

Appendix to: Economic Analysis of the Kyoto Protocol

Jeffrey A. Frankel, Member
Council of Economic Advisers

After Kyoto: Are There Rational Pathways to a Sustainable Global Energy System?
1998 Aspen Energy Forum
Aspen, Colorado
July 6, 1998

Technical Appendix

The potential benefits of the flexibility measures embodied in the Administration's climate change approach are summarized in Figure 19 and Table 4. As already noted, an effective international market in emissions allowances among Annex I countries potentially lowers the cost to the United States of climate change policy by more than half relative to a hypothetical scenario in which all abatement is performed domestically, and would lower the permit price by nearly 3/4. The term "cost" refers to the direct cost to the U.S. economy of meeting its Kyoto target measured as the cost of emissions abated domestically plus the cost of purchases of international emissions allowances and emissions credits by U.S. firms. An international market among "the umbrella countries" (Annex I except for the European Union, in one scenario, and the European Union plus Eastern Europe in another scenario) could lower costs about 60-75% below the domestic only cost. Even without developing country participation, trading among Annex I or a subset of Annex I countries is a fraction of the cost of domestic only reductions. Finally, if some developing countries adopt growth emissions targets and participate in an effective trading system, the total cost to the United States could well fall to between 1/7 and 1/5 (i.e., between about 14% and 20%) of a "domestic only" approach.

Table . Countries/Regions in Second Generation Model

Annex I	Non-Annex I
United States	China
Western Europe	India
Former Soviet Union	Korea
Eastern Europe	Mexico
Japan	Rest of the World
Canada	
Australia	

Source: Second Generation Model

Table 4. Permit Prices and Resource Costs Relative to “Domestic Only” Abatement of Various Trading Scenarios

Trading Scenario	Percent Reduction in Permit Price (relative to domestic only)	Percent Reduction in Resource Cost (relative to domestic only)
Annex I	72%	57%
Umbrella (with Eastern Europe)	85%	74%
Umbrella (without Eastern Europe)	75%	61%
Annex I + Key Developing Countries	88%	80%
Umbrella (with Eastern Europe) + Key Developing Countries	93%	87%
Umbrella (without Eastern Europe) + Key Developing Countries	91%	83%
Annex I + CDM	79%	66%
Umbrella (with Eastern Europe) + CDM	88%	80%
Umbrella (without Eastern Europe) + CDM	82%	71%

Figure 19. Percentage Reductions in Resource Costs Relative to "Domestic Only" Abatement Under Various Trading Scenarios

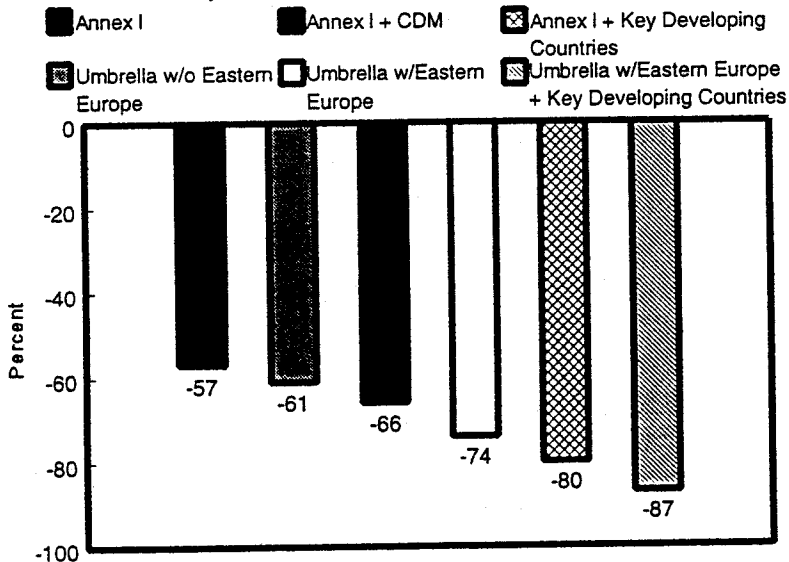


Table 5. U.S. Permit Prices and Resource Costs Under the Administration's Policies

Trading Scenario	Permit Price	Total Resource Cost	Share of 2010 GDP
Umbrella without E.U.+ key developing country participation	\$14/ton	\$7 billion/year	0.07%
Annex I + key developing country participation	\$23/ton	\$12 billion/year	0.11%

The illustrative modeling analysis does not account for several key components of the Kyoto Protocol and the Administration's policies to reduce greenhouse gas emissions. These key issues include the benefits of reducing net emissions through carbon sinks, the Administration's electricity restructuring proposal, and the Administration's Climate Change Technology Initiative. Each of these factors has the potential significantly to increase the amount of reductions made domestically, while lowering the level of permit prices. The illustrative model also does not account for ancillary benefits of reducing greenhouse gas emissions, such as improved local air quality.

U.S. Energy Prices

Under the assumptions of the Administration's analysis, permit prices in the range of \$14/ton to \$23/ton translate into energy price increases at the household level between 3 and 5%. As Table 6 illustrates, the price increases for electricity and an array of fuels would be modest, and in several cases, the prices faced by consumers, even under the \$23/ton permit price, would be lower in real terms than prices experienced today. By 2010, the increase in energy cost for the average household expected with permit prices between \$14/ton and \$23/ton would range between \$70 and \$110 annually, but this would be roughly offset by cost-savings associated with the Administration's electricity restructuring proposal.

Table 6. U.S. Energy Prices Under Permit Prices of \$14/ton to \$23/ton

Energy Source	1996 Price	2010 BAU Price	2010, \$14/ton	2010, \$23/ton
Electricity	6.9¢/Kwh	5.9¢/Kwh	6.1¢/Kwh	6.2¢/Kwh
Gasoline	\$1.225/gallon	\$1.259/gallon	\$1.293/gallon	\$1.314/gallon
Fuel Oil	\$1.087/gallon	\$1.092/gallon	\$1.140/gallon	\$1.170/gallon
Natural Gas	\$4.25/mcf	\$3.80/mcf	\$4.00/mcf	\$4.13/mcf

All data are in 1996 dollars. 1996 and 2010 business as usual (BAU) prices are from Energy Information Administration 1997.

EMF-16: Modeling Exercises of Kyoto Protocol: Permit Prices

Model	No Trading (U.S.)	Annex I Trading	Percent Change from No Trading	Global Trading	Percent Change from No Trading
FUND	n/a	\$17/ton	n/a	\$11/ton	n/a
G-Cubed	\$65/ton	\$38/ton	42%	\$13/ton	80%
RICE	\$150/ton	\$42/ton	72%	\$13/ton	91%
SGM	\$224/ton	\$101/ton	55%	\$27/ton	88%
MIT	\$267/ton	\$177/ton	63%	\$36/ton	87%
AIM	\$182/ton	\$77/ton	58%	\$45/ton	75%
MRT	\$307/ton	\$115/ton	63%	\$50/ton	84%
CETA	\$203/ton	\$106/ton	48%	\$61/ton	70%
MERGE3	\$351/ton	\$179/ton	49%	\$139/ton	61%
Oxford	\$489/ton	\$267/ton	45%	\$147/ton	70%
Average (SD)	\$249/ton (124)	\$112/ton (77)	52% (12)	\$54/ton (50)	78% (0.10)

All permit prices are in 1997\$.

Sinks are assumed to be zero.

Non-carbon dioxide greenhouse gases are assumed to have no offsetting impact on the magnitude of carbon dioxide emissions reductions necessary to comply with Kyoto targets.

In global trading, non-Annex B countries are assumed to have targets set at 2010 BAU.