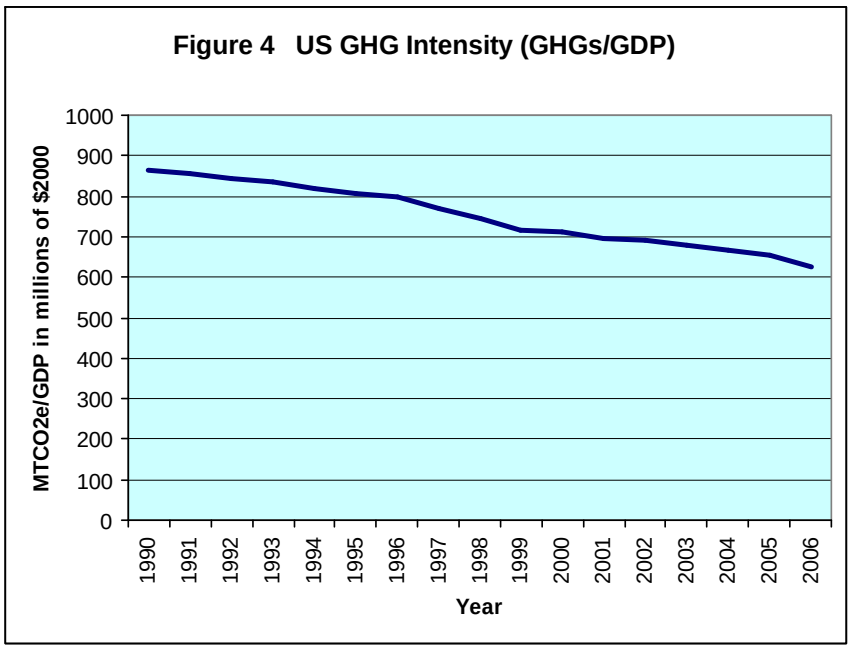


Figure 3 shows trends for the portion of US GHGs made up by CO_2, broken out by fuel type. In the US, petroleum use generates the most CO_2, coal the next most and natural gas the least. US CO_2 emissions from all three sources have trended upwards since 1990.



Despite this trend, the GHG intensity of US GDP has steadily dropped since 1990, and is now more than 27% below what it was in 1990. This is shown in Figure 4. Between 2002 and 2006, US GHG intensity dropped almost 10 percentage points of the 18 percentage points that President Bush set as the national objective between 2002 and 2012.



Though the US record on curbing GHGs arguably has been as good or better than most other developed countries,[2] policy maker concern has grown as successive IPCC reports emphasize the dangers of climate change. Former Vice President Gore has been a strong advocate of taking stronger steps, and his movie depicting consequences of climate change, "An Inconvenient Truth," received international recognition and helped secure him a Nobel peace prize. Though questions about the science of climate change are not fully settled, there is growing sentiment both at the national and state levels that strong, binding measures are necessary to curb increases in US GHGs, and then to reduce them.

Policy Initiatives

Broadly speaking, three different types of policies have been proposed to deal with GHG emissions; cap and trade, command and control, and taxation. In a cap and trade system, GHG emission rights are allocated by the government and subsequently can be traded among emitting parties. This paper focuses mainly on that type of policy.

However, command and control also will be part of the mix. For example, the Senate and House enacted legislation in December 2007 (the Energy Independence and Security Act (EISA)) that mandates an increase in Corporate Average Fuel Economy (CAFÉ) to 35 miles per gallon by 2020. The Department of Transportation, which is charged with implementing the law, recently proposed standards for passenger autos and light trucks under which their combined average fuel economy would reach 31.6 mpg by 2015. One major reason for imposing this constraint is to reduce emissions of CO_2 from motor vehicles.

EISA also mandates vast increases in the use of ethanol, justified in part by projected reductions in GHGs. California has sought to impose a CO_2 standard on vehicles sold in that state, but EPA recently turned down its request for an exception to do so and the matter is currently in the courts. California also plans to impose a Low Carbon Fuel Standard, which would compel sellers of motor fuels in that state to steadily decrease the life cycle carbon content of the fuels they sell. A form of such a fuel standard also was included in a recent climate change bill passed by the Senate Environment and Public Works Committee.[3] Many in Congress would impose a nationwide Renewable Fuel Standard on suppliers of electricity, but such an initiative recently was filibustered in Senate consideration of EISA and excluded from the final legislation.[4] Some

