US Climate Change Policy: Implementing Copenhagen and Beyond[1]

William R. Cline, Senior Fellow
Peterson Institute for International Economics

At the 15th Conference of Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC), held in Copenhagen in December 2009, the United States and other major nations undertook a political commitment to meet certain targets for reducing greenhouse gas emissions by 2020. Although this Copenhagen Accord was not a legally binding treaty like the Kyoto Protocol, it arguably provides an important basis for moving forward on curbing global warming. Crucially, for the first time the Accord incorporated action pledges by major emerging market economies likely to be the largest sources of future increases in emissions.

The first section of this paper reviews the Copenhagen Accord pledges of the United States and other major nations. It discusses findings of my recent analysis of costs of an international abatement strategy that meets 2020 Copenhagen targets and then follows a path through 2050 that is consistent with limiting atmospheric concentrations of carbon dioxide to 450 parts per million and limiting warming to 2°C. Alternative leading cost models are applied to calculate abatement costs of such a strategy. The second section then considers whether political gridlock in the United States is likely to derail fulfillment of the US Copenhagen Accord pledge, and in particular, whether a second-best strategy based on EPA enforcement and regional climate initiatives can provide a strong initial substitute for climate legislation. The third section compares the EU and US Copenhagen pledges and considers mechanisms through which trans-Atlantic cooperation can improve the effectiveness of abatement commitments.

Copenhagen Pledges and Abatement Costs[2]

Table 1 reports the Copenhagen Accord pledges of nineteen major economies. Together, their total carbon dioxide emissions of 24.5 billion metric tons ($GtCO_2$) in 2007 constituted approximately 83 percent of the world total. The table highlights the importance of incorporating the major emerging market economies into international abatement efforts. Already by 2007 carbon dioxide emissions (not counting from deforestation) from 10 major emerging market economies already were about 80 percent as large as those of 9 major Annex I economies; in the business as usual baseline paths, these emerging market economies emissions would far surpass those of the Annex I countries. So the Copenhagen Accord lays at least the initial groundwork for overcoming the single largest problem of the Kyoto Protocol: its omission of developing countries from any abatement efforts. This being said, it should be noted that typically the submissions of the emerging market economies to the Copenhagen Accord were

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[2] Unless otherwise specified, all estimates and calculations in this section are from Cline (2010).

couched in language that made reference to prior UNFCCC clauses pertaining to finance and technological transfer to facilitate abatement.

Table 1
Copenhagen Accord Pledges for Reductions in CO_2 Emissions

	2007 level[a]	Reduction by 2020[b]
Annex I	13,721	
United States	5,812	17% from 2005; 83% by 2050
EU	4,050	20% from 1990 (30% contingent); 80% by 2050
Russia	1,585	15-25% from 1990
Japan	1,236	25% from 1990 (contingent)
Canada	530	Same as US
Australia	377	5% (15% or 25% contingent) from 2000
New Zealand, Norway, Switzerland	131	10-20%, 30-40%, 20-30% from 1990, respectively
Non-Annex I	10,816	
China	6,603	40-45% cut in carbon intensity of GDP from 2005 level
India	1,574	20-25% cut in carbon intensity of GPD from 2005 level
Korea	477	30% cut from BAU
Mexico	445	30% cut from BAU
South Africa	434	34% cut from BAU
Indonesia	416	26% cut fromBAU
Brazil	352	36-39% cut from BAU
Kazakhstan	195	15% from 1992
Argentina	172	No specific target; energy efficiency measures, renewables
Singapore	148	16% cut from BAU
Total	24,537	

a. Excludes deforestation

b. BAU: business as usual baseline level by 2020

Based primarily on projections by the Energy Information Agency of the US Department of Energy (EIA, 2009), I have estimated business-as-usual (BAU) global emissions of carbon dioxide in 2020 at 35.9 $GtCO_2$, or 22 percent above the 2007 level. If the Copenhagen Accord goals of the 19 countries listed in table 1 are achieved, the result would be to cut global emissions to 32.7 $GtCO_2$ in 2020, a reduction of 9.1 percent from the BAU level but still an increase of 11 percent above the 2007 level. Clearly this reduction would be far from sufficient to limit eventual atmospheric concentrations to 450 ppm or warming to 2°C, but this outcome would "bend the curve" of increases and could provide a key turning point for subsequent global reductions.

