Energy Security, Energy Poverty and Greenhouse Gas Emission Reductions
By
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Before the
Committee on Foreign Affairs
Subcommittee on Asia, the Pacific, and the Global Environment
U.S. House of Representatives
July 11, 2007

Executive Summary

Introduction: Security of energy supplies and protection for the environment are two important policy goals on which developed countries have focused significant amounts of time and money in recent years. Developed countries have devoted less attention to the need to increase supplies of clean energy to the world's poorest inhabitants, many of whom live on less that a dollar a day. Since energy use goes hand-in-hand with economic development, many experts think increasing the supply of clean energy for the poor should be a top priority as well.

Trends in Energy Use and Carbon Emissions: Globally, fossil fuels will remain the dominant source of energy to 2030, absent sharp changes in consumption and technological breakthroughs, according to the 2006 International Energy Agency (IEA) report. The IEA projects that global primary energy demand will increase by an average annual rate of 1.6 percent between now and 2030 and carbon emissions will increase by more than half during that period. Over 70 percent of the increase in demand over the projection period comes from developing countries, with China alone accounting for 30 percent.

Energy Security Requires Investment: Rising oil and gas demand, if unchecked, will accentuate the consuming countries' vulnerability to a severe supply disruption and resulting price shock. OECD and developing Asian countries are projected to become increasingly dependent on imports as their indigenous production fails to keep pace with demand. Non-OPEC production of conventional crude oil and natural gas liquids is set to peak within a decade. Meeting the world's growing hunger for energy will require over $20 trillion (in 2005 dollars) over the next 25 years.

Bringing Modern Energy to the World's Poor: By 2030, one-third of the world's population will still be relying on biomass (wood, charcoal, animal dung) for cooking and there will still be 1.4 billion people in the world without electricity. The inefficient and unsustainable use of biomass has severe consequences for health, the environment and economic development. Shockingly, about 1.3 million people - mostly women and children - die prematurely every year because of exposure to indoor air pollution from biomass.

Emission Trading Systems: Myths and Realities: The European Environmental Agency's latest projections show that without strong new measures, the EU 15's greenhouse gas emissions will be 7.4 percent above 1990 levels in 2010, rather than 8 percent below as required by the Kyoto Protocol. Further, the economic burden of California's new climate policy legislation is likely to be high and the targets in AB32 are unlikely to be met. In contrast, the Regional Greenhouse Gas Initiative, which affects the utility sector is unlikely to result in any emission

*The International Council for Capital Formation (www.iccfglobal.org) is a non-profit, Brussels-based think tank promoting a nurturing climate for business expansion, cost-effective regulatory policies and job growth. The ICCF is an affiliate of the American Council for Capital Formation (www.accf.org).

reductions in the Northeastern states before 2015 because the targets are set above current emission levels.

Cap and Trade Approach to Emission Reductions: Emissions caps are not likely to promote new technology development because they will force industry to divert resources to near-term, "end of pipe" solutions rather than promote spending for long-term technology innovations. A fixed cap on emissions also inevitably collides with U.S. population growth; the EU-15 countries are having difficulty meeting their Kyoto targets and they have negligible population growth. In fact, if the U.S. adopts emission caps, higher energy prices will make U.S. industry less competitive vis-a-vis China and India. As a result, China and India, whose primary focus is economic growth, will see it in their interest to accelerate the development of industries that depend on a competitive advantage in energy prices.

Strategies to Increase Energy Security and Reduce Emission Growth and Energy Poverty: Increased energy security and emission reduction will depend on factors such as increased economic growth, energy efficiency, technology developments in both fossil fuels (carbon capture and storage, for example) and renewable fuels (wind and solar, in particular) and possibly increased reliance on nuclear power for electricity generation. To reduce energy poverty, vigorous and concerted government action, with support from the industrialized countries, is needed action to help people switch to modern cooking fuels and technologies.

Role of International Partnerships: The Asia Pacific Partnership on Clean Development and Climate serves as a practical model focusing on sector-specific technologies to increase energy efficiency and reduce emissions. Extending the framework of the AP6 to other major emitters will allow developed countries to focus their efforts where they will get the largest return, in terms of emission reductions for the least cost. By focusing on the key emitters, developed countries may find they have more resources for promoting both energy security of supply and reducing global energy poverty.

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Security of energy supplies and protection for the environment are two important policy goals on which developed countries have focused significant amounts of time and money in recent years. Developed countries have devoted less attention to the need to increase supplies of clean energy to the world's poorest inhabitants, many of whom live on less that a dollar a day. Since energy use goes hand-in-hand with economic development, many experts think increasing the supply of clean energy for the poor should be a top priority as well. My testimony attempts to put these three policy objectives in perspective and suggests ways to move forward on all three fronts. The testimony also reviews the effectiveness of current policies in the European Union and in the United States in reducing greenhouse gas emissions (GHGs) and suggests cost-effective strategies to reduce the threat of human-induced climate change.

Security of Energy Supplies

According to Fatih Birol, Chief Economist of the International Energy Agency, the major challenges faced by both developed and developing countries are: (1) the growing risk of disruptions to energy supplies; (2) the threat of environmental damage and climate change caused by energy use and production; and (3) persistent energy poverty. As he notes in a recent article in *The Energy Journal*, policymakers have devoted considerable time and resources to the first two challenges while the need of the world's poor for clean energy has received much less attention. [1] High energy prices and recent geopolitical events remind us of the essential role affordable energy plays in economic growth and human development and of the vulnerability of the global energy system to supply disruptions. Safeguarding energy supplies is once again at the top of the international policy agenda, yet the current pattern of energy supply carries the possibility of environmental damage, including changes in the global climate. The need to slow the growth in fossil-energy demand, to increase geographic and fuel-supply diversity and to mitigate climate-destabilizing emissions is more urgent than ever.

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1. Fatih Birol, Energy Economics: "A Place for Energy Poverty in the Agenda." *The Energy Journal*, Volume 28, Number 3.

A Reality Check on Trends in Energy Use and Carbon Emissions

Globally, fossil fuels will remain the dominant source of energy to 2030, absent sharp changes in consumption and technological breakthroughs, according to the 2006 International Energy Agency (IEA) report. The IEA report projects that global primary energy demand will increase by an average annual rate of 1.6 percent between now and 2030 and carbon emissions will increase by more than half during that period. Over 70 percent of the increase in demand over the projection period comes from developing countries, with China alone accounting for 30 percent. The economies and population of developing countries grow much faster than those of the OECD countries, shifting the centre of gravity of global energy demand. Almost half of the increase in global primary energy use stems from generating electricity and one-fifth from meeting transport needs, almost entirely in the form of oil-based fuels.

Coal will see the biggest increase in demand in absolute terms over the next two decades, driven mainly by power generation. China and India account for almost four-fifths of the incremental demand for coal. Coal will remain the second-largest primary fuel, its share in global demand increasing slightly. The share of natural gas also rises. Hydropower's share of primary energy use rises slightly, while that of nuclear power falls. The share of biomass falls marginally, as developing countries increasingly switch to using modern commercial energy, offsetting the growing use of biomass as feedstock for biofuels production and for power and heat generation. Non-hydro renewables - including wind, solar and geothermal - grow quickest, but from a small base, the IEA report states.