[2] See Michael E. Canes, "A Cap and Trade System v. Alternative Policies to Curb U.S. Greenhouse Gases," The George C. Marshall Institute, 2006.
[3] S.2191 as amended in committee, co-sponsored by Senators Joe Lieberman (I-CT) and John Warner (R-VA). The bill contained language mandating a 5% cut in the carbon content of the nation's transportation fuels by 2015 and a 10% cut by 2020. See J.R. Pegg, "First US Climate Emissions Control Bill Heads to Senate Floor," Environmental News Service, December 6, 2007. www.ENS-Newswire.com
[4] The standard was removed following failure to invoke cloture by a vote of 59-40.

states have adopted such standards, however. Finally, Congress has mandated home appliance energy efficiency standards and building standards, largely to reduce GHG emissions.

Economists generally have supported a carbon tax as the best means to deal with carbon dioxide emissions and their equivalent among other greenhouse gases.[5] They argue that such a tax would be less costly to administer and would lead to less volatile energy prices. They argue further that the revenues obtained through such a tax could be redistributed to taxpayers via reductions in social security or income taxes, and that such refashioning of the tax system would yield net gains to the economy.[6] However, though a few members of Congress have expressed interest in a carbon tax,[7] most are oriented towards cap and trade, which has broad support within the environmental community and also from some within the business community.

How a Cap and Trade System Would Work

Creation and allocation of rights. Under a cap and trade system, annual US GHG emissions would be capped at some chosen quantity, with emission rights (also called "allowances") given out or auctioned to prospective emitters. Rights would be expressed in terms of metric tons of GHG emissions, usually put into carbon (or carbon dioxide) equivalent terms. Thus, a single allowance might provide its owner the right to emit one metric ton of carbon. An emitter would be required to submit an allowance to the government for each ton of carbon emitted. The rights apply to a given year; each year would have its own set of rights, distributed in accordance with that year's overall national target, and each year emitters would be responsible for turning in allowances equal to the amount of carbon they emitted.

Emission rights would be transferable, so that those needing less than the amount they have could sell them to others who need more. The value of these emission rights would be determined by the tightness of the national constraint on carbon and by the demand for the rights, which in turn would be determined by the demand for goods and services that result in GHG emissions.

[5] See for example William D. Nordhaus, "Life After Kyoto: Alternative Approaches to Global Warming Policies," or Ian W. H. Parry and William A Pizer, "Emission Trading v. CO2 Taxes," Resources for the Future Backgrounder, May, 2007.
[6] See Kenneth P. Green, Steven F. Hayward & Kevin A. Hassett, "Climate Change: Caps vs Taxes," Environmental Policy Outlook, American Enterprise Institute, June 1, 2007.
[7] Congressman Pete Stark (D-CA) has introduced a carbon tax bill (HR.2069) as has Congressman John Larson (D-CT) (HR.3416). Congressman John Dingell (D-MI) has floated a carbon tax proposal, but has not officially submitted a bill to do so.

The greater part of US greenhouse gas emissions result from the burning of fossil fuels.[8] Thus, a price attached to carbon would be embedded in the cost and hence the price of these fuels. Because coal is the most carbon intensive of the fossil fuels its price likely would rise relative to those of oil and gas, and for the same reason the price of oil likely would rise relative to that of natural gas.

Though the mechanics of a cap and trade system are still to be worked out, the general idea is to distribute emission rights to producers, processors or importers of fossil fuels, and let them raise prices to their customers to cover the costs of these rights. Ultimate users of fossil fuels thus would face higher prices for energy but would not themselves be required to acquire emission rights.[9]

Possible features. A cap and trade system could include a so-called "safety valve," under which the government guarantees to sell additional emission rights if the price of those rights in a given year exceeds a pre-specified ceiling. This would limit the increase in allowance price in that year, but also would render uncertain the number of allowances that would be sold. Because of the latter uncertainty, there has been strong opposition to this feature from the environmental community.

A cap and trade system also could include a floor price for allowances on the supposition that potential investors in energy efficiency technologies would be unwilling to commit large amounts of capital without such protection. Other possibilities include banking, in which holders of emission rights could bank part of a given year's rights for future use, and borrowing, in which they could borrow against future emission rights, to be paid back with interest (i.e., by turning in more emission rights per unit of carbon emitted than the amount borrowed today).