It is important to emphasize, nonetheless, that the pledges of the emerging market economies are more ambiguous than those of the industrial countries. It turns out that China and India in particular have made pledges that essentially amount to no departure from business as usual. In China, the energy efficiency of output (units of real GDP per unit of energy) grew at 4.8 percent per year in 1990-2006; the carbon efficiency of energy (units of energy per unit of carbon dioxide emissions) deteriorated

with a growth rate of -0.9 percent per year; so the carbon efficiency of output (units of GDP per unit of carbon dioxide) grew at the combined impact of 3.9 percent per year. In its BAU baseline, the EIA projects that for 2010-2020 China's energy efficiency of output would grow at 3.6 percent and its carbon efficiency of energy at 0.5 percent, once again leaving the carbon efficiency of GDP to grow at about 4 percent, even though there is a modest shift toward less ambitious growth in energy efficiency with some shift toward favorable rather than unfavorable carbon composition of energy. At an annual rise in carbon efficiency of output of 4.1 percent, over the 15 years from 2005 to 2020 the BAU baseline would reduce the carbon emissions per unit of GDP by 45 percent. This is just what China pledged in the Copenhagen Accord, suggesting that its effort is not a departure from business as usual. A similar calculation for India yields a similar conclusion. Perhaps the most important implication of the pledges by China and India, then, is not that they will contribute to a substantial cutback in their own emissions from business as usual, but rather that their commitments will place limits on any "carbon leakage" that might otherwise occur through increased production of carbon-intensive products as a consequence of the curbing of these products in Annex I countries (and other emerging market economies) that have pledged more aggressive cuts.

In principle, the pledges of several other major emerging market economies are more ambitious than those of China and India. Brazil, Korea, Indonesia, Mexico, and South Africa have all pledged cutbacks from the BAU baseline by about 30 percent or more by 2020. Even so, the ambiguity about what the BAU baseline would have been implies future uncertainty about whether the pledge has been fulfilled.

For a meaningful path of global abatement consistent with eventual avoidance of greater than 450 ppm carbon dioxide concentration or greater than 2°C warming, after 2020 there would need to be aggressive steady reductions in emissions by both industrial countries and most developing countries. I have calculated that subsequent to 2020 a straight-line reduction in emissions to reach a per-capita ceiling of 1.43 tCO_2 by 2050 would be necessary to meet these goals. The current levels are about 20 metric tons per capita (i.e. more than ten times the eventual ceiling) in the United States, 8 tons in the EU, 10 in Japan, and 5 in China (but only 1.4 in India). A uniform per capita target by 2050 following achievement of the 2020 pledges, in what can be called a "Copenhagen Convergence" strategy, would have the moral strength of appealing to equity. The industrial countries will be in a much better position to ask China in particular to cut its emissions per capita by about three-fourths from their prospective 2020 peak of 6.7 tons if they themselves commit to future emissions that are no greater per capita than those of China, India, and other emerging market economies.

For the 13 largest emitting economies, Table 2 reports the proportionate cutbacks from BAU baselines that would be required to meet the Copenhagen convergence, or CopCon, policy path for CO_2 abatement. The table also shows global emissions in the BAU baseline, under CopCon, and the depth of corresponding cutbacks.

Table 2

Carbon Dioxide Abatement under Copenhagen-Convergence
(percent cutback from BAU baseline)

	2020	2030	2040	2050
United States	17	40	65	91
European Union	17	41	63	84
Russia	7	40	68	92
Japan	30	50	69	87
Canada	23	47	70	92
Australia	26	48	69	91
China	0	39	68	88
India	0	10	19	27
Korea	30	54	74	91
Mexico	30	46	60	72
South Africa	34	57	76	91
Indonesia	26	38	49	57
Brazil	24	39	51	61
Memorandum: World				
Emissions ($GtCO_2$) – BAU	35.9	41.4	47.1	53.2
CopCon ($GtCO_2$)	32.7	26.8	20.3	13.3
Cut from BAU (%)	9.1	35.2	57.0	75.0

Globally, emissions cuts from the BAU baseline would need to reach 75 percent by 2050. The depth of cutbacks is not only large but also, for some key emerging market economies, surprisingly similar to that of industrial countries. Thus, by 2050 cutbacks from baseline are about 85-90 percent not only for the United States, the EU, Russia, Japan, Canada, and Australia, but also for China, Korea, and South Africa. India starts from such low per capita emissions that its proportionate cutbacks by 2050 are only about one-fourth. Other emerging market economies are intermediate, with cutbacks of about 60-70 percent for Indonesia, Brazil, and Mexico.

For China, the absence of any cutbacks from baseline by 2020 means a more abrupt cutback from baseline by 2030 (a jump from zero to 39 percent). This suggests that Chinese planners might consider the merits of advancing cutbacks more aggressively than currently implied by the Copenhagen Accord pledge.

Cline (2010) estimates synthesis abatement cost functions for major economies using the results of the Energy Modeling Forum's survey of integrated assessment model results (Clarke et al, 2009). Alternative cost functions are available from the Nordhaus (2010) RICE model (Regional Integrated model of Climate and the Economy), and for 2030, from cost functions based on McKinsey (2009) estimates.[3] When these three cost models are applied to the CopCon abatement scenario, the resulting abatement cost estimates for major economies in 2020 and 2030 are as shown in table 3. The

[3] However, the initial negative-cost section of the McKinsey cost curves is suppressed to zero cost.

table also shows the corresponding marginal abatement costs per ton of CO_2, for two of the three models.