- **The Threat to the World's Energy Security is Real and Growing**

Rising oil and gas demand, if unchecked, will accentuate the consuming countries' vulnerability to a severe supply disruption and resulting price shock. OECD and developing Asian countries are projected to become increasingly dependent on imports as their indigenous production fails to keep pace with demand. Non-OPEC production of conventional crude oil and natural gas liquids is set to peak within a decade. By 2030, the OECD as a whole will import two-thirds of its oil needs in the IEA's base case scenario compared with 56 percent today. Much of the additional imports come from the Middle East, along vulnerable maritime routes. The concentration of oil production in a small group of countries with large reserves - notably Middle East OPEC members and Russia - will increase their market dominance and their ability to impose higher prices. An increasing share of gas demand is also expected to be met by imports, via pipeline or in the form of liquefied natural gas from increasingly distant suppliers. The share of transport demand, which is relatively price-inelastic relative to other energy services, in global oil consumption is projected to rise.

Oil prices still matter to the economic health of the global economy. Although most oil-importing economies around the world have continued to grow strongly since 2002, they would have grown even more rapidly had the price of oil and other forms of energy not increased. Most OECD countries have experienced a worsening of their current account balances, most obviously the United States. The recycling of petro-dollars may have helped to mitigate the increase in long-term interest rates, delaying the adverse impact on real incomes and output of higher energy prices. An oil-price shock caused by a sudden and severe supply disruption would be particularly damaging – for heavily indebted poor countries most of all.

- **Investment Needed to Promote Energy Security**

Meeting the world's growing hunger for energy requires massive investment in energy-supply infrastructure, according to the IEA report. The IEA base case calls for cumulative investment of just over $20 trillion (in 2005 dollars) over 2005-2030. The power sector accounts for 56 percent of total investment – or around two-thirds if investment in the supply chain to meet the fuel needs of power stations - is included. Oil investment, three-quarters of which goes to the upstream, amounts to over $4 trillion in total over 2005-2030. There is no guarantee that all of the investment needed will be forthcoming. Government policies, geopolitical factors, unexpected changes in unit costs and prices, and new technology could all affect the opportunities and incentives for private and publicly-owned companies to invest in different parts of the various energy-supply chains. The ability and willingness of major oil and gas producers to step up investment in order to meet rising global demand are particularly uncertain. Capital spending by the world's leading oil and gas companies increased sharply in nominal terms over the course of the first half of the current decade and, according to company plans, will rise further to 2010. But the impact on new capacity of higher spending is being blunted by rising costs. Expressed in cost inflation-adjusted terms, investment in 2005 was only 5 percent above that in 2000. Planned upstream investment to 2010 is expected to slightly boost global spare capacity. Beyond the current decade, higher investment in real terms will be needed to maintain growth in upstream and downstream capacity.

- **Impact of Global Energy Demand on Carbon Dioxide Emissions**

Global energy-related carbon-dioxide (CO_2) emissions will increase by 55 percent between 2004 and 2030, or 1.7 percent per year, in the IEA's base case scenario. Power generation contributes half of the increase in global emissions over the projection period. Coal overtook oil in 2003 as the leading contributor to global energy-related CO_2 emissions and consolidates this position through to 2030. Developing countries account for over three-quarters of the increase in global $_{CO2}$ emissions between 2004 and 2030 in the base case scenario. They overtake the OECD as the biggest emitter around 2010. The share of developing countries in world emissions rises from 39 percent in 2004 to over one-half by 2030. This increase is faster than that of their share in energy demand, because their incremental energy use is more carbon-intensive than that of the OECD and transition economies. In general, the developing countries use proportionately more coal and less gas. China alone is responsible for about 39 percent of the rise in global emissions. China's emissions more than double between 2004 and 2030, driven by strong economic growth and heavy reliance on coal in power generation and industry. China overtakes the United States as the world's biggest emitter before 2010. Other Asian countries, notably India, also contribute heavily to the increase in global emissions.

- **Bringing Modern Energy to the World's Poor Is an Urgent Necessity**

Although the IEA projects steady progress in expanding the use of modern household energy services in developing countries, many people will still depend on traditional biomass in 2030. Today, 2.5 billion people use wood, charcoal, agricultural waste and animal dung to meet most of their daily energy needs for cooking and heating. In many countries, these resources account for over 90 percent of total household energy consumption.

The inefficient and unsustainable use of biomass has severe consequences for health, the environment and economic development. Shockingly, about 1.3 million people - mostly women and children - die prematurely every year because of exposure to indoor air pollution from biomass. The data show that in countries where local prices have adjusted to recent high international energy prices, the shift to cleaner, more efficient ways of cooking has actually slowed and even reversed. In the IEA's base case scenario, the number of people using biomass increases to 2.6 billion by 2015 and to 2.7 billion by 2030 as population rises. That is, one-third of the world's population will still be relying on these fuels in 2030, a share barely smaller than today, and there will still be 1.4 billion people in the world without electricity. Action to encourage more efficient and sustainable use of traditional biomass and help people switch to modern cooking fuels and technologies is needed urgently. According to Dr. Birol, providing LPG cylinders and stoves to all the people who currently still use biomass for cooking would boost world oil demand by a mere 1 percent and cost at most $18 billion a year. The value of the improvements to social welfare, including saving 1.3 million lives each year, is surely worth the cost, he notes.[2] Vigorous and concerted government action, with support from the industrialized countries, is needed to achieve this target, together with increased funding from both public and private sources, he concludes.

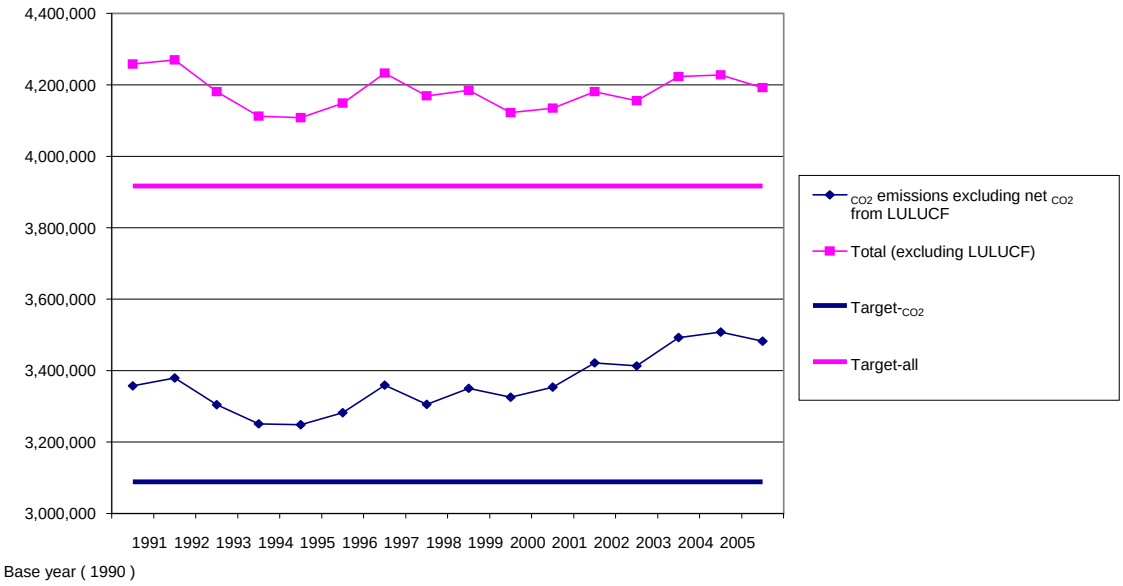
- **European Union Greenhouse Gas Emissions: Myths and Reality**

As we attempt to balance the sometimes conflicting goals of energy security, environmental protection and energy poverty reduction it is useful to examine the cost-effectiveness of current policies to reduce GHG emissions in developed countries. In the European Union, reduction of GHGs has become a major policy goal and billions of Euros, from both the private and the public sector, have been spent on this policy objective. Many policymakers, the media and the public believe that the European Union's Emission Trading System (ETS) has produced reductions in GHG emissions and that their system could serve as a model for the U.S.

