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001. notes	[Handwritten meeting notes] [PII] [partial] (1 page)	00/00/0000	b(6)

COLLECTION:

Clinton Presidential Records
Council of Economic Advisers
Subject Files
OA/Box Number: 20729

FOLDER TITLE:

Climate Change [Binder] [3]

2017-1095-F

bg229

RESTRICTION CODES

Presidential Records Act - [44 U.S.C. 2204(a)]

- P1 National Security Classified Information [(a)(1) of the PRA]
- P2 Relating to the appointment to Federal office [(a)(2) of the PRA]
- P3 Release would violate a Federal statute [(a)(3) of the PRA]
- P4 Release would disclose trade secrets or confidential commercial or financial information [(a)(4) of the PRA]
- P5 Release would disclose confidential advice between the President and his advisors, or between such advisors [(a)(5) of the PRA]
- P6 Release would constitute a clearly unwarranted invasion of personal privacy [(a)(6) of the PRA]

C. Closed in accordance with restrictions contained in donor's deed of gift.

PRM. Personal record misfile defined in accordance with 44 U.S.C. 2201(3).

RR. Document will be reviewed upon request.

Freedom of Information Act - [5 U.S.C. 552(b)]

- b(1) National security classified information [(b)(1) of the FOIA]
- b(2) Release would disclose internal personnel rules and practices of an agency [(b)(2) of the FOIA]
- b(3) Release would violate a Federal statute [(b)(3) of the FOIA]
- b(4) Release would disclose trade secrets or confidential or financial information [(b)(4) of the FOIA]
- b(6) Release would constitute a clearly unwarranted invasion of personal privacy [(b)(6) of the FOIA]
- b(7) Release would disclose information compiled for law enforcement purposes [(b)(7) of the FOIA]
- b(8) Release would disclose information concerning the regulation of financial institutions [(b)(8) of the FOIA]
- b(9) Release would disclose geological or geophysical information concerning wells [(b)(9) of the FOIA]

Summary of Reviewers Comments

(1) The following are a summary of the comments that can likely be addressed by adding to or improving the text of the existing report.

- Include a more complete discussion of the track record of these models in analyzing climate change issues (Kopp, p.2).
- Include more information about how and why the baseline projections in the models differ from the AEO97, particularly the used of 1.0 instead of 0.9 for the annual decrease in E/GDP (Kopp, p.5).
- Explain why many of the assumptions used by the IAT tend to make stabilization less costly (Kopp, p.5). Provide more information on baseline assumptions that serve to decrease baseline carbon emissions, such as declining GDP growth, rapidly declining E/GDP, fossil fuel prices, (Goulder, p.1; Scott, p.4). Explain the low labor force growth rate (Scott, p.3).
- Provide a better explanation of Appendix Table A (Goulder, p.5).
- Explain how domestic carbon permit trading is modeled. If a tax at the port of entry or well-head is used to proxy the trading system, include a discussion of transaction costs of the trading system that are missing from the analysis. (Kopp, p.5; Goulder, p.1). Report the transaction costs associated with an emissions trading system (Scott, p.4).
- Provide greater detail about how revenue recycling by deficit reduction is modeled; in particular provide information on how deficit reduction affects federal taxes and spending in the future (Goulder, pp. 1-2).
- ⇒ • Provide a discussion that places the IAT results in the context of the economic literature (Kopp, p.7).
- Explain the magnitude of the decrease in the implicit price of carbon under Annex I and II trading (Kopp, p.8; Goulder, p.3). Explain whether SGM captures increasing costs of abatement for permit sellers (Goulder, p.3).
- Improve and expand existing discussion of trade effects (Kopp, p.9).
- Discuss the timing issues in the context of cumulative emissions reductions (Goulder, p.3).
- Provide percent change in coal, oil, and natural gas prices (Goulder, p.2).
- Provide a more detailed explanation of how emissions rights are allocated internationally (Goulder, p.2).
- Explain what is occurring in the grandfathered permits scenario (i.e., in the DRI run) (Goulder, p.3; Repetto, p.2).

- Include some discussion of the benefits associated with reducing carbon emissions (Goulder, p.4; Richels pp.3-4; DeCanio, p.1 & pp. 5-6). Include discussion of environmental implications of changes of fuel use patterns and consequent changes in emissions, ambient quality, and environmental/health damages (Repetto, p.1).
- Make explicit the fiscal assumptions in the baseline; specifically detail whether the baseline incorporates the 1997 budget agreement (Repetto, p.1).
- Explain the price elasticities of demand, particularly in the DRI model (Richels, p.3).
- Provide more discussion of how the E/GDP ratio was implemented in each of the models (Richels, p.3).
- Provide more explanation of what drives GDP above baseline in the starting point scenario (fig.2); How much is due to the 1.25 E/GDP? (Richels, p.3). Re-consider the existing explanation of forces at play in the "starting point" scenario with respect to various debates in the economic literature, particularly the relationship between deficits and savings (DeCanio, p.2; Scott, p.3).
- Explain what is assumed about current and future non-Annex I country emissions constraints under JI (Richels, p.4).
- Explain the costs of "backstop" technologies in SGM and Markal-Macro (Scott, p.3).

(2) The following represent specific additional modeling runs or sensitivity analyses requested by the reviewers.

- Run sensitivity analyses based on different baseline growth projections for the FSU, where there may be disagreement over rate of economic growth (Kopp, p.4).
- Address the issues of timing more rigorously, for example by combining delayed implementation with technological advance (Kopp, p.9).
- Run a scenario in which any revenues are recycled to reduce labor taxes.
- Explain the plausibility of the assumptions regarding the federal reserve policy in the "starting point scenario" (Richels, p.3).
- Run an alternative set of scenarios that evaluate the effects of a border equalization tax (Scott, p.3).
- Include discussions of employment effects and the distribution of income and wages under each of the major policy scenarios (Scott, p.3).

29-94

regression results

Excel spreadsheet

a - annual

111 - US country
code

dfl+ - deflator

Personal consumption

053015GS.MAC

053015CY.TXT

a1. uae

FACSIMILE TRANSMISSION

**U.S. Department of Energy
Office of Economic Analysis**

**1000 Independence Avenue, S.W.
Room 7H-062, PE 64
Washington, D.C. 20585**

Phone #: (202) 586-4767
(FTS) 896-4767

Fax #: (202) 586-5391
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Date: May 20, 1997

To: Tom Rhoads

Organization/Location: CEA

Phone Number: 395-3114

Fax Number: 395-6853

Subject: Memo to Ev and MM end-use energy
prices(shadow prices)

No. of Pages (with cover): 8

From: Phillip Tseng

Phone Number: 586-3892

Science - 1984

Energy Economics $\Rightarrow$ 1994
The relation between many product
1929-1992 $\rightarrow$ decomposed price effect

Gately $\Rightarrow$ 1992

price { Current price
all time high energy price
 $\downarrow$ effect is 4

$\downarrow$ all time high
recovers too high
movements away from high

Nature statistical significance of
aerosols on greenhouse
warming

Date: May 29, 1997

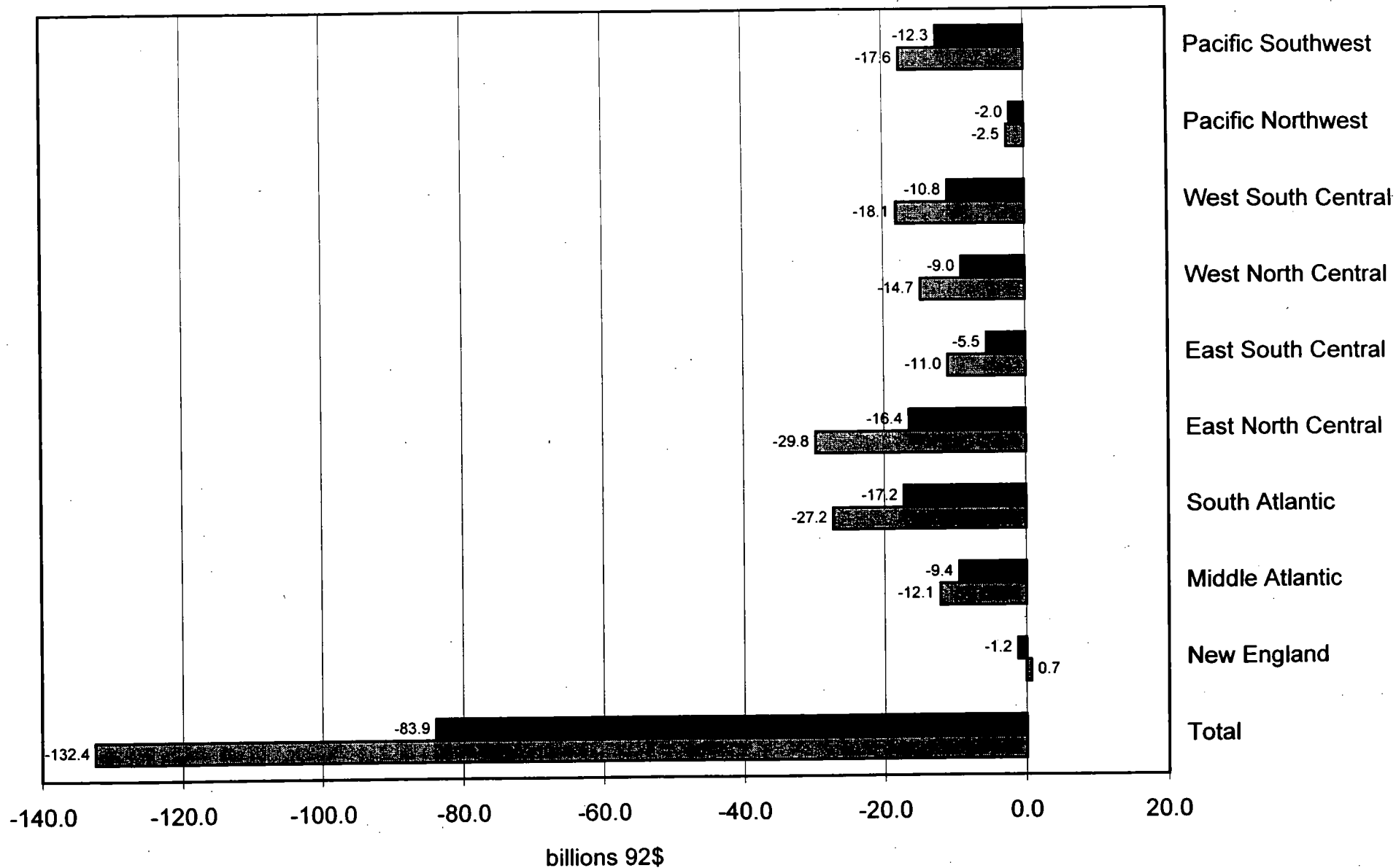
To: Susan Wickwire

From: Tom Rhoads, CEA
Jason Shogren, CEA
Robert Tuccillo, OMB

RE: Comments on the National Communication

In our phone conversation on Friday, May 23, language changes recommended by CEA and OMB were proffered for Chapter 4 and the Appendix to Chapter 4 of the National Communication. Trusting that you are incorporating these adjustments to the text of the revised document, attached is a copy of the pages including these changes for your records.

Disposable Income: 2010 (change from base)



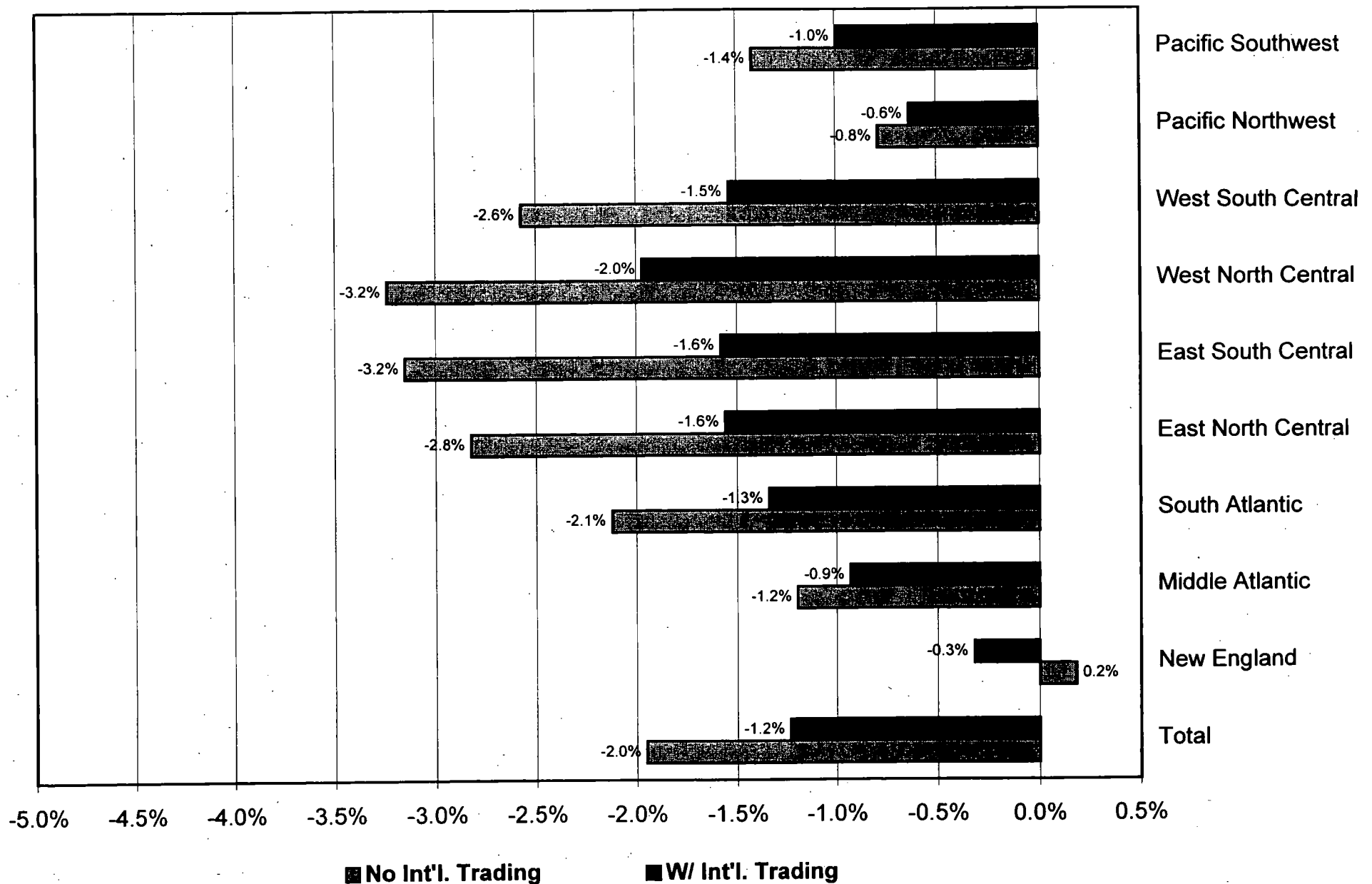
DRI Macro/Energy Model
DRAFT; 6/11/97

■ No Int'l. Trading
\$95 permit
price for carbon

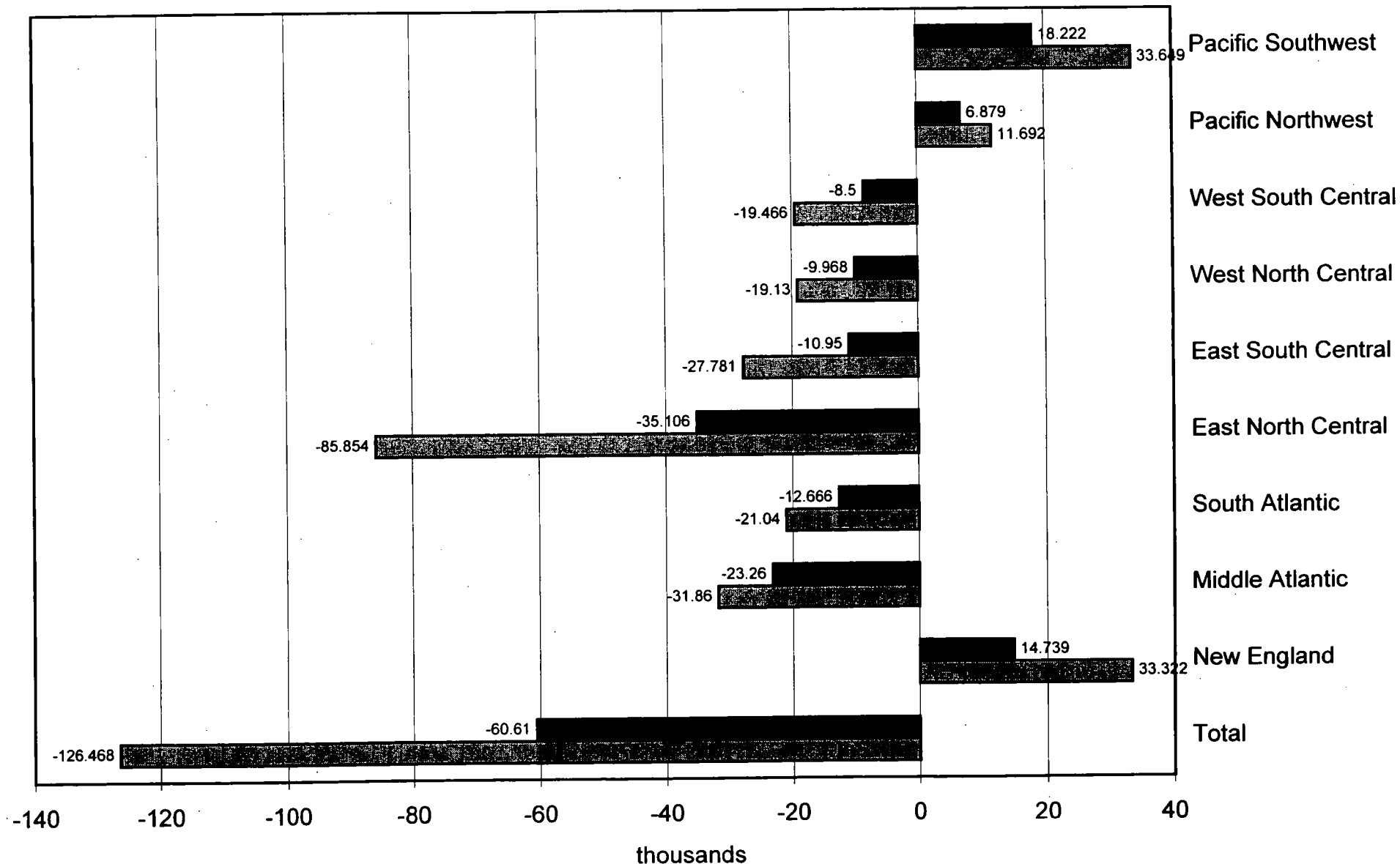
■ W/ Int'l. Trading
\$50 permit price

Stabilization; 1.25 Case
Deficit Reduction

Disposable Income: 2010 (% change from base)



Employment: Manufacturing, 2010 (change from base)

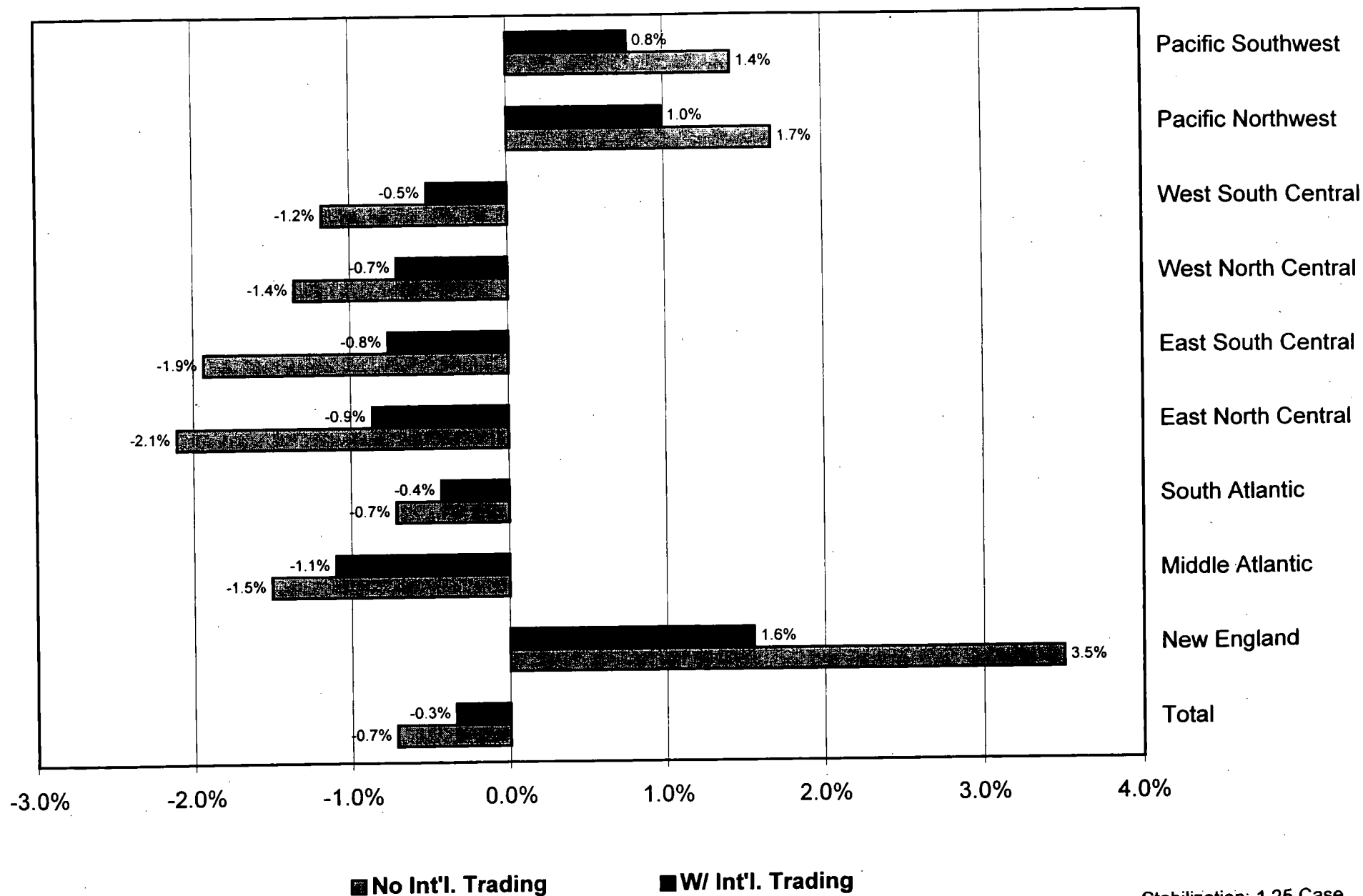


■ No Int'l. Trading

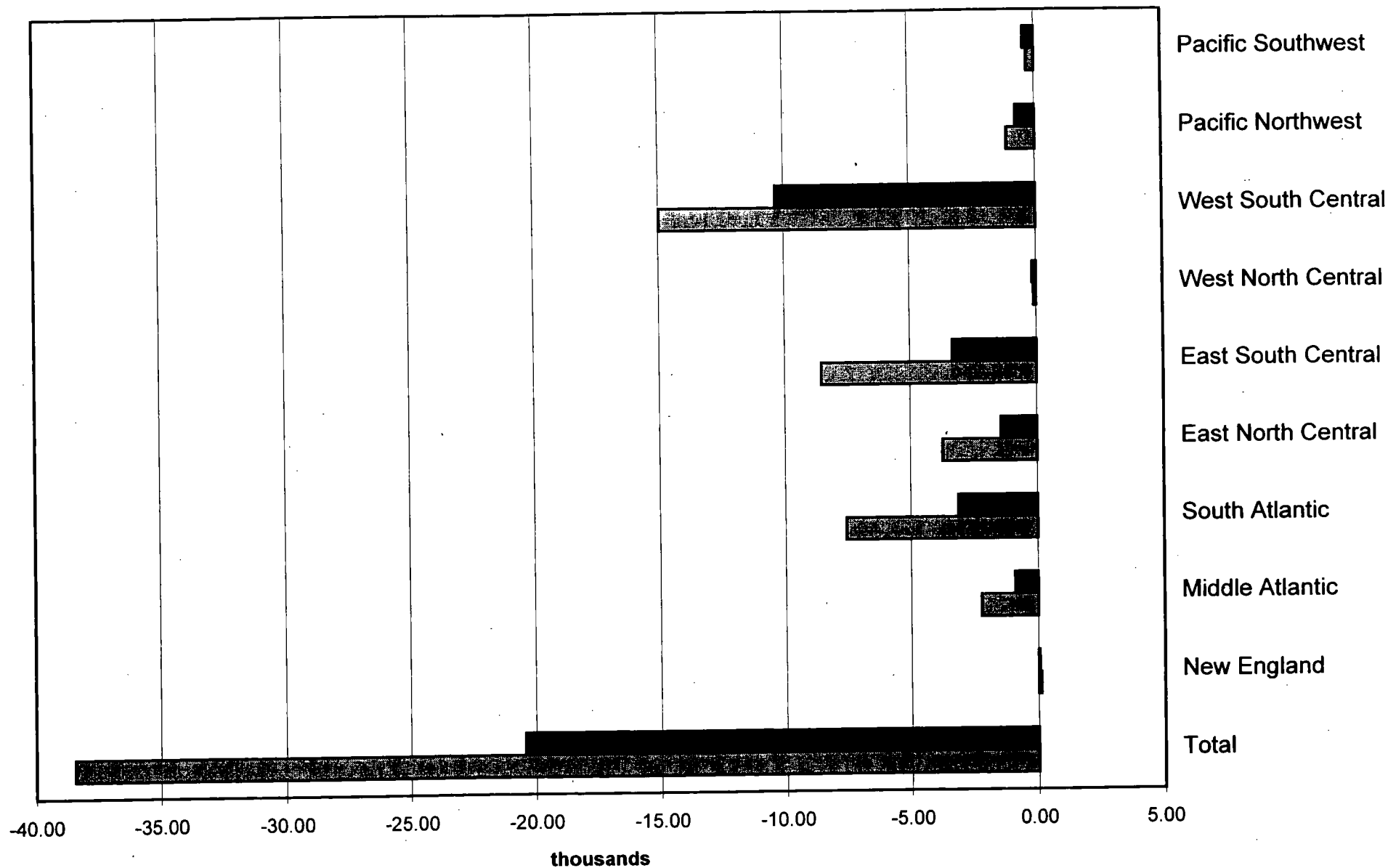
■ W/ Int'l. Trading

Drop in industrial electricity prices drive PN, & NE

Employment: Manufacturing, 2010 (% change from base)

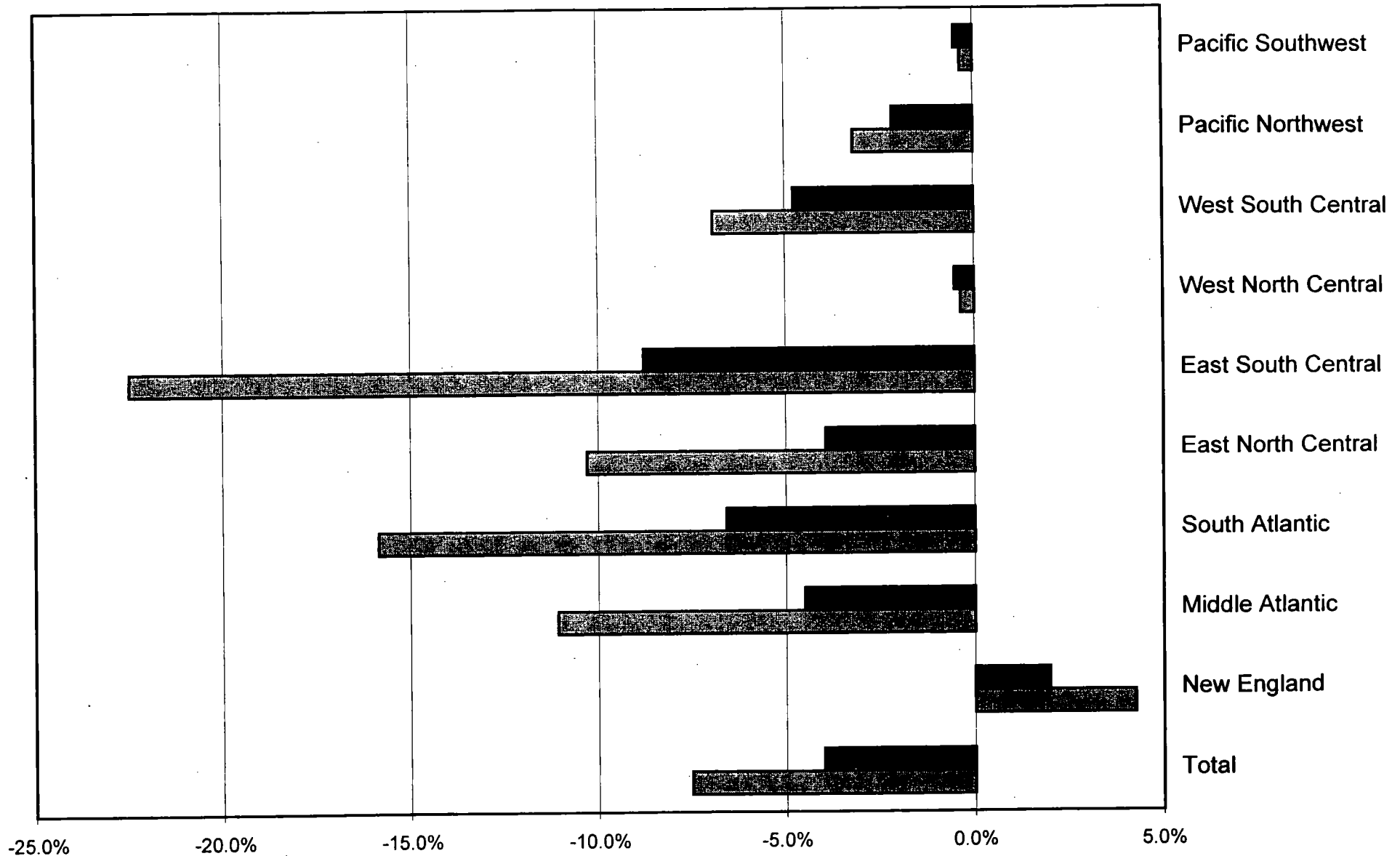


Employment: Fossil Fuel Extraction (change from base)