Table 3

Abatement Costs for the Copenhagen Convergence Policy Scenario: 2020 and 2030
(percent of GDP and 2005 dollars per tCO_2)

	Abatement cost (% GDP)					Marginal cost ($/ tCO_2)			
	RICE:		EMF:		McKinsey	RICE:		EMF:	
	2020	2030	2020	2030	2030	2020	2030	2020	2030
United States	0.02	0.23	0.29	1.18	0.07	12	58	83	166
European Union	0.03	0.23	0.27	0.80	0.12	17	76	81	121
Russia	0.00	0.27	0.17	2.44	0.07	2	44	70	221
Japan	0.17	0.55	0.55	1.14	0.17	55	118	95	127
Canada	0.08	0.46	0.36	1.04	0.28	24	83	60	97
Australia	0.11	0.48	0.44	1.06	0.26	31	92	64	106
China	0	0.36	0	2.42	0.12	0	57	0	188
India	0	0.01	0	0.25	0.00	0	9	0	159
Korea	0.16	0.70	1.69	3.9	0.09	52	147	272	414
Mexico	0.13	0.37	1.69	3.11	0.08	59	128	378	543
South Africa	0.20	0.69	2.01	4.19	1.08	19	39	96	119
Indonesia	0.16	0.39	1.38	2.39	0.08	54	98	232	306
Brazil	0.07	0.22	1.14	2.36	0.09	47	105	410	603

The most important overall implication of table 3 is that abatement costs should be manageable for the key emitting economies, certainly through the 2020 Copenhagen targets but also even by 2030 as aggressive cuts are implemented in the convergence path. The lowest costs are those from the McKinsey-based model, which for example indicates that the 40 percent cut from baseline in both the United States and the EU in 2030 would cost only about 0.1 percent of GDP. An intermediate estimate of 0.23 percent of GDP is obtained in the RICE model. The synthesis models estimated from the EMF survey show considerably higher costs, but these are still only about one-half of one percent of GDP in 2020 for the industrial countries and about 1½ percent for emerging market economies (excluding China and India). The higher costs for five emerging market economies reflect the fact that their Copenhagen pledges amount to greater proportional cutbacks from baseline emissions than those of the industrial countries (except for Japan; table 2).[4]

Table 3 also reports the marginal abatement costs for the RICE and EMF-based models. Somewhat surprisingly these tend to be higher for the emerging market economies than for the industrial countries, again reflecting the more ambitious pledges for 2020. The surge in marginal cost

[4] Note, however, that the EMF-based estimates probably overstate the abatement costs for these economies, especially by 2030. An alternative estimate also based on a synthesis of the EMF results but allowing for trading at the international carbon price places the CopCon abatement costs by 2030 at 1.22 percent of GDP for China, 1.07 percent for Korea, 0.67 percent for Mexico, 2.79 percent for South Africa, 0.85 percent for Indonesia, and 0.50 percent for Brazil, much lower than the EMF-based estimates reported in table 3.

from 2020 to 2030 for especially China (and particularly in the EMF-based estimates) suggests scope for gains from reallocating cutbacks to earlier in the horizon, with cuts already in 2020. An implication of the pattern of marginal abatement costs is that there may be less scope than popularly believed for reducing abatement costs in industrial countries through purchase of offsets from developing countries.[5]

Prospects for Action in the United States

The passage of the Waxman-Markey energy and climate bill in the US House of Representatives in June, 2009, turned out to have been the likely high-water mark for US climate action for at least some time. The bill sought to reduce greenhouse gas emissions by 17 percent from 2005 levels by 2020 (equivalent to a reduction back to the 1990 level); 42 percent by 2030; and 83 percent by 2050 (equivalent to an 80 percent cut from 1990 levels). A cap-and-trade regime was initially to allocate 85 percent of emissions permits without cost to existing electricity distribution companies, energy intensive industries, and other emitting sectors, with the portion of permits auctioned rising from the initial 15 percent to 70 percent by 2030. Auction revenues were to be used to offset additional costs for low-income households, and eventually to include use in funding of international aid, forestation, and technology related to climate change action. The bill set a minimum carbon price for permits at $10 per ton of CO_2; the Environmental Protection Agency projected a range of $11-15 by 2012 and $22-28 by 2025 (in 2005 dollars). The bill provided that 20 percent of electricity would be from renewable sources by 2020; that new coal-fired plants would capture 50 percent of emissions with carbon capture and sequestration (CCS) by 2025; buildings would have standards requiring a 50 percent increase in efficiency by 2016; and included other regulatory measures. By 2022, the President was authorized to require emissions allowances on imports.