The ETS, created in 2005, is a market-based, EU-wide system that allows countries to "trade" (i.e., buy and sell) permits to emit CO_2. The EU 15 (the major industrial countries) have a target of an 8 percent reduction in GHGs by 2010. As shown in **Figure 1**, CO_2 emissions in the EU 15 have risen sharply since 1990. Overall emissions (including all 6 of the greenhouse gases) have held constant only because of one-time events like the collapse of industry in East Germany after the fall of the Berlin wall and the switch away from coal to gas. In 2005, overall emissions were about 6 percent above the target. The main reason the ETS has not had much impact in reducing EU emissions is due to the fact that permits were "over allocated" to the approximately 12,000 industrial facilities covered by the system.

[2] Birol, *The Energy Journal*, page 5.

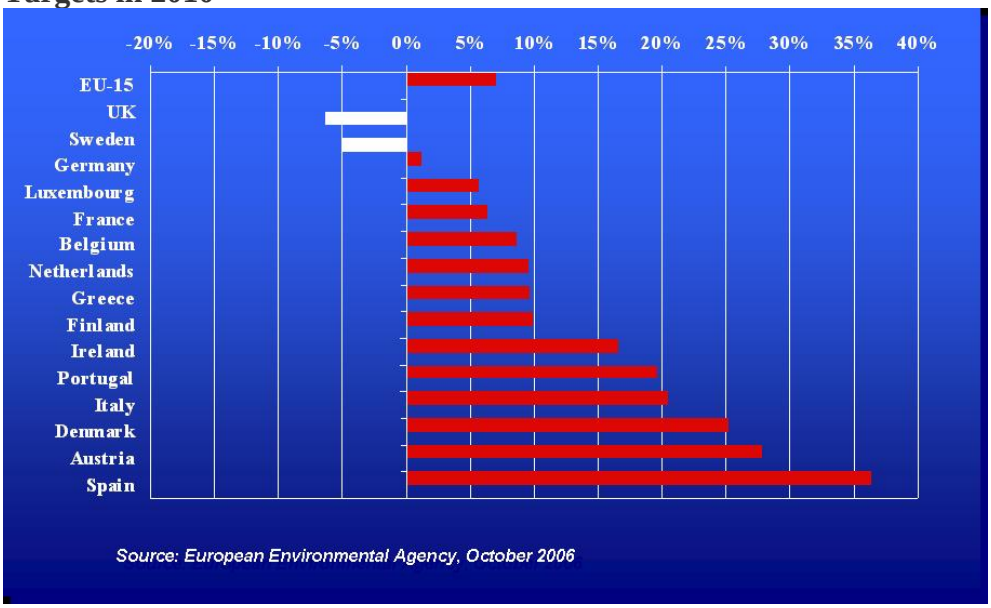
Figure 1. EU $_{CO2}$-equivalent Emissions 1990 – 2005 for EU 15 Countries



Source: Data submitted by the EU to the UNFCCC; units are in 1000 metric tons CO_2 equivalent

The European Environmental Agency's latest projections (October 2006) for the EU 15 show that without strong new measures, EU 15 emissions will be 7.4 percent above 1990 levels in 2010, rather than 8 percent below as required by the Kyoto Protocol. **(**See **Figure 2).**

Figure 2. Greenhouse Gas Emissions in the European Union Projected to Exceed Kyoto Targets in 2010



Now that the ETS has been operational for two years, industry and households are feeling some of the effects of the system, even though its overall impact on emission growth has been small.

As the *Washington Post* reported in "Europe's Problems Color U.S. Plans to Curb Carbon Gases" (April 9, 2007), the ETS has been a bureaucratic morass with a host of unexpected and costly side effects and a much smaller effect on carbon emissions than planned.

Many companies complain that the ETS system is unfair. For example, Kollo Holding's factory in the Netherlands, which makes silicon carbide, a material used as an industrial abrasive, is regarded by its managers as an ecological standout: the plant uses waste gases to generate energy and has installed the latest pollution-control equipment. But Europe's program has driven electricity prices so high that the facility routinely shuts down for part of the day to reduce energy costs. Although demand for its products is strong, the plant has laid off 40 of its 130 employees and trimmed production. Two customers have turned to cheaper imports from China, which is not covered by Europe's costly regulations, the *Post* reports.

"It's crazy," said Kusters, the plant director, as he stood among steaming black mounds of petroleum coke and sand in northern Holland. "We not only have the most energy-efficient plant in the world but also the most environmentally friendly."

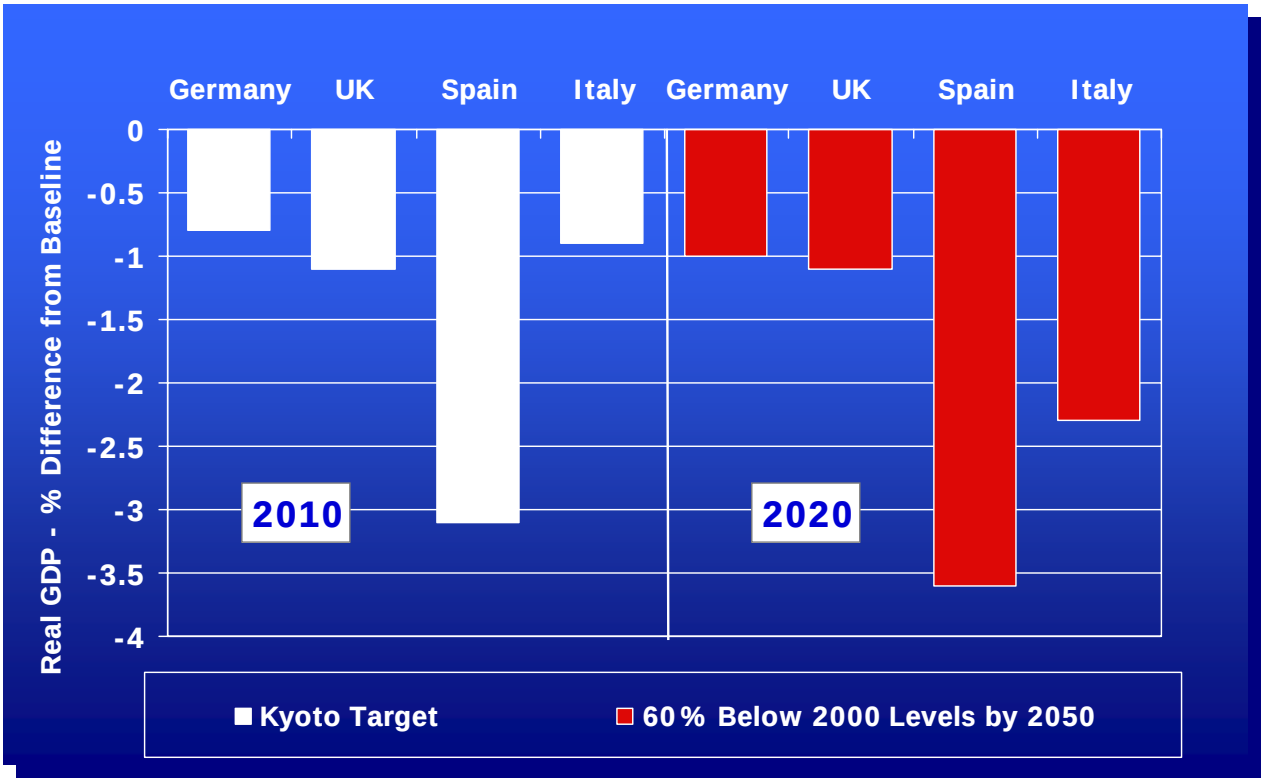
Of all the effects of the new rules, the rise in the price of power has aroused the most outrage. Much of the anger of consumers and industries has been aimed at the continent's utility companies. Like other firms, utilities were given slightly fewer allowances than they needed. Utilities in much of Europe charged customers for 100 percent of the tradable allowances they were given—even though the government handed them out free. Electricity rates soared and environmentalists claimed that the utilities were garnering windfall profits.