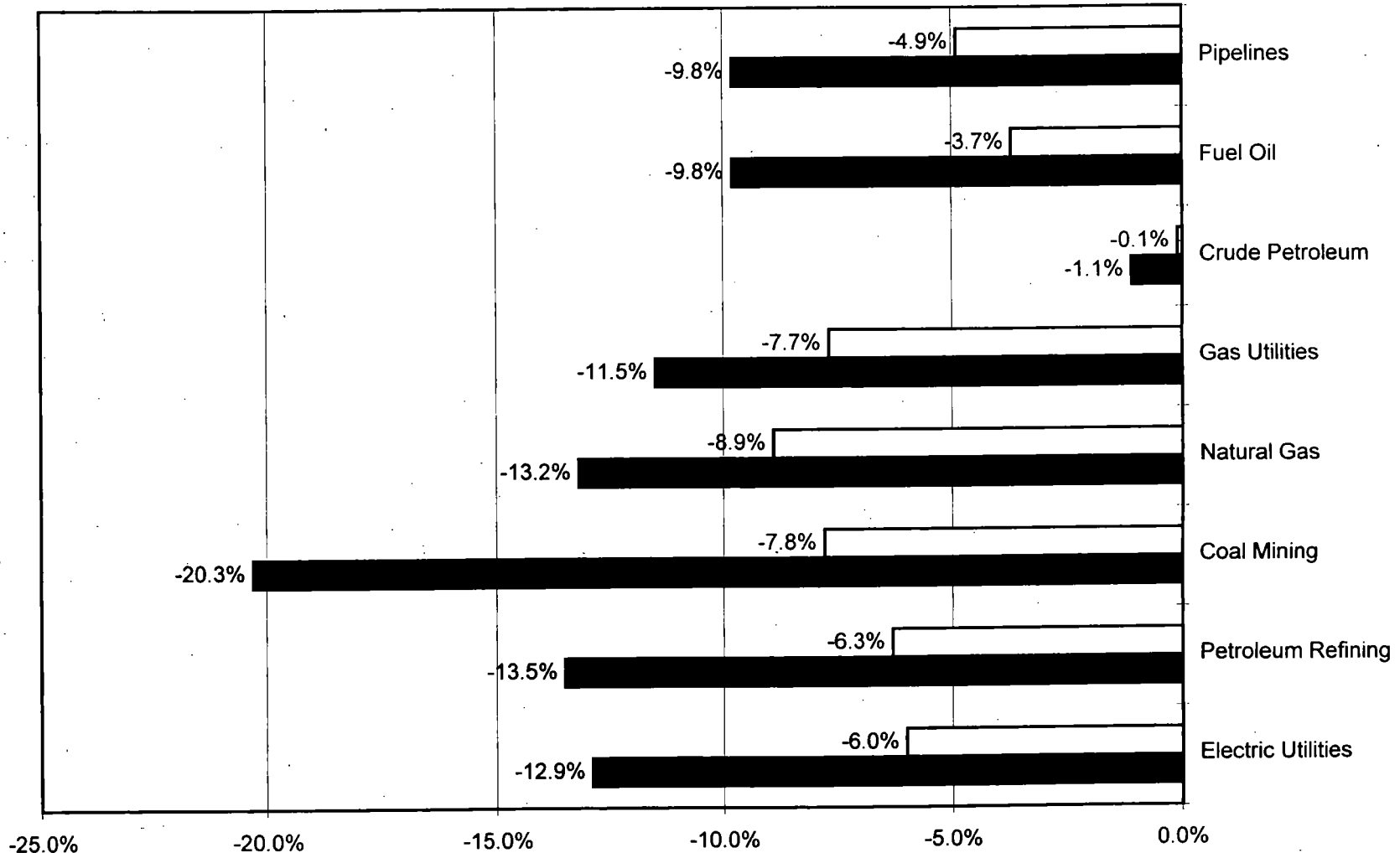


■ No Int'l. Trading ■ W/ Int'l. Trading

Employment: Fossil Fuel Extraction (% change from base)



Energy Producer Output: 2010



Percent Change from Base

■ No International Trading

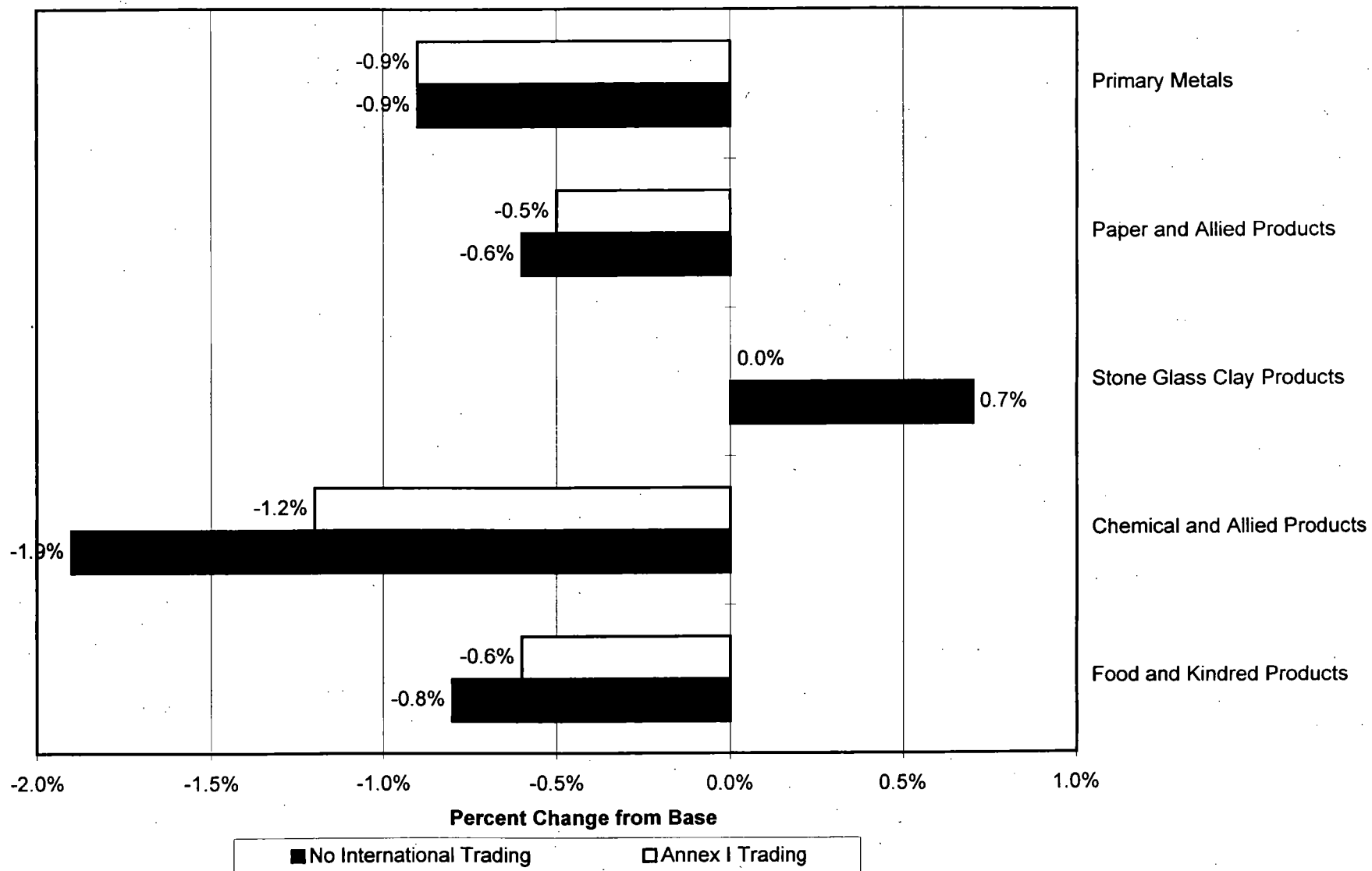
□ Annex I Trading

\$95 carbon permit price

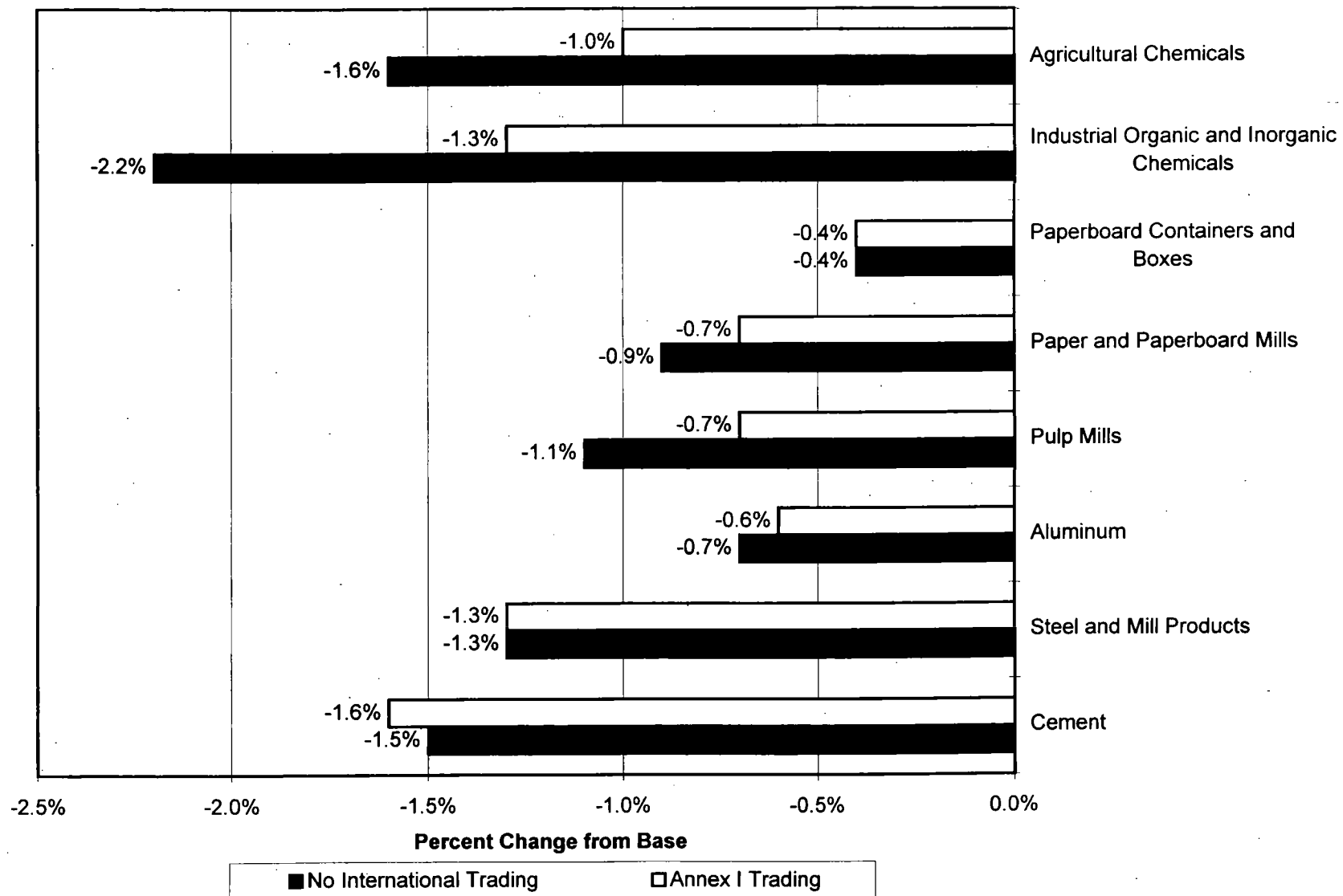
\$50 carbon permit price

even carbon tax than no intl trading

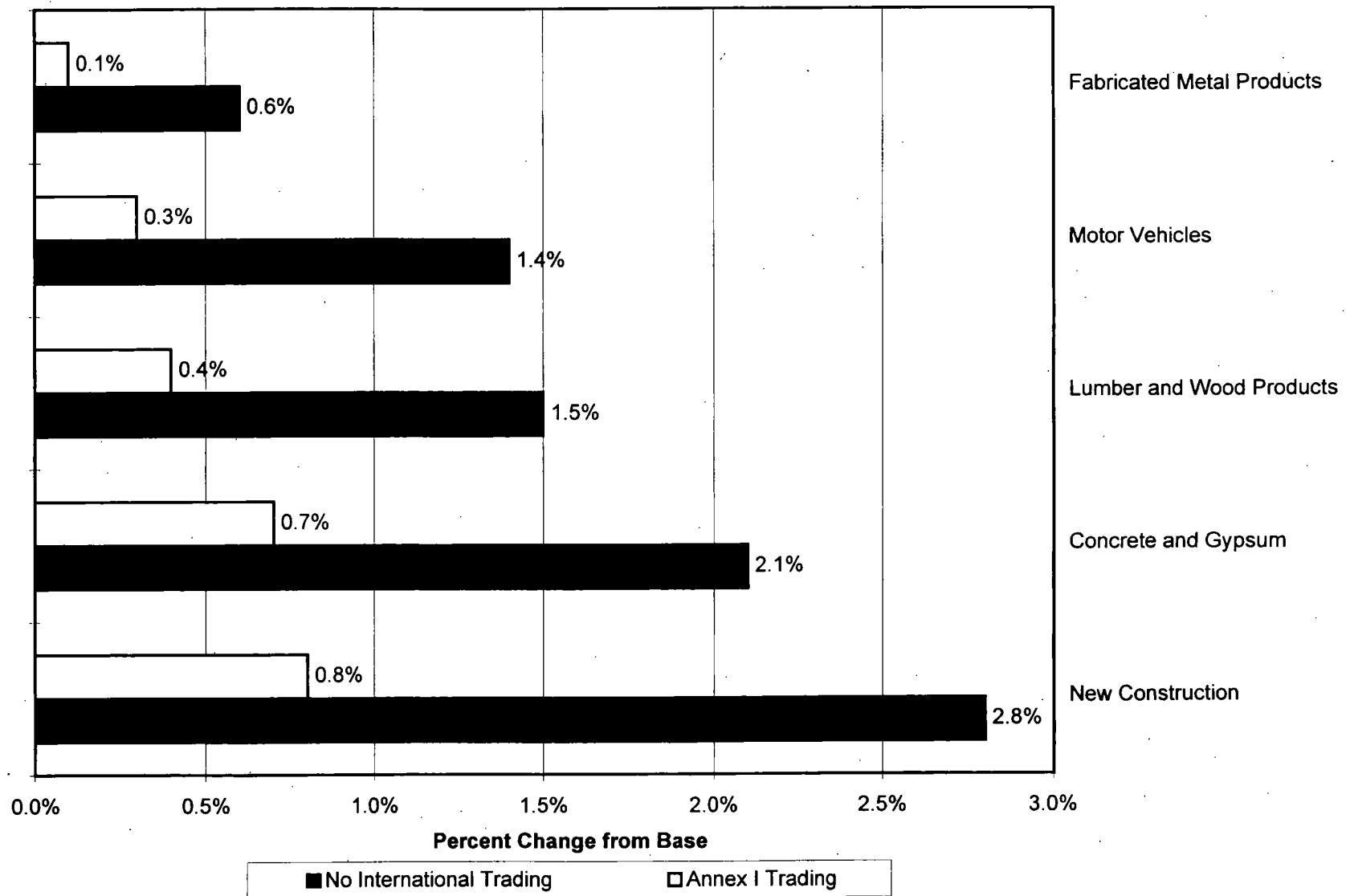
Energy Intensive Industry Output: 2010



Detailed Energy Intensive Output: 2010

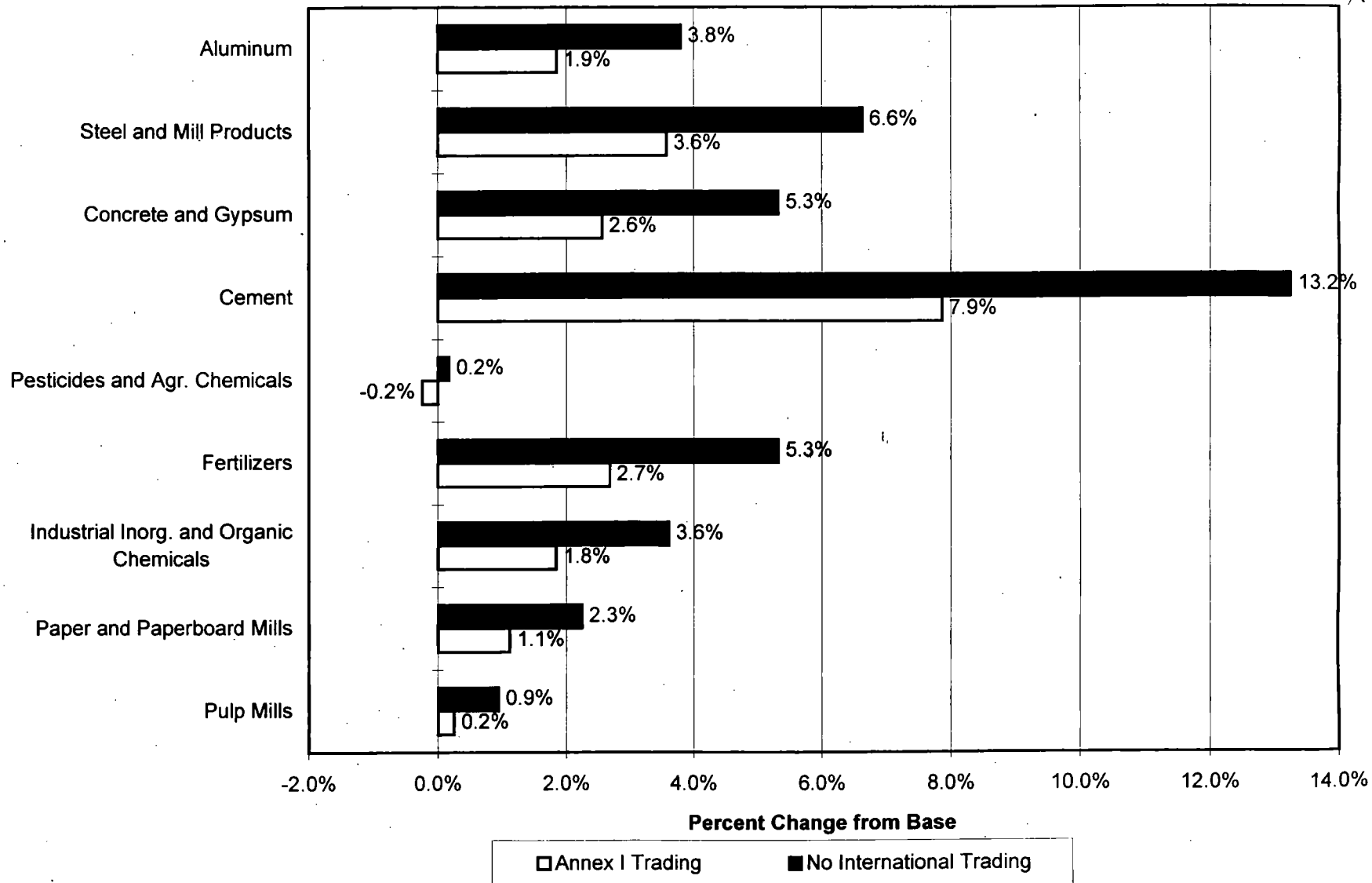


Output Gains Under Policy: 2010

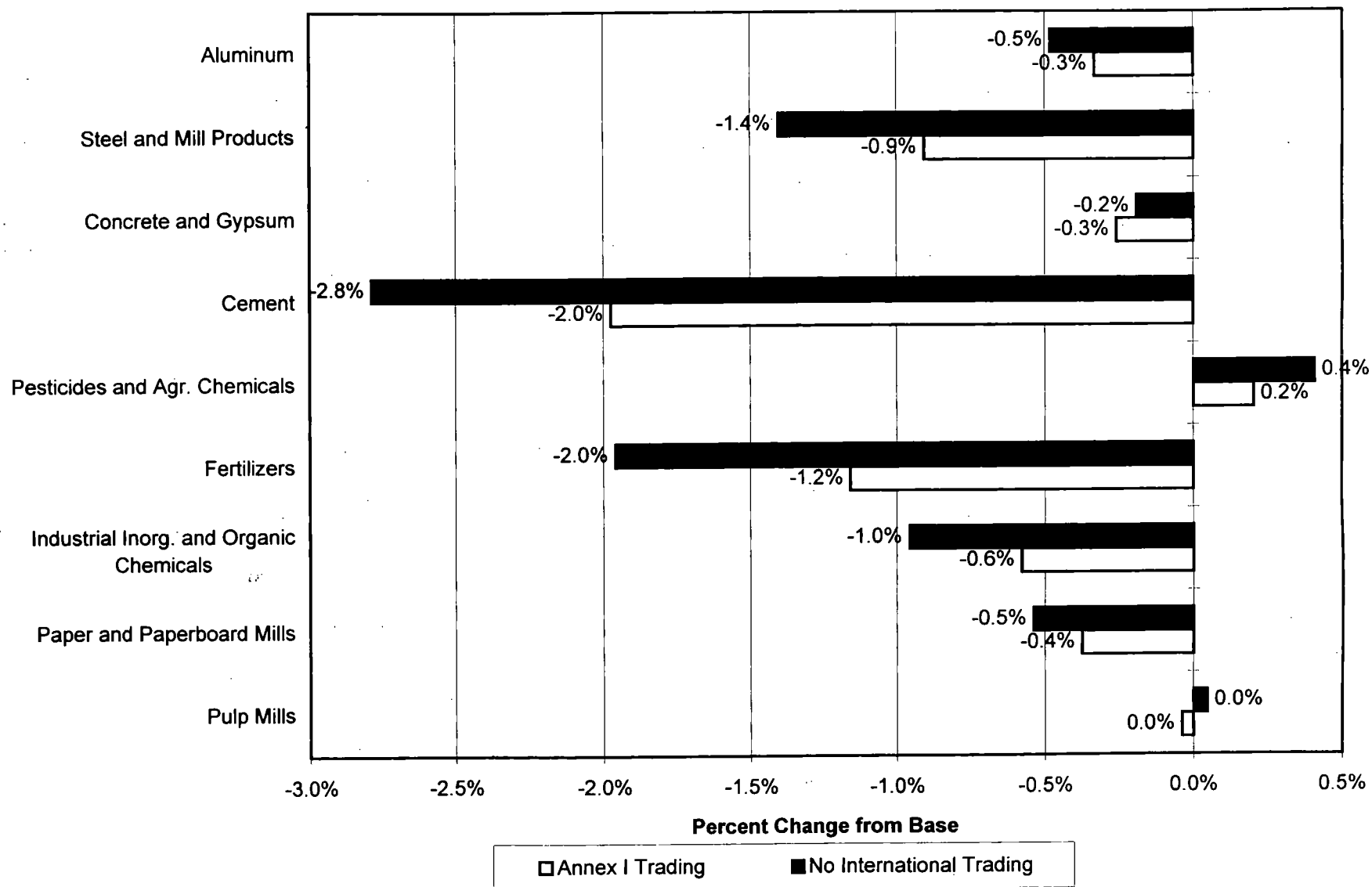


assumed 50% of ^{current} trade from Annex 1 now shifts to trade from non-Annex 1

Energy Intensive Industry Import Changes



Energy Intensive Industry Export Changes: 2010



Energy Consumption for Energy/GDP Ratio Declining at 1.25% and 1.75% Annual Rates Starting in 2000.							
Declining rates start from 1% in 2000 and increase linearly to 1.25/1.75 in 2010, and stay at 1.25/1.75 thereafter.							
Year	AEO97 Energy Consumption (quads)	AEO97 GDP billion \$92	AEO97 E/GDP 000btu/\$	1.25% Improvement E/GDP	Energy Consumption (quads)	1.75% Improvement E/GDP	Energy Consumption (quads)
1995	90.93	\$6,739	13.49	13.49	90.93	13.49	90.93
2000	97.85	\$7,544	12.97	12.97	97.85	12.97	97.85
2001				12.84		12.83	
2002				12.70		12.68	
2003				12.57		12.53	
2004				12.43		12.37	
2005	103.36	\$8,390	12.32	12.29	103.09	12.20	102.32
2006				12.15		12.02	
2007				12.00		11.84	
2008				11.86		11.65	
2009				11.72		11.45	
2010	107.89	\$9,185	11.75	11.57	106.26	11.25	103.34
2015	110.87	\$9,880	11.22	10.86	107.33	10.30	101.76
2020		\$10,591		10.20	108.04	9.43	99.87
2025		\$11,353		9.58	108.76	8.63	98.01
2030		\$12,171		9.00	109.48	7.90	96.19
2035		\$13,047		8.45	110.21	7.24	94.40
2040		\$13,986		7.93	110.94	6.62	92.65
2045		\$14,993		7.45	111.68	6.06	90.93
2050		\$16,072		6.99	112.42	5.55	89.24
2055		\$17,229		6.57	113.17	5.08	87.58
2060		\$18,469		6.17	113.92	4.65	85.95
2065		\$19,799		5.79	114.67	4.26	84.35
2070		\$21,224		5.44	115.44	3.90	82.79
2075		\$22,752		5.11	116.20	3.57	81.25
2080		\$24,390		4.80	116.97	3.27	79.74
2085		\$26,146		4.50	117.75	2.99	78.26
2090		\$28,028		4.23	118.53	2.74	76.80
		\$30,046		3.97	119.32	2.51	75.37
2100		\$32,209		3.73	120.11	2.30	73.97
2105		\$34,527		3.50	120.91	2.10	72.60
2110		\$37,013		3.29	121.72	1.93	71.25
2115		\$39,677		3.09	122.52	1.76	69.93
2120		\$42,534		2.90	123.34	1.61	68.63
2125		\$45,595		2.72	124.16	1.48	67.35
2130		\$48,878		2.56	124.98	1.35	66.10
2135		\$52,396		2.40	125.81	1.24	64.87
2140		\$56,168		2.25	126.65	1.13	63.66
2145		\$60,212		2.12	127.49	1.04	62.48
2150		\$64,546		1.99	128.34	0.95	61.32
2155		\$69,193		1.87	129.19	0.87	60.18
2160		\$74,174		1.75	130.05	0.80	59.06
2165		\$79,513		1.65	130.91	0.73	57.96
2170		\$85,237		1.55	131.78	0.67	56.89
2175		\$91,373		1.45	132.65	0.61	55.83
2180		\$97,951		1.36	133.54	0.56	54.79
2185		\$105,002		1.28	134.42	0.51	53.77
2190		\$112,561		1.20	135.32	0.47	52.77
2195		\$120,664		1.13	136.21	0.43	51.79
2200		\$129,350		1.06	137.12	0.39	50.83

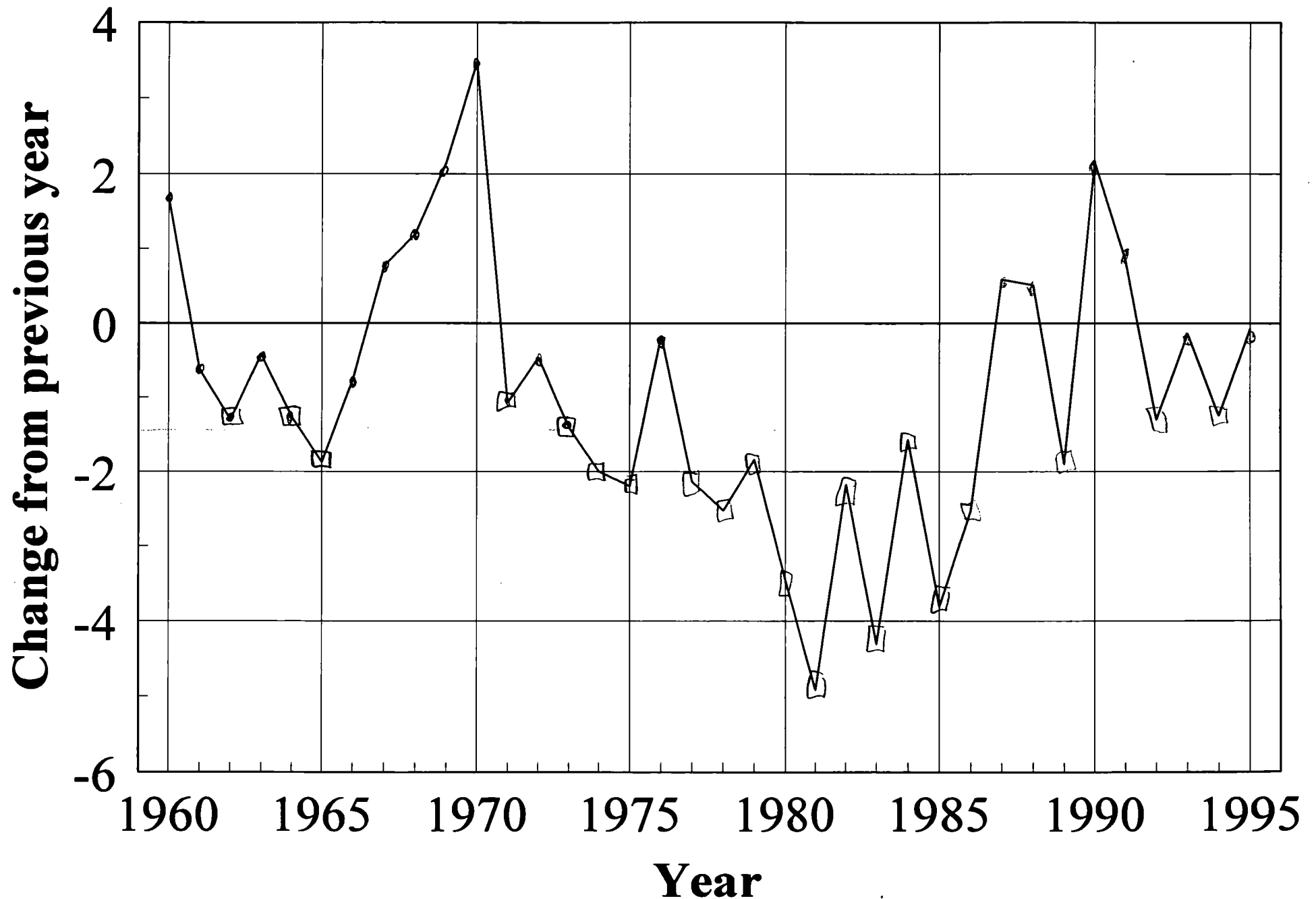
Sheet1

AEO97	Energy	GDP	E/GDP	annual changes
1995	90.93	6739	0.013493	
2000	97.85	7544	0.012971	-0.787% 95-00
2005	103.36	8390	0.012319	-1.025% 00-05
2010	107.89	9185	0.011746	-0.948% 05-10
2015	110.87	9880	0.011222	-0.910% 10-15
				-0.961% 00-15