The Congressional Budget Office (2009) estimated that the bill would reduce US GDP from baseline by 0.2 to 0.6 percent of GDP by 2020; 0.3 to 1.2 percent by 2030, and 1 to 3.5 percent by 2050. It placed the price of emissions allowances at $19 per metric ton of CO_2 in 2015, $25 in 2020, $40 in 2030, and $120 by 2050 (in 2009 dollars). The CBO emphasized that a key factor curbing abatement costs was the flexibility in the bill to achieve up to 2 $GtCO_2$-equivalent of annual reductions through the use of offsets, amounting to about half of the reductions planned through 2030.

Two principal attempts were made toward parallel action in the Senate. The Kerry-Boxer bill, a cap-and-trade proposal similar to Waxman-Markey, passed a key committee in November 2009 despite a Republican boycott, but was subsequently abandoned. Senator Kerry then sought to develop a bill with Senators Lindsay Graham and Joseph Lieberman that applied less comprehensive and less stringent caps, combined with a carbon tax for some sectors (oil, gasoline) (Tutwiler, 2010). But in July 2010, Senate Majority Leader Harry Reid announced he would not bring a compromise bill to the floor. In effect, the concentration of legislative effort on health care reform and then on financial sector regulation, combined with increasing partisan gridlock in especially the Senate, doomed the prospects for legislation on climate action in at least 2010.

[5] That is, purchase of emissions rights from developing countries that otherwise they would use themselves, or arrangements that seek to accomplish this effect in the absence of a formal international emissions rights regime.

All of the legislative proposals had included a strong incentive to persuade opponents that cooperation would be advisable: they would preempt regulatory controls on greenhouse gases that otherwise might be imposed by the Environmental Protection Agency. In 2007 the US Supreme Court ruled that greenhouse gases constituted "air pollutants" that were subject to regulation by the EPA. In late 2009 the EPA formally made a finding of "endangerment," that greenhouse gases threaten public health and welfare, a condition for action (EPA, 2009). Now that legislative initiatives on climate have stalled, the role of the EPA shifts at least potentially from being the club in the closet to becoming the front-line mechanism for implementing the Copenhagen pledge. Ideally the legislative track would regain momentum following the November 2010 mid-term elections, and something like the Waxman-Markey bill would become law within the next year or two. However, few observers seem to be optimistic about legislative action within this time frame.

"Plan B" for US climate action does not depend solely on the EPA. In addition, there are three regional initiatives at the state level that seek to limit greenhouse gas emissions (Annex A). Researchers at the World Resources Institute have compiled estimates of emissions reductions that might be attained under low, medium, and high levels of intensity of action at the federal and state levels, considering both EPA enforcement and the regional initiatives at the state level (Bianco and Litz, 2010).[6] In the area of electric power, which account for 28 percent of US emissions in the case of coal-fired plants and another 5 percent for natural gas-fired, the EPA has scope for action under the New Source Performance Standards and pre-construction permits, ash disposal regulations, and traditional air regulations (also subject to state action). The Department of Energy (DOE) and states can act under energy efficiency standards. For emissions from vehicles, with light-duty vehicles accounting for 16 percent of total US greenhouse gas emissions and medium- and heavy-duty vehicles another 8 percent, regulations apply under the Corporate Average Fuel Efficiency (CAFE) standards of the Department of Transportation (DOT), emissions standards under the Clean Air Act (EPA), renewable or low-carbon standards (EPA), and miles traveled policies (states and cities). For light vehicles, the authors assume CAFE standards of 40 miles per gallon by 2030 in the low case, ranging to 51 mpg in the high case.

At the state level, the authors consider existing legislation, additional action under existing gubernatorial executive orders on emissions reduction targets, and additional cap-and-trade action within the regional programs as the three levels of intensity of action. Regarding the latter, there are three existing regional initiatives: the Regional Greenhouse Gas Initiative (RGGI) of 10 northeastern states; the Western Climate Initiative (WCI), encompassing California and 6 other states as well as four Canadian provinces; and the Midwestern Greenhouse Gas Reduction Accord (MGGRA), with 6 member states. Together the three initiatives include states that account for about 40 percent of US emissions (Bianco and Litz, 2010, p. 18).[7]

Overall, Bianco and Litz judge that for the low level of ambition, federal and state action would reduce greenhouse gas emissions by 6 percent below 2005 levels by 2020 (and by 5 percent by 2030); the corresponding intermediate action cuts would 9 percent (18 percent); the high-intensity level of

[6] "Lackluster," "middle-of-the-road," and "Go-getter," in their terminology.
[7] In Canada, the four provinces constitute almost 80 percent of population and GDP (WCI, 2010).

action would achieve cuts of 14 percent below 2005 levels by 2020 (and 27 percent by 2030). About 80 percent or more of the reductions would be attributable to action at the federal level, with the rest occurring from additional state-level action. The upper end of the cutbacks is reasonably close to the US Copenhagen target of 17 percent cutback from 2005 levels by 2020. A key issue, however, is whether the political obstacles that have hindered federal legislation would impede aggressive action using existing regulatory authority. Some Senators have already proposed legislation that would limit or postpone the EPA's authority to regulate emissions of greenhouse gases.