The chief executive of one utility, Vattenfall, which owns a coal plant that is one of the continent's biggest carbon emitters, defended the decision. Lars G. Josefsson, who is also an adviser to German Chancellor Angela Merkel, said higher electricity prices are "the intent of the whole exercise. . . . If there were no effects, why should you have a cap-and-trade system?"

An examination of the actual European emissions data, combined with anecdotal reports on its actual operation in the EU like those above, reinforce the idea that a cap and trade system is probably not an effective way to reduce GHG growth in the U.S.

Further, several different economic analyses show that if the EU were to actually meet its emission reduction targets under the protocol, the economic costs would be high. For example, macroeconomic analyses by Global Insight, Inc. show the cost of complying with Kyoto for major EU countries could range between 0.8 percent of GDP to over 3 percent in 2010. **(**See **Figure 3.)**

Figure 3: Impact of Purchasing Carbon Emission Permits on Gross Domestic Product Levels under the Kyoto Protocol and under More Stringent Targets on Major Industrial Economies



Source: International Council for Capital Formation "The Cost of the Kyoto Protocol: Moving Forward on Climate Change Policy While Preserving Economic Growth," November, 2005, (www.iccfglobal.org) and unpublished estimates for the U.S. prepared by Global Insight, Inc.

According to Global Insight, the reason for the significant economic cost is that energy prices, driven by the cost of cap/trade emission permits**,** have to rise sharply in order to curb demand and reduce GHG emissions. Tighter targets for the post-2012 period will also be costly. For example, a target of reducing emissions to 60 percent below 2000 levels of emissions in the year 2050 would cause losses ranging from 1.0 percent to 4.5 percent of GDP in 2020. (This target is less stringent than the post- 2012 targets adopted by the European Commission in January, 2007.) Even the EU's Commission for the Environment admits that emission reductions could cost as much as 1.3 percent of GDP by 2030. The fact that the European Environmental Agency projects that the EU 15 will be 7 percent above 1990 levels of emissions in 2010 (instead of 8 percent below) demonstrates that the mandatory ETS system as currently structured is not providing the desired results and that much stronger measures will be required to meet the Kyoto Protocol target as well as the new post-2012 target.

- **Emission Reductions in California and the Northeastern States: Myths and Realities**

Several states have adopted or are considering mandatory emission reduction targets. An examination of the GHG reduction programs in California and in the Northeastern states provides a study in contrasts.

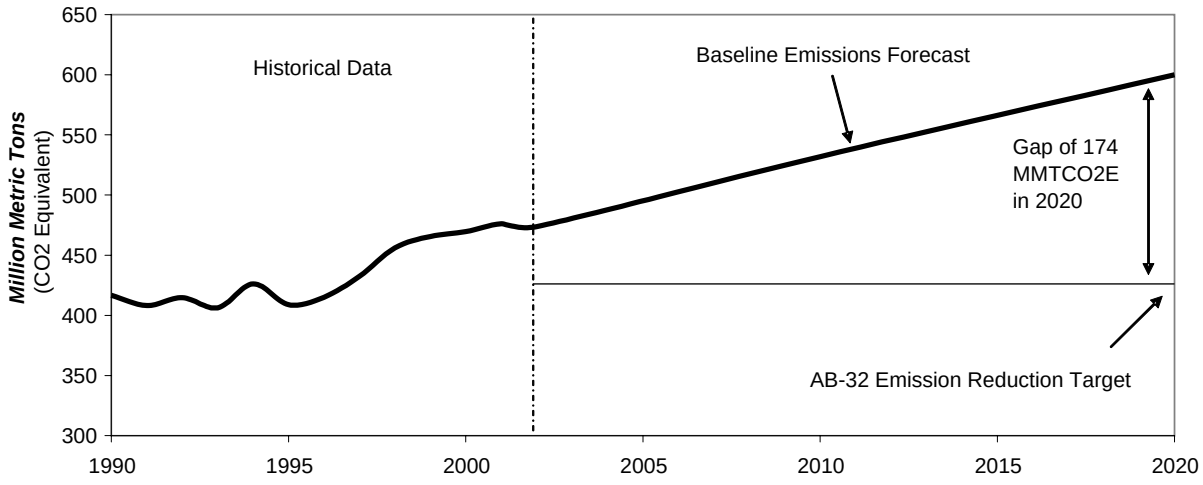
1. California's Emission Reduction Program

In August 2006, the California Legislature enacted a bill requiring the state to sharply reduce its greenhouse gas emissions. AB 32 requires California to reduce its statewide GHG emissions to 1990 levels by 2020. Reductions are scheduled to begin in 2012. The law requires that utilities account for the carbon emissions from imported electricity, which means that coal-fired electricity would tend to be replaced by electricity produced from natural gas, hydro or nuclear power. In addition, California law already required that 20 percent of electricity be produced from renewables by 2017. Achieving the emission targets in AB 32 will be a difficult challenge for Californians, given current emission trends and population growth in the state.

A major stumbling block to California's meeting the AB 32 targets is its projected in emissions and population over the next 14 years. California's GHG emissions are projected to grow by 27 percent from 2000 to 2020 under the baseline forecast, according to estimates in their Climate Action Team (CAT) report. The baseline forecast already includes assumptions about increased energy efficiency but, even so, GHG emissions are projected to rise to 600 million metric tons of carbon dioxide ($MMTCO_2$) by 2020, compared to the AB 32's required reduction to 426 $MMTCO_2$. **(**See **Figure 4.)**

In fact, the latest data from the U.S. Department of Energy's Energy Information Administration show that California's CO_2 emissions rose by 2 percent from 2002 to 2003. Sharp cutbacks in California's energy use would be necessary to close the 41 percent gap ($174/MMTCO_2$) in 2020 between projected emissions and the AB 32 target. The projected increase in California's population (from 30 million residents in 1990 to 37 million residents in 2004 and 44 million in 2020) will make emission reductions very challenging, since more people means more energy is needed for home heating and cooling, job growth and transportation.