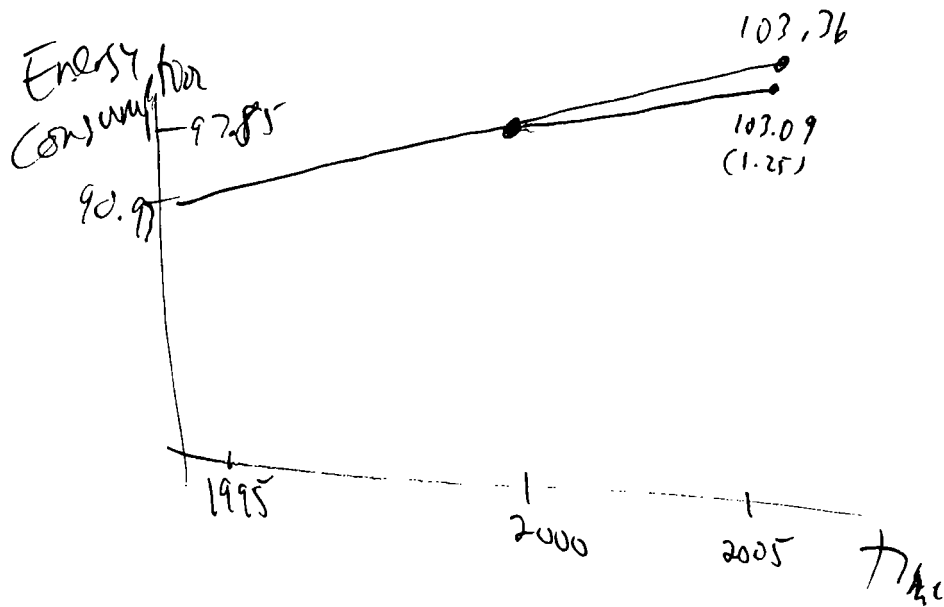
Markal-macro				
1995	91.6	6731	0.013609	
2000	96.7	7544	0.012818	-1.190% 95-00
2005	101.7	8381	0.012135	-1.090% 00-05
2010	106.6	9203	0.011583	-0.926% 05-10
2015	108.5	9883	0.010978	-1.067% 10-15
				<u>-1.028% 00-15</u>

1.25%

Energy Consumption per Dollar of GDP (E/GDP)



Year	E\GDP	% change pa
1959	19.05	
1960	19.37	1.67979
1961	19.25	-0.61951
1962	19	-1.2987
1963	18.92	-0.42105
1964	18.68	-1.2685
1965	18.33	-1.87366
1966	18.19	-0.76378
1967	18.33	0.769654
1968	18.55	1.200218
1969	18.95	2.156334
1970	19.61	3.48285
1971	19.4	-1.07088
1972	19.31	-0.46392
1973	19.04	-1.39824
1974	18.66	-1.9958
1975	18.25	-2.19721
1976	18.22	-0.16438
1977	17.83	-2.1405
1978	17.38	-2.52384
1979	17.06	-1.8412
1980	16.47	-3.45838
1981	15.66	-4.91803
1982	15.32	-2.17114
1983	14.66	-4.30809
1984	14.43	-1.56889
1985	13.88	-3.8115
1986	13.53	-2.52161
1987	13.61	0.591279
1988	13.68	0.514328
1989	13.42	-1.90058
1990	13.71	2.160954
1991	13.83	0.875274
1992	13.65	-1.30152
1993	13.63	-0.14652
1994	13.46	-1.24725
1995	13.45	-0.07429



Energy Consumption

NEO 97 $\Rightarrow$ sector by sector

~~Exp.~~

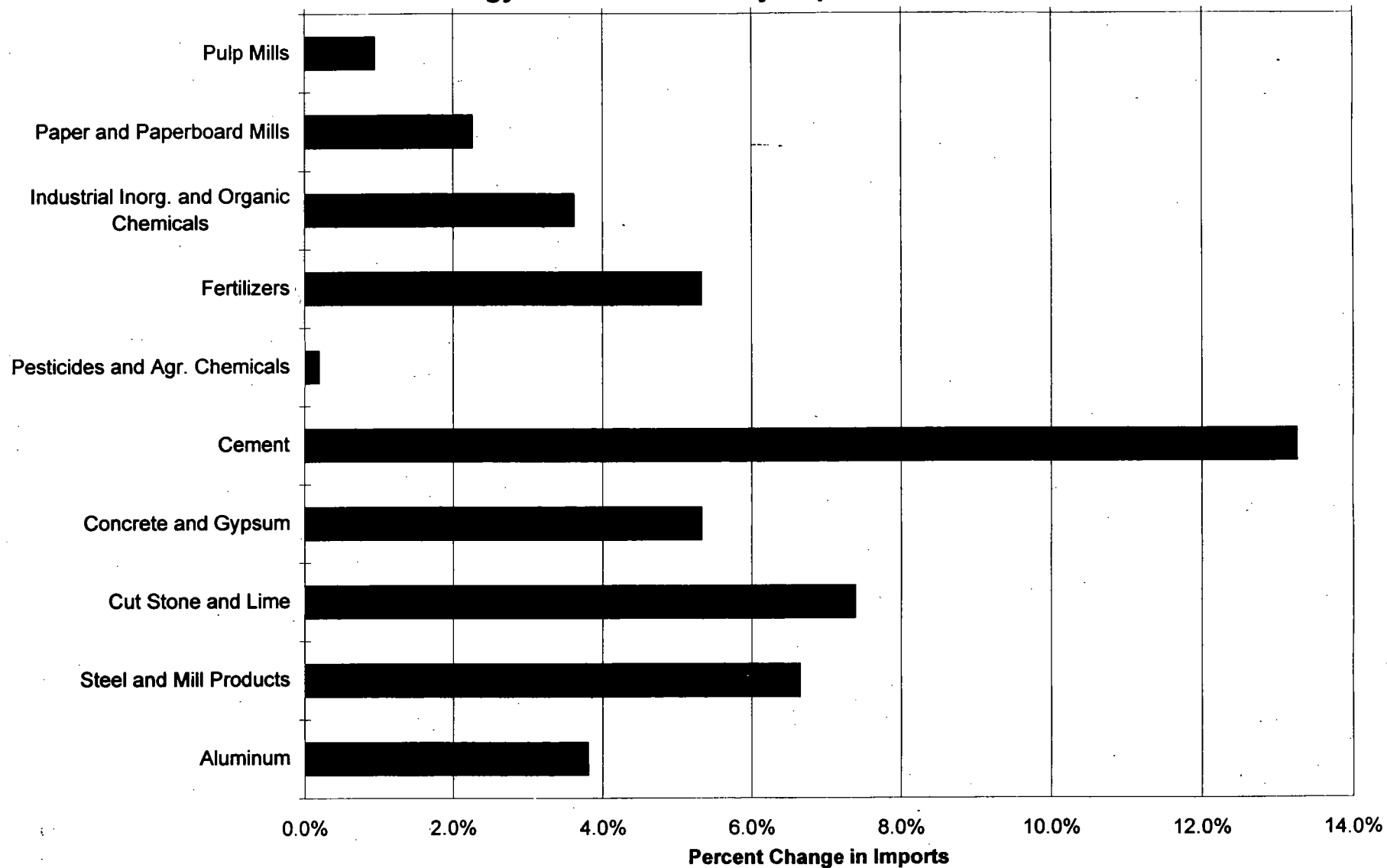
Energy Exp. $\approx$ 7.5% of GDP 2010 $\approx$ 9-10%

1995 $\equiv$ Energy Exp. over \$500 billion

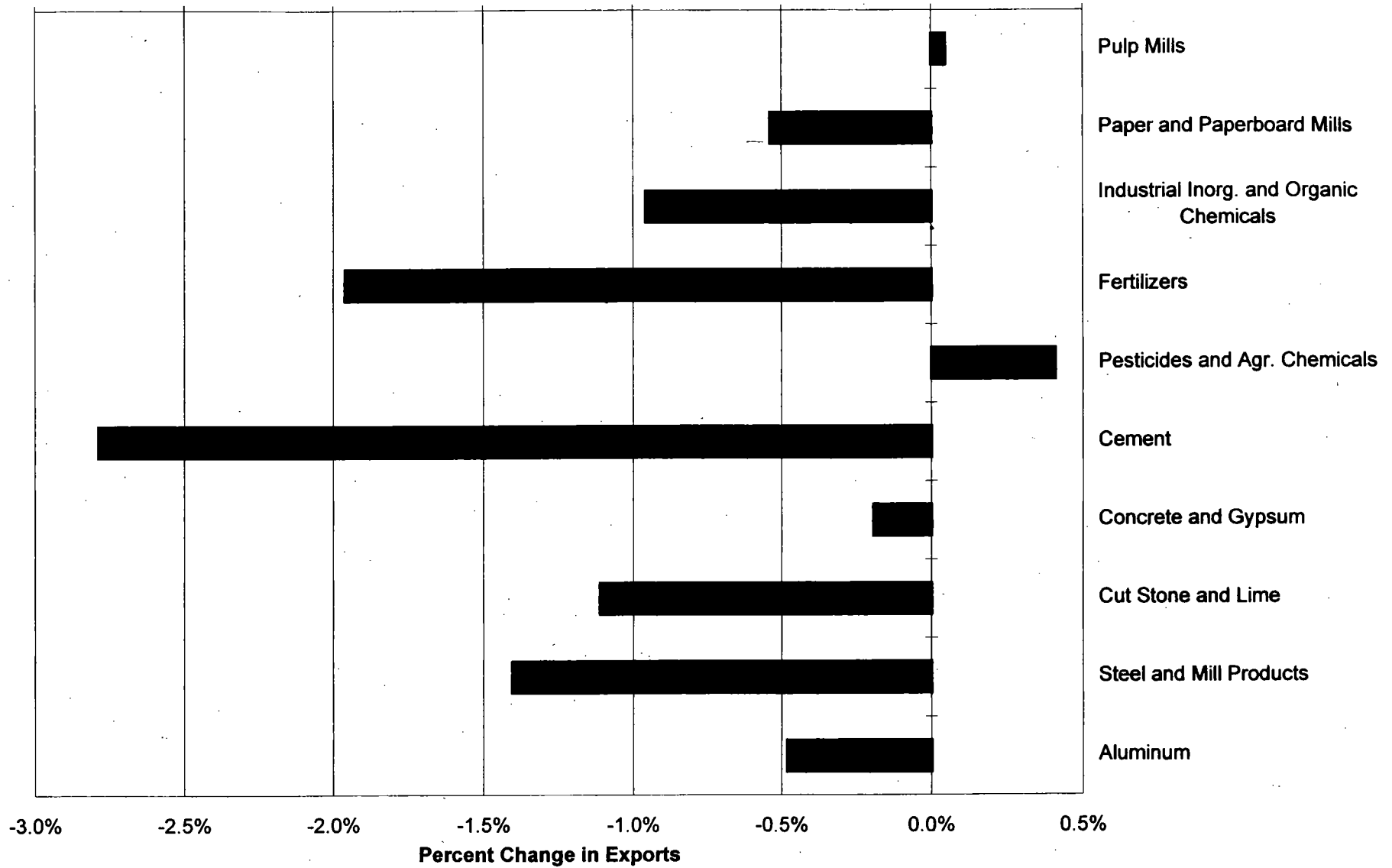
TABLE 2A: Fuel Shadow Prices By Sector
1991 \$ PER MBTU

	1991	1995	2000	2005	2010	2015	2020	2025
RESIDENTIAL SECTOR								
DISTILLATE	15.112	14.706	14.004	13.404	12.904	12.404	11.904	11.404
LPG	15.112	14.706	14.004	13.404	12.904	12.404	11.904	11.404
Pipeline Gas	9.458	9.458	9.458	9.458	9.458	9.458	9.458	9.458
Electricity	9.458	9.458	9.458	9.458	9.458	9.458	9.458	9.458
COMMERCIAL SECTOR								
DISTILLATE	15.112	14.706	14.004	13.404	12.904	12.404	11.904	11.404
LPG	15.112	14.706	14.004	13.404	12.904	12.404	11.904	11.404
Pipeline Gas	9.458	9.458	9.458	9.458	9.458	9.458	9.458	9.458
Electricity	9.458	9.458	9.458	9.458	9.458	9.458	9.458	9.458
INDUSTRIAL SECTOR								
COAL	15.112	14.706	14.004	13.404	12.904	12.404	11.904	11.404
DISTILLATE	15.112	14.706	14.004	13.404	12.904	12.404	11.904	11.404
LPG	15.112	14.706	14.004	13.404	12.904	12.404	11.904	11.404
FUEL OIL	15.112	14.706	14.004	13.404	12.904	12.404	11.904	11.404
Pipeline Gas	9.458	9.458	9.458	9.458	9.458	9.458	9.458	9.458
Electricity	9.458	9.458	9.458	9.458	9.458	9.458	9.458	9.458
TRANSPORTATION SECTOR								
DISTILLATE	15.112	14.706	14.004	13.404	12.904	12.404	11.904	11.404
LPG	15.112	14.706	14.004	13.404	12.904	12.404	11.904	11.404
FUEL OIL	15.112	14.706	14.004	13.404	12.904	12.404	11.904	11.404
COAL	15.112	14.706	14.004	13.404	12.904	12.404	11.904	11.404
Pipeline Gas	9.458	9.458	9.458	9.458	9.458	9.458	9.458	9.458
Electricity	9.458	9.458	9.458	9.458	9.458	9.458	9.458	9.458
ELECTRIC UTILITY SECTOR								
COAL	15.112	14.706	14.004	13.404	12.904	12.404	11.904	11.404
FUEL OIL	15.112	14.706	14.004	13.404	12.904	12.404	11.904	11.404
Pipeline Gas	9.458	9.458	9.458	9.458	9.458	9.458	9.458	9.458
NATURAL GAS WELLHEAD PRICE								
CRUDE OIL IMPORT PRICE	15.112	14.706	14.004	13.404	12.904	12.404	11.904	11.404
OVERSEAS COAL MINERALS PRICE	15.112	14.706	14.004	13.404	12.904	12.404	11.904	11.404

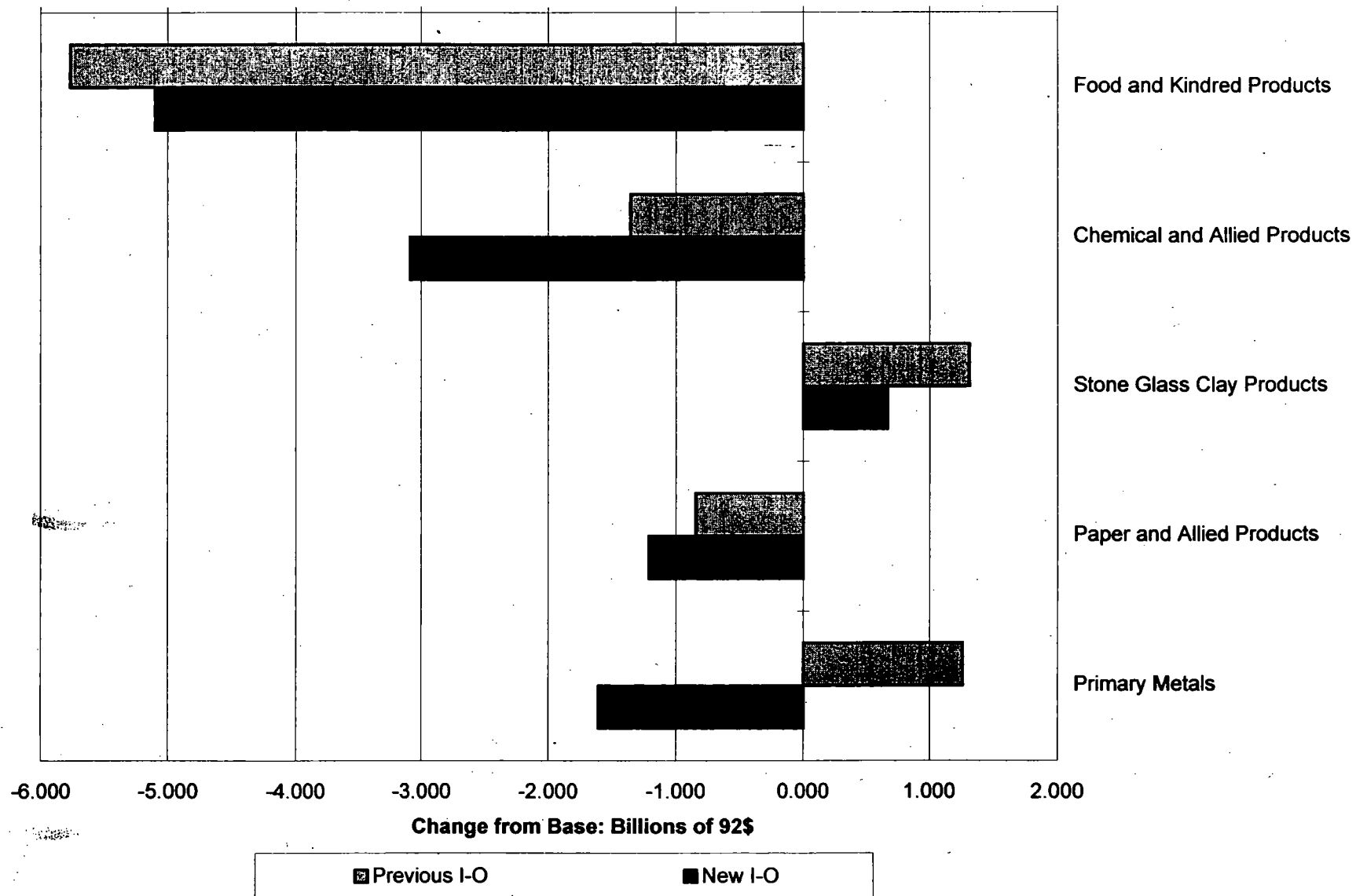
Energy Intensive Industry Imports: 2010



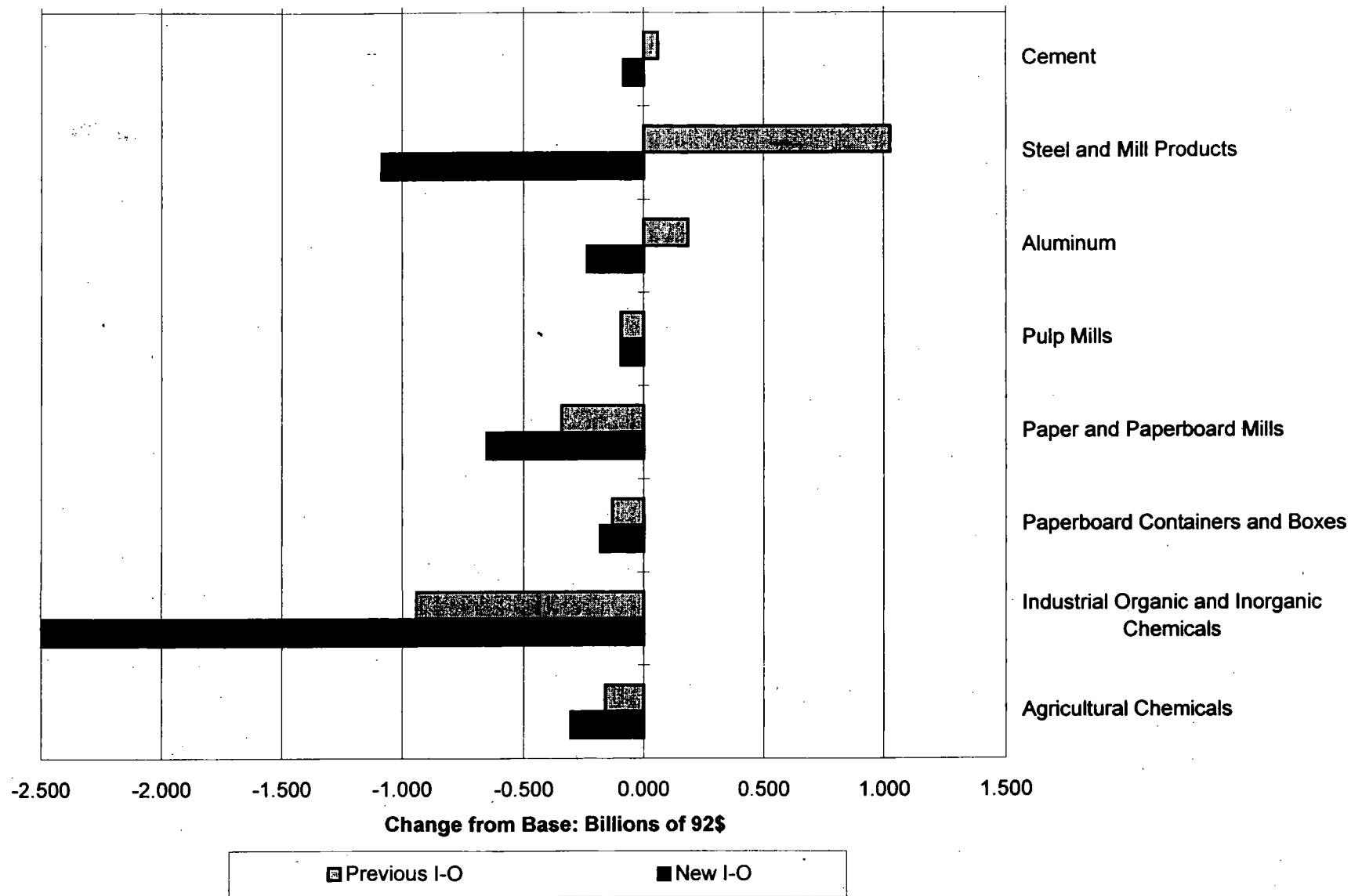
Energy Intensive Industry Exports: 2010



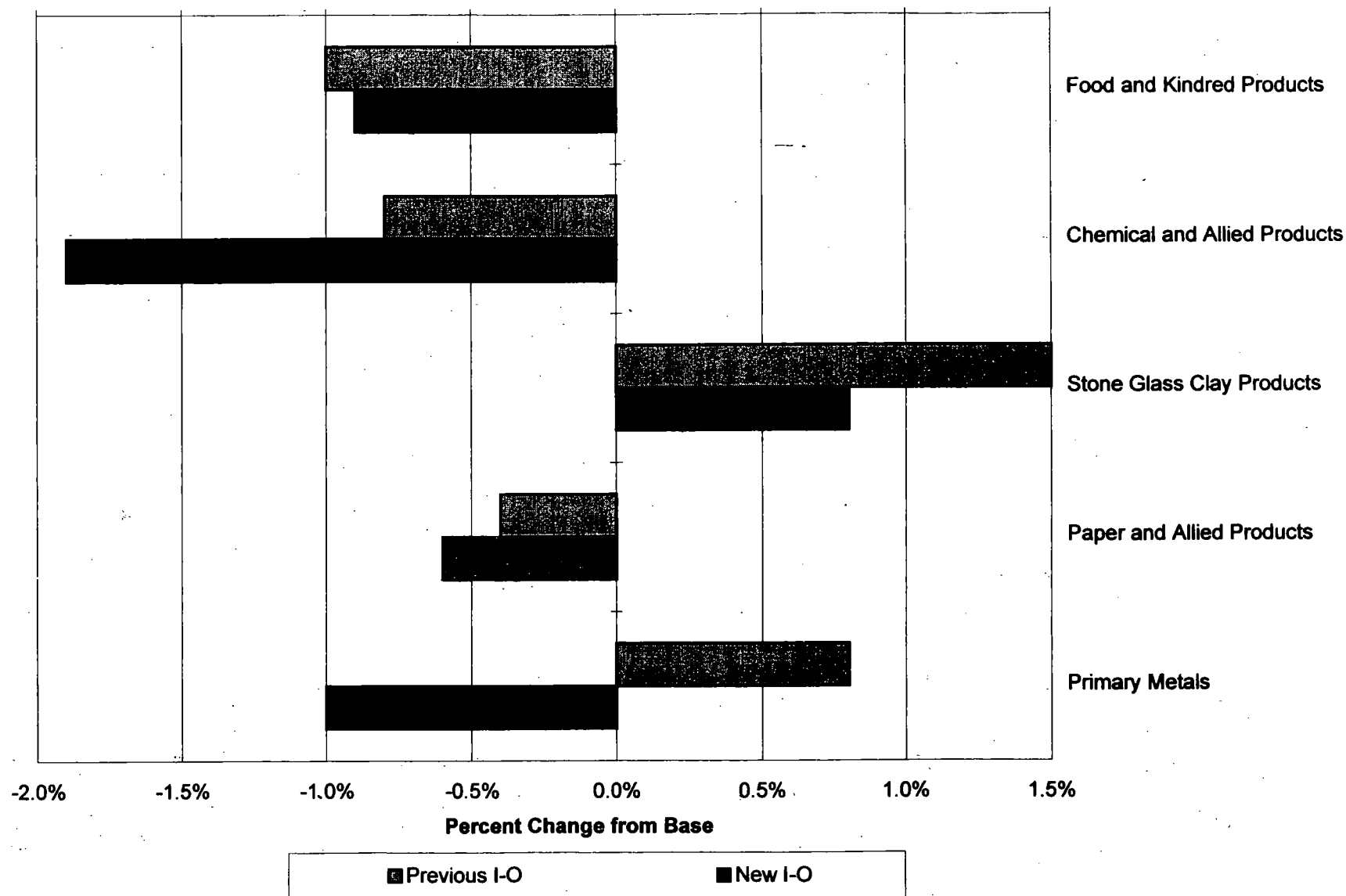
Output Changes: 2010



Output Changes: 2010

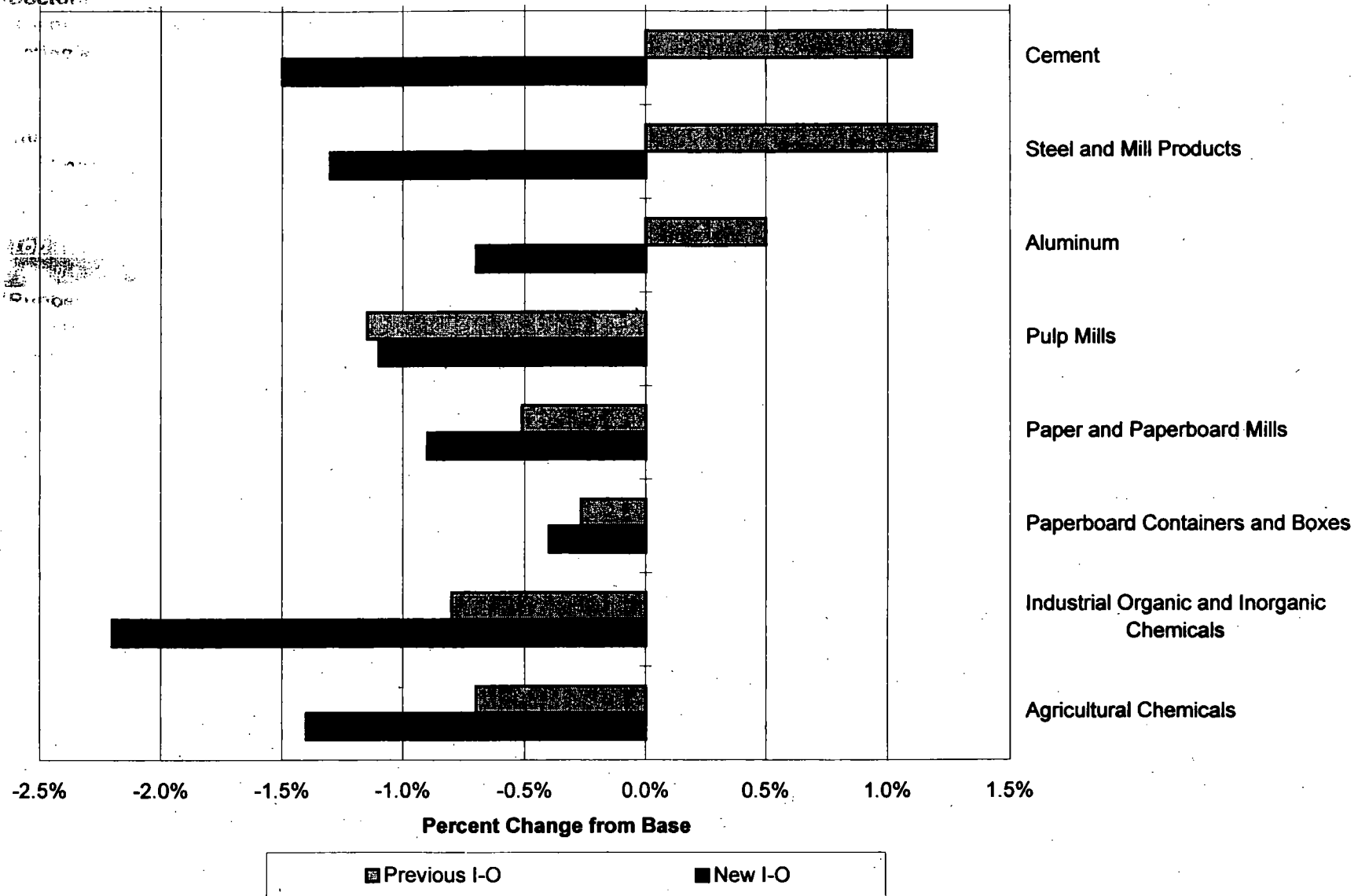


Output Changes: 2010



Output Changes: 2010

Model:
Date of Run:
Scenario:



New I-O Analysis

<i>Top Ten Industries: Dollars Below Base Output in 2010 *</i>			<i>Top Ten Industries: Dollars Below Base Output in 2020 *</i>		
<i>*(Excluding Energy Production Sectors)</i>	Billions of 92\$	% Above Base	<i>*(Excluding Energy Production Sectors)</i>	Billions of 92\$	% Above Base
Semiconductors	-8.298	-2.0%	Semiconductors	-35.311	-3.3%
Maintenance and Repair Construction	-7.156	-2.1%	Computers	-13.881	-6.1%
Real Estate	-4.345	-0.6%	Maintenance and Repair Construction	-5.902	-1.5%
Doctors and Dentists	-3.156	-1.3%	Computer Peripherals and Equipment	-4.583	-4.6%
Hospitals	-3.138	-1.3%	Misc. Electronic Components	-3.253	-1.7%
Eating and Drinking Establishments	-3.042	-0.8%	Industrial Organic and Inorg. Chemicals	-2.589	-2.1%
Computers	-3.015	-2.1%	Household Audio and Video Equipment	-1.270	-6.1%
Computer Peripherals and Equipment	-2.939	-1.0%	Railroads and Related Services	-1.022	-1.6%
Industrial Organic and Inorg. Chemicals	-2.493	-2.2%	Steel and Mill Products	-0.969	-1.2%
Auto Repair and Related Services	-2.203	-1.2%	Metal Coating and Engraving	-0.757	-1.9%
Insurance Carriers and Agents	-2.148	-0.6%	Computer Processing and Software	-0.742	-0.2%