Implications for US-EU Cooperation

The European Union has long taken the lead on international action to limit global warming. Until recent months it seemed that the United States had finally joined in this effort in earnest. Public attitudes had shifted in favor of action, perhaps in part because of Hurricane Katrina.[8] In the 2008 presidential election, both candidates called for action to curb global warming. Despite the financial crisis and Great Recession, as recently as May 2009 a survey commissioned by Pew Charitable Trust found that 77 percent of voters favored action to reduce greenhouse gas emissions (Pew, 2009b).[9]

A major political challenge for moving ahead in the United States will be to reengage the climate issue on a bipartisan basis. The dynamics of massive legislative change in 2010, marked by health care reform and financial regulatory reform, became heavily partisan, turning on the ability to muster the 60 votes in the Senate needed to stop filibuster. Addressing climate change is such a central and long-term issue that it will likely need to marshal wide congressional support rather than being forced through with one party heavily in opposition. This could be especially so because several Senators from the majority party represent coal- and industrial-states and might not support a closure vote.

Even before the recent setbacks to climate action by the United States, many in Europe had thought that the US goals in the Waxman-Markey legislation were inadequate and not comparable to the efforts the EU had made in the past and planned to make in the future. Such doubts were based primarily on the grounds that whereas the EU sought a goal of reducing emissions 20 percent below the 1990 level by 2020 (and possibly 30 percent if other nations were ambitious in their goals), the US goal of 17 percent below 2005 levels only amounted to a reduction back to the 1990 level. EU carbon dioxide emissions (excluding deforestation) were 4.20 $GtCO_2$ in 1990; US emissions were 4.87 $GtCO_2$. By 2007,

[8] A global poll in the fall of 2004 found 58 percent of Americans surveyed considered violent storms, flooding and drought to be "part of a natural pattern;" the same question asked in 2006 found only 39 percent giving the same response, and 59 percent viewing them as unusual – boosting the US response to the global average (World Public Opinion, 2006).

[9] Even so, another Pew survey had found that out of twenty subjects viewed by Americans as "top priorities," such as the economy, terrorism, immigration, and so forth, dealing with global warming had slipped from mention by 38 percent as a top priority in January 2007 to 30 percent in January 2009, whereas those indicating strengthening the economy as a top priority had risen from 68 percent to 85 percent. (Pew, 2009a).

EU emissions had fallen by 3.6 percent to 4.05 $GtCO_2$ whereas US emissions had risen by 19.3 percent to 5.81 $GtCO_2$.[10]

A major difference in population growth accounts for part of this difference in past performance. From 1990 to 2007, EU population rose only 3.8 percent; US population rose 20.4 percent. In terms of percentage change, then, the per capita comparison shows the US in a less unfavorable light than the change for total emissions, as the decline of 0.9 percent in US per capita emissions from 1990 to 2007 was considerably closer to the EU performance of a 7 percent per capita decline (a gap of 6 percent) than the 23 percentage point gap in the change in total emissions.

A second consideration is that the abatement performance of the EU was to some extent exaggerated by developments peculiar to Eastern European members, who experienced sharp reductions in emissions associated with economic reform and the phasing out of highly inefficient energy production facilities. Thus, for the core 15 countries that were initial EU members, CO_2 emissions rose by 4.7 percent from 1990 to 2006; it was for the 12 countries that subsequently joined the EU that emissions declined, by 24.4 percent (calculated from WRI, 2010).

Perceptions about mutual performance are also affected by a popular if misleading impression in the United States that the EU's Emissions Trading System (ETS) had been a failure – because of over-issuance of permits that led to a collapse of the carbon price to zero in 2007 (CCC, 2008). On the other side, a reasonable impression for EU citizens would be that the United States has been a serious laggard on climate change, not only because it failed to join the Kyoto Protocol but also because its emissions are so much higher per capita than those in Europe. Thus, in 2007, per capita emissions in the United States amounted to 19.3 tCO_2, more than twice the level of 8.3 tCO_2 in the EU (Cline, 2010). However, it turns out that the difference between the two is partly explained by per capita income, considering that for the EU as a whole per capita income (in purchasing power parity terms) is considerably lower than in the United States because the EU includes several Eastern European economies. Average per capita income is considerably lower than that of the United States (approximately $27,500 for the EU in 2007 versus $43,100 in the United States, in 2005 ppp dollars). Thus, whereas per capita GDP in the EU-15 core of original members at about $~~34~~32,000 is considerably closer to US per capita income, for the EU-12 group of new members per capita GDP is only about half as high.[11]