Figure 4. California Carbon Dioxide Emissions
(Million Metric Tons CO2 Equivalent)



Sources ***Historical Data*** Gerry Bemis and Jennifer Allen, "Inventory of California Greenhouse Gas Emissions and Sinks: 1990 to 2002 Update", June 2005.

Baseline Emissions Forecast Baseline forecast includes the California Energy Commission's projections of anticipated energy efficiency improvements. Source for 2010 and 2020 forecasts is California Environmental Protection Agency, "Climate Action Team Report to Governor Schwarzenegger and the Legislature", March 2006, pg 64.

To illustrate the difficulty of reducing California's emissions to 1990 levels by 2020, consider that over the entire 1990-2000 period, per capita emissions in California fell by only 2.9 percent **(**see **Table 1 and Figure 5)**. California's projections show that, under its baseline forecast, emissions per capita will decline by 2.3 percent from 2000 to 2010 but will **increase** by 0.9 percent from 2010 to 2020 **(**see **Table 1).**

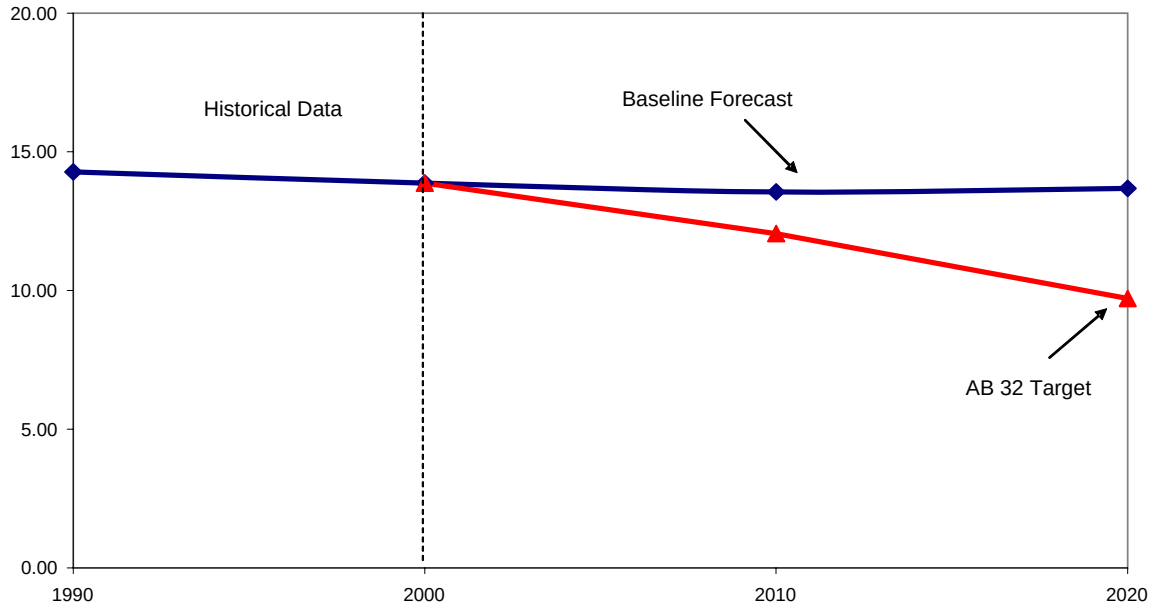
In order to meet the emission reduction target in AB 32, per capita emissions would have to fall by 13.1 percent over the 2000-2010 period and an additional 19.4 percent from 2010 to 2020 **(**see **Table 1)**. In other words, the required reductions in per capita emissions are 4.5 to 6.5 times greater than what occurred from 1990 to 2000. The technologies simply do not exist to reduce total (and per capita emissions) over the next 14 years by the amounts mandated in AB 32—to say nothing of the time and expense required to replace existing energy using equipment—without severely reducing the growth in California's Gross State Product (GSP) and in employment.

Table 1. California's Per Capita Emissions Under Baseline Forecast and Decrease Required for AB 32 Target

Year	Emissions ($MMT_{CO_2}E$)	Population (Millions)	Per Capita Emissions	Percentage Change	AB 32 Emissions Target ($MMT_{CO_2}E$)	Required Per Capita Emissions	Percentage Change
1990	426	29.83	14.28				
2000	473	34.10	13.87	-2.9%	473	13.87	
2010	532	39.25	13.56	-2.3%	473*	12.05	-13.1%
2020	600	43.85	13.68	0.9%	426	9.71	-19.4%
			2000-2020	-1.4%			-30%

Source: CalEPA, Climate Action Team Report to Governor Schwarzenegger and the Legislature, March 2006. Table 5-5 Baseline Inventory Estimates (pg 64). * Note that while AB 32 does not contain an emission reduction target for 2010, the CAT report does.

Figure 5. Emissions Per Capita
(Metric Tons CO2 Equivalent per Person)



Source: CalEPA, Climate Action Team Report to Governor Schwarzenegger and the Legislature, March 2006. Table 5-5 Baseline Inventory Estimates (pg 64)

2. The Regional Greenhouse Gas Initiative

In sharp contrast to the tight emission targets of California's climate change legislation, Northeastern states have taken a much less stringent approach. Ten northeastern states[3] formed the Regional Greenhouse Gas Initiative ("RGGI") in 2004, with the intention of reducing carbon dioxide (CO_2) emissions from electric utilities. In December 2005, the RGGI states agreed to a Memorandum of Understanding limiting utility CO_2 emissions to "current" emission levels from 2009 to 2014, followed by a 10 percent reduction to be phased in from 2015 to 2018. The RGGI states are now pursuing state legislative and regulatory authority to implement Model Rules for a CO_2 cap-and-trade program.

Utility CO_2 emissions represent about one-third of total greenhouse gas emissions in the RGGI states. While the RGGI agreement will cap CO_2 emissions from the utility sector, greenhouse gas emissions from transportation and other sectors are projected to increase. Overall, greenhouse gas emissions in the northeast RGGI region will grow, even when the RGGI program is fully operational.

In contrast to the likely significant impacts of California's AB32, RGGI may have very little impact on electric utility emissions or Northeastern states' economies. Evidence of RGGI's lack of "teeth" comes from a recent Congressional Research Service report, "Greenhouse Gas Reductions: California Action and the Regional Greenhouse Gas

[3] ME, NH, VT, CT, MA, RI, NY, NJ, DE and MD. Maryland joined RGGI in 2007 as a result of adoption of the Maryland Healthy Air Act in 2006. Pennsylvania served as an observer of the RGGI process, but did not join the RGGI MOU.

Initiative" (April 2007). As the CRS report notes, RGGI's initial cap of 121.3 million short tons of carbon dioxide may be higher than actual emissions when the cap applies in 2009. Private estimates also suggest that most states will not face actual reductions until the middle of the next decade. If that is the case, no reductions will be necessary and thus RGGI may be a "paper tiger" at least until 2015.