<i>Top Ten Industries: Percent Below Base Output in 2010 *</i>			<i>Top Ten Industries: Percent Below Base Output in 2020 *</i>		
<i>*(Excluding Energy Production Sectors)</i>	% Above Base	Billions of 92\$	<i>*(Excluding Energy Production Sectors)</i>	% Above Base	Billions of 92\$
Rubber and Plastic Footware	-10.3%	-0.088	Household Audio and Video Equipment	-6.1%	-1.270
Nonferrous Metals	-3.2%	-0.304	Computers	-6.1%	-13.881
Household Audio and Video Equipment	-3.2%	-0.568	Nonferrous Metals	-5.4%	-0.510
Chemical and Fertilizer Mining	-3.1%	-0.092	Watches and Clocks	-4.9%	-0.030
Watches and Clocks	-2.8%	-0.018	Computer Peripherals and Equipment	-4.6%	-4.583
Iron and Ferroalloy Ores	-2.6%	-0.080	Rubber and Plastic Footware	-3.9%	-0.034
Other Leather Goods	-2.5%	-0.048	Misc. Nonferrous Ores	-3.7%	-0.362
Nonferrous Wire and Cable	-2.5%	-0.463	Semiconductors	-3.3%	-35.311
Misc. Nonferrous Ores	-2.3%	-0.215	Chemical and Fertilizer Mining	-3.3%	-0.083
Industrial Organic and Inorg. Chemicals	-2.2%	-2.493	Mobile Homes	-3.1%	-0.233
Computers	-2.1%	-3.015	Truck and Bus Bodies	3.5%	0.281

New I-O Analysis

Top Ten Industries: Dollars Above Base Output in 2010

	Billions of 92\$	% Above Base
New Construction	8.423	2.8%
Motor Vehicles	3.975	1.4%
Aircraft	1.919	3.0%
Engineering, Architecture and Surveying	1.070	1.0%
Structural Metal Products	1.004	2.2%
Lumber Mill and Wood Products	0.747	1.7%
Telecommunications Equipment	0.746	1.6%
Concrete and Gypsum	0.691	2.1%
Refrigeration and Heating Equipment	0.586	1.7%
Aircraft Parts and Equipment	0.469	1.8%
Medical Equipment	0.454	1.9%

Top Ten Industries: Dollars Above Base Output in 2020

	Billions of 92\$	% Above Base
Retail Trade	22.643	2.3%
New Construction	17.688	5.4%
Security and Commodity Brokers	9.767	1.5%
Motor Vehicles	8.375	2.4%
Telecommunications and Cable Services	7.220	1.3%
Owner-Occupied Dwellings	6.924	1.4%
Wholesale Trade	6.085	0.6%
Real Estate	4.383	0.6%
Insurance	4.169	1.0%
Social Services	3.366	2.2%
Recreation Services	3.327	2.3%

Top Ten Industries: Percent Above Base Output in 2010

	% Above Base	Billions of 92\$
Aircraft	3.0%	1.919
Truck Trailers	3.0%	0.200
New Construction	2.8%	8.423
Truck and Bus Bodies	2.7%	0.202
Partitions and Fixtures	2.5%	0.344
Lawn and Garden Equipment	2.3%	0.169
Elevators and Materials Handling Equipment	2.3%	0.196
Structural Metal Products	2.2%	1.004
Concrete and Gypsum	2.1%	0.691
Plumbing and Heating Equipment	2.1%	0.144
Packaging Machinery	2.1%	0.092

Top Ten Industries: Percent Above Base Output in 2020

	% Above Base	Billions of 92\$
New Construction	5.4%	17.688
Concrete and Gypsum	4.3%	1.507
Plumbing and Heating Equipment	4.0%	0.277
Sawmills	4.0%	1.139
Veneer and Plywood	4.0%	0.276
Partitions and Fixtures	3.9%	0.584
Lumber Mill and Wood Products	3.9%	1.941
Aircraft	3.7%	2.942
Truck Trailers	3.7%	0.251
Floor Coverings	3.6%	0.552
Truck and Bus Bodies	3.5%	0.281

Key Industry Trade Impacts: 2010

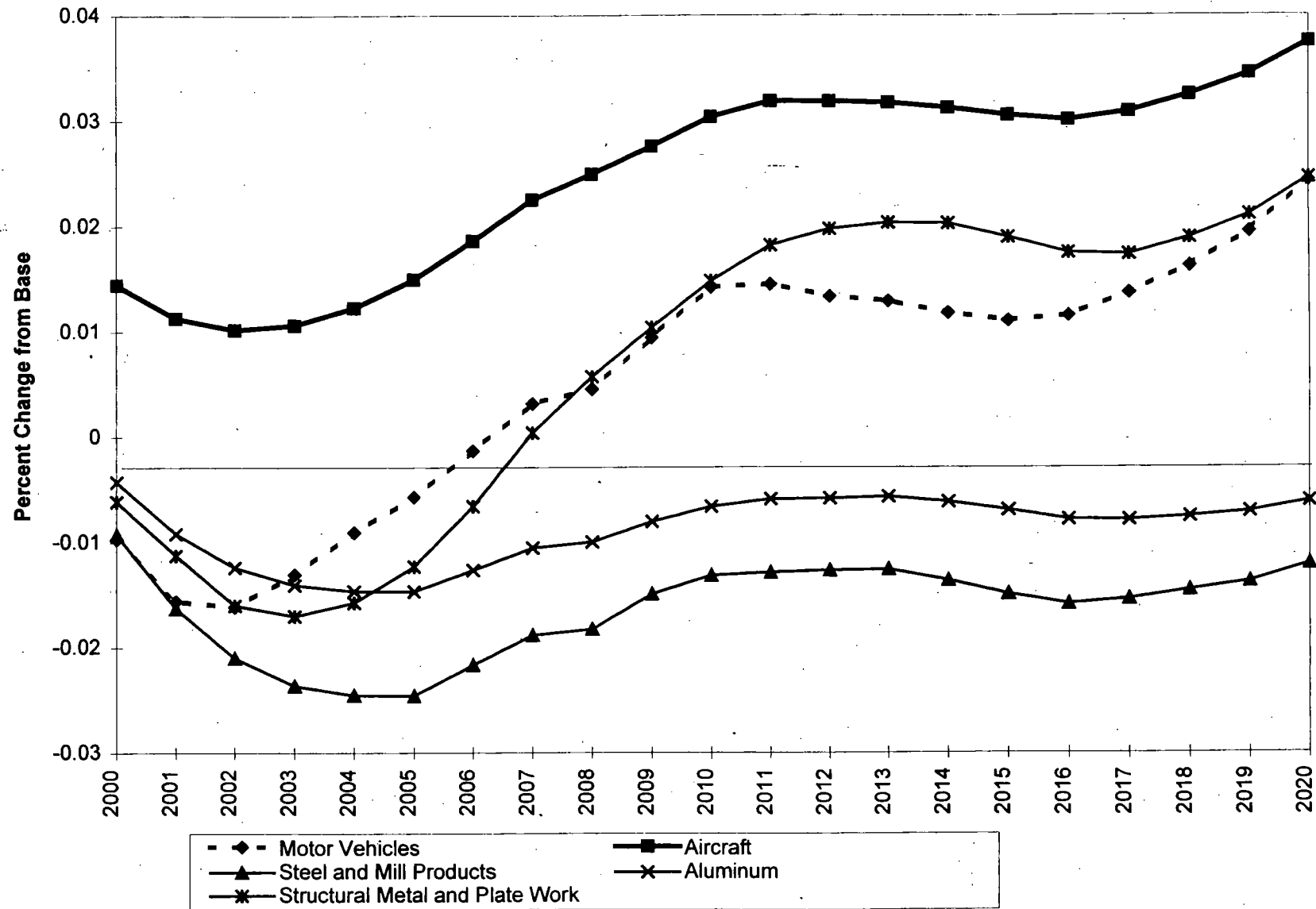
	Imports		Exports		% Chg from Base	
	Base Level	Policy Level	Base Level	Policy Level	Imports	Exports
Paper and Allied Products						
Pulp Mills	2.367	2.390	2.926	2.927	0.9%	0.0%
Paper and Paperboard Mills	10.098	10.325	7.759	7.717	2.3%	-0.5%
Paperboard Boxes and Containers	0.408	0.415	1.568	1.565	1.6%	-0.2%
Paper Coating and Laminating	0.747	0.756	2.205	2.206	1.2%	0.1%
Sanitary Paper Products	0.793	0.799	4.853	4.868	0.8%	0.3%
Chemical and Allied Products						
Industrial Inorg. and Organic Chemicals	27.419	28.409	34.136	33.809	3.6%	-1.0%
Fertilizers	1.561	1.644	0.101	0.099	5.3%	-2.0%
Pesticides and Agr. Chemicals	0.626	0.627	1.151	1.155	0.2%	0.4%
Petroleum and Coal Products						
Petroleum Refining	10.652	9.831	4.464	4.485	-7.7%	0.5%
Fuel Oil	12.419	7.629	4.345	4.370	-38.6%	0.6%
Stone Glass and Clay Products						
Cement	1.117	1.265	0.139	0.135	13.2%	-2.8%
Concrete and Gypsum	0.563	0.593	0.286	0.286	5.3%	-0.2%
Cut Stone and Lime	1.152	1.238	0.119	0.117	7.4%	-1.1%
Primary Metals						
Steel and Mill Products	21.165	22.569	12.368	12.194	6.6%	-1.4%
Iron and Steel Foundries	0.422	0.434	0.561	0.561	2.7%	0.0%
Iron and Steel Forgings	0.153	0.159	0.050	0.050	3.6%	-0.1%
Aluminum	7.369	7.649	6.307	6.276	3.8%	-0.5%
Transportation Equipment						
Truck and Bus Bodies	0.570	0.589	0.052	0.052	3.4%	0.1%
Truck Trailers	0.269	0.282	0.874	0.874	4.7%	0.0%
Motor Vehicles	106.120	109.434	53.202	53.154	3.1%	-0.1%
Motor Vehicle Parts and Accessories	36.150	36.656	65.328	65.298	1.4%	0.0%
Aircraft	3.741	3.851	26.548	27.542	3.0%	3.7%
Aircraft and Missile Engines and Parts	8.390	8.518	9.194	9.424	1.5%	2.5%
Computer and Electronic Equipment						
Computers	164.096	168.538	98.807	97.993	2.7%	-0.8%
Computer Peripheral Equipment	121.748	124.595	41.961	41.871	2.3%	-0.2%
Semiconductors	442.555	443.791	262.638	261.126	0.3%	-0.6%

New I-O Results

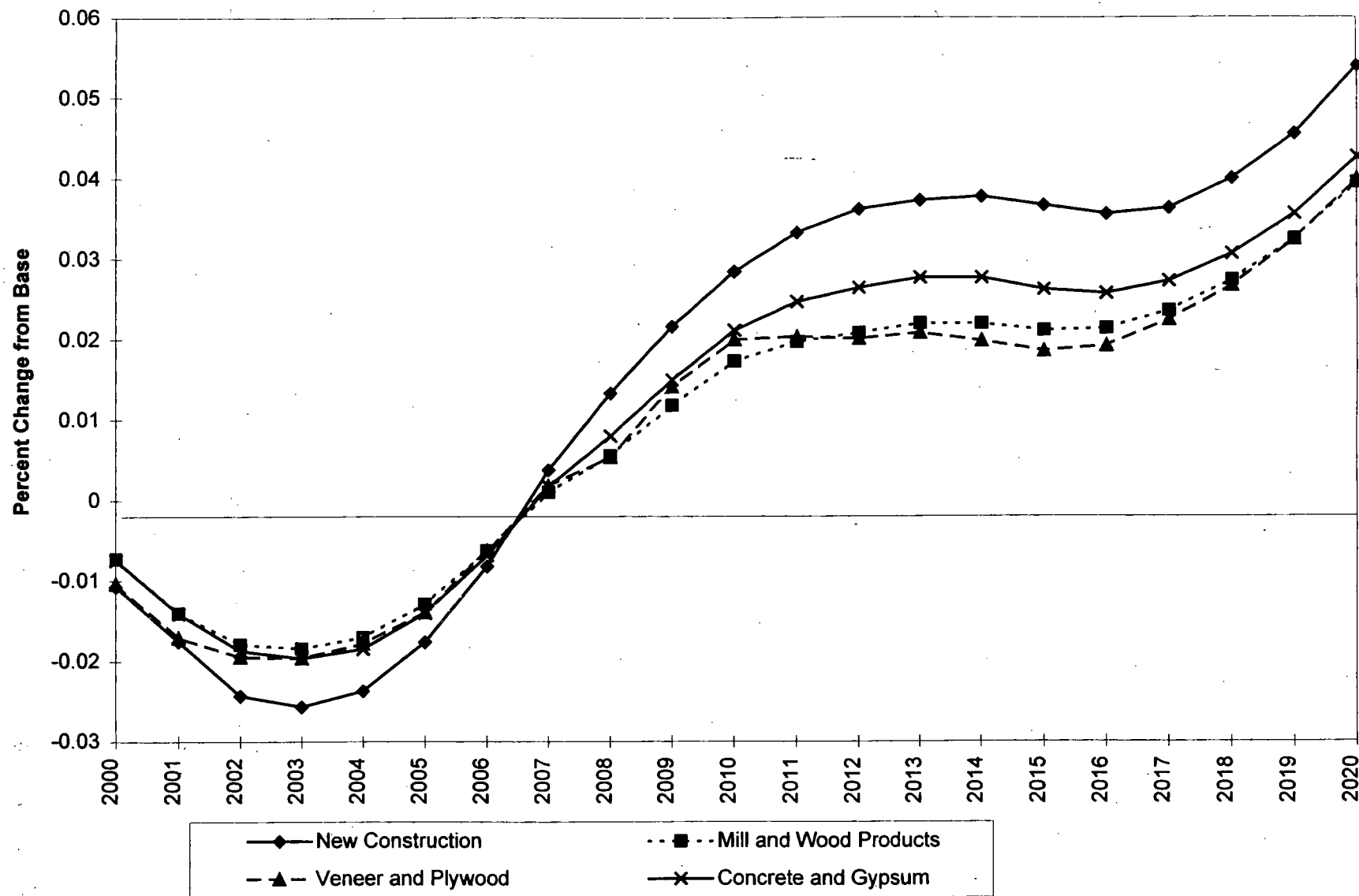
<u>Manufacturing Industries</u>	Change from Base		\$\$ Change from Base	
	2010	2020	2010	2020
Food and Kindred Products	-0.9%	0.2%	-5.101	1.106
Textile and Apparel	-0.3%	1.6%	-0.692	3.844
Lumber and Wood Products	1.5%	3.2%	1.640	3.746
Furniture and Fixtures	1.5%	3.1%	0.821	1.874
Paper and Allied Products	-0.6%	0.4%	-1.212	0.817
Printing and Publishing	-0.5%	0.8%	-1.119	1.796
Chemical and Allied Products	-1.9%	-1.6%	-3.090	-2.917
Plastics Materials and Resins	-0.4%	0.3%	-0.313	0.282
Petroleum and Coal Products	-9.2%	-10.0%	-18.563	-20.828
Rubber and Misc. Plastics Products	-0.3%	0.4%	-0.879	1.147
Leather and Leather Products	-1.4%	1.0%	-0.117	0.094
Stone Glass Clay Products	0.8%	2.3%	0.672	2.053
Primary Metals	-1.0%	-1.0%	-1.608	-1.653
Fabricated Metal Products	0.6%	1.2%	1.438	3.412
Industrial Machinery and Equipment	-0.2%	-2.0%	-1.125	-13.610
Electronic and Other Electrical Equipment	-1.0%	-2.4%	-8.357	-37.753
Transportation Equipment	1.2%	2.0%	7.523	15.652
Instruments and Related Equipment	0.8%	1.4%	1.573	3.428
Misc. Manufacturing Industries	-0.6%	0.4%	-0.378	0.268

<u>Non-manufacturing Industries</u>	Change from Base		\$\$ Change from Base	
	2010	2020	2010	2020
Agriculture Forestry and Fishing	-0.7%	0.3%	-2.506	1.095
Mining and Fossil Fuel Extraction	-15.3%	-18.8%	-26.169	-33.085
Construction	0.2%	1.6%	1.267	11.787
Transportation Services	-1.0%	-0.1%	-5.685	-0.692
Telecommunications and Broadcasting	-0.4%	1.2%	-2.210	7.686
Utilities	-10.2%	-14.1%	-39.683	-59.766
Wholesale Trade	-0.2%	0.6%	-1.738	6.085
Retail Trade	-0.1%	2.3%	-1.320	22.643
FIRE	-0.4%	1.0%	-9.674	31.971
General and Professional Services	-0.7%	0.7%	-25.308	31.971
Government	-1.1%	0.6%	-1.868	1.184
Total	-0.9%	-0.1%	-143.781	-16.363

Output in Key Industries



Output in Key Industries



• Subs, dies $\Rightarrow$

• Jeff (2) TIME SERIES ANALYSIS E/GDP
FNC OF ENERGY PRICES - ~~dist~~^{tributive} lag on prices
 $\Rightarrow$ call list $\Rightarrow$ Price

• conference call

^{Thomas}
Mike, Bob, Jay, Me
(st. they wed. morning)

Kaufman
Stavins

AEO '97

$\Rightarrow$ MEMO - E/GDP stagled E/GDP ratios from 1980 on
+ energy prices
Treat ink all over

BETA $\Rightarrow$ Change in E/GDP per year - plot out

$\Rightarrow$ From Phil (1) What is 1995: 2000? rational expectations
Is that pre-announced?
RE (2) Is 2000 when the policy comes in?
(for policy)

for. Since Ohio State

1:30 or later

DATA TO 1.XLS

Withdrawal/Redaction Marker

Clinton Library

DOCUMENT NO. AND TYPE	SUBJECT/TITLE	DATE	RESTRICTION
001. notes	[Handwritten meeting notes] [PII] [partial] (1 page)	00/00/0000	b(6)

COLLECTION:

Clinton Presidential Records
Council of Economic Advisers
Subject Files
OA/Box Number: 20729

FOLDER TITLE:

Climate Change [Binder] [3]

2017-1095-F
bg229

RESTRICTION CODES

Presidential Records Act - [44 U.S.C. 2204(a)]

- P1 National Security Classified Information [(a)(1) of the PRA]
- P2 Relating to the appointment to Federal office [(a)(2) of the PRA]
- P3 Release would violate a Federal statute [(a)(3) of the PRA]
- P4 Release would disclose trade secrets or confidential commercial or financial information [(a)(4) of the PRA]
- P5 Release would disclose confidential advice between the President and his advisors, or between such advisors [(a)(5) of the PRA]
- P6 Release would constitute a clearly unwarranted invasion of personal privacy [(a)(6) of the PRA]

C. Closed in accordance with restrictions contained in donor's deed of gift.

PRM. Personal record misfile defined in accordance with 44 U.S.C. 2201(3).

RR. Document will be reviewed upon request.

Freedom of Information Act - [5 U.S.C. 552(b)]

- b(1) National security classified information [(b)(1) of the FOIA]
- b(2) Release would disclose internal personnel rules and practices of an agency [(b)(2) of the FOIA]
- b(3) Release would violate a Federal statute [(b)(3) of the FOIA]
- b(4) Release would disclose trade secrets or confidential or financial information [(b)(4) of the FOIA]
- b(6) Release would constitute a clearly unwarranted invasion of personal privacy [(b)(6) of the FOIA]
- b(7) Release would disclose information compiled for law enforcement purposes [(b)(7) of the FOIA]
- b(8) Release would disclose information concerning the regulation of financial institutions [(b)(8) of the FOIA]
- b(9) Release would disclose geological or geophysical information concerning wells [(b)(9) of the FOIA]

CPR

NLSR - NLSR Institute for Dispute Resolution

SS6-7249

M. J. Zimmer

(b)(6)

(b)(6)

Jeremy

395-6853

Brian Cant

DOB
SSN

(b)(6)

5/19

→ 328-5091 - Mike Green

→ Mary Beth Zimmerman - how to wrap up meeting

PHOTOCOPY
PRESERVATION

From Kaufmann Ecological Econ. 1992

$$\frac{E}{GDP} = \alpha + \beta_1 h(\% \text{ petro}) + \beta_2 h(\% \text{ prim. electricity}) \\ + \beta_3 (\% \text{ PCE}) + \beta_4 (\text{product mix}) + \beta_5 (\text{price})$$

~~$\frac{E}{GDP}$~~ 

$$\frac{E}{GDP} =$$

How does E/GDP vary over time?
→ price

Energy Consumption for Energy/GDP Ratio Declining at 1.25% and 1.75% Annual Rates Starting in 2000.

Declining rates start from 1% in 2000 and increase linearly to 1.25/1.75 in 2010, and stay at 1.25/1.75 thereafter.

Year	AEO97 Energy Consumption (quads)	AEO97 GDP billion \$92	AEO97 E/GDP 000btu/\$	1.25% E/GDP Improvement	Energy Consumption (quads)	1.75% E/GDP Improvement	Energy Consumption (quads)
1995	90.93	56,739	13.49	13.49	90.93	13.49	90.93
2000	97.85	57,544	12.97	12.97	97.85	12.97	97.85
2001			12.87	12.84		12.83	
2002			12.76	12.70		12.68	
2003				12.57		12.53	
2004				12.43		12.37	
2005	103.36	58,390	12.32	12.29	103.09	12.20	102.32
2006				12.15		12.02	
2007				12.00		11.84	
2008				11.86		11.65	
2009				11.72		11.45	
2010	107.89	\$9,185	11.75	11.57	106.26	11.25	103.34
2015	110.87	\$9,880	11.22	10.86	107.33	10.30	101.76
2020		\$10,591		10.20	108.04	9.43	99.87
2025		\$11,353		9.58	108.76	8.63	98.01
2030		\$12,171		9.00	109.48	7.90	96.19
2035		\$13,047		8.45	110.21	7.24	94.40
2040		\$13,986		7.93	110.94	6.62	92.65
2045		\$14,993		7.45	111.68	6.06	90.93
2050		\$16,072		6.99	112.42	5.55	89.24
2055		\$17,229		6.57	113.17	5.08	87.58
2060		\$18,469		6.17	113.92	4.65	85.95
2065		\$19,799		5.79	114.67	4.26	84.35
2070		\$21,224		5.44	115.44	3.90	82.79
2075		\$22,752		5.11	116.20	3.57	81.25
2080		\$24,390		4.80	116.97	3.27	79.74
2085		\$26,146		4.50	117.75	2.99	78.26
2090		\$28,028		4.23	118.53	2.74	76.80
		\$30,046		3.97	119.32	2.51	75.37
		\$32,209		3.73	120.11	2.30	73.97
2105		\$34,527		3.50	120.91	2.16	72.60
2110		\$37,013		3.29	121.72	1.93	71.25
2115		\$39,677		3.09	122.52	1.76	69.93
2120		\$42,534		2.90	123.34	1.61	68.63
2125		\$45,595		2.72	124.16	1.48	67.35
2130		\$48,878		2.56	124.98	1.35	66.10
2135		\$52,396		2.40	125.81	1.24	64.87
2140		\$56,168		2.25	126.65	1.13	63.66
2145		\$60,212		2.12	127.49	1.04	62.48
2150		\$64,546		1.99	128.34	0.95	61.32
2155		\$69,193		1.87	129.19	0.87	60.18
2160		\$74,174		1.75	130.05	0.80	59.06
2165		\$79,513		1.65	130.91	0.73	57.96
2170		\$85,237		1.55	131.78	0.67	56.89
2175		\$91,373		1.45	132.65	0.61	55.83
2180		\$97,951		1.36	133.54	0.56	54.79
2185		\$105,002		1.28	134.42	0.51	53.77
2190		\$112,561		1.20	135.32	0.47	52.77
2195		\$120,664		1.13	136.21	0.43	51.79
2200		\$129,350		1.06	137.12	0.39	50.83

not enough GDP
growth after
2015 to 2020
to achieve 1.25
E/GDP.

1.25 vs. 1.25
stabilization

Targets/goals

Sheet1

AEO97	Energy	GDP	E/GDP	annual changes
1995	90.93	6739	0.013493	
2000	97.85	7544	0.012971	-0.787% 95-00
2005	103.36	8390	0.012319	-1.025% 00-05
2010	107.89	9185	0.011746	-0.948% 05-10
2015	110.87	9880	0.011222	-0.910% 10-15

-0.961% 00-15

Markal-macro

1995	91.6	6731	0.013609	
2000	96.7	7544	0.012818	-1.190% 95-00
2005	101.7	8381	0.012135	-1.090% 00-05
2010	106.6	9203	0.011583	-0.926% 05-10
2015	108.5	9883	0.010978	-1.067% 10-15

-1.028% 00-15

DI

FACSIMILE TRANSMISSION

**U.S. Department of Energy
Office of Economic Analysis**

**1000 Independence Avenue, S.W.
Room 7H-062, PE 64
Washington, D.C. 20585**

Phone #: (202) 586-4767
(FTS) 896-4767

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Date: May 21, 1997

To: Tom Rhoads

Organization/Location: CEA

Phone Number: 395-3114

Fax Number: 395-6853

Subject: Energy to GDP Ratios

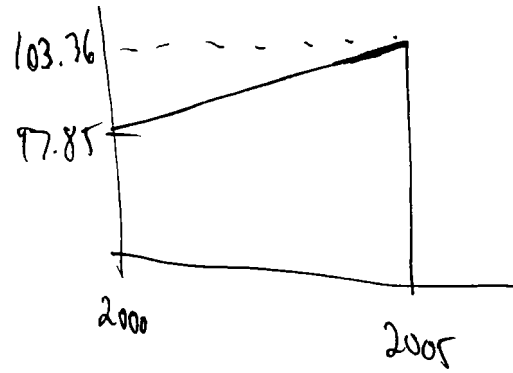
No. of Pages (with cover): 3

From: Phillip Tseng

Phone Number: 586-3892

2000	97.85
2001	98.8285
2002	99.8168
2003	100.8190
2004	101.8231
2005	102.8413

90.93



$$12.84 \times = 12.97$$

1.010125

1.011024

58.26

TABLE 3A: Fuel Shadow Prices By Sector
(1990 \$ PER MBTU)

	1990	1995	2000	2005	2010	2015	2020	2025
RESIDENTIAL SECTOR								
HEATING OIL	1.9106	1.9106	1.9106	1.9106	1.9106	1.9106	1.9106	1.9106
NATURAL GAS	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500
ELECTRICITY	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500
COMMERCIAL SECTOR								
HEATING OIL	1.9106	1.9106	1.9106	1.9106	1.9106	1.9106	1.9106	1.9106
NATURAL GAS	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500
ELECTRICITY	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500
INDUSTRIAL SECTOR								
HEATING OIL	1.9106	1.9106	1.9106	1.9106	1.9106	1.9106	1.9106	1.9106
NATURAL GAS	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500
ELECTRICITY	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500
TRANSPORTATION SECTOR								
HEATING OIL	1.9106	1.9106	1.9106	1.9106	1.9106	1.9106	1.9106	1.9106
NATURAL GAS	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500
ELECTRICITY	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500
UTILITY SECTOR								
HEATING OIL	1.9106	1.9106	1.9106	1.9106	1.9106	1.9106	1.9106	1.9106
NATURAL GAS	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500
ELECTRICITY	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500
NON-FUEL SECTOR								
HEATING OIL	1.9106	1.9106	1.9106	1.9106	1.9106	1.9106	1.9106	1.9106
NATURAL GAS	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500
ELECTRICITY	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500	0.4500

EXECUTIVE OFFICE OF THE PRESIDENT
COUNCIL OF ECONOMIC ADVISERS
WASHINGTON, D.C. 20502

1

I do not understand your
e-mail note from Phil at
all. If E/GDP between
1995-2000 = $-1.27\%/yr$,

how can it equal 1.0025 in
2000, 1.005 in 2001, etc.

until 1.25 in 2010 given
that ~~for~~ 2005-2010
 $E/GDP = -2.9\%$?

✓

Announcement effect Jan 1, 2000
 ⇒ Congress ratifies

SGM E/GDP

1.00 → 1.25

SGM uses
C/GDP

Market-Macro
12.8721

2000	1.00	3	1.0075
↓ 2001	↓ 1.0025	4	1.01
↓ 2002	↓ 1.0050	5	1.0125
2009	1.0225	6	1.015
2010	1.25	7	1.0175
↓		8	1.02
2011	1.25	9	1.0225
2012	1.25	10	1.025

Similar story for 1.75

E/GDP

DRT

2000 → 1.25
 ↓
 2010

immediately

lower baseline energy consumption

4:15 tomorrow

APA TECHNICAL AMENDMENTS

P.L. 102-354

subsection (b) of section 577, as redesignated by paragraph (2) of this section, by striking "583" and inserting "573";

and

(4) in subsection (b)(2) of section 581, as redesignated by paragraph (2) of this section, by striking "590" and inserting "580".

SEC. 4. CLERICAL AMENDMENTS.

The table of sections at the beginning of chapter 5 of title 5, United States Code, is amended by striking "SUBCHAPTER III" and all that follows through the end of the table and inserting the following:

"SUBCHAPTER III—NEGOTIATED RULEMAKING PROCEDURE

- *Sec. 561. Purpose.
- *Sec. 562. Definitions.
- *Sec. 563. Determination of need for negotiated rulemaking committee.
- *Sec. 564. Publication of notice; applications for membership on committees.
- *Sec. 565. Establishment of committee.
- *Sec. 566. Conduct of committee activity.
- *Sec. 567. Termination of committee.
- *Sec. 568. Services, facilities, and payment of committee member expenses.
- *Sec. 569. Role of the Administrative Conference of the United States and other entities.
- *Sec. 570. Judicial review.