For the 25 largest emitting economies, for 2007 a simple regression of the logarithm of emissions per capita on the logarithm of ppp GDP per capita yields a relationship that places the United States almost exactly on the cross-country curve but shows the EU considerably below it (figure 1).[12] The divergence of US and EU emissions per capita can then be decomposed into two parts: the amount that can be attributed to the fact that the US has higher per capita GDP; and the amount that can be

[10] Unless otherwise specified, data cited in this section once again are from Cline (2010).
[11] Calculated from IMF (2010).
[12] For 25 major economies, a regression of the natural logarithm of emissions per capita ("EPC", metric tons CO_2 per year on the natural logarithm of ppp per capita income ("y", dollars of 2005) yields the following results, for 2007: ln (EPC) = –6.3069 (-5.8) + 0.8664 (7.5) ln y, adjusted R^2= 0.70, t-statistics in parentheses. Data are from Cline (2010).

explained by the departure of each economy from the cross-country line. US emissions per capita would be expected to be 48 percent higher than those of the EU because of higher per capita income. In addition, it turns out that the US emissions per capita were 2.1 percent above the cross-country curve whereas EU emissions per capita were 36 percent below it. The EU does have well-above average efficiency of emissions performance, then, but the superiority to that of the United States is much more moderate than would be suspected by a raw comparison of the absolute levels of emissions per capita for the two economies.

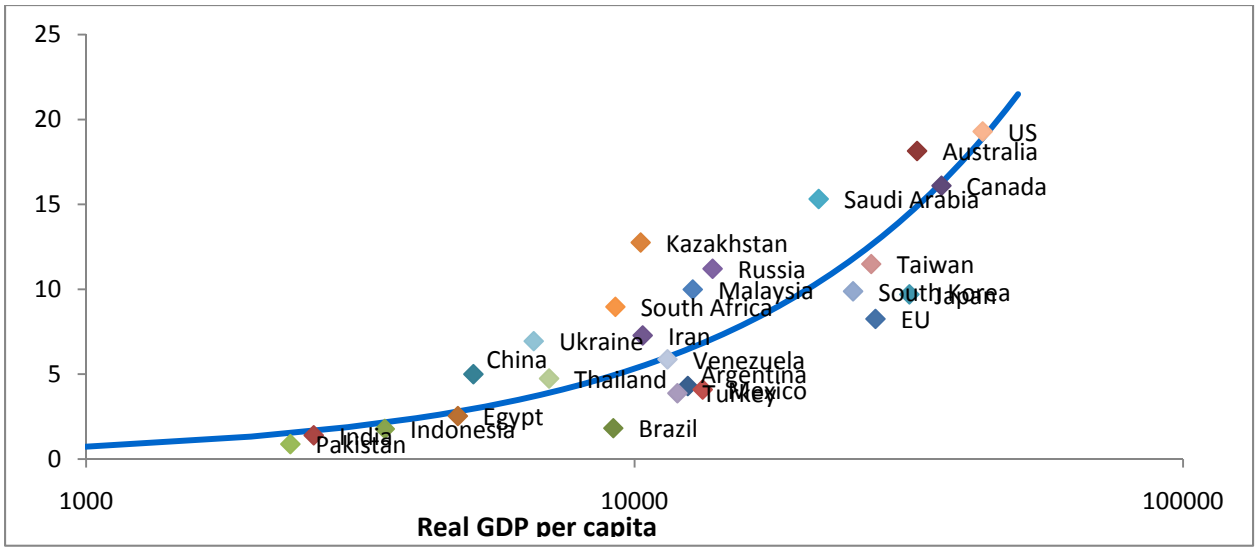
Of the other economies shown in the figure, notable departures from the cross-country curve occur in the case of China's high emissions per capita, and Brazil's low emissions (but excluding deforestation). Notably, India's low emissions are explained by low per capita GDP rather than a departure from the cross-country line.

To recapitulate, despite the various qualifications concerning the extent to which the European Union has led and the United States lagged in the international effort to curb global warming, there is little doubt that to at least some degree the EU has been ahead in this effort. Even so, the US commitment in the Copenhagen Accord marks a major advance over what the United States has done in the past, and it is to both economies' interest to maximize the chances that the United States, the EU, and other economies actually deliver on the Accord pledges going forward. What steps could the EU and United States take to help ensure this outcome?

