Understanding The Economic Benefits Of Climate Change Commitments

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ABSTRACT

Much has been written about the likely economic costs of United States commitment to a global climate change treaty, whereby signatory countries would be expected to stabilize or reduce carbon emissions. A great deal of rhetoric has surrounded the potential costs of such action, with some estimates stating that committing to such a treaty would result in 1.2 to 1.8 million job losses by the year 2010 (Bailey 1997). On the other side of the discussion, the *Energy Innovations* report prepared by ACEEE and others showed that emissions could be cut by 10% by 2010, at the same time that the economy would grow modestly by $2.8 billion over a base case, including a net gain of 800,000 additional jobs (Energy Innovations 1997).

One area that has not been adequately addressed in the debate is quantifying the current level of activity of the positively affected industries from such a climate treaty, including the energy efficiency and renewable energy industries and other environmental businesses. This paper presents information on the current and prospective contribution of the energy efficiency industries to U.S. economic output, exports and job creation. This will better define what the possible benefits to the U.S. economy might be of potential global climate change policies.

The magnitude of the beneficial economic impact will in part be determined by the extent to which energy efficiency products, and the components which comprise them, are manufactured in the U.S.. An important issue to be addressed is the existence, scale, and the competitive position of these energy efficiency industries in the U.S..

Introduction

During the past decade the concerns over global climate change have been growing, and the international community has responded with increasing activity to address these concerns. There is now general agreement that human activity is affecting the global climate, and studies show that the U.S. population is generally supportive of policies to reduce greenhouse gas emissions. There has been a very spirited debate about the potential economic costs of such policies, with some affected industries claiming economic disaster from the proposed international agreements.

In 1992 the international community adopted the Framework Convention on Climate Change, in which over 160 nations signed a treaty whereby the industrialized nations would voluntarily return their emissions of carbon dioxide and other greenhouse gases to 1990 levels by the year 2000. By 1996 it became clear that most nations would not meet this target voluntarily (the significant exception being Europe where overall emissions have been reduced primarily due to the economic collapse in the early 1990s of the former Soviet Union). With the scientific evidence of potential climate change consequences growing, there has been increasing pressure to move beyond voluntary commitments, and by 1997 the Clinton administration stated that it was prepared to accept "legally binding commitments" for greenhouse gas emission stabilization and eventual reduction.

In December 1997 the nations of the world met in Kyoto to address the climate predicament, which resulted in the "Kyoto Protocol," where, on average, the industrialized countries of the world committed to limit combined emissions in 2010 to about 5% below 1990 levels. This is significant because business as usual projections of emissions in 2010 are roughly 20% above 1990 levels (the U.S. has agreed to a 7% reduction). The protocol includes several other items that were important to U.S. interests, including provisions for trading and other flexibility.

During the lead up to the Kyoto meeting, and the debate about the outcome since, the major issue of the protocol's opponents is the effect that it will have on the U.S. economy and the competitiveness of U.S. businesses.

Background And Context

In order to reasonably quantify the costs and benefits of climate change commitments, there have been numerous attempts to simulate the economic consequences of different scenarios. Not surprisingly, there is a wide variation in the outcomes of these different modeling exercises, and various interest groups have used some of the predictions to support their own policy conclusions.

It is generally agreed that most of the modeling activities have very comprehensively quantified the costs of emissions reductions, though there is marked disagreement on several of the key factors that determine economic cost outcomes. It is much more difficult to measure the potential benefits (Yellen 1998; Laitner 1997). Indeed, Dr. Janet Yellen, chair of the White House Council of Economic Advisers, testified in March 1998 that

> "... it is evident that the benefits of averting climate change are potentially immense. But we have chosen not to try to quantify them in monetary terms." (Yellen 1998)

This paper reviews the different economic analyses that have been done and provides some explanation for the variations in the conclusions of the different efforts, with particular emphasis on how the benefits of climate change commitments are accounted for. The paper also attempts to quantify the size of the industries that most directly benefit from climate change commitments and discusses the competitive positions of those industries in the global market.