"SUBCHAPTER IV—ALTERNATIVE MEANS OF DISPUTE RESOLUTION IN THE ADMINISTRATIVE PROCESS

- *Sec. 571. Definitions.
- *Sec. 572. General authority.
- *Sec. 573. Neutrals.
- *Sec. 574. Confidentiality.
- *Sec. 575. Authorization of arbitration.
- *Sec. 576. Enforcement of arbitration agreements.
 - Arbitrators.
 - Authority of the arbitrator.
 - Arbitration proceedings.
 - Arbitration awards.
- *Sec. 581. Judicial review.
- *Sec. 582. Compilation of information.
- *Sec. 583. Support services.

"SUBCHAPTER V—ADMINISTRATIVE CONFERENCE OF THE UNITED STATES

- *Sec. 591. Purpose.
- *Sec. 592. Definitions.
- *Sec. 593. Administrative Conference of the United States.
- *Sec. 594. Powers and duties of the Conference.
- *Sec. 595. Organization of the Conference.
- *Sec. 596. Authorization of appropriations."

SEC. 5. ADDITIONAL TECHNICAL AND CONFORMING AMENDMENTS.

a) NEGOTIATED RULEMAKING ACT OF 1990.—(1) Section 4 of the Negotiated Rulemaking Act of 1990 (Public Law 101-648; 104 Stat. 4976) is amended by striking "576" and inserting "596".

5 USC 561 note.

(2) Section 5 of that Act is amended—

(A) by striking "Subchapter IV" and inserting "Subchapter III of chapter 5";

(B) by striking ", as added by section 3 of this Act," and inserting "(enacted as subchapter IV of chapter 5 of title 5, United States Code, by section 3 of this Act and redesignated as subchapter III of such chapter 5 by section (3)(a) of the Administrative Procedure Technical Amendments Act of 1991)";

and



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May 28, 1997

Ms. Alicia Munnell

Member

Council of Economic Advisers

Old Executive Office Building, Room 314

Washington, DC 20502

Dear Alicia:

Thank you for taking the time to meet with my staff and me recently. ^(4/30) We appreciated having the opportunity to share with you the Center's views on the issues of greenhouse gas trading and joint implementation.

As a follow-up to our discussion, I wanted to make some formal recommendations to you and the Interagency Task Force for changes in the U.S. draft protocol proposal to be submitted June 1. I have enclosed two papers which present the Center's recommendations and rationale in some detail.

On the issue of the integration of joint implementation into an Annex I greenhouse gas trading system, we recommend that the U.S. *drop the additionality test* for 1) projects that reduce net emissions (fuel switching, efficiency improvement and other projects that reduce emissions at existing facilities); and 2) all renewable energy projects, which clearly do not increase GHG emissions. Dropping the additionality test would make credits produced by these projects more fungible, increase transparency and reduce transaction costs associated with the current JI process both here and abroad.

We also recommend the *discounting of JI project credits* to account for uncertainty and to improve the credibility of JI generally. Discounting JI credits across the board by ten percent would provide non-Annex I countries with financial incentives to opt into binding commitments. In addition to this system-level discount, we suggest that a country-level discount of 20 percent be applied to JI project credits flowing from countries with weaker monitoring and reporting systems. Based on in-country review, the Secretariat would decide whether or not this discount should be applied to a particular country.

We suggest that the U.S. protocol proposal on joint implementation be amended to account for these points. Specifically, we recommend the following changes:

cc: SS
TR
SR

1. Article 7.2 (b) should be modified as follows:

(b) Projects other than those that employ renewable energy sources or result in net reductions of greenhouse gas emissions at existing facilities must provide a reduction in emissions that is additional to any that otherwise would occur. (New language has been underlined; we suggest that "renewable energy sources" be defined in the protocol to include wind, solar and biomass.)

2. A new Article 7.5 should be added to the protocol. It would read as follows:

Reviews of non-Annex I greenhouse gas emissions calculation, measurement, monitoring, verification, review and reporting practices will be conducted by expert review teams, which will be coordinated by the secretariat and composed of experts selected from those nominated by Parties and, as appropriate, by intergovernmental organizations. Reviews will be conducted in accordance with guidelines to be adopted by the Meeting of the Parties. Expert reviews will result in a judgment as to whether or not the calculation, measurement, monitoring, verification, review and reporting practices of the country under review meet the guidelines established under Article 3 for Annex I Parties for such activities. (New language has been underlined.)

3. Finally, the existing Article 7.5, which would become Article 7.6, should be amended as follows:

An Annex A or Annex B Party may acquire tonnes of carbon equivalent emissions allowed under this Article for the purpose of meeting its obligations under Article 2, provided it is in compliance with its obligations under Article 3 (Measurement and Reporting). If, pursuant to the review process described in Article 7.5, the Party transferring emissions has been found to employ practices substantially equivalent to those defined under Article 3 for the calculation, measurement, monitoring, verification, review and reporting of greenhouse gas emissions, then the Party acquiring the emissions may add 90 percent of acquired emissions to its emissions budget. If the practices of the Party transferring emissions have been found to not be substantially equivalent to those defined under Article 3, then the Party acquiring the emissions may add 70 percent of acquired emissions to its emissions budget. (New language has been underlined.)

On the issue of compliance, we believe that *maintaining the integrity of the trading system* will be of primary importance in ensuring that trading is successful in helping Annex I countries to meet their GHG commitments. This may best be accomplished by requiring participants in trading to maintain strong domestic compliance systems as a condition of participation in trading. We suggest that the preconditions for participation in trading include the establishment of *tough domestic financial penalties* (commensurate with the marginal cost of reducing GHG emissions to required levels) on companies that exceed allowed emissions, in addition to the requirements already provided for in the U.S. proposal.

We also recommend a *rigorous international compliance system*, the features of which would include: annual monitoring and reporting (as called for in the U.S. proposal), in-depth reviews both during and at the end of budget periods, and, if interim in-depth reviews uncover major weaknesses in domestic administrative systems, interim sanctions such as the *loss of the right to sell allowances or inclusion on a Greenhouse Watch List*. In addition, strict end-of-period sanctions also should be imposed. *Trade*

sanctions and financial penalties on countries probably would be most effective but probably are not politically feasible. Preferred options include a reduction of future allowances and loss of the right to sell allowances.

To implement our recommendation regarding domestic compliance penalties, we suggest that Article 6.1 of the U.S. protocol proposal be revised as follows:

An Annex A or Annex B Party that is in compliance with its obligations under Article 3 (Measurement and Reporting), has in place a national mechanism for the certification and verification of trades, and has established financial penalties against domestic entities for non-compliance with emissions reduction requirements, may transfer to or receive from, any Annex A or Annex B Party, any of its tonnes of carbon equivalent emissions allowed for a budget period, for the purpose of meeting its obligations under Article 2. Financial penalties should be established on a per tonne of carbon equivalent basis commensurate with the marginal cost of reducing such carbon equivalent emissions to required levels. (New language has been underlined.)

Alicia, I hope you find these proposed amendments to be helpful improvements to the U.S. protocol proposal. As you know, the Center strongly supports the U.S. position regarding emissions budgets and trading, and we believe these changes will enhance your pathbreaking proposal. If you have any questions or comments on our recommendations, please do not hesitate to call me. We thank you for your consideration of our ideas.

Sincerely,

Edward A. Helme
Executive Director

enclosures

Integration of Joint Implementation into an Annex I Greenhouse Gas Trading System Summary of Key Points

1. The U.S. is advocating the establishment of a greenhouse gas (GHG) **trading** system and the continuation of **joint implementation** (JI).
 2. A critical issue that policymakers will face is **how to integrate** GHG reductions from JI projects into a trading system. Two characteristics of the current JI system could impede the integration of JI into the trading system:
 - the **administrative burden** associated with JI project approval, which restricts the flow of JI project credits. In particular, the **additionality test** is time-consuming and subjective; and
 - **uncertainty** about the legitimacy of some JI project credits, which could undermine confidence in trading and create doubt as to whether trading was contributing to the meeting of Annex I GHG emissions targets. Reasons behind the uncertainty of JI credits include: a lack of national caps in host countries, which means that **leakage** of emissions from JI projects to other activities may occur; problems in developing **baselines** against which projects are judged; and difficulty in **measuring** project emissions.
 3. We advocate that the **additionality test be dropped** for 1) projects that reduce net emissions (fuel switching, efficiency improvement and other projects that reduce emissions at existing facilities); and 2) all renewable energy projects, which certainly do not increase GHG emissions. Dropping the additionality test would make credits produced by these projects more fungible.
 4. In addition, we advocate the **discounting of JI project credits**. Discounting would reduce the number of credits flowing from JI projects to **account for uncertainty**. Two discounts would be applied:
 - **system level**: All JI project credits entering the trading system would be subject to one uniform discount relative to Annex I emissions allowances.
 - **country level**: This discount would adjust for the fact that the quality of GHG monitoring and reporting systems will vary across countries. Based on in-country review, the Secretariat would decide whether or not this discount should be applied to the country in question.
- Discounting would provide non-Annex I countries with **financial incentives** to opt into binding commitments and to develop stronger administrative systems.
5. Predetermined discounting would be preferable to leaving discounting to the market because it would provide **added incentive to adopt targets and develop strong GHG control infrastructure**. In addition, under market-driven discounting, buyers would address uncertainty by reducing the **price** they offer rather than by discounting reductions. This would introduce doubt as to whether purchasing countries were really meeting their emissions reduction targets.

Methods for Ensuring Compliance in an International Greenhouse Gas Trading System: Summary of Key Points

1. An **international cap-and-trade system** in principle appears to be one of the most cost-effective means of reducing GHG emissions.
2. **Maintaining the integrity of the trading system** is of primary importance in ensuring that trading helps countries to meet their GHG commitments. This may best be accomplished by limiting participation in trading to **Annex I countries that maintain strong domestic compliance systems**. At first, trading will be country-to-country but should quickly evolve to **include companies**. Preserving the integrity of the trading system will also require the establishment of a **strong international compliance system**.
3. **Domestic Compliance**: The U.S. protocol proposal establishes a number of preconditions for participation in trading. These include the adoption of international measurement standards and the establishment of domestic compliance and enforcement programs. In addition to these, minimum preconditions for participation in trading should include establishment of a) **tough domestic financial penalties** on companies that exceed allowed emissions; and b) **seller responsibility** for the quality of allowances traded.
4. **International Compliance**: Key features of the international compliance system include:
 - A. **Interim compliance**: Reporting should occur annually, as called for in the U.S. proposal, while in-depth reviews should take place both during and at the end of budget periods. If interim in-depth reviews uncover major weaknesses in domestic administrative systems, then interim sanctions should be applied. These could include *loss of the right to sell allowances or inclusion on a Greenhouse Watch List*.
 - B. Strict rules regarding the **participation of companies from countries not adopting cap-and-trade systems**. Only the governments of these countries should engage in trading; they could make side arrangements with companies making GHG reductions.
 - C. **The imposition of sanctions**: End-of-period sanctions could include *trade sanctions and financial penalties on countries*, although both of these would be politically difficult to achieve. Financial penalties would be imposed per ton of exceedance and be large enough to deter violations. More feasible sanctions options include *a reduction of future allowances and loss of the right to sell allowances*.
5. The **protocol** adopted in Kyoto should establish the preconditions for participation in trading. In addition to the requirements already provided for in the U.S. protocol, these preconditions should include the establishment of tough domestic financial penalties for non-compliance.

FAX

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Date May 28, 1997

Number of pages including cover 6

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REMARKS:☐ Urgent☒ For your review☐ Reply ASAP☐ Please comment

Attached please find a copy of a letter that will be coming by mail to you later this week. The letter offers several recommendations regarding the U.S. Kyoto protocol proposal. Also attached are one-page summary versions of two papers we are sending you.

We enjoyed meeting with you recently and hope that you find our proposals helpful.

E/GDP

The confusion is over short-term and long-term changes in the E/GDP ratio.

1. ^{after shock} In the ~~short term~~, higher energy prices due to carbon policy will increase the penetration rate of more energy efficient technologies. The average historical rate between 1975-1986 equaled -2.4%/year. In Markal-Macro the low-technology case (1.25) translates into an average E/GDP = -2.9%/year between 2005-2010. In DRI the low-technology case (1.25) translates into an average E/GDP = -2.4%/year between 2005-2010.

In Markal-Macro the **high-technology** case (1.75) translates into an average E/GDP = -2.0%/year between 2005-2010.

2. ^{post shock} In the ~~long term~~, after energy prices stabilize at the optimal level of efficiency in the economy (i.e., optimal new technology choices), the E/GDP ratio should stabilize at a lower level that reflects a long term rate based on capital stock turnover rate and R&D investment (energy prices have stabilized). The average historical long-term rate between 1987-1995 after the oil shock equaled -0.06%/year. But in Markal-Macro the 1.25 case translates into an average E/GDP = -1.13%/year between 2010-15 and -0.64%/year 2015-20. In DRI with the 1.25 case this translates into an average E/GDP = -2.0%/year between 2010-15 and -1.4%/year 2015-20. → Exhausted all the opportunities earlier

In Markal-Macro the **high-technology** case (1.75) translates into an average E/GDP = -1.47%/year between 2010-15, and E/GDP = -0.86%/year ₂₀₁₅₋₂₀₂₀.

3. The assumed ^{immediate} ~~short term~~ effect of the carbon shock seems reasonable, but the assumed ~~long term~~ ^{post shock} persistence seems too high given historical evidence.
4. The high E/GDP ratio is due in large part to a slow down of long-run GDP (2010- 2015) to an average annual growth rate of 1.4%/year; and for (2015-20) 1.2%/year.

Lower energy cost
Lower E/GDP profile
2000 already
(2000-05)
2%

E/GDP ~ 1.25
Assumed effect
- lower hurdle rate
- more tech progress

Table 1.7 Energy Consumption per Dollar of Gross Domestic Product, 1949-1995

Year	Energy Consumption			Gross Domestic Product (GDP) ¹	Energy Consumption per Dollar of GDP			
	Petroleum and Natural Gas	Other Energy	Total		Petroleum and Natural Gas	Other Energy	Total	Change from Previous Year
	Quadrillion Btu	Quadrillion Btu	Quadrillion Btu		Thousand Btu per Chained (1992) Dollar	Thousand Btu per Chained (1992) Dollar	Thousand Btu per Chained (1992) Dollar	Percent ²
1949	17.03	13.43	30.46	()	()	()	()	()
1950	19.28	13.79	33.08	()	()	()	()	()
1951	21.48	13.99	35.47	()	()	()	()	()
1952	22.51	12.80	35.30	()	()	()	()	()
1953	23.46	12.81	36.27	()	()	()	()	()
1954	24.17	11.10	35.27	()	()	()	()	()
1955	25.25	12.57	38.82	()	()	()	()	()
1956	27.55	12.83	40.38	()	()	()	()	()
1957	25.12	12.36	40.46	()	()	()	()	()
1958	29.19	11.16	40.35	()	()	()	()	()
1959	31.04	11.10	42.14	R2,212.3	R14.03	R5.02	R19.05	()
1960	32.30	11.50	43.80	R2,261.7	R14.28	R5.08	R19.37	1.7
1961	33.14	11.32	44.46	R2,309.8	R14.35	R4.90	R19.25	R0.6
1962	34.78	11.75	46.53	R2,449.1	R14.20	R4.80	R19.00	R1.3
1963	36.10	12.22	48.32	R2,554.0	R14.14	R4.78	R18.92	R0.4
1964	37.53	12.91	50.50	R2,702.9	R13.91	R4.78	R18.68	R1.3
1965	39.01	13.67	52.68	R2,874.8	R13.57	R4.76	R18.33	R1.9
1966	41.40	14.26	55.66	R3,060.2	R13.53	R4.66	R18.19	R0.8
1967	43.23	14.34	57.57	R3,140.2	R13.77	R4.57	R18.33	0.8
1968	46.19	14.81	61.00	R3,288.6	R14.05	R4.50	R18.55	R1.2
1969	49.02	15.18	64.19	R3,388.0	R14.47	R4.48	R18.95	R2.2
1970	51.32	15.12	66.43	R3,388.2	R15.15	R4.46	R19.61	3.5
1971	53.03	14.85	67.89	R3,500.1	R15.15	R4.24	R19.40	R1.1
1972	55.64	15.61	71.26	R3,690.3	R15.08	R4.23	R19.31	R0.5
1973	57.35	16.93	74.28	R3,902.3	R14.70	R4.34	R19.04	R1.4
1974	55.19	17.36	72.54	R3,888.2	R14.19	R4.46	R18.66	R2.0
1975	52.68	17.87	70.55	R3,865.1	R13.63	R4.62	R18.25	R2.2
1976	55.52	18.84	74.36	R4,081.1	R13.60	R4.62	R18.22	R0.2
1977	57.05	19.24	76.29	R4,279.3	R13.33	R4.50	R17.83	R2.1
1978	57.97	20.12	78.09	R4,493.7	R12.90	R4.48	R17.38	R2.5
1979	57.79	21.11	78.90	R4,624.0	R12.50	R4.56	R17.06	R1.8
1980	54.60	21.36	75.96	R4,611.9	R11.84	R4.63	R16.47	R3.5
1981	51.86	22.13	73.99	R4,724.9	R10.98	R4.68	R15.66	R4.9
1982	48.74	22.11	70.85	R4,623.6	R10.54	R4.78	R15.32	R2.2
1983	47.41	23.11	70.52	R4,810.0	R9.86	R4.81	R14.66	R4.3
1984	49.56	24.59	74.14	R5,138.2	R9.65	R4.78	R14.43	R1.6
1985	48.76	25.22	73.98	R5,329.5	R9.15	R4.73	R13.88	R3.8
1986	48.90	25.39	74.30	R5,489.9	R8.91	R4.63	R13.53	R2.5
1987	50.61	26.26	76.89	R5,648.4	R8.96	R4.65	R13.61	R0.8
1988	52.77	27.44	80.22	R5,962.9	R9.00	R4.68	R13.68	R0.5
1989	53.59	27.73	81.33	R6,060.4	R8.84	R4.58	R13.42	R1.9
1990	52.85	R31.32	R84.17	R6,138.7	R8.61	R4.50	R13.11	R2.2
1991	52.45	R31.60	R84.05	R6,079.0	R8.63	R4.50	R13.83	R0.9
1992	53.66	R31.60	R85.26	R6,244.4	R8.59	R4.06	R13.65	R1.3
1993	R54.67	R32.36	R87.03	R6,383.8	R8.56	R4.07	R13.63	R0.1
1994	R56.07	R32.83	R88.90	R6,504.2	R8.49	R4.97	R13.46	R1.2
1995P	56.83	33.79	90.62	6,739.0	8.43	5.01	13.45	-0.1

¹ A comprehensive revision of the National Income and Product Accounts was released by the U. S. Department of Commerce in early 1996 that resulted in changes to the entire Gross Domestic Product series; the revised values for 1949-1958 were not available in time to include in this table.

² Percent change calculated from data prior to rounding.

R=Revised data. P=Preliminary data.

Note: See "Chained Dollars" in the Glossary.

Sources: Tables 1.3 and E.1.

Historical Evidence

Sheet2

1.25 case

GDP

(billion 1992 \$'s)	1995	2000	2005	2010	2015	2020
MARKAL-MACRO, Case 1.25	<u>6,731</u>	7,544	8,381	9,203	9,883	10,535
DRI Macro/Energy Model, CCAP	6,743	7,522	8,337	<u>9,172</u>	10,003	<u>10,574</u>
MARKAL-MACRO, Case 1.25 Stab.	6,730	7,538	8,370	9,144	9,803	10,435
DRI Macro/Energy Model, CCAP Stab.	6,743	7,503	8,211	9,061	9,955	10,538

Energy/GDP Ratio

(Thos. Btu's per 1992 \$ of GDP)	1995	2000	2005	2010	2015	2020
MARKAL-MACRO, Case 1.25	13.61	12.82	12.13	11.58	10.98	10.77
DRI Macro/Energy Model, CCAP	13.18	12.50	11.71	10.99	10.20	9.73
MARKAL-MACRO, Case 1.25 Stab.	13.49	12.64	11.76	10.13	9.57	9.27
DRI Macro/Energy Model, CCAP Stab.	13.18	12.37	10.97	9.73	8.81	8.23

Energy/GDP Ratio

(Thos. Btu's per 1992 \$ of GDP)	95-00	00-05	05-10	10-15	15-20	00-20
MARKAL-MACRO, Case 1.25	-1.19%	-1.09%	<u>-0.93%</u>	<u>-1.07%</u>	-0.38%	-0.87%
DRI Macro/Energy Model, CCAP	<u>-1.05%</u>	-1.30%	-1.28%	-1.48%	-0.93%	-1.24%
MARKAL-MACRO, Case 1.25 Stab.	<u>-1.29%</u>	-1.44%	<u>-2.94%</u>	<u>-1.13%</u>	-0.64%	-1.54%
DRI Macro/Energy Model, CCAP Stab.	<u>-1.27%</u>	-2.36%	-2.37%	-1.98%	-1.36%	<u>-2.02%</u>

Total Primary Energy Consumption

(Quad. Btu's)	1995	2000	2005	2010	2015	2020
MARKAL-MACRO, Case 1.25	<u>91.6</u>	96.7	101.7	<u>106.6</u>	108.5	113.5
DRI Macro/Energy Model, CCAP	88.9	94.0	97.6	<u>100.8</u>	102.0	102.9
MARKAL-MACRO, Case 1.25 Stab.	90.8	95.3	98.4	<u>92.6</u>	93.8	96.7
DRI Macro/Energy Model, CCAP Stab.	88.9	92.8	90.1	88.2	87.7	86.7

Total Carbon Emissions

(Mill. Metric Tons)	1995	2000	2005	2010	2015	2020
MARKAL-MACRO, Case 1.25	1,771	1,540	1,636	1,716	1,766	1,870
DRI Macro/Energy Model, CCAP	1,398	1,482	1,548	1,606	1,665	1,689
MARKAL-MACRO, Case 1.25 Stab.	1,454	1,501	1,554	1,338	1,339	1,339
DRI Macro/Energy Model, CCAP Stab.	1,398	1,454	1,390	1,356	1,369	1,352

Imputed Value of Carbon

(1995 \$'s per metric Ton)	1995	2000	2005	2010	2015	2020
MARKAL-MACRO, Case 1.25 Stab.	0	0	0	<u>145.53</u>	143.62	<u>130.89</u>
DRI Macro/Energy Model, CCAP Stab.	0	10.56	63.33	95.00	110.00	125.00

1.25 stab.

1990

66% 84-94 AGN
p.17

Table 3.7 Energy Price Estimates by Sector, 1970, 1975, 1980, and 1985-1993
(Dollars¹ per Million Btu)

Sector	1970	1975	1980	1985	1986	1987	1988	1989	1990	1991	1992	1993
Residential and Commercial Sector	2.07	3.93	7.68	11.37	11.14	10.99	10.90	11.31	12.09	12.29	12.28	12.58
Primary Energy	1.08	1.97	4.36	6.12	5.49	5.27	5.17	5.49	5.78	^a 5.71	^a 5.66	5.85
Coal	0.73	1.73	2.10	2.37	2.23	2.03	1.97	1.99	2.17	^a 2.16	^a 2.16	2.27
Natural Gas	0.96	1.56	3.50	5.73	5.42	5.12	5.03	5.16	5.28	5.30	5.36	5.63
Petroleum Products ²	1.32	2.82	6.58	7.47	5.89	5.87	5.79	6.72	7.67	7.40	6.97	6.88
Distillate Fuel Oil	1.32	2.66	6.86	7.32	5.70	5.49	5.49	6.20	7.30	6.90	6.38	6.25
Liquefied Petroleum Gases	1.98	3.81	7.50	9.02	8.51	8.49	8.35	9.92	10.59	10.65	10.09	10.04
Motor Gasoline	2.86	4.66	9.77	9.01	6.77	7.22	7.33	8.03	9.15	8.98	9.07	9.38
Residual Fuel Oil	0.45	1.91	4.12	4.50	2.70	3.10	2.52	2.92	3.41	2.61	2.68	2.75
Electricity	6.53	10.21	15.86	21.50	21.45	21.18	21.19	21.64	22.12	22.70	23.15	23.46
Industrial Sector	0.83	2.20	4.71	6.09	5.40	5.19	5.03	^a 5.12	^a 5.40	^a 5.35	^a 5.30	^a 5.30
Primary Energy ³	0.50	1.66	3.77	4.49	3.65	3.50	3.34	^a 3.32	^a 3.70	^a 3.57	^a 3.53	3.55
Coal	0.45	1.50	1.87	1.89	1.80	1.68	1.68	1.69	1.69	1.69	1.63	1.66
Coking Coal	0.45	1.65	2.10	2.33	1.90	1.74	1.79	1.79	1.79	1.83	1.83	1.79
Steam Coal	0.44	1.28	1.56	1.81	1.75	1.64	1.61	1.61	1.63	1.62	1.62	1.59
Natural Gas	0.38	0.95	2.52	3.87	3.20	2.88	2.90	2.93	2.95	2.80	2.91	3.15
Petroleum Products ⁴	0.96	2.41	5.59	6.20	4.80	4.80	4.48	^a 4.62	^a 5.37	^a 5.20	^a 4.90	4.73
Asphalt and Road Oil	0.68	1.89	3.68	4.77	4.34	3.56	3.39	2.95	3.02	3.14	2.50	2.90
Distillate Fuel Oil	0.72	2.23	5.54	6.10	3.76	4.16	3.83	4.78	5.68	5.14	^a 4.91	4.78
Liquefied Petroleum Gases	1.10	2.51	5.18	5.56	5.63	5.16	4.97	4.06	5.37	5.42	^a 4.91	4.74
Lubricants	5.38	7.48	14.36	17.61	15.59	12.70	14.61	^a 14.48	^a 14.60	^a 16.79	^a 19.43	18.94
Residual Fuel Oil	3.46	1.91	3.69	4.24	2.51	2.87	2.34	2.75	3.10	2.44	2.46	2.41
Electricity	2.99	6.07	10.81	14.57	14.45	13.98	13.78	13.85	15.92	14.18	14.18	14.22
Transportation Sector	2.31	4.02	8.61	8.26	6.22	6.57	6.56	^a 7.17	^a 8.27	^a 7.98	^a 7.92	^a 8.03
Primary Energy	2.31	4.02	8.60	8.25	6.21	6.56	6.55	^a 7.16	^a 8.26	^a 7.97	^a 7.91	8.02
Coal	0.41	1.26	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)
Petroleum Products ⁶	2.31	4.32	8.60	8.25	6.21	6.56	6.55	^a 7.16	^a 8.26	^a 7.97	^a 7.91	8.02
Distillate Fuel Oil	1.31	2.80	7.19	7.50	6.36	6.75	6.59	7.16	8.46	8.11	8.01	8.05
Jet Fuel	0.73	2.05	6.36	5.91	3.92	4.03	3.80	4.39	5.68	4.83	4.52	4.29
Motor Gasoline	2.85	4.64	9.84	9.01	6.79	7.22	7.32	8.01	9.12	8.93	8.96	9.07
Residual Fuel Oil	0.38	1.72	3.31	4.36	2.11	2.64	2.22	2.47	2.98	2.83	^a 1.98	1.98
Electricity	4.65	11.72	14.71	19.74	19.63	23.03	22.05	22.99	23.49	23.79	^a 25.23	26.03
Electric Utilities	0.32	0.96	1.75	1.85	1.55	1.51	1.45	1.46	1.46	1.37	1.34	1.35
Coal	0.31	0.82	1.35	1.65	1.58	1.51	1.47	1.45	1.45	1.45	1.41	1.39
Natural Gas	0.28	0.75	2.20	3.43	2.35	2.24	2.26	2.36	2.32	2.14	2.32	2.56
Petroleum Products ⁷	0.42	2.00	4.34	4.35	2.48	3.04	2.49	2.95	3.41	2.59	2.58	2.45
Heavy Oil ⁸	0.41	1.99	4.25	4.24	2.42	2.97	2.41	2.85	3.30	2.46	2.46	2.37
Nuclear Fuel	0.18	0.24	0.43	0.71	0.70	0.71	0.73	0.70	0.67	0.63	0.59	0.56
Biomass Fuels	0.65	0.92	1.74	0.79	0.32	0.95	0.87	0.69	0.52	0.55	^a 0.55	0.53

¹ Nominal dollars.

² In addition to listed products, includes kerosene.

³ In addition to listed energy sources, includes imports and exports of coal coke.

⁴ In addition to listed products, includes kerosene, motor gasoline, still gas, special naphthas, petrochemical feedstocks, petroleum coke, wax, pentanes plus, and miscellaneous products.

⁵ Not applicable.

⁶ In addition to listed products, includes aviation gasoline, liquefied petroleum gases, and lubricants.

⁷ In addition to listed products, includes fuel oil nos. 1 and 2, kerosene, jet fuel, and petroleum coke.

⁸ Heavy oil includes fuel oil nos. 4, 5, and 6, and residual fuel oils.

R=Revised data.

Sources: Residential and Commercial Sector: Developed from the Energy Information Administration (EIA) State Energy Price and Expenditure Data System (SEPEDS) 1993, which contains data for 1970-1993, for the individual sectors. All Other Sectors: EIA, SEPEDS 1993, as published for selected years in the State Energy Price and Expenditure Report 1993 (December 1995), p. 18. Data also available by State in the report and data system.