Downward ratchet. In 2006 US GHGs were a little over 7 billion metric tons of carbon dioxide equivalent (CO_2e). Various cap and trade proposals have different rates at which they would reduce US GHGs, but the general idea is to establish an initial target near present levels, and then reduce them over time. For example, S.2191 as initially proposed would have distributed 5.2 billion allowances in 2012 to covered facilities (comprising about 80% of all emissions) and ratchet these down by 96 million tons each year between 2012 and 2050. By 2050, this proposal would have resulted in a 70% reduction in US GHGs from 2005 levels. Some proponents of cap and trade have called for even greater cuts, by as much as 85% relative to present levels.

---

[8] According to the Energy Information Agency, in 2006 CO_2 from the burning of fossil fuels accounted for 82.3% of all US emissions. There are five other internationally recognized categories of GHGs: methane (CH_4), Nitrous oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). These combined made up the other 17.7%.

[9] This assumes that system design would be made as simple as possible to keep Administrative costs to a minimum. In the European (carbon) Trading System, however, large industrial energy users are required to obtain emission rights with the result that over ten thousand firms are covered and the system is far from simple.

The proportionate cut would be even greater from what otherwise likely would be an upward trend. For example, if emissions otherwise would have risen by 1% per year, a reduction of 10% from 2008 levels by 2020 would imply a reduction of almost 23% from what otherwise likely would have occurred. Over time, this gap would steadily widen.

Offsets. A US cap and trade system almost certainly would be part of an international emission rights trading system. Under the Kyoto protocol, offsets can be obtained through Joint Implementation projects among developed countries, and via the Clean Development Mechanism, which involves projects in developing countries. In addition, many cap and trade proposals would enable emitters to secure offsets from domestic agricultural sources. Yet to be determined is whether US parties could trade within the European Trading System, a cap and trade system among the countries of the EU. However that is resolved, the essence is that under most cap and trade proposals US parties would be able to secure emission rights produced elsewhere that they either had purchased or caused to occur.

Administration and monitoring. A cap and trade system would require both private firms and the government to engage in administration and monitoring. Each affected firm would have to monitor the emissions it is responsible for in order to match those with the allowances it has or must secure. Because the system is dynamic, firms would need to develop strategies regarding whether to sell, purchase, bank or borrow allowances in any given year and over a stretch of several years, in order to meet its obligations. The government would have to monitor firms to be sure their accounting systems properly count the emissions they are responsible for, and that they submit sufficient allowances to cover those emissions. It also would have to monitor offsets to be sure these are legitimately obtained and do not exceed amounts allowed by law.[10] Experience to date indicates this may pose significant challenges.[11]

Distribution of Allowances. The government also would be responsible for the distribution of emission rights. As these likely would have considerable value, a great deal of importance attaches to how they would be distributed and to whom. Many in the environmental community advocate auctioning these rights, while many in the business community argue they should be compensated with free allowances for the fact that their costs of energy will rise. Most Federal proposals would compromise between these two methods, with the number of allowances auctioned initially set low but scheduled to rise over time. For example, S.2191 as introduced would have initially auctioned 22% of allowances, with the number rising steadily till 100% would be auctioned in 2036.

[10] Many proposals to cap US GHGs also would cap the amount of offsets that could be used.
[11] The *Financial Times* of London described some of the difficulties being encountered, including production of false allowances and multiple sale of the same ones. See "Industry Caught in Carbon Credit Smokescreen" (April 6, 2007, p.1) and "Beware the Carbon Offsetting Cowboys," (April 6, 2007, p. 4).

A very large amount of money is involved. For example, if the 5.2 billion initial allowances under S.2191 were to sell for $40 per allowance,[12] they would yield over $200 billion in 2012. Though the number of allowances would decrease over time, the per allowance price likely would rise as they became scarcer, so that this initial total might well substantially understate future annual amounts.

Distribution of revenues from the sale of allowances. To the extent allowances are auctioned rather than freely distributed, monies would accrue to the US Treasury. Revenues also would be raised if cap and trade included a safety valve under which additional allowances were sold if the allowance price exceeded a pre-specified level. The spending of these revenues is another issue to be resolved within a cap and trade plan.