Summary Of Economic Models

Estimates of the costs of climate change policies that would reduce greenhouse gas emissions to 1990 levels have ranged as high as 2% to 4% of GDP in the terminal year (2010, 2015 or 2020). The American Petroleum Institute has prepared an analysis of the Administration's carbon abatement policy which show that real GDP would be 2.4% below the baseline 2010 estimate, and 1.7% below the 2020 estimate. The lost GDP, just in the year 2010, is equal to 227 billion 1992 dollars, approximately equal to total federal, state and local expenditures on elementary and secondary education (API 1998).

This API study had the objective of establishing the minimum cost to the U.S. economy of stabilizing emissions to 1990 levels by 2010. They assumed that intra-country tradable permits were available at the first point of purchase, though they state that analytically, tradable permits are similar to a carbon tax or fee. They predict significant reduced global competitiveness for U.S. industry, thereby causing the substantial reduction in GDP. The study showed that the high economic costs are borne by all states, though energy producing state and export dependent states suffer a disproportionate burden.

A range of estimates presented in a Forbes magazine article showed job losses in the range of 1.2 to 1.8 million persons, along with GDP changes of negative 0.1% to negative 4.6% in 2010 (Bailey 1997).

In contrast, the 1997 *Energy Innovations* study concluded that an innovative path encouraging the adoption of new energy efficiency technologies could reduce carbon dioxide emissions 10 percent below 1990 levels by the year 2010. This study went on to demonstrate that this could be achieved at a savings to consumers of $530 per household, and the economy would support 800,000 more jobs in 2010 relative to present path projections (Energy Innovations 1997). In contrast to the above mentioned studies, the *Energy Innovations* analysis posits an increase of $2.8 Billion in GDP in 2010.

The *Energy Innovations* report states that the reason their results differ so from fossil fuel interest studies is that such analyses have examined unrealistic policies using misleading assumptions that exclude many proven cost-effective energy efficiency opportunities, neglect the potential for technological innovations, and often fail to count the net savings of reduced energy bills.

The Alliance to Save Energy report *"Price It Right: Energy Pricing and Fundamental Tax Reform*" examined the impact on economic performance (GDP, industry output and prices, consumer wealth), energy use and carbon emissions of shifting taxes from income and savings to energy and consumption. The analysis utilized an intertemporal general equilibrium model of the economy developed by professor Dale Jorgenson of Harvard University. The terminal year of the Alliance analysis was 2025. As compared with a business as usual case, the analysis finds that GDP is in fact 7% greater, (consumption increases by 5% and investment spending is up by 14%), average industrial output in non-energy industries is 16% higher and the price level is 25% lower (Norland & Ninassi 1998).

How can this divergent range of outcomes be explained? As noted above, there are a multitude of different models that have been developed and utilized to attempt to characterize the costs and benefits of climate policies. The World Resources Institute has prepared an excellent summary of the different modeling methodologies and results in a report entitled "*The Costs of Climate Protection: A Guide for the Perplexed*" (Repetto and Austin 1997). In this report they identify the key assumptions that drive the results of various models, and find that "... under a reasonable set of common assumptions, models indicate that the macroeconomic impacts of stabilizing greenhouse gas emissions are likely to be modest and, if the environmental benefits are factored in, are likely to be beneficial."

Repetto and Austin demonstrate in their report that there are really a very limited number of key assumptions that are key to the outcome of the model. Through 162 simulations using 16 of the most reputable and widely used economic models (including the models used by many of the most pessimistic economic predictions that are widely quoted), they show that there are only two salient policy assumptions that really differentiate model predictions: does the model assume that carbon tax revenues are returned to the economy through the reduction of a distorting tax rate, or through lump-sum rebates; and does the model assume that joint implementation options are available (such that international trading of emissions can occur), or not.

In preparation for the Kyoto climate negotiations, the U.S. government formed an Interagency Analytic Team (IAT) to analyze the economic effects of policies to limit emissions. The IAT was directed to sort out the conflicting data to provide unbiased policy guidance. In June 1997 the IAT released a draft report on their findings, which showed that while they anticipate small economy-wide losses, some sectors of the economy will bear large burdens. These economic losses can be minimized trading of emission rights (or permits), and policies that use any resulting revenues to favor investment and long-term growth (IAT 1997).