Table 9.4 Motor Gasoline Retail Prices, U.S. City Average
(Cents per Gallon, Including Taxes)

	Leaded Regular	Unleaded Regular	Unleaded Premium	All Types ^a
1973 Average	38.8 - 1973	NA	NA	NA
1974 Average	53.2	NA	NA	NA
1975 Average	56.7	NA	NA	NA
1976 Average	58.0	61.4	NA	NA
1977 Average	52.2	65.6	NA	NA
1978 Average	62.8	67.0	NA	65.2
1979 Average	55.7 - 1979	90.3 - 1979	NA	68.2
1980 Average	110.1	124.5	NA	122.1
1981 Average ^b	131.1	137.8 -	^c 147.0	135.3
1982 Average	122.2	129.6	141.6	128.1
1983 Average	116.7	124.1	138.3	122.5
1984 Average	112.9	121.2 - 1985	136.6	118.8
1985 Average	111.6	120.2	134.0	119.8
1986 Average	85.7	92.7	108.5	93.1
1987 Average	89.7	94.8	109.3	95.7
1988 Average	89.9	94.6	110.7	96.3
1989 Average	89.8	102.1	119.7	106.0
1990 Average	114.9	116.4	134.8	121.7
1991 Average	NA	114.0	132.1	119.8
1992 Average	NA	112.7	131.6	118.0
1993 Average	NA	110.8	130.2	117.3
1994 January	NA	104.3	124.0	110.9
February	NA	105.1	124.5	111.4
March	NA	104.5	124.3	110.9
April	NA	108.4	126.0	112.8
May	NA	108.0	127.4	114.3
June	NA	110.6	130.0	116.7
July	NA	113.6	132.7	119.9
August	NA	118.2	136.7	124.3
September	NA	117.7	135.4	123.7
October	NA	115.2	134.6	121.2
November	NA	118.3	135.4	122.2
December	NA	114.3	133.7	120.3
Average	NA	111.2	130.5	117.4
1995 January	NA	112.9	132.4	119.0
February	NA	112.0	131.6	118.1
March	NA	111.5	130.6	117.3
April	NA	114.0	132.5	119.7
May	NA	120.0	138.3	125.6
June	NA	122.6	141.1	128.1
July	NA	119.5	138.4	125.2
August	NA	118.4	135.2	122.2
September	NA	114.8	133.2	120.6
October	NA	112.7	131.5	118.5
November	NA	110.1	129.2	116.1
December	NA	110.1	129.0	116.0
Average	NA	114.7	133.8	120.5
1996 January	NA	112.9	131.7	118.6
February	NA	112.4	131.1	118.1
March	NA	118.2	134.6	121.9
April	NA	125.1	143.1	130.6
May	NA	132.3	150.7	137.8
June	NA	129.9	148.1	135.4
July	NA	127.2	145.3	132.6
August	NA	124.0	142.1	129.8
September	NA	123.4	141.7	129.3
October	NA	122.7	140.6	128.7
November	NA	125.0	142.8	130.8
December	NA	126.0	143.8	131.8
Average	NA	123.1	141.3	126.8

^a Also includes types of motor gasoline not shown separately.

^b In September 1981, the Bureau of Labor Statistics changed the weights used in the calculation of average motor gasoline prices. From September 1981 forward, gasohol is included in the average for all types, and unleaded premium is weighted more heavily.

^c Based on September through December data only.

NA=Not available.

Notes: • See Note 5 at end of section. • Geographic coverage for

1973-1977 is 66 urban areas. Geographic coverage for 1978 forward is 85 urban areas.

Sources • Monthly Data: U.S. Department of Labor, Bureau of Labor Statistics, *Consumer Prices: Energy*. • Annual Data: 1973—*Platt's Oil Price Handbook and Oilmanac*, 1974, 51st Edition. 1974 forward—calculated by the Energy Information Administration as the simple averages of monthly data.

Figure 1.9 Passenger Car Efficiency
(Index, 1973 = 100)

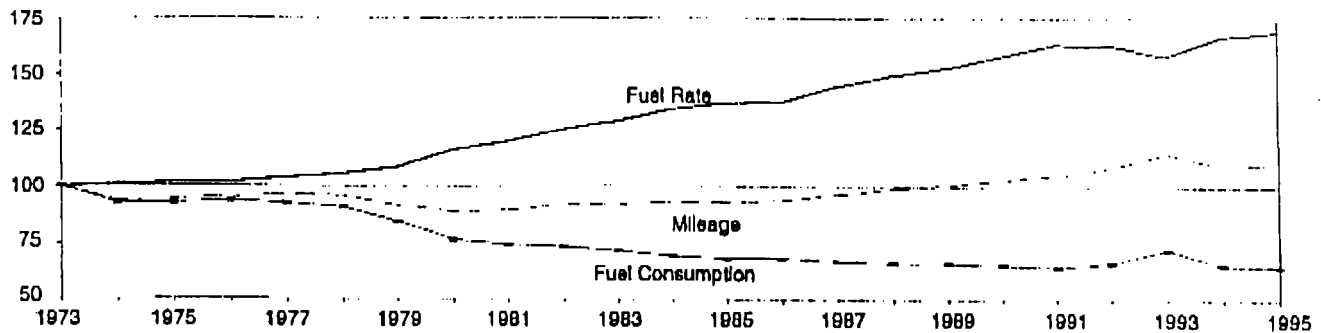


Table 1.10 Passenger Car Efficiency

	Mileage		Fuel Consumption		Fuel Rate	
	Miles per Car	Index 1973=100.0	Gallons per Car	Index 1973=100.0	Miles per Gallon	Index 1973=100.0
1973	10,266	100.0	771	100.0	13.30	100.0
1974	9,606	93.7	716	92.9	13.42	100.9
1975	9,890	96.5	716	92.9	13.52	101.7
1976	9,785	95.4	723	93.6	13.53	101.7
1977	9,879	96.3	718	92.9	13.60	103.6
1978	9,826	95.9	701	90.9	14.04	105.6
1979	9,403	91.7	653	84.7	14.41	108.3
1980	9,141	89.1	591	76.7	15.46	116.2
1981	9,166	89.6	578	74.7	15.94	119.8
1982	9,428	91.9	566	73.4	16.65	125.2
1983	9,475	92.4	553	71.7	17.14	128.9
1984	9,558	93.2	536	69.8	17.83	134.1
1985	9,560	93.2	528	68.1	18.20	136.8
1986	9,609	93.7	526	68.2	18.27	137.4
1987	9,678	98.3	514	66.7	19.20	144.4
1988	10,121	98.7	509	66.0	19.87	149.4
1989	10,332	100.7	509	66.0	20.31	152.7
1990	10,646	102.9	502	65.1	21.02	158.0
1991	10,787	104.9	496	64.3	21.69	163.1
1992	11,100	108.2	512	66.4	21.88	163.0
1993	11,760	114.7	559	72.8	21.04	158.2
1994	11,210	109.3	504	66.4	22.24	167.2
1995 ^a	11,329	110.8	502	65.1	22.56	169.8

^a Preliminary data.

Note: Geographic coverage is the 50 States and the District of Columbia.

Sources: Indices are prepared from statistics published by the U.S. Department of Transportation, Federal Highway Administration, Federal

Highway Statistics Division. • 1973-1985: *Highway Statistics Summary to 1985*, Table VM-201A. • 1986 forward: *Highway Statistics*, annual, Table VM-1.

Sheet2

GDP

(billion 1992 \$'s)	1995	2000	2005	2010	2015	2020
MARKAL-MACRO, Case 1.25	6,731	7,544	8,381	9,203	9,883	10,535
DRI Macro/Energy Model, CCAP	6,743	7,522	8,337	9,172	10,003	10,574
MARKAL-MACRO, Case 1.25 Stab.	6,730	7,538	8,370	9,144	9,803	10,435
DRI Macro/Energy Model, CCAP Stab.	6,743	7,503	8,211	9,061	9,955	10,538

Energy/GDP Ratio

(Thous. Btu's per 1992 \$ of GDP)	1995	2000	2005	2010	2015	2020
MARKAL-MACRO, Case 1.25	13.81	12.82	12.13	11.58	10.98	10.77
DRI Macro/Energy Model, CCAP	13.18	12.50	11.71	10.99	10.20	9.78
MARKAL-MACRO, Case 1.25 Stab.	13.49	12.64	11.76	10.13	9.57	9.27
DRI Macro/Energy Model, CCAP Stab.	13.18	12.37	10.97	9.73	8.81	8.23

Energy/GDP Ratio

(Thous. Btu's per 1992 \$ of GDP)	95-00	00-05	05-10	10-15	15-20	00-20
MARKAL-MACRO, Case 1.25	-1.19%	-1.09%	-0.93%	-1.07%	-0.38%	-0.87%
DRI Macro/Energy Model, CCAP	-1.06%	-1.30%	-1.28%	-1.49%	-0.93%	-1.24%
MARKAL-MACRO, Case 1.25 Stab.	-1.29%	-1.44%	-2.94%	-1.13%	-0.64%	-1.54%
DRI Macro/Energy Model, CCAP Stab.	-1.27%	-2.36%	-2.37%	-1.98%	-1.36%	-2.02%

Total Primary Energy Consumption

(Quad. Btu's)	1995	2000	2005	2010	2015	2020
MARKAL-MACRO, Case 1.25	91.8	96.7	101.7	106.6	108.5	113.5
DRI Macro/Energy Model, CCAP	88.9	94.0	97.6	100.8	102.0	102.9
MARKAL-MACRO, Case 1.25 Stab.	90.8	95.3	98.4	92.6	93.8	96.7
DRI Macro/Energy Model, CCAP Stab.	88.9	92.8	90.1	88.2	87.7	86.7

Total Carbon Emissions

(Mill. Metric Tons)	1995	2000	2005	2010	2015	2020
MARKAL-MACRO, Case 1.25	1,771	1,540	1,636	1,716	1,766	1,870
DRI Macro/Energy Model, CCAP	1,398	1,482	1,548	1,806	1,665	1,689
MARKAL-MACRO, Case 1.25 Stab.	1,454	1,501	1,554	1,338	1,339	1,339
DRI Macro/Energy Model, CCAP Stab.	1,398	1,454	1,390	1,356	1,369	1,352

Imputed Value of Carbon

(1995 \$'s per metric Ton)	1995	2000	2005	2010	2015	2020
MARKAL-MACRO, Case 1.25 Stab.	0	0	0	145.53	143.82	130.89
DRI Macro/Energy Model, CCAP Stab.	0	10.58	63.33	95.00	110.00	125.00

Table 1.7 Energy Consumption per Dollar of Gross Domestic Product, 1949-1995

Year	Energy Consumption			Gross Domestic Product (GDP) ¹	Energy Consumption per Dollar of GDP			Change from Previous Year
	Petroleum and Natural Gas	Other Energy	Total		Petroleum and Natural Gas	Other Energy	Total	
	Quadrillion Btu	Quadrillion Btu	Quadrillion Btu		Thousand Btu per Chained (1992) Dollar	Thousand Btu per Chained (1992) Dollar	Thousand Btu per Chained (1992) Dollar	
				Billion Chained (1992) Dollars				Percent ²
1949	17.03	13.43	30.46	()	()	()	()	()
1950	19.28	13.79	33.08	()	()	()	()	()
1951	21.48	13.99	35.47	()	()	()	()	()
1952	22.51	12.80	35.30	()	()	()	()	()
1953	23.46	12.81	36.27	()	()	()	()	()
1954	24.17	11.10	35.27	()	()	()	()	()
1955	25.25	12.57	38.82	()	()	()	()	()
1956	27.55	12.83	40.38	()	()	()	()	()
1957	28.12	12.36	40.48	()	()	()	()	()
1958	29.19	11.16	40.35	()	()	()	()	()
1959	31.04	11.10	42.14	R2,212.3	R14.03	R5.02	R19.05	()
1960	32.30	11.50	43.80	R2,261.7	R14.28	R5.08	R19.37	1.7
1961	33.14	11.32	44.46	R2,309.8	R14.35	R4.90	R19.25	-0.6
1962	34.78	11.75	46.53	R2,449.1	R14.20	R4.80	R19.00	-1.3
1963	36.10	12.22	48.32	R2,554.0	R14.14	R4.78	R18.92	-0.4
1964	37.59	12.91	50.50	R2,702.9	R13.91	R4.78	R18.68	-1.3
1965	39.01	13.67	52.68	R2,874.8	R13.57	R4.76	R18.33	-1.9
1966	41.40	14.26	55.66	R3,060.2	R13.53	R4.66	R18.19	-0.8
1967	43.23	14.34	57.57	R3,140.2	R13.77	R4.57	R18.33	0.8
1968	46.19	14.81	61.00	R3,288.6	R14.05	R4.50	R18.55	1.2
1969	49.02	15.18	64.19	R3,388.0	R14.47	R4.48	R18.95	2.2
1970	51.32	15.12	66.43	R3,388.2	R15.15	R4.46	R19.61	3.5
1971	53.03	14.85	67.89	R3,500.1	R15.15	R4.24	R18.40	-1.1
1972	55.64	15.61	71.26	R3,690.3	R15.08	R4.23	R19.31	0.5
1973	57.35	16.93	74.28	R3,902.3	R14.70	R4.34	R19.04	-1.4
1974	55.19	17.36	72.54	R3,888.2	R14.19	R4.46	R18.66	-2.0
1975	52.68	17.87	70.55	R3,865.1	R13.63	R4.62	R18.25	-2.2
1976	55.52	18.84	74.36	R4,081.1	R13.60	R4.62	R18.22	-0.2
1977	57.05	19.24	76.29	R4,279.3	R13.33	R4.50	R17.83	-2.1
1978	57.97	20.12	78.09	R4,493.7	R12.90	R4.48	R17.38	-2.5
1979	57.79	21.11	78.90	R4,624.0	R12.50	R4.56	R17.06	-1.8
1980	54.60	21.36	75.96	R4,611.9	R11.84	R4.63	R16.47	-3.5
1981	51.86	22.13	73.99	R4,724.9	R10.98	R4.68	R15.66	-4.9
1982	48.74	22.11	70.85	R4,623.6	R10.54	R4.78	R15.32	-2.2
1983	47.41	23.11	70.52	R4,810.0	R9.86	R4.81	R14.66	-4.3
1984	49.56	24.59	74.14	R5,138.2	R9.65	R4.78	R14.43	-1.6
1985	48.76	25.22	73.98	R5,329.5	R9.15	R4.73	R13.88	-3.8
1986	48.90	25.39	74.30	R5,489.9	R8.91	R4.63	R13.53	-2.5
1987	50.61	26.28	76.89	R5,648.4	R8.96	R4.65	R13.61	-0.8
1988	52.77	27.44	80.22	R5,862.9	R9.00	R4.68	R13.68	0.5
1989	53.59	27.73	81.33	R6,060.4	R8.84	R4.58	R13.42	-1.9
1990	52.85	R31.32	R84.17	R6,138.7	R8.61	R5.10	R13.71	2.2
1991	52.45	R31.60	R84.05	R6,079.0	R8.63	R5.20	R13.83	0.9
1992	53.66	R31.60	R85.26	R6,244.4	R8.59	R5.06	R13.65	-1.3
1993	R54.67	R32.36	R87.03	R6,383.8	R8.56	R5.07	R13.63	-0.1
1994	R56.07	R32.63	R88.90	R6,504.2	R8.49	R4.97	R13.46	-1.2
1995 ^P	56.83	33.78	90.62	6,739.0	8.43	5.01	13.45	-0.1

¹ A comprehensive revision of the National Income and Product Accounts was released by the U. S. Department of Commerce in early 1996 that resulted in changes to the entire Gross Domestic Product series; the revised values for 1949-1958 were not available in time to include in this table.

² Percent change calculated from data prior to rounding.

R=Revised data. P=Preliminary data.
Note: See "Chained Dollars" in the Glossary.
Sources: Tables 1.3 and E.1.

Table 9.4 Motor Gasoline Retail Prices, U.S. City Average
(Cents per Gallon, Including Taxes)

	Leaded Regular	Unleaded Regular	Unleaded Premium	All Types ^a
1973 Average	38.8	NA	NA	NA
1974 Average	53.2	NA	NA	NA
1975 Average	56.7	NA	NA	NA
1976 Average	59.0	61.4	NA	NA
1977 Average	52.2	65.6	NA	NA
1978 Average	62.6	67.0	NA	65.2
1979 Average	65.7	80.3	NA	68.2
1980 Average	119.1	124.6	NA	122.1
1981 Average ^b	131.1	137.8	^c 147.0	135.3
1982 Average	122.2	129.6	141.6	128.1
1983 Average	116.7	124.1	136.3	122.6
1984 Average	112.9	121.2	136.6	119.8
1985 Average	111.6	120.2	134.0	119.6
1986 Average	85.7	92.7	108.5	93.1
1987 Average	89.7	94.8	109.3	95.7
1988 Average	89.9	94.6	110.7	95.3
1989 Average	99.8	102.1	119.7	106.0
1990 Average	114.9	116.4	124.9	121.7
1991 Average	NA	114.0	132.1	119.6
1992 Average	NA	112.7	131.6	118.0
1993 Average	NA	110.8	130.2	117.3
1994				
January	NA	104.3	124.0	110.9
February	NA	105.1	124.6	111.4
March	NA	104.5	124.3	110.9
April	NA	106.4	126.0	112.8
May	NA	108.0	127.4	114.3
June	NA	110.6	130.0	116.7
July	NA	113.6	132.7	119.9
August	NA	116.2	136.7	124.3
September	NA	117.7	136.4	123.7
October	NA	115.2	134.6	121.2
November	NA	116.3	135.4	122.2
December	NA	114.3	133.7	120.3
Average	NA	111.2	130.5	117.4
1995				
January	NA	112.9	132.4	119.0
February	NA	112.0	131.6	118.1
March	NA	111.5	130.6	117.3
April	NA	114.0	132.5	119.7
May	NA	120.0	136.3	125.6
June	NA	122.6	141.1	128.1
July	NA	119.5	138.4	125.2
August	NA	116.4	135.2	122.2
September	NA	114.8	133.2	120.6
October	NA	112.7	131.5	118.5
November	NA	110.1	129.2	116.1
December	NA	110.1	129.0	116.0
Average	NA	114.7	133.6	120.5
1996				
January	NA	112.9	131.7	118.6
February	NA	112.4	131.1	118.1
March	NA	116.2	134.8	121.9
April	NA	125.1	143.1	130.6
May	NA	132.3	150.7	137.6
June	NA	129.9	148.1	135.4
July	NA	127.2	145.3	132.6
August	NA	124.0	142.1	129.8
September	NA	123.4	141.7	129.3
October	NA	122.7	140.8	126.7
November	NA	125.0	142.8	130.6
December	NA	126.0	143.8	131.6
Average	NA	123.1	141.3	126.8

^a Also includes types of motor gasoline not shown separately.

^b In September 1981, the Bureau of Labor Statistics changed the weights used in the calculation of average motor gasoline prices. From September 1981 forward, gasohol is included in the average for all types, and unleaded premium is weighted more heavily.

^c Based on September through December data only.

NA=Not available.

Notes: • See Note 5 at end of section. • Geographic coverage for

1973-1977 is 68 urban areas. Geographic coverage for 1978 forward is 85 urban areas.

Sources: • Monthly Data: U.S. Department of Labor, Bureau of Labor Statistics, *Consumer Prices: Energy*. • Annual Data: 1973—*Pitt's Oil Price Handbook and Almanac*, 1974, 61st Edition. 1974 forward—calculated by the Energy Information Administration as the simple averages of monthly data.

Figure 1.9 Passenger Car Efficiency
(Index, 1973 = 100)

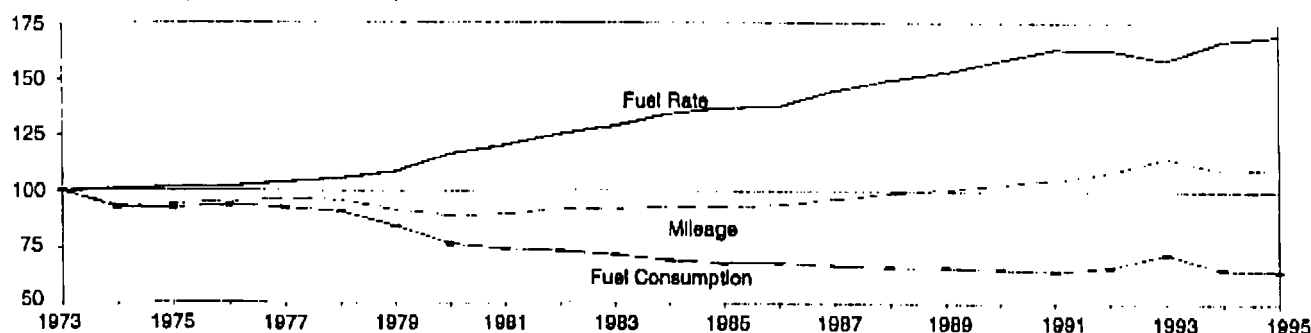


Table 1.10 Passenger Car Efficiency

	Mileage		Fuel Consumption		Fuel Rate	
	Miles per Car	Index 1973=100.0	Gallons per Car	Index 1973=100.0	Miles per Gallon	Index 1973=100.0
1973	10,256	100.0	771	100.0	13.30	100.0
1974	9,606	93.7	716	92.9	13.42	100.8
1975	9,890	94.5	716	92.9	13.52	101.7
1976	9,786	95.4	723	93.8	13.53	101.7
1977	9,879	96.3	716	92.9	13.60	103.6
1978	9,836	95.9	701	90.9	14.04	105.6
1979	9,403	91.7	853	84.7	14.41	108.3
1980	9,141	89.1	891	76.7	16.46	116.2
1981	9,166	89.6	876	74.7	16.94	119.8
1982	9,428	91.9	866	73.4	16.85	125.2
1983	9,475	92.4	853	71.7	17.14	128.9
1984	9,558	93.2	836	69.6	17.83	134.1
1985	9,560	93.2	828	68.1	18.20	138.8
1986	9,606	93.7	826	68.2	18.27	137.4
1987	9,678	96.3	814	66.7	19.20	144.4
1988	10,121	98.7	809	66.0	19.67	149.4
1989	10,332	100.7	809	66.0	20.31	152.7
1990	10,646	102.9	802	66.1	21.02	158.0
1991	10,767	104.9	496	64.3	21.69	163.1
1992	11,100	108.2	512	66.4	21.88	163.0
1993	11,760	114.7	559	72.6	21.04	159.2
1994	11,210	109.3	504	65.4	22.24	167.2
1995*	11,329	110.8	502	65.1	22.56	169.6

* Preliminary data.

Note: Geographic coverage is the 50 States and the District of Columbia.

Sources: Indices are prepared from statistics published by the U.S. Department of Transportation, Federal Highway Administration, Federal

Highway Statistics Division. • 1973-1985: *Highway Statistics Summary to 1985*, Table VM-201A. • 1986 forward: *Highway Statistics*, annual, Table VM-1.

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**U.S. Department of Energy
Office of Economic Analysis**

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Room 7H-062, PE 64
Washington, D.C. 20585**

Phone #: (202) 586-4767
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(FTS) 896-5391

Date: May 19, 1997

To: Jay Shogren

Organization/Location: CEA

Phone Number: 395-5012

Fax Number: 395-6853

Subject: E/GDP Statistics and Projections

No. of Pages (with cover): 5

From: Phillip Tseng

Phone Number: 586-3892

Overview of methods used to calculate co-control benefits from stabilization of greenhouse gases

◆ Energy Model: NEMS

- Baseline: AEO 97

- Policy: US Stabilization at 1990 levels in 2010

- We assumed no new regulations to control criteria air pollutants would be implemented at the federal or state level.

If the new regs are passed, these benefits would not appear as a result of GHG stabilization

- ◆ *only* Utility emissions of SO₂ and NO_x (no transportation, etc.)

- In 1995 Utilities emitted 66% of all SO₂ and 29% of all NO_x

- ◆ Apportion emissions to county level

- ◆ Air quality modeling

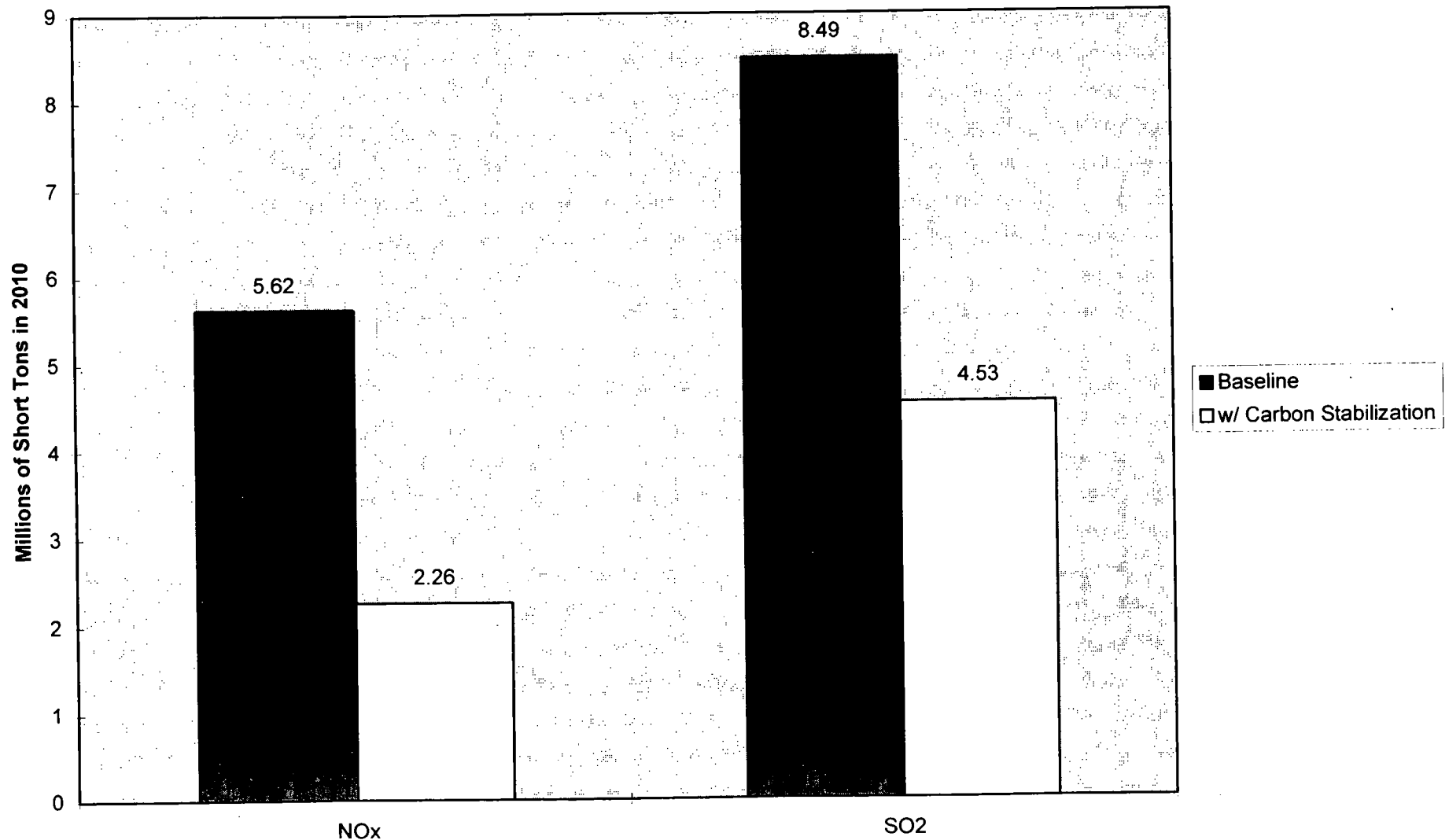
- ◆ Changes to health and welfare

- ◆ Monetize benefits

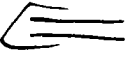
Utility coal consumption

Utility Coal Consumption	1990	2000	Quads	2010 w/Policy	Percent Reduction
			2010 Baseline		
NEMS	17.31	18.77	19.85	6.8	66%
DRI/DRI Energy Model	16.3	18.4	22	15.9	28%
Markal Macro	16.49	16.32	18.76	7.67	59%

NEMS Utility Emissions of NOx and SO2 in 2010 with and w/out Carbon Stabilization



Methodology to apportion emissions to county level

- ◆ NEMS provides emissions estimates at the 13 NERC  region level
- ◆ 1990 NEMS emissions were consistent with the 1990 utility emissions from the National Particulate Inventory (NPI) -- which provides detail at the county level.
- ◆ We used the proportions at the county level from the NPI to apportion emissions projections from NEMS to counties.

Air Quality Modeling

- ◆ NO_x and SO_2 combine with NH_3 to form ammonium nitrate and ammonium sulfate in the atmosphere -- constituents of Particulate Matter that is less than 2.5 microns in size ($\text{PM}_{2.5}$)
- ◆ $\text{PM}_{2.5} = \text{direct PM}_{2.5} + \text{Amm. Nitrate} + \text{Amm. Sulfate} + \text{SOA} + \text{Biogenics}$
- ◆ $\text{PM}_{10} = \text{Direct PM}_{10} + \text{PM}_{2.5}$
- ◆ Indirect PM formation causes most of the health costs associated with NO_x and SO_2 emissions.

Air Quality Modeling (Cont.)

- ◆ Emissions from one county can affect air quality in other counties.
- ◆ EPA used a reduced form of the climatological regional dispersion model (CRDM) to convert emissions by (source) county into changes in air quality across all (receptor) counties. .

Health Effects

- ◆ Reductions in NO_x and SO_2 associated with GHG emissions stabilization result in:
 - over 12,000 cases of avoided mortality (ages 30+) in 2010
 - 46 avoided cases of infant mortality
 - over 20,000 avoided cases of chronic bronchitis
- ◆ Other benefits include reduced: acute bronchitis, upper and lower respiratory symptoms, lost work days, and household soiling.
- ◆ The mean value of benefits that can be monetized is over \$66 billion. *annual benefits in 2010*

2010 National Particulate Matter Benefits from GHG Stabilization - Avoided Incidence and Monetized Benefits

2010 National Particulate Matter Benefits from GHG Stabilization - Avoided Incidence and Monetized Benefits
(based on NEMS energy model emissions forecast)

Endpoint	PM Indicator	Source of Concentration-Response Relationship	Applied Population	Estimated Value per case (\$)	Avoided Incidence (cases/year)	mean (Million \$)
Mortality (long-term exposure)	PM2.5 —	Pope et al, 1995	ages 30+	4,800,000	12,575	\$60,358
Mortality (postneonatal infants)	PM10	Woodruff et al. (1997)	1 month - 1 year old	4,800,000	46	\$220
Development of chronic bronchitis	PM10	Schwartz, 1993b	all	260,000	20,619	\$5,361
Hospital Adm. All Respiratory (all ages)	PM2.5 —	Thurston et al, 1994	all	13,425	3,575	\$48
Hospital Adm. Congestive Heart Failure	PM10	Schwartz and Morris, 1995	65+	16,559	630	\$11
Hospital Adm. Ischemic Heart Disease	PM10	Schwartz and Morris, 1995	65+	20,615	720	\$15
Acute Bronchitis	PM10	Dockery et al, 1989	10-12 yr. olds	45	9,449	\$0
Acute Respiratory Symptoms (any of 19)	PM10	Krupnick et al., 1990	18-65 yr. olds	18	4,786,196	\$88
Lower Respiratory Symptoms (LRS)*	PM10	Schwartz et al., 1994	8-12 yr. olds	12	148,476	\$2
Upper Respiratory Symptoms (URS)	PM10	Pope et al., 1991	9-11 yr. old asthmatics	19	17,289	\$0
Asthma - Moderate or worse	PM2.5 —	Ostro et al., 1991	asthmatics, all ages	32	144,016	\$5
MRAD	PM2.5 —	Ostro and Rothschild, 1989	18-65 yr. olds	<to be added>		
RAD**	PM2.5 —	Ostro, 1987	18-65 yr. olds	<to be added>		
Work Loss Days (WLD)	PM2.5 —	Ostro, 1987	18-65 yr. olds	<to be added>		
Household Soiling Damage***	PM10	ESEERCO, 1994	all households		direct valuation	\$269
Total						\$66,376

← drives

(based on NEMS energy model emissions forecast)

Review of Results

Methodology/Model	Extent of Review
Energy modeling	
Baseline	AEO 97
Policy Scenario	IAT Process
Utility Emissions Estimates	Consistent with other analyses, e.g. IPM
Apportion emissions to counties	National Particulate Inventory has been thoroughly reviewed
Air Quality Modeling	Reduced form of a model that is undergoing review by EPA's Science Advisory Board (SAB)
Changes to health and welfare	Reviewed and endorsed by EPA's SAB
Monitized benefits	Reviewed and endorsed by EPA's SAB

The SAB Members include: Richard Schmalensee (Chair), Robert Mendelsohn, William Nordhaus, Paul Portney, Thomas Tietenberg, Gorge Wolff

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Divider Title: _____

January 31, 1997

To: Jeff Frankel

From: Tom Rhoads

Re: Possible questions on climate change for Janet's mock hearing.