Economics of Cap and Trade

A cap and trade system would effectively tax fossil energy through constraining by fiat the amount that could be used. Overall, the cost of energy would rise to firms, and they would seek to pass this rise in costs through in their product prices. Depending upon how easily consumers could substitute other products, a greater or lesser fraction of the cost increase would be passed through. For firms producing products where energy is but a small fraction of total cost, cost passthrough might be relatively straightforward. But for firms who produce energy intensive products, particularly those constrained by foreign competition not subject to cap and trade, cost passthrough likely would be more difficult.

Assuming that the number of allowances granted in any year is less than what would be demanded in an unconstrained market, allowances will have value. If they are freely distributed to firms, say based on historical emissions, these firms will capture that value. And though the firms may obtain the allowances for free, they represent a cost in that the allowances either can be used or sold in the market – i.e., there is a foregone use. Thus, if a firm can both obtain free allowances and fully pass through its increased costs of energy, it can obtain a "windfall."[13] More likely, it will not fully pass through all of its cost increase and the free allowances are a form of compensation.

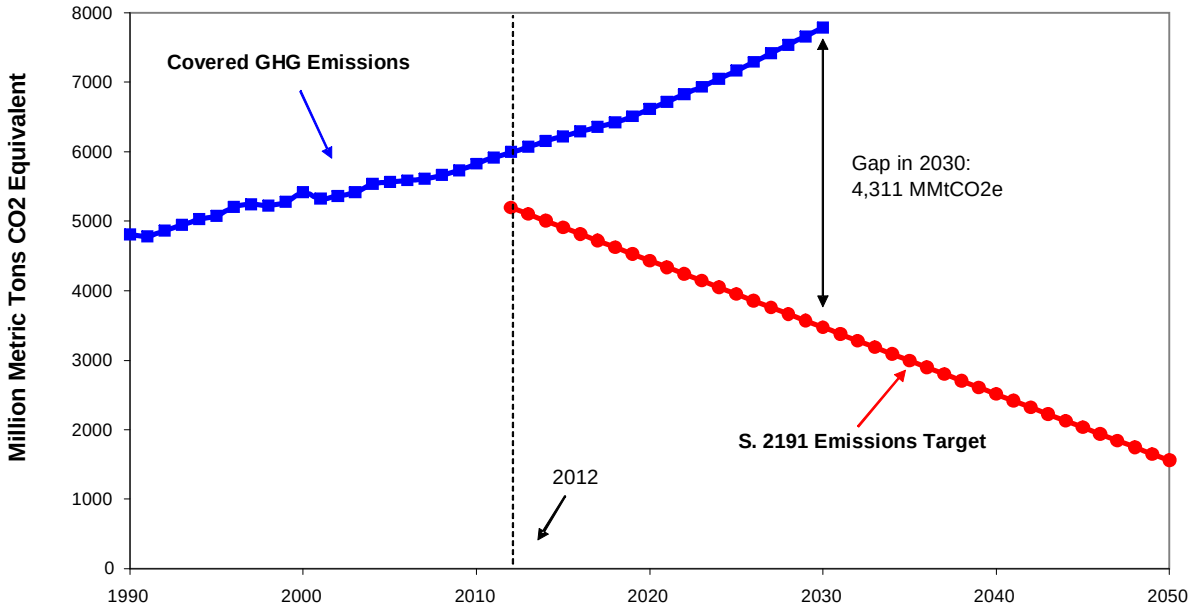
[12] For reference, the present price of a 2008 allowance in the European Trading System (ETS) is about 27 Euros per metric ton of carbon, or approximately $40 per ton.

[13] Some observers of the ETS have complained that "windfall" gains were made through the allocation of free allowances to firms who were able to pass through a substantial share of their energy cost increase. However, without such gains, the European business community might have been much less willing to accept ETS in the first place.

Economic Impacts of Cap and Trade

The economic impact of a cap and trade system depends upon how tightly it constrains fossil fuel use relative to demand and how rapidly inexpensive sources of energy and of energy efficiency enter the market. Though the particulars of cap and trade are uncertain at this point, they can be assessed to some extent. Figure 5 shows the gap between US GHG emissions under business as usual as projected by the Energy Information Administration and under S.2191 as proposed. Even in 2012, the first year of the program, GHG emissions from fossil fuels would have to be reduced by about 14% relative to baseline, and the reductions grow rapidly after that.

Figure 5 GHG Emissions Under EIA Baseline Forecast and S. 2191 Targets
(Million Metric Tons CO2 Equivalent)



Source: American Council for Capital Formation, Testimony of Dr. Margo Thorning before the Senate Committee on Environment and Public Works, November 8, 2007. Reproduced with permission.