Among the sets of modeling runs performed by the IAT were two scenarios that examined potential behavioral responses to carbon constraints (modeled as an emissions cap), and a technology investment case that assumed both the existence of presently cost-effective but underutilized technologies and the development and deployment of cost-effective advanced technologies. In the behavioral case, the assumed carbon price rises rather significantly before it begins to come down later in the modeling period, which causes a small but negative impact on GDP (in 2010 the GDP is 0.05% lower than the IAT's base case). In the technology case, where more of the cost-effective energy efficiency improvements are utilized, results in a much smaller assumed carbon price, and results in a net gain in the GDP through the entire study period, with the GDP 0.23% above the base case in 2010 (Laitner 1997).

In March 1998 testimony before the House Commerce Subcommittee On Energy And Power On The Economics Of The Kyoto Protocol, Dr. Janet Yellen stated that the economic cost of the climate change agreement was on the order of one-tenth of one percent of GDP in 2010.

> "This implies that overall costs, excluding not only climate and non-climate benefits, but also such cost mitigating factors as sinks and payoffs from the President's electricity restructuring and climate change initiatives, would reach roughly one tenth of one percent of projected GDP in 2010."

Dr. Yellen's analysis concludes that the job impacts of the treaty, under the conditions accepted, would have no net effect on national employment levels.

> "Although there may be job gains in some sectors and job losses in others, we do not anticipate any significant aggregate employment effect if we achieve the conditions we have discussed." (Yellen 1998)

By comparison, these relatively modest GDP effects can be compared with the expected economic effects of the Year 2000 computer software problem, which has gotten a lot of press but has never been characterized as a potential economic disaster in the way that climate policies have. In testimony before the Senate Banking Committee on February 25, 1998, the chief economist of Standard & Poors DRI said that the computer bug could reduce economic growth by 0.3% in 1999 and 0.5% in 2000, though he went on to say that this economic damage would not trigger a recession (USA Today 1998).

Positively Benefiting Industries From Climate Change Commitments

There has been a great deal of research and publicity about the negative implications of climate commitments for large energy intensive industries, which show losses of domestic output and employment and international competitiveness. While it is easy to focus on these "losers" from climate policy, there has not been any equal characterization of the "winners" from these policies.

There are many groups of potential winners from climate policies, including the insurance industry (which could see a significant reduction in loss claims from extreme weather events) (Mills 1996), and reductions in medical costs from reduced pollution and changes in disease patterns. The obvious groups of beneficiaries, though, are those that will see increases in their business from higher, or expectation of higher, energy prices which include the cost of carbon mitigation, and those that provide equal energy services at lower carbon emissions. These businesses include the energy efficiency and renewable energy industry, and certain parts of the environmental business sector.

In order to provide some information to counter the information on negatively affected industries, the U.S. Department of Energy, through Argonne National Laboratory, commissioned a study to examine the businesses that would benefit from higher conventional fuel prices. The draft report (Bourgeois 1997) showed that the potentially benefiting industries, those in the energy efficiency industry alone (excepting the Environmental Business Sector and the Renewable Energy industries) today collectively have sales of about $28 Billion and employ in excess of 163,000 people in direct terms. Because the energy efficiency industry is a very heterogeneous group of firms providing hundreds of products and services, it is difficult to accurately track the size of the industry and make predictions about the magnitude of its growth in response to different policies.

To accurately assess the potential economic benefits, it is also necessary to understand the competitive position of the U.S. energy efficiency industry relative to its global competitors. The developing countries have the fastest growing rates of energy usage and greenhouse gas emissions, so climate commitments have the potential to greatly increase the exports of U.S. energy efficiency services and products.

Estimates Of The Size Of The Energy Efficiency Industry

One of the most widely quoted estimates of the size of the energy efficiency industry was a report prepared by Hagler Bailly Consulting, Inc., for presentation at an international energy finance conference in 1995 (Hagler Bailly 1995). The Hagler Bailly study estimated the size of the energy efficiency industry at $80 Billion worldwide. They estimate that more than 40% of the industry is in North America. Estimates for the size of the industry in the United States is on the order of $25 Billion to $28 Billion.