One area for possible US-EU cooperation would be in the harmonization of their cap-and-trade systems to allow for trading emissions permits between the two economies. It would be extremely helpful for international progress on abatement if there were a predominant world price on carbon dioxide. Such a price would not only help ensure least-cost abatement but would also be a spur to technological change by sending a strong signal about the likelihood of the future opportunity cost of carbon—based energy. If the United States were to adopt legislation similar to the Waxman-Markey bill, then there is no reason that the trading of emissions allowances could not be made available to potential purchasers from within the EU's ETS, and vice-versa. Mutual eligibility for trading in the two economies' cap-and-trade regimes would go a long way toward establishing "the" world price on carbon dioxide emissions.

Figure 1

CO_2 Emissions per capita and ppp GDP per capita (2007)



The marginal cost estimates in table 1 suggest that in principle carbon prices could be broadly comparable in the EU and the United States in 2020 and 2030. The RICE model is more non-linear than the synthesis of the EMF model survey, and the RICE marginal costs are only about $15 per metric ton of CO_2 in 2020 versus about $80 in the EMF models. But in both models the two regions show relatively similar marginal costs. In part this outcome reflects the fact that the EU and US have the same estimated cutback from baseline in 2020 (17 percent), as the RICE and EMF-based models both calibrate cost as a function of the depth of emissions cut from baseline.

A similar marginal cost in the EU and US could be interpreted as having two alternative implications for trading. The first might be that trading would not accomplish much because neither economy would benefit much from buying or selling permits to the other. The second, which I prefer, is that trading could be allowed without much fear on either side that there would be a severe dislocation domestically as a consequence of large trading operations, yet the availability of trading would strongly enhance the market perception that there was a "world price" for carbon. Moreover, there has been sufficient experience with sharply fluctuating prices within the ETS that a much broader market that included the US would seem desirable to smooth out prices.

At present it might be feared by some in Europe that the US efforts would be so meager, and over-allowances so great, that permitting trading would simply weaken the overall abatement effort that otherwise would be accomplished under the EU's leadership. If those in the United States (for example, in regional trading initiatives) shared this expectation, they might similarly be concerned for the opposite reason: that openness to trading would drive up the cost of local abatement. Indeed, if one were to look at today's spot prices for the only relevant trading information, one would conclude that a large price divergence would be likely to realize such fears. Thus, as of early September the ETS trading price for December 2010 was €15 per ton of carbon dioxide, whereas the price in the RGGI

auctions was $1.86, only about one-tenth as much.[13] However, in the relevant time period, the third trading period for the ETS beginning in 2013 (the first was 2005-07; the second covers 2008-12) and a comparable period in the United States, it seems highly likely that the EU price level will be at least modestly higher than presently and the US price would be much higher than the current RGGI level.[14] That would be especially true if either the EPA were to move forcefully ahead and were to use trading mechanisms, as it has done in past abatement initiatives (especially for sulphur dioxide) or, preferably, if congress were to pass a comprehensive climate bill that implemented either cap-and-trade (as in Waxman-Markey) or adopted a carbon tax of some form. In principle the regional initiatives could also make their trading regimes open to trading with the EU's ETS, as was envisioned in mid-2006 in a letter-of-intent agreement between UK Prime Minister Tony Blair and California Governor Arnold Schwartzenegger.[15] However, the EPA would probably need to cooperate, rather than opposing such initiatives on grounds that any such arrangements should be controlled at federal level.

Besides integrating their cap-and-trade regimes through permitting mutual carbon trading, and first and foremost meeting their own 2020 goals pledged at Copenhagen, perhaps the other most important action the United States and the EU could take to help ensure successful international action on climate change would be to develop concrete plans for implementing the target for financing of developing-country climate action on something like the Copenhagen Accord's scale of $100 billion per year scale by 2020. China's huge holdings of foreign exchange reserves (about $2.5 trillion) mean that it should be able to act without external finance. For other developing countries, Cline (2010) estimates that annual investments in developing countries needed to meet Copenhagen-convergence abatement goals would amount to about $40 billion annually in 2020 and $120 billion in 2030 (in dollars of 2005). Adaptation costs in developing countries (excluding not only China but also Korea, Malaysia, and Taiwan by virtue of their by-then high income levels) could require financing of about $40 billion in 2020 and $50 billion in 2030. Even with only moderate global financial flows associated with the purchase of offsets from developing countries, by 2020 and especially 2030 the financing needs could easily meet the $100 billion benchmark incorporated in the Copenhagen Accord language. Presumably such financing could be at market-related rates for emerging-market economies but on concessional terms for low-income countries.

[13] See www.pointcarbon.com and www.rggi.org/home.

[14] As noted above, the CBO estimates the carbon allowance price under Waxman-Markey at $19 per ton of CO_2 by 2015.

[15] Patrick Wintour, "Blair signs climate pact with Schwartzenegger," *The Guardian*, August 1, 2006.