Because allowance trading will likely be international in scope, the price of allowances in the US will not much differ from that in Europe and elsewhere. A preliminary assessment of S.2191 suggests that price would be no more than $20 per metric ton of CO_2 in 2015, or about 20¢ per

gallon of petroleum product.[14] However, the present price per ton in the ETS is about $40 per metric ton and Charles River Associates projects that under S.2191 the price of allowances would be closer $35 to $60 per ton, or 35¢ - 60¢ per gallon.[15] In both of the assessments, the price of allowances is forecast to rise with time.

While there is much uncertainty about market conditions in 2012 and beyond, several things are apparent. The price of fossil fuel energy would rise over time, perhaps fairly rapidly. Economic growth in the US would be adversely affected since energy is a factor of production and an increase in its relative scarcity will constrain output. Charles River Associates, for example, estimates that S.2191 would result in a reduction of GDP by between 1% and 1.6% in 2015, and by more thereafter.[16]

Because cap and trade fixes the quantity of fossil energy in any given year while demand is uncertain, an element of price volatility is introduced. In years when a great deal of fossil energy is demanded relative to the quantity permitted, prices could rise rapidly. Similarly, in years when fossil energy demand is weak relative to the quantity permitted, prices could fall just as rapidly. Recent experience in the European Trading System, where it became apparent that more permits for 2006 and 2007 had been distributed than were needed, illustrates the latter point.[17]

Significant resources are likely to be expended by parties seeking free allowances and revenues derived from auctioning. With upwards of $100 billion in allowance value at stake each year, a variety of interests can be expected to compete, expending resources in the process. In the aggregate, such competition may lead to hundreds of millions if not billions of dollars in expenditures, none of it enhancing the wealth of the country.

Another aspect of cap and trade is the impact it will have on US per capita GHG emissions. Continued immigration plus a relatively high birthrate is projected to increase the US population from about 300 million at present to 336 million in 2020 and about 364 million in 2030.[18] As shown in Table 1, per capita emissions presently are around 19 metric tons of carbon equivalent.

---

[14] Brian C. Murray and Martin T. Ross, "The Lieberman-Warner America's Climate Security Act: A Preliminary Assessment of Potential Economic Impacts," RTI International Policy Brief, October 2007.

[15] See testimony of Ann E. Smith before the Senate Committee on Environment and Public Works, November 8, 2007.

[16] Ibid. Murray and Ross estimate the effect at .5% of GDP in 2015, op cit.

[17] Prices for permits to emit carbon dropped from about $30 per ton to just a few dollars in a matter of days. Prices also have been volatile in the US sulfur dioxide allowance trading program. According to Robert J. Shapiro, prices for permits in that program experienced monthly volatility averaging 10% and annual volatility averaging 43%. ("Addressing the Risks of Climate Change: The Environmental Effectiveness and Economic Efficiency of Emissions Caps and Tradable Permits, Compared to Carbon Taxes," February 2007, p. 6.

[18] Given recent population trends in the US, these numbers are conservative. US population growth over the past 15 years or so has averaged about 1.2% per annum. The projections assume it will slow to .9% per year over the next 25 years.

Under the targets of S.2191, these per capita emissions would have to decrease by about 30% in 2020 and 50% in 2030. Possibly offsets, large scale carbon sequestration and alternative forms of energy will be sufficiently inexpensive that per capita energy consumption could be sustained. But more likely, fairly dramatic changes in lifestyle would be necessary to achieve the targets.

Table 1 US Per Capita Covered GHGs under Baseline Forecast v. S.2191

Year	Covered Emissions ($MMTCO_2e$)	US Population (millions)	Per Capita GHG Emissions under Baseline	Per Capita GHG Emissions under S.2191
2006	5661*	299.4	18.9	18.9
2012	5995	314.3	19.1	16.6
2020	6614	335.8	19.7	13.2
2030	7783	363.6	21.4	9.6

*Covered emissions are assumed to be 80% of total US GHG emissions.

Impacts of Recent Petroleum Price Increases on CO_2 Emissions

Recent increases in the price of petroleum products already are having some of the effects that a constraint on carbon would have. For example, over the past year the price of gasoline has risen by about $1 per gallon or by about a third, which is roughly equivalent to a $100 increase in the cost per ton of emitting CO_2. The price of jet fuel has risen by a similar amount, and the price of diesel by even more. Hence, impacts similar to those of a carbon cap and trade system recently have been experienced in petroleum markets.