In a Rocky Mountain Institute (RMI) report on the U.S. Department of Energy efforts to create conditions that would permit development of a secondary market in energy efficiency, a DOE source was quoted saying that "energy efficiency in buildings currently attracts $3-4 billion in financing annually in the United States; DOE hopes the [measurement and verification] protocol and other initiatives will increase that figure to $10 billion within five years, which would create 100,000 jobs within a decade and yield $20 billion a year in savings to the U.S. economy" (RMI 1996).

In a report prepared for the World Bank, the energy services company (ESCO) industry has been estimated to have sales of approximately $500 million annually (Cudahy & Dreesen 1996). In the report, the authors trace the development of the U.S. ESCO industry, and find that there were three major factors that have influenced the growth and health of the industry: the energy price rises of the 1970s, the tax benefits for energy efficiency during the early 1980s, and the growth of utility DSM programs. They estimate that performance-based energy efficiency project development grew at a rate of 25% per year during the period from 1989 through 1994 (a more comprehensive assessment of the size and scope of the U.S. ESCO industry, funded by the US Department of Energy, is presently underway).

The states of California and New York have begun to collect data about the size of the energy industries in those state, in part to support the development of export business for them. In New York, for example, a recent completed directory of energy efficiency businesses in the state prepared by the Alliance to Save Energy found that 263 companies, employing over 13,000 persons, were located in the state (NYSERDA 1997). The California Energy Commission has similarly cataloged its industry, and reports that the Commission's Energy Technology Export Program has helped spur over $330 million in energy export sales from California, which have produced jobs, revenue and an increased tax base for California. The California figures on sales and new job creation are inclusive of just the favorable economic impacts of the export sales program and do not include the larger economy-wide benefits of in-state energy efficiency industry activities.

Another good source of information which attempts to categorize the energy efficiency industry is the 1997 "*Opportunity Knocks*" report prepared by the International Institute for Energy Conservation (IIEC 1997). In that report, IIEC breaks the industry down into three major categories: demand-side technologies and services (including energy service companies, building environmental controls, HVAC equipment, lighting, household appliances, building materials, industrial and process controls, and motors and adjustable speed drives); supply-side and distribution technologies (including cogeneration, transformers, and cable and wiring); and transportation technologies and services (including electric vehicles and mass transit planning). This categorization can be useful in exercises to catalog the scope of the industry.

Revenues and Employment In Selected Energy Efficiency Industries

While only portions of the larger business segments manufacturing energy consuming products can be included in the energy efficiency industry, it is useful to look at the size of the overall markets for energy using products to see the magnitude of the potential growth market for energy efficiency. Table 1 below shows some of the major categories of energy efficiency equipment, and the annual sales of those products.

Table 1. 1995 Sales and Employment in Major Categories of Energy Efficiency Equipment

SIC	INDUSTRY	SHIPMENTS ($000,000)	EMPLOYMENT
3296	Mineral Wool	$ 3,966.7	16,200
3561	Pumps & Pumping Equipment	$ 4,887.6	21,000
3563	Air & Gas Compressors	$ 3,168.8	16,800
3564	Blowers & Fans	$ 3,652.6	19,600
3585	Refrigeration & Heating Equipment	$ 20,216.5	103,200
3612	Power, Distribution & Spec. Transformers	$ 5,344.2	32,400
3621	Motors & Generators	$ 10,704.1	61,800
3625	Industrial Relays & Controls	$ 9,840.5	63,400
3632	Household Refrigerators & Freezers	$ 5,111.4	27,300
3633	Household Laundry Machines	$ 3,217.9	16,300
3639	Water Heaters; Electric & Non Electric	$ 2,313.4	7,400
3641	Electric Lamp Bulbs & Tubes	$ 2,888.9	13,900
3645	Residential Lighting Fixtures	$ 972.9	13,300
3646	Commercial Lighting Fixtures	$ 3,529.8	16,600
3822	Environmental Controls	$ 2,619.1	16,300
	TOTALS:	$ 82,434.4	445,500