Challenges in Implementing a Cap and Trade Approach to Reduce U.S. Greenhouse Gas Emissions

Trying to reduce U.S. emissions through a cap and trade system applied at the "upstream" level (at the wellhead or minemouth) or "downstream" (at the retail level) could have significant consequences for the U.S. economy, including reduced GDP and increased unemployment rates. For example, various economic models show that the imposition of the Kyoto Protocol (a target of reducing emissions to 7 percent below 1990 levels) would reduce U.S. GDP levels by 1 to 4.2 percent annually by 2010. While the upstream approach is perhaps easier to monitor and enforce because far fewer emitters would be in the system, it suffers from the fact that final consumers won't see much of a direct impact of the energy tax (or permit price) on their energy and fuel bills because those also include the cost of delivering the energy to consumers. On the other hand, if a business owner (say a paint manufacturer) who owns equipment that emits CO_2 has to submit an emission allowance for each ton emitted, he will be able to make a careful cost-benefit analysis of when it makes economic sense to replace his capital equipment or make other production-related decisions. An obvious question is, if a "downstream" system for reducing CO_2 emissions is impractical (because of millions of small emitting sources) and an "upstream" system results in only attenuated decision making on emissions, how efficient would a cap and trade system be in providing emission decision makers with a realistic incentive to efficiently and significantly reduce emissions?

In addition, a fixed cap on emissions inevitably collides with U.S. population growth. The EU-15 countries are having difficulty meeting their Kyoto targets and they have negligible population growth. In sharp contrast, U.S. population is projected to grow more than 20 percent over 2002-2025, according to the EIA. More people means more mouths to feed, more houses to warm, more factories to run, all of which require more energy and at least some additional GHG emissions.

- **Impact of a Cap and Trade System on Innovation**

Caps on emissions are not likely to promote new technology development because caps will force industry to divert resources to near-term, "end of pipe" solutions rather than promote spending for long-term technology innovations that will enable us to reduce GHGs and increase energy efficiency. An emission trading system will send exactly the wrong signals to investors because it will create uncertainty about the return on new investment. A "safety-valve" price of carbon (designed to create a sense of confidence about future energy costs) can easily be changed. Such uncertainty means that the hurdle rate, which new investments must meet, will be higher (thus less investment will occur) and they will be less willing to invest in the U.S. Now is the time to provide incentives for companies to voluntarily undertake additional carbon dioxide intensity reducing investments, not promote a system that raises the risk premium for any investment in our economy.

- **Property Rights Not Enforceable**

Caps on U.S. emission growth are unlikely to succeed unless all the relevant markets exist (in both developed and developing countries) and operate effectively. All the important actions by the private sector have to be motivated by price expectations far in the future. Creating that motivation requires that emission trading establish not only current but future prices, and create a confident expectation that those prices will be high enough to justify the current R&D and investment expenditures required to make a difference. Motivating new investment requires that clear, enforceable property rights in emissions be defined far into the future so that emission rates for 2030, for example, can be traded today in confidence that they will be valid and enforceable on that future date. The EU's experience over the last two years, with the price of CO_2 emission credits fluctuating between 1 and 30 euros per ton of CO_2 does not inspire confidence in companies having to make investment decisions. The international framework for climate policy that has been created under the UNFCCC and the Kyoto Protocol cannot create that confidence for investors because sovereign nations have different needs and values.

- **Developing Countries Not Likely to Accept Emission Reduction Targets**

Many U.S. policymakers are aware that even if the U.S. were to adopt a cap and trade system, it is unlikely that developing countries, where most of the future growth in emissions will occur, would decide to follow suit. In fact, if we adopt emission caps, higher energy prices will make U.S. industry less competitive vis-a-vis China, India and other developing countries. As a result, China and India, whose primary focus is economic growth, will see it in their interest to accelerate the development of industries that depend on a competitive advantage in energy prices. As this process proceeds, it will be harder and harder for China and India to reverse course and undertake policies (emission caps) which threaten these industries. Adopting GHG caps in the U.S. will, therefore, have the perverse effect of creating disincentives for developing countries to curb emissions. In addition, because developing countries use much more energy per dollar of output than does the U.S., global carbon emissions could increase due to "leakage" of U.S. industry and jobs. Therefore, it seems likely that the ETS system which the EU has implemented will fail to spread to other parts of the world and will eventually be replaced with a more practical approach to reducing GHG growth.

Strategies to Increase Energy Security and Reduce Emission Growth and Energy Poverty

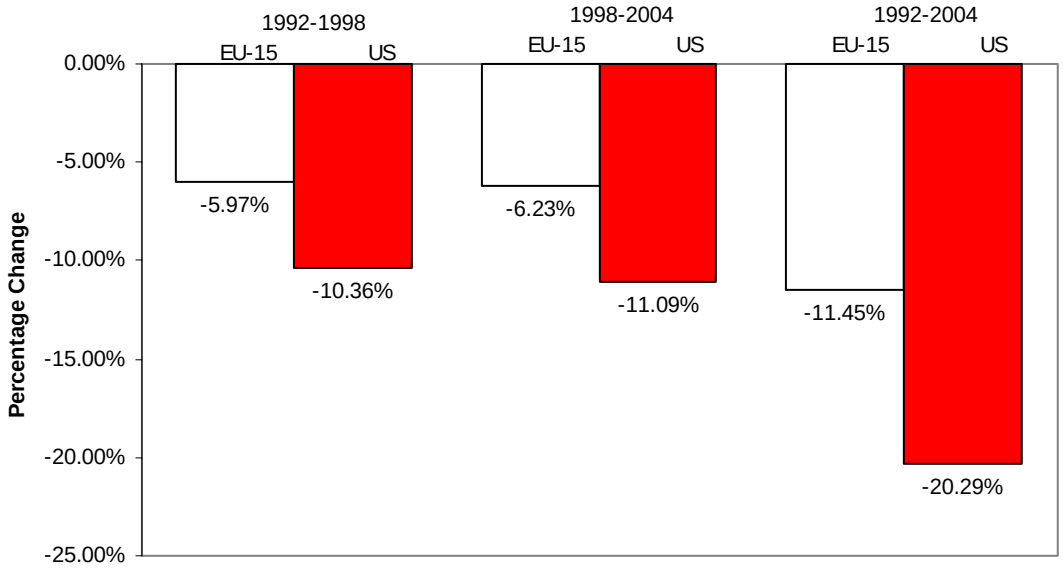
Increased energy security in the developed countries including the U. S. and the EU will depend on factors such as increased economic growth, energy efficiency, technology developments in both fossil fuels (carbon capture and storage, for example) and renewable fuels (wind and solar, in particular) and possibly increased reliance on nuclear power for electricity generation. However, in order to reduce the potential threat of global climate change, it will be necessary to increase energy efficiency and reduce the growth of greenhouse gas emissions in the developing world since that is where the strong growth in emissions is coming from. Reducing the extreme energy poverty in the world's poorest nations will take a combination of technology transfer and public-private partnerships between wealthy nations and less developed countries. Making progress on all three objectives will require a significant commitment of resources, much of which will need to come from the private sector.

- **The Role of Economic Growth and Technology in GHG Reduction**

Many policymakers overlook the positive impact that economic growth can have on GHG emission reductions. For example, in 2006, while the U.S. economy grew at 3.3 percent, CO_2 emissions fell to 5,877 $MMTCO_2$, down from 5,955 $MMTCO_2$ in 2005, a 1.3 percent decrease. Overall energy use only declined by 0.9 percent, indicating the U.S economy is becoming less carbon intensive even without mandatory emission caps.