How much effect will a sustained increase in oil prices of the magnitude of the past year have on US carbon dioxide emissions? Assuming that the short run elasticity of demand for petroleum products is about 0.1 and the long run elasticity about .6, the increased prices of the past year will reduce petroleum demand by about 3 percent within a year and about 20 percent over the long run. Though rising population and per capita income will offset these reductions, price effects taken alone will reduce long run CO_2 emissions from the consumption of petroleum products by about a fifth, or by roughly 500 million metric tons per annum.

Direct and Indirect Impacts of Cap and Trade on the US Petroleum Industry

Petroleum firms will be affected by a carbon emission cap and trade system in several ways. For one, their customers will be adversely affected by steadily rising prices for petroleum products. The initial price increase may only be on the order of 20¢ - 60¢ per gallon, but as allowances become ever more scarce relative to fossil fuel demand the increase will become larger. Sellers

of petroleum products can expect demand to fall off even more than already is occurring as consumers conserve and substitute products enter the market.

Petroleum demand also would be adversely affected if a cap and trade program causes macroeconomic harm. At minimum, even if the economy transitions smoothly to less carbon intensive forms of energy, a cap and trade program will impose a "tax" on consumers of energy that may well exceed $100 billion per year.[19] If S.2191 is an indication, none of the monies raised by a cap and trade system would be returned directly to taxpayers and little if any to consumers. A "tax" of that magnitude starting in 2012 and likely rising after that could have considerable adverse effect on aggregate economic activity and hence on energy demand.

Under cap and trade, the cost of energy used to process crude would increase to refiners, and transport costs would increase to refiners, pipeline companies, jobbers, and heating oil and LPG distributors. The cost of processing chemical feedstocks into finished product would increase as would the cost of power, particularly in areas where coal is a major feedstock for generation.

These various consequences of cap and trade would affect all petroleum firms operating in the US. But though cap & trade in some ways is a worldwide system, not all countries are committed to reducing their GHGs. In consequence, US petroleum firms may be squeezed by competitors operating elsewhere, where caps on GHG emissions are not in force. For example, refineries operating in Asian countries that have not agreed to constrain their GHGs would gain competitive advantage from a US cap and trade program.

Though the ultimate structure of a cap and trade system is yet to be determined, petroleum companies may well be required to secure allowances not only for the carbon that they themselves emit but also for that emitted when their products are combusted. Since transport constitutes about 28% of all US GHGs, this means that petroleum firms would be required to submit about that percentage of the annual allowances issued. Many cap and trade proposals would allocate only a fraction of allowances to private sector firms, with the fraction diminishing with time. Thus, it is unlikely that petroleum firms would be freely allocated as many allowances as the emissions they would be held responsible for. Indeed, in some cases such as the Regional Greenhouse Gas Initiative in which a number of northeastern states are participating, 100% of allowances will be allocated through auction.

Under cap and trade petroleum firms will have to monitor the emissions they are responsible for as well as their numbers of allowances to be sure they comply with the law. Assuming that banking and borrowing are a part of a cap and trade program, strategic management of the use of allowances over time would be important. This would necessitate the auditing of emissions

[19] Cap and trade does not literally impose a tax, but its effects are very similar. From a financial perspective, the differences are that the government distributes some of the allowances to favored parties for free while auctioning the rest rather than imposing a direct tax.

within each firm as well as managing its allowance accounts. Because the price of allowances may be volatile, firms might well find it useful to hedge via forward purchases or other contractual mechanisms. In short, management of allowances is likely to be a major activity at larger petroleum firms.