Source: 1995 Annual Survey of Manufactures: Statistics for Industry Groups and Industries. M95(AS)-1

U.S. Energy Efficiency Industry's Competitive Position In A Global Marketplace

Industries in which energy efficiency products are manufactured play a significant role in the U.S. economy. Certain of these industries in the United States are "mature" industries, in which the rate of shipments growth has reached a fairly stable level. Innovative companies in these industries, including the heating, ventilation, air-conditioning and refrigeration industries (HVAC&R), major household appliances (refrigerators, washing machines, dryers, water heaters) motors and drives, environmental building controls could be the beneficiaries of significant new growth domestically and internationally spurred by development of new energy efficient products.

New energy efficient products with collateral benefits can stimulate growth a more rapid pace of growth in mature, "evolving" industries and lead to competitive advantage in the marketplace. A recent financial analysts' review of Maytag keyed in specifically on the company's new high efficiency washing machine line, the NEPTUNE, stating:

> "We also like Maytag Corp. [NYSE:MYG - news], at 1.82% of the Fund. Maytag did well in the fourth quarter after refreshing its product line with the new Neptune high- efficiency washing machine." (Founders Fund 1998)

The higher value, innovative products that are developed as companies look for new ways to improve energy efficiency can lead to more sales for leading manufacturers, and in the case of Maytag, even substantial new shareholder wealth. Since the introduction of their new Neptune high efficiency clothes washer line (which also has ancillary benefits of less water usage and, reportedly, cleaner clothes), numerous financial analysts have noticed the boost that this new product line has given to Maytag, which had previously been viewed as a lackluster performer in a mature, somewhat stodgy industry (INVESTools 1998).

This highlights the fact that many energy efficient products bring additional value to consumers (whether a homeowner or a large industrial facility). Many of the projects undertaken in recent years through the US Department of Energy's Office of Industrial Technologies have begun as energy efficiency projects, but this motivation became less of a driver as the clients doing the research began to understand many of the process improvement and other benefits that would result.

Many products that are included in the broad definition of energy efficiency have significant exports, and contribute strongly to the US balance of trade. Table 2 depicts 1996 exports and imports of products that are within a set of industries that produce energy efficiency products.

Table 2. Exports, Import and Balance of Trade for Selected Energy Efficiency Products

	EXPORTS ($000,000)	IMPORTS ($000,000)	BALANCE OF TRADE
			($000,000)
Unitary AC	$312.2	$ 47.1	$ 265.1
Washing Machines	$256.4	$ 36.6	$ 219.8
Refrigerators (>= 13.5 cu. ft.)	$414.8	$ 49.1	$ 365.7
Pumps	$832.4	$518.4	$ 314.0
Controls for residential and commercial environments, appliance regulating controls	$923.7	$840.0	$ 83.7

Source: Current Industrial Reports: 1996. Report MA35M *Refrigeration, Air Conditioning and Warm Air Equipment*, Report MA36F *Major Household Appliances*, Report MA35P *Pumps and Compressors*, Report MA38B *Measuring Instruments and Related Products*.

International trade is an issue of significant importance to the U.S. air-conditioning and refrigeration industry. The industry is already a global one; approximately 80% of ARI member companies sell products outside the U.S. Members have over 100 manufacturing facilities in foreign markets. The global market for refrigeration and air-conditioning is estimated at $45 Billion to $50 billion. The producers' in the U.S., Canada, Europe and Japan have greater than an 80% market share presently. Indication of the competitive position of the HVAC&R industry is given by the favorable balance of trade. Figures from the American Refrigeration Institute show positive net exports in each of the last 15 years. The positive balance of trade exceeded $2 Billion from 1991 – 1994, the last year for which data was available to us (ARI 1998).

Technological Change, Induced Innovation, And The Costs (Or Net Benefits) Of Global Climate Change Policy

Of critical importance in the debate about the costs of climate change policies are the assumptions that are made about the future pace of technological change. Some analysts have suggested that the induced technological change that would be fostered by "smart" climate change policies could result in net benefits to the U.S. economy over a 15 to 20 year time period. The collateral benefits of energy-saving technological change and innovation in manufacturing, and commercial businesses could increase productivity resulting in a greater degree of competitiveness.