Internationally, the U.S. compares well in terms of reducing its energy intensity (the amount of energy used to produce a dollar of output). The U.S., with its voluntary approach to emission reductions, has cut its energy intensity by 20 percent over the 1992-2004 period compared to only 11.5 percent in the EU with its mandatory approach (see **Figure 6**). Strong U.S. economic growth, which averaged over 3 percent per year from 1992 to 2005 compared to about 1 percent in the EU, is responsible for the U.S.'s more rapid reduction in energy intensity in recent years.

Figure 6: Comparison of EU and US Energy Intensity Reduction, 1992-2004



Source: EIA, International Energy Annual 2007. (Percentage changes are calculated using Total Primary Energy Consumption per Dollar of Gross Domestic Product.)

Technology development and deployment offers the most efficient and effective way to reduce GHG emissions and a strong economy tends to pull through capital investment faster. There are only two ways to reduce CO_2 emissions from fossil fuel use - use less fossil fuel or develop technologies to use energy more efficiently to capture emissions or to substitute for fossil energy. There is an abundance of economic literature demonstrating the relationship between energy use and economic growth, as well as the negative impacts of curtailing energy use. Over the long-term, new technologies offer the most promise for affecting GHG emission rates and atmospheric concentration levels.

- **Strengthening U.S. Energy Security and Environmental Protection through Tax Code Reform**

The efforts of U.S. industries to increase energy security and efficiency and to reduce growth in GHG emissions are hindered by the slow rate of capital cost recovery allowed under the U.S. federal tax code and by the high U.S. corporate tax rate. As a new Ernst &Young international comparison shows, the U.S. ranks last or nearly last among our trading partners in terms of how quickly a dollar of investment is recovered for many key energy investments. For example, a U.S. company gets only 29.5.cents back through depreciation allowances in for each dollar invested after 5 years for a combined heat and power project (see **Table 2**). In contrast, in China the investor gets 39.8 cents back. In Japan, the figure is 49.7 cents and in India the investor gets 55.6 cents back after 5 years. (See full report at: http://www.accf.org/pdf/Energy-Depreciation-Comparison.pdf.)

In addition to slow capital cost recovery allowances, U.S. industry faces the highest corporate income tax rates among our primary trading partners. Of the 12 countries in the E&Y survey, only Japan had a higher corporate tax rate than the U.S. Reforms to the U.S. tax code to speed up capital cost recovery allowances and reduce the corporate tax rate would reduce the cost of capital and could have a positive impact on energy sector investment, help "pull through" cleaner, less emitting new technology, increase energy efficiency and promote U.S. industrial competitiveness.

- **The Role of International Partnerships in Promoting Institutional Change and Favorable Investment Climate in Developing Countries**

New research by Drs. David Montgomery and Sugandha Tuladhar of CRA International makes the case that agreements such as the Asia-Pacific Partnership on Clean Development and Climate (AP6), an agreement signed in 2005 by India, China, South Korea, Japan, Australia and the United States, offers an approach to climate change policy that can reconcile the objectives of economic growth and environmental improvement for developing countries (see www.iccfglobal.org for full paper). Together, the AP6 partners have 45 percent of the world's population and emit 50 percent of man-made CO_2 emissions. The projections of very strong growth in greenhouse gases in developing countries over the next 20 years mean that there is enormous potential for reducing emissions through market-based mechanisms for technology transfer.

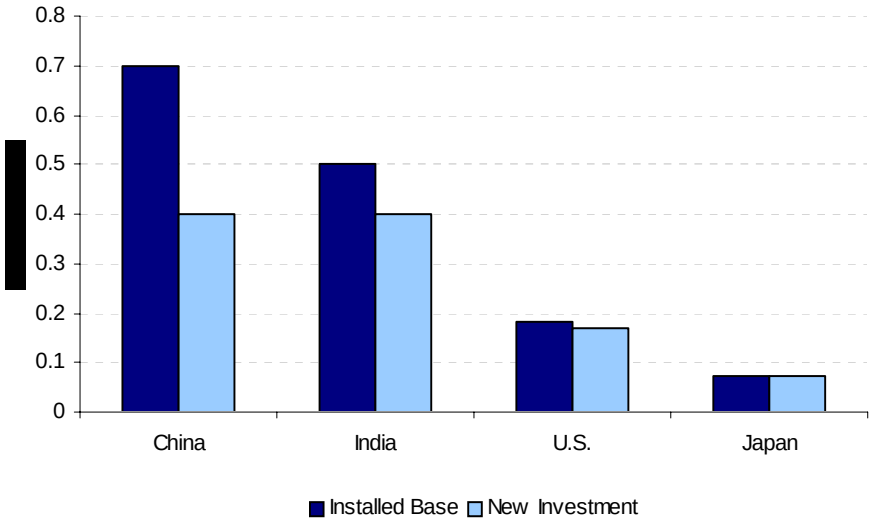
Drs. Montgomery and Tuladhar note that there are several critical factors for ensuring the success of an international agreement which relies strongly on private sector investment for success. Their research shows that institutional reform is a critical issue for the AP6, because the lack of a market-oriented investment climate is a principal obstacle to reducing greenhouse gas emissions in China, India and other Asian economies. China and India have both started the process of creating market-based economic systems, with clear benefits in the form of increased rates of economic growth. But the reform process has been slow and halting, leaving in place substantial institutional barriers to technological change, productivity growth, and improvements in emissions. The World Bank and other institutions have carried out extensive investigations about the role of specific institutions in creating a positive investment climate. These include minimizing corruption and regulatory burdens, establishing an effective rule of law, recognition of intellectual property rights, reducing the role of government in the economy, removing energy price distortions, providing an adequate infrastructure and an educated and motivated labor force.

- **Quantifying the Importance of Technology Transfer for Emission Reductions**

As described above, technology is critically important because emissions per dollar of income are far larger in developing countries than in the United States or other industrial countries. This is both a challenge and an opportunity. It is a challenge because it is the high emissions intensity – and relatively slow or non-existent improvement in emissions intensity – that is behind the high rate of growth in developing country emissions.

Opportunities exist because the technology of energy use in developing countries embodies far higher emissions per dollar of output than does technology used in the United States; this is true of new investment in countries like China and India as well as their installed base (See **Figure 7**). The technology embodied in the installed base of capital equipment in China produces emissions at about four times the rate of technology in use in the United States. China's emissions intensity is improving rapidly, but even so its new investment embodies technology with twice the emissions intensity of new investment in the United States. India is making almost no improvement in its emissions intensity, with the installed base and new investment having very similar emissions intensity. India's new investment also embodies technology with twice the emissions intensity of new investment in the United States.

Figure 7: Greenhouse Gas Emissions Associated with Existing and New Investment in 2001 (Million tons of Carbon per $Billion of Gross Domestic Product at Market Exchange Rates)



Source: Promoting A Positive Climate for Investment, Economic Growth and Greenhouse Gas Reductions, W. David Montgomery and Sugandha Tuladhar (see www.iccfglobal.org.)