Jeff,

Jay and I composed a list of possible questions concerning issues on climate change as well as brief answers for each of them for Janet's mock hearing on Monday. Any comments on these questions would be greatly appreciated.

Thanks,

A handwritten signature in black ink, appearing to be the name 'Tom' written in a cursive, stylized script.

Tom

Is global warming a problem?

Those that would say that global warming is not a problem point to historical evidence demonstrating that there have been previous periods of global warming and cooling trends. Effectively, the level of global warming that we are experiencing now is simply one increase in a continuing cycle of the earth's changing mean temperature. Conversely, there have been numerous studies suggesting that global warming is a problem due to the many irreversible ecological effects associated with increasing carbon emissions. Perhaps the most well documented is the concern about greenhouse gas emissions and their impact on the ozone layer. IN WHAT IS PERHAPS THE MOST RECENT STUDY ON WHETHER OR NOT GLOBAL WARMING IS A PROBLEM, WORKING GROUP III OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC) BELIEVES THAT GLOBAL WARMING AND CLIMATE CHANGE IS INDEED A PROBLEM, PRESENTING THE POLICY MAKER WITH A LARGE SET OF FORMIDABLE COMPLICATIONS.

1. I am not a scientist, but there is ~~an~~ now fairly wide scientific consensus that anthropogenic warming is happening.

~~But~~ The speed, and the effects, ~~seem~~ still to be uncertain.

~~At~~

(on crop yields, sea levels, disease patterns, ~~etc.~~ storm frequency, ocean currents)

Nevertheless, one cannot view the prospect of such changes with equanimity. The risks to the planet do make this a problem.

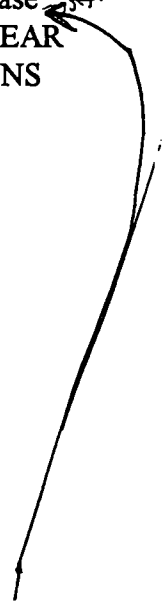
The U.S. is currently engaged in international negotiations concerning limits on greenhouse gas emissions with the goal of signing an agreement in Kyoto, Japan in December 1997? What will be the economic impact of such a treaty if it is signed?

Studies of global CO₂ abatement costs relative to the baseline projection range from a 0.1% loss of GNP for a 14% reduction of emissions to a 5.7% loss of GNP for an 88% reduction of emissions. Studies of U.S. CO₂ abatement costs relative to the baseline projection range from a -1.2% loss of GNP for a 21% reduction in emissions to a 10.9% loss of GNP for a 96% reduction in emissions. These estimates vary considerably due to the choice of methodologies, underlying assumptions (i.e. population growth, energy intensity, etc.), emission scenarios, policy instruments, reporting year, and others. Manne and Richels (1994) polled a group of experts on their beliefs about the key parameters to which abatement costs are especially sensitive. A probability distribution was constructed for the costs of stabilizing global carbon emissions at 1990 levels using their Global 2100 model. THE DISTRIBUTION EXPRESSES COSTS RANGING FROM 0.2% TO 6.8% OF GROSS WORLD PRODUCT, WITH THE MEDIAN COST OF EMISSIONS STABILIZATION EQUAL TO 1.0% OF GWP AND THE MEAN APPROXIMATELY 1.5% OF GWP.

(Assumes no
~~depends on whether~~ revenues are raised,
by auctioning off tradable emission permits.)

What will be the effect on the U.S. if we adhere to an emissions reduction treaty by reducing our level of CO₂ emissions, but none of the other non-Annex I countries do their part?

Evidence demonstrates that no single country is sufficiently important or powerful enough to control global carbon emissions in the short term or in the long run. If non-Annex I nations do not alter their emissions path, global emissions levels will continue to increase even if all Annex I nations completely eliminated all emissions. **THIS MAKES IT CLEAR THAT THE U.S. WOULD BEAR THE COSTS OF ELIMINATING CO₂ EMISSIONS BUT GLOBAL EMISSIONS WOULD CONTINUE TO RISE WITHOUT COOPERATION FROM NON-ANNEX I COUNTRIES.**



The situation is exacerbated by the fact that, if ~~any~~ controls (of some sort) were adopted only in the industrialized countries, "dirty" industries would migrate to the non-member countries.

What would be a cost effective approach to lowering emissions in the U.S.? Should we be supportive of tradable permits or carbon taxes?

U.S. experience with emissions trading includes the SO₂ Allowance Trading program which has dramatically reduced the cost of the SO₂ abatement program. Emissions in 1995 were 40% below legally required levels for the year at a cost. The lead trading program was also a success, providing a savings of approximately \$200 million annually while it was in effect. There are numerous other examples. One problem to address in implementing a CO₂ emissions tradable permit system is in how to deal with non-point source polluters as direct emitters of CO₂ number in the hundreds of millions since they include sources such as automobiles. One of the problems surrounding a system of carbon taxes is the lack of market incentives to reduce emissions well below the targeted level. A TRADABLE PERMIT SYSTEM IS CAPABLE OF CREATING THE APPROPRIATE MARKET INCENTIVES TO LOWER EMISSION LEVELS BELOW TARGETED LEVELS.

?

no!

?!
-!

Nb

What should be the role of government in promoting the adoption of currently available energy efficient technologies? What should be the role of government in funding R&D for new technologies?

The most important issue here is to address the role of market failures versus that of market barriers when deciding upon the strategies that government should use. IF MARKET FAILURE IS PRESENT, THE GOVERNMENT SHOULD INTERVENE; IF A MARKET BARRIER IS PRESENT THEN GOVERNMENT SHOULD NOT INTERVENE. If there is not an appropriate amount of energy efficient technologies currently being adopted (many of the papers that EPA drafts voice this opinion), then it must be determined whether the problem stems from the presence of a market failure or a market barrier. If there is an inherent market failure due to these technologies demonstrating attributes of a public good or if there are information problems, then the government should lead an active role in promoting the adoption of currently available energy efficient technologies. Otherwise, if the lack of currently available technologies being adopted cannot be attributed to problems associated with the provision of public goods or a lack of information, the market should be relied upon to arrive at an efficient outcome, whatever that may be. The role of government in providing R&D funding for new technologies, where not much is known about their economic feasibility, involves more uncertainty. If there are concerns that development of new technologies will yield positive externalities due to the generation of information that will be of value to others, there will be an underprovision of new technology development. This is a market failure that would have to be addressed by the government through the implementation of incentives.

Memorandum

To: Janet Yellen, Jeff Frankel
CC: Jason Shogren, Tom Rhoads
From: Quindi Franco
Date: July 1, 1997
Subject: **Nordhaus' Climate Allowances Protocol (CAP)
Regime Paper¹**

Characteristics of a Successful Regime

Nordhaus identifies several criteria for a successful regime which current proposals do not meet. His CAP system includes:

- Moderate efficiency from an economic and administrative point of view.
- Positive incentives for countries to participate and to fulfill their obligations.
- A decision process which will induce countries to agree to efficient levels of greenhouse gas reduction.

An ideal regime would also meet the following three criteria, which the CAP system addressess only partly:

- Recognize that countries with inept or corrupt governments may subvert the process or use it for personal gain.
- The regime must not injure other international agreements (trade and other).
- The decision process should be simple and familiar to countries.

The CAP Regime

The basic philosophy of the CAP system is that it should balance the costs against the benefits, be economically efficient, and respect the fact that the agreement must be in the self-interest of participating nations.

Determining Global Target for Reductions The main difference between the CAP regime and the current US proposal is that the overall emissions target and individual nations' allocation of permits are based on a dynamic cost-benefit analysis. Integrated assessment models are used to calculate what the ideal abatement is at any given time with currently available technologies and a global willingness to pay. Countries will vote a given "value" of reducing climate change, and the global willingness to pay will be set

¹ This summary is based on the June 17, 1997 draft of "Climate Allowances Protocol (CAP): Comparison of Alternative Global Tradable Emissions Regimes," by William D. Nordhaus.

to the median vote; each nation's expressed WTP is weighed by its share of reducible emissions.

National Allocation of Permits Emission baselines are rolling targets for each nation.

Permits will be allocated according to a formula that reflects each country's uncontrolled emissions and its ability to pay. Therefore, countries with rapid growth would not be penalized, and historically inefficient nations would not have windfalls.

Trading, Budgets, & Banking In this regard, the CAP regime is essentially the current US proposal. Nations will be allowed to buy, sell, barter and borrow other countries' allowances as long as the rules are obeyed (emissions = allowances + net purchases). To avoid costly mistakes, extra carbon allowances would be available at some premium (50 percent) above the estimated efficient price.

Evolution Countries are expected to make emissions reductions when their per capita incomes reach a certain "entry-level income" and fully participate when they reach "full-participation income."

Incentives for Participation Sanctions against violations, and incentives to participate, will come from import duties on the carbon content of imports.

Simulations

The RICE model was used to simulate five policy proposals and one baseline:

- ***Baseline*** Market, or "no-control" case where no climate policies are in place.
- ***"Optimal" policy*** Complete participation with lump-sum redistribution
- ***Three CAP Regimes*** Middle progressive assumes an entry-level income of \$5,000 per capita and full-participation at \$15,000; regressive (\$0 and \$5,000) and progressive (\$10,000 and \$20,000).
- ***"Rio w/out Trade"*** Emissions capped at 1990 levels for OECD countries
- ***"Rio w/Trade"*** Rio limits with emissions trading among OECD countries; this is effectively the U.S. proposal.
- ***"Berlin Mandate"*** Rio treaty but has 20 percent cuts in emissions from 1990 levels starting in 2010 and no trading.

Results (see attached tables)

Emissions Reduced -- All proposals are very similar over the next century (though CAP achieves slightly more reduced emissions). In the long run, however, current proposals do not have a mechanism to bring in big developing countries. In CAP, important developing nations incur some reduction obligations in the next century.

Economic Costs -- the three current proposals on the international agenda have substantial negative net benefits. According to these simulations, they are worse than doing nothing, imposing more than \$100 billion of discounted costs (control costs and

7/1/97

Memorandum

climate damages discounted at a rate of 5 percent annually) for the Rio approach and \$1 trillion of discounted costs for the Berlin approach.

Efficiency -- CAP would achieve between 40 and 75 percent of the potential economic benefit and more than 96 percent of the long-term environmental benefit (depending on the time frame and progressivity schedule).

Reservations

- Sanctions linked to punitive import duties for non-participants could be a dangerous and unwarranted distortion of international trade.
- Mechanism for determining country preferences is complicated.
- Treatment of corrupt countries is problematic -- can we put conditions on the use of monies raised from sale of emissions allowances?
- Countries will have an incentive to "ratchet" up their emissions in one period to increase their base in the next.

Figure 5

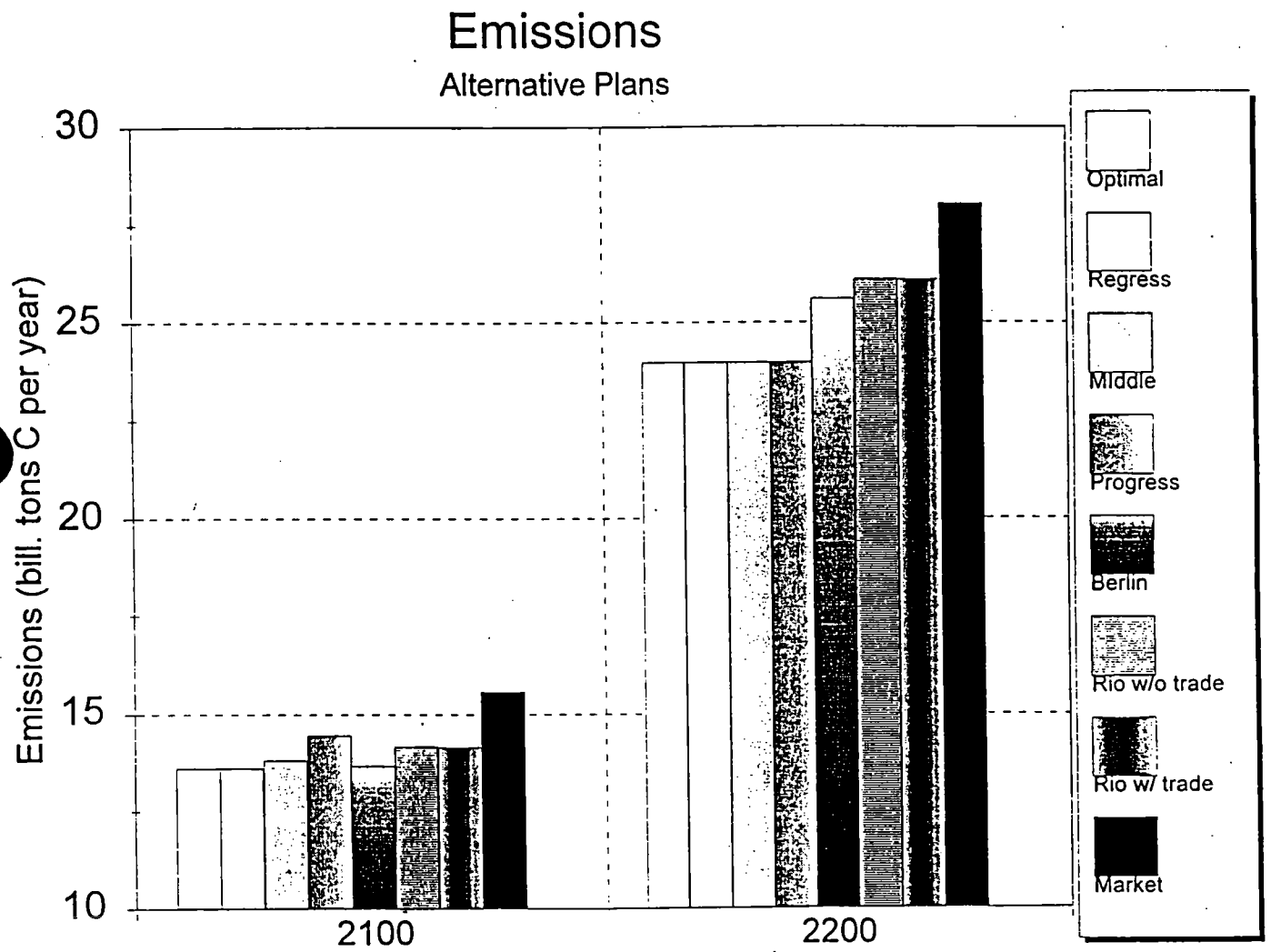


Figure 8

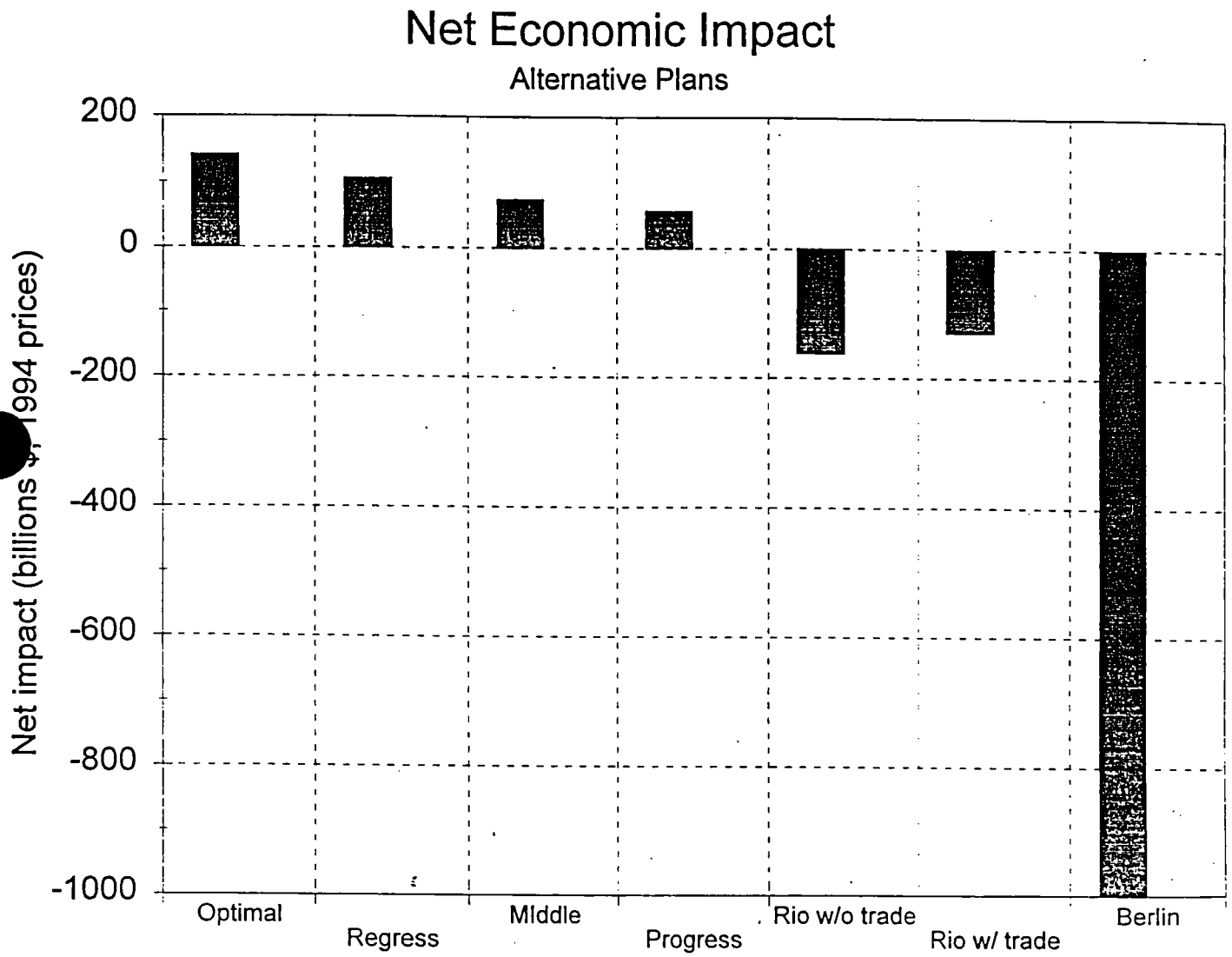
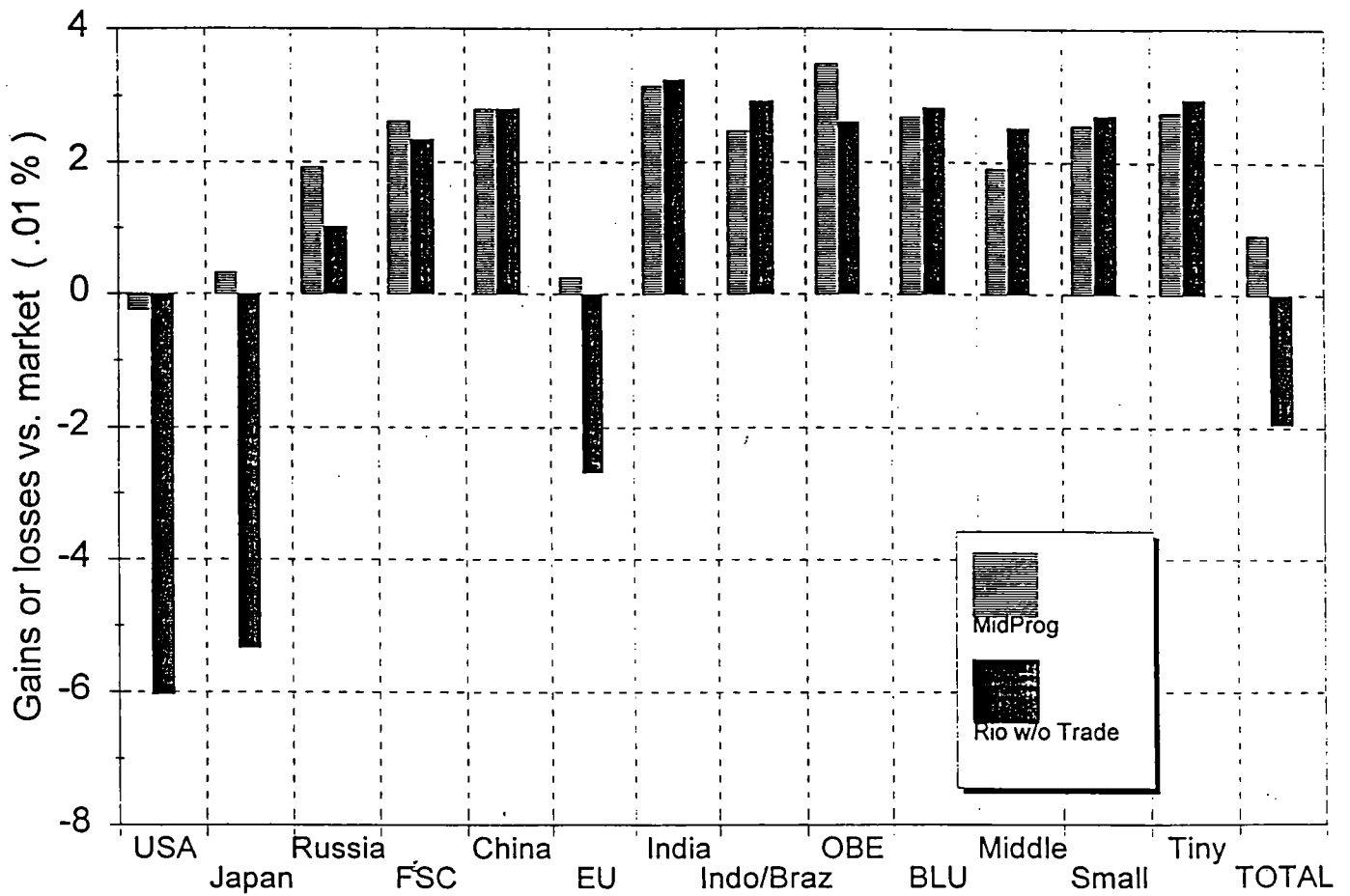


Figure 9

Gainers and Losers Alternative Plans



Efficiency

Regime	Economic		Temperature*		Concentrations*	
	Percent of Optimum*	Benefit/Cost Ratio**	2150	2350	2100	2300
Market	0	0.00	0.0	0.0	0.0	0.0
Optimal	100	2.88	100.0	100.0	100.0	100.0
Regress	75	2.87	96.2	99.6	93.0	99.8
Middle	53	2.87	82.7	98.5	70.7	98.8
Progress	40	2.87	61.9	96.3	46.3	96.5
Rio w/o trade	-114	0.44	67.7	41.0	73.8	44.2
Rio w/ trade	-91	0.49	69.4	40.1	72.8	43.6
Berlin	-704	0.20	97.3	51.9	111.5	55.5

* Percentage gain in net benefits, temperature, or concentrations as percent of optimal relative to market.

**Ratio of reduction in climate damages to abatement costs.

Table 3

Costs and Benefits for the United States

[Billions of dollars, 1994 prices; costs and damages measures negatively*]

Relative to no controls	Costs	Benefits	Net Benefits	Benefit-Cost Ratio
Market	0.0	0.0	0.0	na
Optimal	-14.0	29.9	15.8	2.13
Regressive	-20.8	21.4	0.6	1.03
Middle	-19.4	14.9	-4.4	0.77
Progressive	-14.3	11.5	-2.8	0.80
Rio w/o Trading	-131.9	16.2	-115.8	0.12
Rio with Trading	-112.3	15.6	-96.8	0.14
Berlin with 20 percent cuts	-571.1	34.6	-536.5	0.06

*Calculations are from the 1997 version of the RICE model. All numbers cover the period 1990 through 2400 and include the present value of the costs of compliance (including both resource costs and permit purchases) and the climate damages discounted at a 5 percent discount rate back to 1990 in 1994 prices. The "Costs" column measures the compliance costs and the "Benefits" column measures the averted climate damage.

Memorandum

TO: Jeff Frankel
FROM: Christian Santesteban
Quindi Franco
DATE: June 30, 1997
RE: Energy Efficiency, Energy Prices & AEEI

Analysis on Historical Data

Data: CPI Energy Price Index and Energy/GDP for 1959 through 1995

Geometric Lag Regression:

$$\ln(\text{Energy Efficiency}_t) = \beta_0 + \beta_1 \ln(\text{Energy Price Index}) + \beta_2 \ln(\text{Energy Efficiency}_{t-1}) + \beta_3(\text{Time})$$

Results:

Short Run Price Elasticity	-0.03855 (0.008)
Long Run Price Elasticity	-0.76832
Short Run Time Trend Coefficient	-0.00031 (0.0006)
Long Run Time Trend Coefficient	-0.00627

Additional Results:

Short Run Price Elasticity	-0.03075 (0.014)
Long Run Price Elasticity	-0.71051
Short Run Time Trend Coefficient	-0.00024 (0.00062)
Long Run Time Trend Coefficient	-0.00544
Energy R&D/Total R&D Short Run	-0.00610 (.00878)
Energy R&D/Total R&D Long Run	-0.143

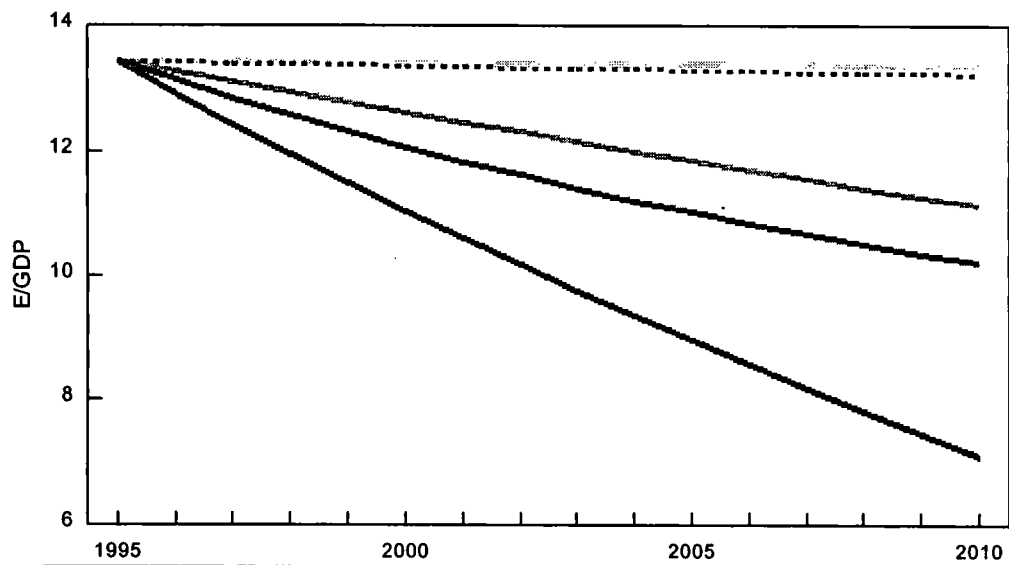
Scenario:

A \$100 per ton carbon tax is levied on all fuels in 1995; assume a 30% energy price increase (range in literature is 15% to 200%). Initial E/GDP of 13.45
Time period 1995-2010. Impact of Long-Run price increase is fully incorporated by 2010.

Results (for simulation not including Energy R&D):

	Drop in E/GDP
CEA Estimated AEEI	-3.23
Price Increase	-3.1
Total Price and CEA Time Effect	-6.33

Energy Efficiency Improvements



CEA ABE (SR Coeff.) IAT Assumption (1.25%) CEA Price & ABE
 CEA ABE (Regression) 10% R&D Increase

MEMORANDUM

COUNCIL OF ECONOMIC ADVISERS

Date: February 3, 1997

To: Michele Jolin

From: Tom Rhoads

RE: Questions on climate change and Superfund for Janet.

Jay and I have prepared a list of possible questions concerning issues on climate change and Superfund legislation for Janet's Confirmation preparation. We also have provided brief answers for each of the questions.

CLIMATE CHANGE

- Is global warming a problem?

There is now fairly wide scientific consensus that anthropogenic warming is happening. The speed, and the effects on crop yields, sea levels, disease patterns, storm frequency, and ocean currents still seem to be uncertain. Nevertheless, one cannot view the prospect of such changes with equanimity. The risks to the planet do make this a problem.

- The U.S. is currently engaged in international negotiations concerning limits on greenhouse gas emissions with the goal of signing an agreement in Kyoto, Japan in December 1997? What will be the economic impact of such a treaty if it is signed?

Studies of global CO₂ abatement costs relative to the baseline projection range from a 0.1% loss of GNP for a 14% reduction of emissions to a 5.7% loss of GNP for an 88% reduction of emissions. Studies of U.S. CO₂ abatement costs relative to the baseline projection range from a -1.2% loss of GNP for a 21% reduction in emissions to a 10.9% loss of GNP for a 96% reduction in emissions. These estimates vary considerably due to the choice of methodologies, underlying assumptions (i.e. population growth, energy intensity, etc.), emission scenarios, policy instruments, reporting year, and others. Manne and Richels (1994) polled a group of experts on their beliefs about the key parameters to which abatement costs are especially sensitive. A probability distribution was constructed for the costs of stabilizing global carbon emissions at 1990 levels using their Global 2100 model. The distribution expresses costs ranging from 0.2% to 6.8% of gross world product, with the median cost of emissions stabilization equal to 1.0% of GWP and the mean approximately 1.5% of GWP. Note that these models assume that no revenues are raised by auctioning off tradable emission permits. CEA prepared a review of published literature, indicating that the median price of carbon in the studies was \$82 per ton and the median impact on GDP by 2020 was -0.6% of GDP.