Being first to market carbon reducing products and processes will give U.S. businesses a strategic advantage in a huge global marketplace. By exerting technological leadership, U.S. companies will take a dominant position, by virtue of being first to market, with low carbon or no carbon technologies that will be in great demand in the next century.

Dr. Janet Yellen highlighted the importance, and the controversy surrounding estimates of the future pace of technological change in climate change modeling and benefit/cost assessment.

> "One area in which the uncertainty is particularly large is the pace of technological progress -- especially the diffusion of existing energy-efficient technologies, but also the development of new technologies -- and the extent to which the pace will accelerate in response to government programs. Models and experts on climate change policy tend to have a wider range of disagreement on the scope for speeding the diffusion of existing energy-efficient technologies than on any other single issue." (Yellen 1998)

The Autonomous Energy Efficiency Index (AEEI), a key model parameter that embodies the expected impacts of future innovation and diffusion of energy efficiency technology is assumed to be 0.9% per year in the Energy Information Administration's most recent long-term forecast (Kyles 1997). There is empirical evidence of declines in energy intensity that exceeded 2.5% per year over the period 1974 – 1986 (Bourgeois 1997). Policies that speed innovation and diffusion of cost-effective energy efficiency investments would greatly reduce costs of climate change policies. Dr. Yellen notes;

> "Published results based on SGM model simulations with different assumed rates of AEEI suggest that an increase in the AEEI of 25 percent could lead to declines in the permit price of approximately 40 percent." (Yellen 1998)

If the rate of autonomous energy efficiency used in climate change models were increased from 0.5% to 1.5% per year, the cost of cutting carbon emissions to 20% below 1990 levels falls from $1 trillion nearly to zero (Manne and Richels 1990).

Industry has demonstrated an ability to significantly reduce the energy requirements of consumer goods and producers durable equipment. At the same time, energy efficiency has typically been accompanied by higher levels of product services.

For example, the American Home Appliance Manufacturers (AHAM 1998) report the following;

Comparing new (1997) models with 1980 offerings, the industry has reduced energy use as follows:

- Refrigerators 1,277 kWh/y to 660 kWh/y -48%
- Freezers 883 kWh/y to 461 kWh/y -48%

- Room Air Conditioners 1,134 kWh/y to 829 kWh/y -28%
- Dishwashers 2.87 kWh/cycle to 2.07 kWh/cycle -28%
- Washers 2.59 kWh/cycle to 2.22 kWh/cycle -14%

The AHAM release states that at least 18% of US households own refrigerators that are over 16 years old. If all of these households replaced their refrigerators today with a new model, they would collectively save over 11 billion kWhs of energy in the first year. At the same time, they would have saved over $820 million in electricity costs. "Should a significant portion of the public update their major appliances, the environmental impact would be dramatic and extremely favorable for the reduction of the nation's energy use," claims Robert L. Holding, AHAM president (AHAM 1998).

Conclusions

There are undoubtedly significant costs in achieving climate change abatement, and these have been widely presented. However, there are also significant benefits which have not been well articulated. One primary reason, acknowledged by policy makers, is that the costs are much easier to quantify and predict than the benefits.

Some of the beneficiaries of climate policies and higher (or anticipated or perceived higher) energy prices have been identified in this paper. Because the positively affected industries are so heterogeneous and small relative to the negatively affected industries (including oil, coal, utilities and major heavy industries) there has not been an effective quantification and articulation of the potential benefits. However, this is beginning to change as more forward thinking major corporations (e.g., BP, ENRON, United Technologies and Toyota) have realized the potential competitive advantage that their embracing this issue can bring.

Even those who trumpet the debilitating costs of climate change abatement are beginning to realize that some action is inevitable, and are looking for ways to engage in constructive debate about ways to minimize negative implications and maximize the flexibility of whatever agreements are reached. The issue of the economics of climate change commitments will definitely continue to be a hotly debated topic during the next several years, and one that will have a dramatic effect on the health and growth of the energy efficiency industry.

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