Impacts on Petroleum Companies of Command and Control Mechanisms to Control GHGs

Of the many programs whose policy rationales at least partly include reductions in GHGs, two particularly will affect petroleum firms. Recently enacted legislation (EISA) to compel very large increases in the use of ethanol will both increase costs and absorb gasoline market share. If the targets set in EISA are met, ethanol use will rise to 36 billion gallons per year by 2022, of which up to 15 billion gallons could come through the distillation of corn, and the rest from cellulosic or other advanced biofuel sources. If 36 billion gallons of ethanol were supplied the market in 2022 and if gasoline demand in that year were on the order of 160 billion gallons, the implication is that ethanol would supply 15.8% of the total.[20]

A second program with potentially large consequences for petroleum firms is the Low Carbon Fuel Standard (LCFS), adopted via legislation in California and likely to spread elsewhere. California has identified seven strategies for meeting the goals. These include distribution of E10 and of E85, substituting low-carbon (cellulosic) for corn-based ethanol, selling power sources for hybrid electric or pure electric vehicles, selling hydrogen for fuel cell or hydrogen-burning vehicles, selling CNG or LPG, or selling newly developed low carbon fuels such as biobutanol. At present, most of these alternatives would deliver higher cost or lower energy content fuel to motorists and as such are not attractive in the marketplace. Because of this, sellers of gasoline and diesel effectively will be "taxed" in the sense that they will be required to subsidize the sale of these fuels in order to meet the targets of the LCFS. Over time, as the LCFS rises, it is likely that sellers will be forced to resort to increasingly expensive means of supplying low carbon fuels to the market, resulting in ever larger subsidies from high carbon to low carbon fuels.

Opportunities for Petroleum Companies Created by Cap and Trade

Under cap and trade, allowances to emit carbon have value and hence are a potential source of wealth to the private sector. There are several means whereby petroleum firms may be able to take advantage of opportunities to acquire a portion of this wealth.

The most obvious is by securing free rights to allowances. Virtually all of the Congressional proposals freely allocate substantial proportions of the annual allowances to the private sector,

[20] Assuming that the energy content of ethanol is 70% that of gasoline.

though usually these proportions diminish over time as more of the allowances are auctioned. Petroleum firms will be forced to compete with a wide variety of others to secure free allowances but one criterion for awarding them likely will be historical emissions and petroleum firms can qualify for allowances via this route.

A second means would be by creating offsets at less cost than the price of allowances in the US market. For example, a petroleum firm might sponsor the planting of trees under the Joint Development Mechanism in a developing country and receive sufficient credits to more than cover the costs. Under several of the Congressional proposals, opportunities to obtain such net savings also might be possible working with US agricultural interests.

A third possibility would be to obtain allowances in one year and sell them for a higher price in another. Organized allowance markets already exist in the US and elsewhere, and with cap and trade these markets would greatly expand. Many firms probably would mainly use such markets to hedge against future allowance price changes, but if allowances rose in price over time, it would be possible to generate offsets in one year, sell them at a later time, and profit thereby. More generally, adroit management of allowances and of participation in allowance markets may provide a means for petroleum firms to profit. Given the numbers of allowances that some of the firms likely would have to deal with on an annual basis, investment in allowance market expertise may well prove worthwhile.

One almost certain result of constrained carbon emissions will be to change the relative prices of fuels, with higher carbon content fuels becoming relatively more costly to produce and sell, and lower carbon fuels less so. Under these changed conditions, petroleum firms likely will experience greater relative demand for lower carbon fuels, especially natural gas in the power sector and possibly also in the industrial sector. Sales of LPG too may be relatively encouraged.

Finally, if a portion of carbon allowances are auctioned, the federal government will receive substantial new revenues. Proposals to date have earmarked these funds for utilities, states, alternative energy R&D and deployment and other climate-related purposes. Petroleum firms engaged in alternative fuel markets may receive benefits from some of the spending in the form of technology development and larger and more rapidly expanding sales opportunities.

Would a Carbon Tax be a Better Alternative?

Many economists have suggested that imposition of a carbon tax would be a better mechanism for curbing GHGs than cap and trade.[21] The economic argument for a carbon tax is that GHGs

[21] Congressman John Dingell (D-MI), Chairman of the House Energy and Commerce Committee, recently said that "I realize that just about every economist – including President Bush's former Chief Economist (Greg Mankiw, formerly head of the CEA) – says that a carbon tax would be a better approach. That's probably true."

impose an external cost, i.e., a cost not borne by the emitter, so that a tax in the amount of the external cost would promote socially desirable behavior.

Such a tax would be imposed on fossil fuels based on their carbon content. The tax presumably would be passed through to energy users, providing incentive to curb the use of fossil fuels. It also would provide incentive to develop and use low-carbon or no-carbon fuels. Just as a cap and trade system might gradually tighten an annual cap, the rate of tax could rise over time to achieve ever greater reductions.