CRAI calculations show that emission reductions can be achieved by closing the technology gap. The potential from bringing the emissions intensity of developing countries up to that currently associated with new investment in the United States is comparable to what could be achieved by the Kyoto Protocol. (See **Table 3**). These are near-term opportunities from changing the nature of current investment and accelerating replacement of the existing capital stock. Moreover, if achieved through transfer of economic technologies it is likely that these emission reductions will be accompanied by overall economic benefits for the countries involved.

Table 3: Cumulative Greenhouse Gas Emission Reductions Achievable Through Technology Transfer and Increased Investment

	To 2012 (MMTCE)	To 2017 (MMTCE)
Adopt US technology for new investment in China and India	**2600**	**5200**
Adopt US technology with accelerated replacement in China and India	**4200**	**7700**
Adopt continuously improving technology with accelerated replacement in China and India	**5000**	**9800**
EU under Kyoto Protocol (without hot air)	***600***	***1400***
All Annex B countries under Kyoto Protocol (including US and hot air)	***2800***	***7300***

Source: Promoting A Positive Climate for Investment, Economic Growth and Greenhouse Gas Reductions, W. David Montgomery and Sugandha Tuladhar (see www.iccfglobal.org.)

In the first example in **Table 3,** the CRAI study assumed that in 2005 new investment in China and India immediately moves to the level of technology observed in the United States, and calculates the resulting reduction in cumulative carbon emissions through 2012 and 2017. This is the technology transfer case. In the second case, the CRAI analysis assumes that policies to stimulate foreign direct investment accelerate the replacement of the oldest capital with new equipment, giving even larger savings. In the third case, the assumption is that the new technology continues to improve over time, as it will if policies to stimulate R&D into less emissions-intensive technologies are also put in place. Even the least aggressive of these policies has potential for emissions reductions comparable to those that would be possible if all countries (including the U.S.) achieved exactly the emission reductions required to meet their Kyoto Protocol targets.

- **Strategies for Promoting Institutional Change**

Although it is clear that there is a relationship between institutions, economic growth, and greenhouse gas emissions, there is no general formula that can be applied to identify the specific institutional failures responsible for high emissions per unit of output in a specific country. If there is to be progress on institutional reform, at a minimum the key actors or stakeholders - concerned businesses, other groups with influence on opinion and policy in China, India and other developing countries (including local and regional governments), and national governments - must agree on the nature and scope of the problems and on reforms required to address the problems and identify concrete actions that each government will take to bring about institutional reforms.

For example, making progress on implementing the AP6 can be accelerated if the governments of Australia, Japan and the United States would fund research on topics such as the investment climate, the level of technology embodied in new investment, the role of foreign direct investment and potential energy savings from technology transfer, and the nature and impacts of pricing distortions on energy supply, demand and greenhouse gas emissions in China and India. Government support for research to make clear the direct consequences of proposed reforms for energy efficiency and the benefits of a market based investment climate for the overall process of economic growth would also be helpful.

- **Broadening the International Partnership to Include all Major Emitters**

At the recent G-8 Summit in Germany, policymakers agreed to take a series of steps toward GHG reductions. Recognizing that 85 percent of all emissions come from about 15 countries, G-8 leaders agreed convene the major energy consuming countries to agree on a new international framework by the end of 2008. The leaders agreed to work toward a long-term global goal for reducing GHGs and to accelerate the development and deployment of clean energy technologies. They also agreed to work towards the reduction and /or elimination of tariff and non-tariff barriers to environmental goods and services through the WTO Doha negotiations. Other points of agreement included developing and implementing national energy efficiency programs and advancing international energy efficiency cooperation as well as pursuing joint efforts in key sectors such as sustainable forestry, power generation, transportation, industry, and buildings. Finally, they agreed to enhance cooperation with developing countries to adapt to climate change.

Conclusions

To be successful, international partnerships will need to bring forth a sufficient set of offers from each country to bring about meaningful changes in institutions with significant and quantifiable effects on greenhouse gas emissions. These offers would be embodied in an agreement on actions to be taken by all parties, and a framework under which actions would be monitored and additional steps could be agreed. This is the place where the current efforts of the AP6 partnership's taskforces on clean fossil energy, renewable energy and distributed generation, power generation and transmission, steel, aluminum, cement, coal mining and building and appliances to identify technologies and investments that have profit potential and could also reduce emissions would become most useful. These investments would become in a way the reward to China and India for progress on institutional reform. The voluntary nature of private sector actions in the AP6 underscores the need for institutional reform to turn these potentially profitable investments into real projects.

The Marshall Plan is a good example of such a process. After World War II, Europe pledged various actions with the money provided by the US and, when it made good on those pledges, the program was extended and broadened. Exactly the same could be undertaken by the members of the Asia Pacific Partnership. Future actions by Australia, Japan and the United States desired by China and India would be contingent on success in implementing near term reforms agreed in the process.

The recent G-8 agreement suggests that developed countries are moving closer to achieving a consensus on how to reduce global GHG growth in a more cost-effective way than that embodied in the Kyoto Protocol. Extending the framework of the AP6 to other major emitters will allow developed countries to focus their efforts where they will get the largest return, in terms of emission reductions for the least cost. By focusing on the key emitters, developed countries may find they have more resources for promoting both energy security of supply and reducing global energy poverty.

Table 2. International Comparison of Nominal Capital Costs Recovered After Five Years for Selected Energy Investments, 2006

	Electric Generation					Electric Transmission & Distribution Lines			Pollution Control Equipment	Petroleum Refining	
	Gas	Coal	Nuclear	Combined Heat & Power Generation	Self-Generated Electricity	Transmission Lines	Distribution Lines	Smart Meters	Discharge Modification	Crude Unit (Distillation Unit)	Fluid Catalytic Cracking Unit
United States	37.7%	29.5%	37.7%	29.5%	37.7%	37.7%	29.5%	29.5%	64.3%	63.1%	63.1%
Brazil	37.7%	47.5%	N/A	37.7%	63.1%	20.6%	20.6%	31.2%	89.6%	63.1%	63.1%
Canada	79.6%	79.6%	79.6%	79.6%	79.6%	31.2%	31.2%	63.1%	79.6%	79.6%	79.6%
China	39.8%	39.8%	39.8%	39.8%	39.8%	39.8%	39.8%	39.8%	41.3%	39.8%	39.8%
Germany	30.0%	30.0%	37.5%	30.0%	30.0%	33.1%	33.1%	63.1%	79.6%	72.3%	79.6%
India	55.6%	55.6%	55.6%	55.6%	55.6%	55.6%	55.6%	100.0%	100.0%	66.1%	66.1%
Indonesia	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%
Japan	49.7%	49.7%	49.7%	49.7%	45.6%	37.4%	37.4%	49.7%	76.9%	72.3%	72.3%
Rep of Korea	57.7%	57.7%	57.7%	57.7%	57.7%	57.7%	57.7%	57.7%	89.0%	89.0%	89.0%
Malaysia	100.0%	100.0%	100.0%	100.0%	100.0%	90.0%	90.0%	90.0%	100.0%	90.0%	90.0%
Mexico	46.2%	46.2%	46.2%	46.2%	46.2%	23.1%	23.1%	23.1%	101.2%	32.3%	32.3%
Taiwan	49.7%	49.7%	49.7%	49.7%	49.7%	49.7%	49.7%	49.7%	96.6%	78.5%	78.5%