Annex A[16]

US Regional Climate Initiatives

Currently there are three regional climate initiatives at the inter-state level encompassing a total ~~number~~ of 23 U.S. states and four Canadian provinces. All of the three initiatives have announced goals for the next decade for the reduction of greenhouse gas emissions and intend to im~~i~~plement regional cap-and-trade programs to achieve these goals. Among the three initiatives, the Regional Greenhouse Gas Initiative~~s~~ (RGGI) is the only one that has already begun operating its regional cap-and-trade program. The Western Climate Initiative (WCI) has completed the design of its cap-and-trade program, which is schedule to start in January 2012. The Midwest Greenhouse Gas Reduction Accord (MGGRA), the newest initiative, is still in the stage of designing its cap-and-trade program.

Regional Greenhouse Gas Initiative (RGGI)[17]

The member states of RGGI include Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont. In addition, Pennsylvania has observer status. In January 2009, RGGI launched its regional CO_2 cap-and-trade program, which became the nation's first mandatory, market-based program to curb emissions of greenhouse gases.[18] The program currently covers 209 fossil fuel-fired power plants of 25 megawatts or greater in size in the 10 participating states, accounting for 95% of the CO_2 emissions from the electric power generation sector in the area.

Total CO_2 emissions from the RGGI member states are capped by the sum of CO_2 allowances issued by the 10 states, which is initially set at 188 million short tons per year.[19] This ceiling applies from 2009 through 2014. From 2015 through 2018, the cap will decline at an annual rate of 2.5%, achieving a total four-year reduction of 10%.

Carbon dioxide allowances are traded through quarterly regional auctions.[20] According to the *2009 Annual Report on the Market for RGGI CO_2 Allowances*, by the end of 2009, 172 million allowances had been sold in total, which yielded auction proceeds of $494 million.[21] The RGGI states are investing approximately 70% of auction proceeds in programs that improve energy efficiency and promote renewable energy.

Western Climate Initiative (WCI)[22]

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[16] Prepared by Yimei Zou.
[17] http://www.rggi.org

[18] Overview of the program: http://rggi.org/docs/program_summary_10_07.pdf
[19] One short ton = 907.2 kg.
[20] Detailed auction data and CO_2 allowance prices are available on the RGGI website: http://www.rggi.org/market/co2_auctions/results

[21] Full report: http://www.rggi.org/docs/MM_2009_Annual_Report.pdf
[22] http://www.westernclimateinitiative.org

Member states of the WCI include Arizona, California, Montana, New Mexico, Oregon, Utah, and Washington, as well as four Canadian provinces: British Columbia, Manitoba, Ontario, and Quebec. Observer states include Colorado, Idaho, Kansas, Nevada, and Wyoming.

The WCI released the design of its regional greenhouse gases cap-and-trade program in July 2010.[23] The program is scheduled to start in January 2012, although not all members will implement the program when it begins. The goal of the program is to cut regional greenhouse gases emissions to 15% below 2005 levels by 2020. When fully implemented, the program is projected to cover a broad range of emitters jointly responsible for approximately 90% greenhouse gases emissions in the WCI participating regions.

Each state is to issue limited amounts of tradable "emission allowances". Not yet determined, these allowances are to follow these guidelines. Starting from 2012, allowances will only apply to the electricity sector and large industrial sources. Each state's allowance ceiling is to be the best estimate of actual emissions anticipated from the covered emitters for that year. In 2015, allowance ceilings are to rise to provide for expansion of coverage to transportation, residential and commercial fuels. For 2020, allowance ceilings are to be set for each state such that, together with emissions from uncapped sources, they will amount to the state's 2020 economy-wide emissions target. The allowance budgets are to follow a linear decline from 2012 to 2015, and again from 2015 to 2020.

Midwestern Greenhouse Gas Reduction Accord (MGGRA)[24]

Member states of the MGGRA include Illinois, Iowa, Kansas, Michigan, Minnesota, and Wisconsin. States with observer status include Indiana, Ohio, and South Dakota.

The Accord[25], established in November 2007, calls for the development of targets for greenhouse gas emissions and a regional cap-and-trade program to help achieve these targets. The cap-and-trade recommendations were completed in May 2010 and are now under review by the member states.[26] The recommended emissions reduction targets for individual states were set at 18-20% below 2005 levels by 2020, and 80% below 2005 levels by 2050.

[23] Detailed design of the program: http://westernclimateinitiative.org/component/remository/general/program-design/Design-for-the-WCI-Regional-Program/

[24] http://midwesternaccord.org

[25] See http://www.midwesternaccord.org/midwesterngreenhousegasreductionaccord.pdf

[26] Full recommendations: http://www.midwesternaccord.org/Accord_Final_Recommendations.pdf

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