A carbon tax could comprise part of a system to improve the efficiency of the US tax system. Economists at the American Enterprise Institute have estimated that a tax of $10 per ton of carbon dioxide would provide sufficient revenue to reduce the corporate income tax rate by 20 percent, or income or payroll taxes by 6-7 percent, thus using the revenues raised from taxing something of which less is desired to reduce taxes on things of which more is desired. According to their analysis, such a tax also would reduce US GHGs by about 7.5 percent.[22] Similarly, an economist at Resources for the Future estimates that with a $15 per ton tax on carbon dioxide and complete recycling of the revenues into income tax reductions, the overall efficiency gain for the economy would be $25 billion per year.[23]

A carbon tax also has the advantage of making clear to the public what is being done. Cap and trade as presently formulated in Senate or House legislation gets at carbon reduction through what is essentially a very large tax and spending initiative but which is not easily understood as such. The public is "taxed" through the higher prices it would pay for fossil energy, with the revenues distributed to states, agricultural interests, private firms and others via access to free allowances, or if raised through allowance auction then spent on a variety of climate-related programs. To date, none of the leading legislative initiatives would recycle allowance-related monies back to the public in the form of reduced taxes.

Would a carbon tax be better than cap and trade for petroleum firms? In some ways, it would be. There likely would be less energy price volatility from such a tax than with cap and trade. If revenues from such a tax were redistributed via corporate tax rate reductions, petroleum firms would be among the beneficiaries. Also, a carbon tax would avoid many of the administrative and monitoring issues raised by cap and trade, and might be easier for firms to adjust to. Further, assuming a tax on the carbon content of fuels were imposed uniformly among petroleum firms, none would gain at the expense of others. Under cap and trade, the distribution of

---

Congressman Dingell went on to say, however, that a carbon tax is less politically attractive. Speech to the Detroit Economic Club, May 14, 2007.

[22] Green, Hayward and Hassett, op. cit.

[23] Ian W.H. Parry, "Should We Abandon Cap-and-Trade in Favor of a CO2 Tax?" unpublished paper, March 27, 2007.

allowances among petroleum firms could be biased, distorting markets and creating politically-based uncertainties for future investment.

On the other hand, a carbon tax would negate chances for petroleum firms to obtain free allowances, nor would there be opportunity to produce and sell offsets. Further, the government probably would use at least some of the proceeds from a carbon tax to subsidize the production and consumption of alternative energy, further eroding markets for petroleum firms. Thus, while a carbon tax appears superior to cap and trade from a social perspective, that superiority is less evident from the perspective of petroleum firms.

Conclusions

Political momentum is building in the US to take legislative and regulatory action to constrain the country's GHGs. Some actions, such as the mandating of large quantities of ethanol, may have other purposes but their policy rationale in part is to control GHGs. Others, such as cap and trade, are directly aimed at curbing these gases.

Cap and trade would fix the amount of GHG emissions at some quantity and then ratchet that quantity down over time. S.2191 as proposed, for example, would ratchet the quantity down by around 2 percent per year initially, with that percentage growing as the absolute quantity of emissions diminishes. Relative to what GHG emissions would be under business as usual, the percentage reduction would be even greater.

Petroleum firms are likely to be adversely affected by cap and trade for several reasons. Costs of energy-related inputs would rise, and the firms likely would not be able to pass through all of the increase, particularly if they are subject to competition from foreign sources not subject to GHG controls.

A cap and trade system probably would cause energy price volatility, adversely affecting demand and hindering investment. There also could be macroeconomic harm from cap and trade, which would reduce demand for product.

On the other hand, under cap and trade allowances have value, and petroleum firms may be able to secure some of these for free. They also may be able to obtain offsets to their GHG emissions for less cost than the market price of allowances.

Because natural gas is a relatively low carbon fossil fuel, its sales in the power sector are likely to gain at the expense of coal. LPG sales also may be relatively encouraged by the relatively low carbon content of this fuel.

If GHGs are to be constrained, a carbon tax would be a socially superior alternative to cap and trade. However, its relative impact on petroleum firms is mixed. If the proceeds from a carbon tax were used to reduce other taxes, particularly corporate income taxes, petroleum firms would share in the benefit. However, under a tax approach, no free allowances would be available, and if a portion of the proceeds were used to subsidize alternative transportation fuels, that would have further adverse effects on petroleum markets. Thus, a tax would avoid many of the problems of cap and trade, but it would negate opportunities to profit from such a system as well.