- What will be the effect on the U.S. if we adhere to an emissions reduction treaty by reducing our level of CO₂ emissions, but none of the other non-Annex I countries do their part?

Evidence demonstrates that no single country is sufficiently important or powerful enough to control global carbon emissions in the short term or in the long run. If non-Annex I nations do not alter their emissions path, global emissions levels will continue to increase even if all Annex I nations completely eliminated all emissions. This situation is exacerbated by the fact that, if controls of some sort were adopted only in the industrialized countries, "dirty" industries would migrate to the non-member countries. This makes it clear that the U.S. would bear the costs of eliminating CO₂ emissions but global emissions would continue to rise without cooperation from non-Annex I countries.

- What would be a cost effective approach to lowering emissions in the U.S.? Should we be supportive of tradable permits or carbon taxes?

U.S. experience with emissions trading includes the SO₂ Allowance Trading program which has dramatically reduced the cost of the SO₂ abatement program. Emissions in 1995 were 40% below legally required levels for the year. The lead trading program was also a success, providing a savings of approximately \$200 million annually while it was in effect. There are numerous other examples. One problem to address in implementing a CO₂ emissions tradable permit system is in how to deal with non-point source polluters. Direct emitters of CO₂ number in the hundreds of millions since they include sources such as automobiles. A tradable permit system is capable of creating the appropriate market incentives to lower emission levels below targeted levels.

SUPERFUND LEGISLATION

- What is the most viable way to reduce the costs of Superfund?

The Superfund Cleanup Acceleration Act of 1997 (S 8) provides relief from liability for most parties. Based on CEA's historical position on Superfund legislation, limited liability relief is a key factor in reducing the costs of Superfund. CEA's past positions have been to also support: (1) cost-effective remedy reform; (2) provision of equivalent value at a substitute site when restoration of the original site is not technically feasible; and (3) state cost sharing to avoid states viewing Superfund as a cash cow. Note that CEA feels that it is imperative to encourage and continue the path towards making remedy selection more flexible and efficient.

- Should non-use valuation methods (such as existence value) matter?

Non-use values should not matter since there is no good method to capture them. Effectively, the debate surrounding the effectiveness of Contingent Valuation Methods (CVM) to assess the value of a non-market good has not been resolved. This makes it difficult to award damages based on the results of specific CVM studies.

- Brownfield sites are abandoned, contaminated industrial sites, usually found in urban areas. Senator Frank Lautenberg (D-NJ) introduced legislation (S 18) to provide grants to local and state governments to evaluate brownfield sites and to establish and capitalize loan programs for cleanup. Is this approach useful?

One issue to examine is whether or not there is some degree of market failure in addressing the problem of brownfield sites. So far, the market has not been aggressive in obtaining these sites with the intention of cleaning them up. This may be in part an indication of the need for stronger liability waivers offered by EPA. Further, there seems to be some serious difficulties in determining the level of cleanup required for each of these sites. Not all sites are located next to an elementary school; some sites are industrial by nature and may not need the level of cleanup that other sites may require. Conversely, some sites require more than just a surface cleanup (i.e. simply cleaning and containing the dirt and dust) since there may be large groundwater contamination. Some feel that S 8 does not address this issue clearly or thoroughly enough.

Date: March 26, 1997

To: Jay Shogren

From: Tom Rhoads

RE: Climate change seminar sponsored by OMB

Dr. Ari Patrinos from DOE gave a brief discussion on the science of climate change, using as his guide the IPCC Climate Change 1995. This presentation did not provide anything new or noteworthy.

Dr. Jae Edmonds from the Pacific Northwest Laboratory discussed the economics of climate change. His focus was on the issue of "where" and "when" flexibility in determining the most cost-effective method to achieve reductions in greenhouse gas emissions. Starting from a base case that offered no flexibility in the "where" or the "when," the EMF analysis (consisting of around 8 different models) with which he was involved suggests a range of costs between \$2 and \$8 trillion for the world (present discounted value for a 60 year emission reduction to 1990 levels). Most of these costs accrue to OECD countries.

By allowing for full implementation of "where" flexibility (akin to full JI) the costs of meeting the emission targets relative to the base case drops by 70%. Allowing for full "when" flexibility drops the costs relative to the base case by 30%. Full flexibility in both the "where" and the "when" drops the costs of meeting emission targets by 85% relative to the base case.

Finally, Edmonds suggested that it may be cheaper to stabilize the atmosphere than it is to stabilize emissions, using an example of attempting to reach 1990 concentration levels by the year 2100 (a bit longer than the time frame that we are working with). Having such a long window is a luxury in meeting these targets since full flexibility in the "where" and "when" can produce significant technological, economic, and dynamic efficiencies. This suggests that we may be trying to do too much too quickly in our proposed mitigation strategies.

Post-It® Fax Note 7671		Date 1/24/90	# of pages 17
To Jay SHOGREN	From Ray Squitieri		
Co./Dept. CEA	Co. Treasury		
Phone #	Phone #		
Fax # 395-586853	Fax # 396-22-1294		

To: IAT members

From: Ray Squitieri
Jay Shogren

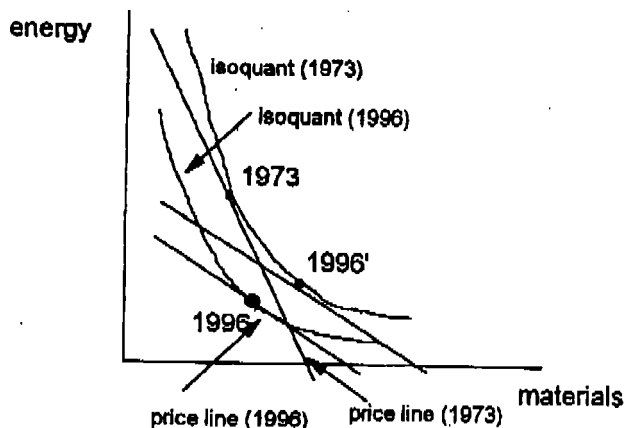
Subject: Technical change, carbon taxes, R&D:

Today's meeting was useful, and well-run by our Chairman. To continue the discussion, and to clarify some points that came up, we will set down some thoughts in words and diagrams, and invite your response.

Why it's easy to confuse technical change with price-induced input substitution

We have data on input quantities used in different years. But this does not tell us whether we are seeing movement along an isoquant as prices change (but without technical change), or movement from one isoquant to another (i.e., with technical change).

Over the last 2 decades, we have probably seen both, as the diagram illustrates.



The vertical axis measures energy input. This could apply to an industry, a sector, or to the economy as a whole; the horizontal axis measures materials input. The top curve is the isoquant for 1973; it shows different combinations of energy and materials that would have yielded the same quantity of output with 1973 technology. With energy and materials prices set according to the price line for 1973, the economy settled at the point labeled 1973. Since then, input prices have changed, and energy became more expensive with respect to materials; this is shown by a change in the slope of the price line. If technology had not changed, we would be at the point labeled 1996'. But technology did change. Now we require less energy and less materials per unit of output than in 1973. The diagram shows this as a shift to a new isoquant. (If this technical change has been more energy-conserving than materials-conserving, as drawn here, then we have what is called biased technical change.) With the new ~~new~~ price line, the economy is at the point labeled 1996.

In the LAT, we have sometimes conflated movement along an isoquant (price-induced input substitution, such as from point 1973 to point 1996) with movement from one isoquant to another (technical change).

The claim that we have "more technology" now than in 1973, or that there is "a lot of room for improvement" in energy use can have 2 different meanings:

1. We are inside (northeast) of the isoquant, using more energy or other inputs than necessary for a given quantity of output. Of course, we are never right on the isoquant: there is always room for improvement. But are we farther off the isoquant than we were in 1973? We don't see any evidence for this.
2. The economy has adjusted to one set of prices; if relative prices changed, firms and consumers would make different energy choices.

We all agree that a further flattening of the slope of the price line (e.g., if a carbon tax were imposed) would cause a shift away from energy and toward materials. We would observe more energy-saving technologies coming into use — more compact fluorescents, more variable-speed drive motors, etc. But we cannot then say that people are making bad decisions today, or that they would be making better decisions in the future. We do know that in the short term we would see the adjustment to a new set of input prices as movement along an isoquant, rather than movement to a new isoquant.

Date: March 28, 1997

To: Jay Shogren
Mark Mazur

From: Tom Rhoads

RE: Yesterday's climate change modeling meeting

Move to get Markal Macro off the table

Perhaps the most notable event at yesterday's meeting was Skip Laitner's proposition that the Markal Macro model be taken off the table for about two weeks (getting close to the April 15 deadline) in order to address some of the problems the model seems to be having with the 1.75 technology growth assumptions. In their memo, which was distributed at the meeting, Laitner and Eric Petersen argue that Markal Macro cannot effectively implement the 1.75 technology case or the administration's technology assumptions. In short, they claim that the model is not capable of accounting for the 1.75 technology assumptions and should be adjusted (by adding the appropriate "heroic" technologies) accordingly. This proposition comes on the heels of a suggestion (only a few weeks ago) by Laitner and his friends at EPA that the modeling process should move past the stage of tinkering with the models and their assumptions and on to more substantive evaluations of the results.

Other current modeling issues

Currently, the U.S. budget deficit is not explicitly accounted for in the models. Ev decided this is not a major problem since we can simply assume that the government would save this money anyway. This assumption implies that the saving that is already in the model picks up the budget deficit.

Ev also wants to make more realistic assumptions about the introduction of new technologies in the transportation sector. In the present models, there are a handful of technologies competing for market share in transportation (i.e., alternative fuel vehicles). It was decided that to make the models describe this sector more accurately, electric vehicles should be dropped (in light of Honda's success with developing a hybrid car), penetration rates should be lowered, and just one generic new technology should be included (to take the place of the many competing technologies that were previously in the models).

What's next?

The following runs will be made on SGM

- $\pm 10\%$ on the emission targets
- 5 years up and back

Additional sectoral and regional detail needs to be added at some point

- coal
- utilities
- other industries
- regional impacts

The next modeling meeting is scheduled for April 2 at 10:30 in Commerce, Room 1869.

To: **Ev Ehrlich**

From: Ray Squitieri, Treasury
Jay Shogren, CEA

Subject: **Rate of technical change**

Summary

We remain concerned that the IAT continues to assume very fast technical change in its modeling of climate control costs. We believe the chosen range is much higher than the historical evidence can support. Even if the IAT assumes that the future will differ greatly from the past, we suggest that, at least for comparison, runs be done using rates of technical change consistent with historical evidence.

Discussion

The IAT has decided on a range of 1.25 percent per year to 1.75 percent per year for the rate of improvement in the energy/gdp ratio. To our knowledge, the historical evidence would suggest a number in the range of 0.5 percent to 1.0 percent per year [Studies done to date generally focus on the rate of autonomous energy efficiency improvement (AEEI). When energy prices remain about flat, as we have been assuming, the aeei is about equal to the rate of change of in the energy/gdp ratio].

The U.S. economy rapidly became less energy intensive from 1973 to 1985, at the rate of 2 percent per year. Some have used this experience to argue that the AEEI is high. But, according to one often-cited study, 1.5 percent per year of that was attributable to the quadrupling of energy prices over the period, and only 0.5 percent per year to non-price-induced technical change. Thus the AEEI implied is 0.5 percent, not 2 percent per year.

In a recent study at Stanford's Energy Modeling Forum (EMF), the modelers collectively agreed to set the AEEI at 40 percent of per capita income growth for each region of the world (per capita income grows fast when technical change is fast, and thus the AEEI is high). Thus, when U.S. per capita income growth is assumed to be 2 percent, the AEEI would be set at 0.8 percent. In a separate 1995 EMF study, the models used, which covered a broad range, implied an economy-wide AEEI from 0.6 percent per year to 1.0 percent per year. In a 1993 survey of climate modelers, the median AEEI was 0.7 percent per year, with a range of 0.2 percent (10th percentile) to 1.2 percent (90th percentile).

We are also troubled over the emphasis given to "announcement effect." It seems hard to believe that serious analysts would accept the assumption that an announcement could reduce the rate of energy consumption by 0.25 percent to 0.75 percent per year forever. If that were true, critics will ask, why sweat over a Climate Change Action Plan, when all we need is a series of announcements?

If we want the work of the IAT to be accepted by serious analysts, we should run some cases using rates of technical change in the range of the historical evidence which, as we read it, is 0.5 percent to 1.0 percent per year.

E X E C U T I V E O F F I C E O F T H E P R E S I D E N T

04-Mar-1997 06:25pm

TO: Jason F. Shogren

FROM: Jeffrey A. Frankel
 Council of Economic Advisers

SUBJECT: RE: climate change issues

If we were to make a proposal on "Ban Coal Subsidies" for the G-7 Summit, it would be good to have information on the magnitude of coal use, coal subsidies, and effects on carbon emissions for each of the following:

- (1) Each of the G-7
- (2) OECD collectively
- (3) Other Annex I countries (E.Eur. and NIS?) collectively
- (4) Rest of World (perhaps with China broken out separately)

Tan

This is
what we
need ASAP

Clinton Presidential Records Digital Records Marker

This is not a presidential record. This is used as an administrative marker by the William J. Clinton Presidential Library Staff.

This marker identifies the place of a tabbed divider. Given our digitization capabilities, we are sometimes unable to adequately scan such dividers. The title from the original document is indicated below.

8

Divider Title: _____

July 3, 1997

To: Janet Yellen, Alicia Munnell

Cc: Jay Shogren, Mark Mazur,
Tom Rhoads, Cristian Santesteban, Quindi Franco

From: Jeff Frankel

Re: Climate Change, "Technology", and Prices

It appears that two engineering-based studies have just been, or are about to be, released -- both fitting into our "wishful thinking" category. They are being widely touted. Janet: Jack Gibbons asked me to pass on to you the enclosed one-pager on the DOE/Labs study. The other study, co-sponsored by Alliance to Save Energy, Tellus and others, was touted by John Holdren at a recent State Department lunch (a summary from Quindi and Tom is enclosed). The Vice President mentioned one of these studies to me at my swearing-in.

Meanwhile, I have had Quindi and Cristian doing some econometrics on Energy Efficiency Improvement numbers (memo enclosed, though I am not sure whether it is in final form). It seems to support my prior expectations, that **we can claim to be technology optimists, in the sense of the EEI bang one gets per change in energy prices**. It's just that we don't think you get much without a change in price. (Let me remind you that this definition of technology is not remotely what economists would call technological change. In addition to true innovation, it includes dissemination of existing technology, substitution among well-known technologies, the switch from manufacturing to services, and energy conservation. In short, it is everything.)

- * The point estimate of the truly autonomous component of EEI is only .54-.63 per cent per year, generally not statistically significant, but near the .6-.7 range that our outside reviewers cite.
- * The price elasticity is highly significant.
- * Adjustment is gradual, so that the long-run elasticity is 20 times the one-year elasticity.
- * When one includes government spending on energy R&D, its effect on EEI is insignificant.
- * The "simulation" that Quindi and Cristian carried out (see graph at the back) suggests that under our assumptions, we get a slightly more rapid path of energy saving for a somewhat lower carbon tax than in the IAT results. The main point is that we think that our relative emphasis on the price component vs. the truly autonomous component of EEI is based on better economics, and is more likely to lead to good policy, than some others'. But it is nice that the bottom line is one that our green friends should like!

I think we want to verify and refine these results a bit more before using them, but I hope you agree that they are very suggestive.

Re: DOE/Labs Study

Attachment 2.

U.S. CARBON REDUCTIONS BY 2010 AND BEYOND

The Potential Impact of Energy-Efficient and Low-Carbon Technologies

CONCLUSION: Technology can lower the cost of stabilizing carbon emissions at 1990 levels in the medium term (i.e. 2010) to \$10 billion a year or less (0.1% of GDP). The study did not consider international trading or more flexibility in meeting the stabilization target, which could reduce costs by another 50% or more. The study assumes penetration of technologies from expanded Administration initiatives, such as the Partnership for a New Generation of Vehicles.

BACKGROUND: Five DOE national laboratories led by Oak Ridge and Lawrence Berkeley labs have conducted a comprehensive, peer-reviewed, 9-month "bottom-up" analysis of the role technology can play in stabilizing U.S. carbon emissions. It is the most authoritative and documented study of this subject since the National Academy of Sciences report in 1992 and the Office of Technology Assessment Report in 1991. The study documents in detail how four key sectors of the economy—buildings, transportation, industry, and electric utilities—could respond to the same climate scenario being modeled by the interagency team: a climate treaty is launched in the year 2000 with a goal of stabilizing in 2010, and a cap and trade system is phased in with gradually rising permit prices. The lab study examined what an aggressive program of research, development, and deployment of clean technologies could have combined with a marginal permit price of \$50/ton of carbon (the average permit price is much lower).

RESULTS: The study concludes that energy efficiency and low-carbon technologies have a very large potential to cost-effectively reduce U.S. carbon emissions while meeting the full energy needs of U.S. businesses and families. Many consumers will save money. Current projections suggest that a carbon emissions reduction of 380 million metric tons (MMT) is required to stabilize U.S. emissions in 2010 at 1990 levels. Under moderate technology and market assumptions, energy efficiency technologies alone can reduce emissions in 2010 by 120-190 MMT. This level of carbon reductions estimated to be possible at little or no net cost—that is, the energy bill savings exceed the investments required to achieve the carbon savings. Under more aggressive assumptions, a combination of energy efficiency, low-carbon technologies and relatively inexpensive coal power plant conversions to natural gas can reduce 2010 emissions by 340-390 MMT. The net cost of reductions of this magnitude is estimated to be on the order of \$10 billion per year in 2010 (0.1% of GDP). These low costs are due to the net savings resulting from investments in many of the technologies considered.

METHODOLOGY: In contrast to the current top-down economic modeling of the interagency team, the five laboratory study uses a bottom-up technology-by-technology assessment as well as a top-down engineering-economic modeling approach. It draws upon a wide variety of technology cost and performance information to assess potential impacts. It has been peer-reviewed by industry experts. A utility sector analysis quantifies the impacts of end-use efficiency improvements on utility carbon emissions, potential emissions reductions through operations changes, and the costs of converting coal power plants to natural gas. Finally, a number of promising very low carbon technologies are examined to determine their potential for emissions reductions, including advanced gas turbines in industry, biomass/biofuels energy, and improved aluminum smelting.

TOTAL BENEFITS EXCEED TOTAL COSTS: In the long term, these climate change mitigation actions will provide additional benefits not fully considered in the study—reductions in criteria air pollutants (i.e. ozone and fine particles), decreased dependence on foreign oil, greater industrial productivity, and U.S. leadership in technologies likely to be a major source of international trade and jobs in the next century.

CHOOSING OUR ENERGY FUTURE

The Present Path

National energy consumption rises from 85 Quads in 1990 to 105 Quads in 2010 and 119 Quads in 2030.

Economic growth averages 2.2% per year under *Present Path* assumptions.

In spite of economic growth, many job opportunities are lost due to energy waste and rising oil imports.

National energy bill rises to \$650 billion in 2010 from \$540 billion in 1990.

Fossil fuels, which account for 85% of U.S. energy use today, still account for 85% in 2010.

The United States remains fossil-fuel dependent for the foreseeable future, with renewable resources meeting only 11% of our energy needs in 2030.

Petroleum use rises from 17 Mbd (million barrels of oil per day) to 21 Mbd in 2010 and 25 Mbd by 2030.

U.S. oil import bill rises to \$104 billion annually by 2010, continuing to add to our trade deficit and drain the economy.

Energy intensity of the U.S. economy declines at 1.1% per year.

Air pollution from nitrogen oxide (NOx) emissions persists with little change from present level of 20 million tons per year.

Sulfur dioxide (SO₂) emissions decline only slowly, from 19 million tons annually today to 13 million tons by 2010.

Global warming emissions of carbon dioxide (CO₂) rise steadily from 1338 MTc (million metric tons of carbon per year) in 1990 to 1621 MTc in 2010 and 1892 MTc in 2030.

The Innovation Path

National energy consumption held to 89 Quads in 2010 and is cut to 69 Quads in 2030.

Economic growth averages 2.2% per year under the *Innovation Path*.

Energy savings result in job creation, with a net employment boost of nearly 800,000 jobs nationwide by 2010.

National energy bill held to \$560 billion in 2010. Net savings amount to \$530 per household per year in 2010.

Fossil fuel dependence drops to 79% by 2010 and down to 68% by 2030.

The country starts a clear transition toward renewable resources, which meet 14% of U.S. energy use needs by 2010 and 32% by 2030.

U.S. petroleum use trimmed to 16 Mbd by 2010 and then drops to 12 Mbd by 2030.

Oil import bill cut to \$83 billion by 2010, saving \$21 billion per year that would be otherwise largely lost to the economy.

U.S. energy intensity declines at 1.9% per year, falling 32% by 2010.

NOx air pollution is reduced 24% below the 1990 level by 2010, falling to 15 million tons per year.

SO₂ pollution is reduced 64% below the 1990 level by 2010, dropping to 7 million tons per year.

U.S. CO₂ emissions are cut to 1207 MTc; 10% below the 1990 level, by 2010 and reductions continue, pushing emissions down to 728 MTc, or 45% below the 1990 level, by 2030.



Memorandum

To: Jeff Frankel, Jason Shogren
From: Quindi Franco, Tom Rhoads
Date: July 2, 1997
Subject: **Review of *Energy Innovations, A Prosperous Path to a Clean Environment*¹**

Summary

This summary is based on the executive summary (full report is scheduled for release sometime mid-July). As such, specifics on the analysis are superficial at best. The study shows that CO2 emissions by 2010 can be reduced to 10 percent below 1990 levels at a net benefit to the economy, reducing annual energy costs by \$530 per household and creating nearly 800,000 net jobs. All of this by enhancing energy efficiency, using new technologies, and tapping into domestic renewable resources through a set of sector specific, revenue neutral policies.

The "Innovation Path" -- Policies & Technologies

The study analyzes a set of policies that can "put the U.S. on an innovative, prosperous path leading to an economically and environmentally sustainable future... The approach involves setting fair performance standards, creating incentives, providing better information, and reducing transaction costs in order to foster investments in clean and efficient technologies." The set of policies does not include an economy wide carbon or energy tax. Rather, the policies are sector specific (transportation, buildings, electricity, industry), and present no net increase in taxes or fees within any sector.

Examples of Sectoral Policies:

- Renewables Content Standards A credit-trading system requiring increasing percentages of electricity & motor fuels to come from renewable sources.
- Emissions Performance Allowances Caps on emissions of sulfur dioxide, nitrogen oxides, and carbon dioxide, with emissions allowances allocated to generators in proportion to their electrical output.
- Advanced Vehicles Initiative Stronger fuel economy and emissions standards, backed by rebates paid for by fees on gas guzzlers, market introduction programs and technology R&D.
- Investment Tax Credit 10 percent tax credit for investments in new manufacturing equipment, paid for by fees on purchased energy.

¹ "Energy Innovations, A Prosperous Path to a Clean Environment," by Alliance to Save Energy, American Council for an Energy-Efficient Economy, Natural Resources Defense Council, Tellus Institute, and Union of Concerned Scientists, June 1997.

- Market Introduction Incentives Technology demonstrations, manufacturer incentives, consumer education, and “market innovations” to reduce transactions costs.

Technologies Developed: fuel cells, advanced gas turbines, integrated green building designs, membrane technology, fuels and electricity from biomass, advanced wind turbines, photovoltaic modules.

Analysis

The National Energy Modeling System (NEMS) and the Long-range Industrial Energy Forecasting (LIEF) model were used to represent the different energy sectors. Results were then fed into a macroeconomic model (IMPLAN) to project GDP, wage, and employment impacts. NEMS and IMPLAN are federal government models. *Details as to how energy diffusion and innovation (and the costs associated with them) were modeled are unclear from information released so far.*

Results:

Along the “innovation path” (full adoption of the policy approaches described above), primary energy consumption is 15 percent lower than the present path by 2010, and 42 percent lower by 2030. CO2 emissions are 10 percent below 1990 levels by 2010. Oil and coal use decline, and an increasing share of energy is supplied from renewable sources (14% of energy need by 2010, almost doubling energy output from renewable sources). Wages, GDP, and employment all improve in the innovation path over the baseline.

Economic Benefits of “Innovation Path” (\$1993, versus business as usual)

	2000	2010
Incremental Investments (B\$)	28	73
Fuel Cost Savings (B\$)	38	131
Net Savings per Household (\$)	100	530
Avoided Petroleum Imports (B\$)	5	21
Cumulative Investments (B\$)	89	588
Cumulative Savings (B\$)	96	1005
Cumulative Benefit/Cost Ratio	1.1	1.7
Net Employment	n/a	773,000
GDP (B\$)	n/a	2.8
Income (B\$)	n/a	14

Memorandum

TO: Jeffrey Frankel, Jason Shogren
FROM: Quindi Franco, Cristian Santesteban
DATE: July 2, 1997
RE: Energy Efficiency, Energy Prices & AEEI Revisited

As you requested, we ran a series of regressions to look at the relationship between energy efficiency (E/GDP), energy prices, energy R&D, and time. We then constructed a small scenario to illustrate differences between our estimates and those of the IAT. After re-running the numbers in the scenario, our results have changed significantly from a previous memo (June 30). We are confident the numbers presented below are accurate. In brief, we find that while the total (price and time) impact of the our estimates is similar to the IAT results, the portion due to prices (and therefore the costs involved) is much greater.

Analysis of Historical Data

Geometric Lag Regression:

$$\ln(E/GDP_t) = \beta_0 + \beta_1 \ln(\text{Energy Price Index}) + \beta_2 \ln(E/GDP_{t-1}) + \beta_3(\text{Time})$$

Where the energy price index is a relative index of the CPI Energy Price Index over the general CPI. Data from 1959 through 1995.

Variable	Coefficient (std. error)
Price Elasticity (β_1) Short Run	-0.03855 (0.008)
Long Run	-0.76832
Lagged Energy Efficiency (β_2)	0.949 (0.042)
Time Trend (β_3) Short Run	-0.00031 (0.0006)
Long Run	-0.00627
$R^2 = .99$	

AEEI = 6.3 %/yr

Energy R&D:

$$\ln(E/GDP_t) = \beta_0 + \beta_1 \ln(\text{Energy Price Index}) + \beta_2 \ln(E/GDP_{t-1}) + \beta_3(\text{Energy R\&D Intensity}) + \beta_4(\text{Time})$$

Where Energy R&D intensity is government funded Energy R&D over total R&D. Various forms of Energy R&D data (real R&D expenditures, and various lag times) generate roughly the same non-statistically significant results. This could be because our aggregate energy R&D

figures include substantial funding for energy production technologies; we are not isolating the component of Energy R&D that is specifically efficiency related.

Variable	Coefficient (std. error)
Price Elasticity (β_1) Short Run	-0.03075 (0.014)
Long Run	-0.71051
Lagged Energy Efficiency (β_2)	0.9567 (0.043)
Energy R&D (β_3) Short Run	-0.00619 (0.00878)
Long Run	-0.14307
Time Trend (β_4) Short Run	-0.00024 (0.00062)
Long Run	-0.00544
$R^2 = .99$	

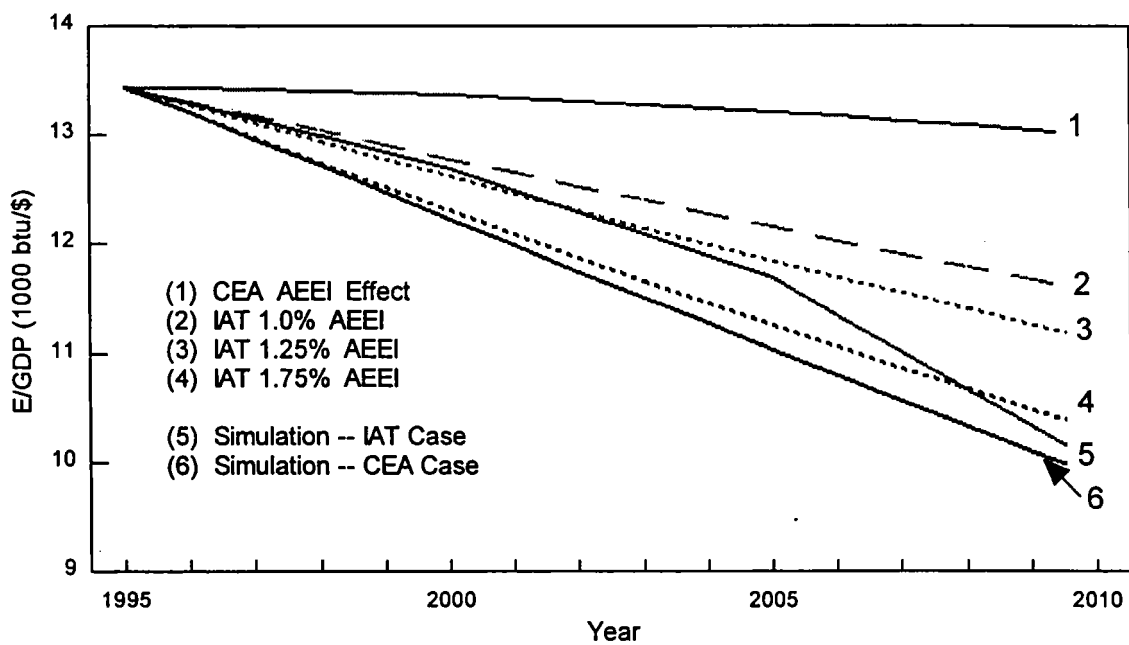
Scenario:

CEA CASE A \$100 per ton carbon tax is levied on all fuels in 1995; we assume this causes a 30% increase in energy prices (range in literature is 15% to 200%). Initial E/GDP of 13.45 (000btu/\$) in 1995, and a time horizon of 1995-2010. The long-run impact of the price increase is fully incorporated by 2010. The simulation uses the original regression estimates excluding energy R&D (lines 1 and 6 in the graph). Over this time period, the CEA estimated time effect is equivalent to an annual AEEI of 0.23 percent.

IAT CASE IAT results are from the most recent Markal-Macro simulations for stabilization at 1990 levels by 2010 under a 1.25% annual AEEI (5). This is a complex policy scenario and should only serve as a rough comparison to our simulation (the model estimates an implicit carbon tax of \$144 in 2010). The impact of the IAT AEEI assumptions (1.0% -- #2, 1.25% -- #3, and 1.75% -- #4) have been modeled continuously throughout the period (some IAT runs assume the rate starts at 1% in 2000, and increases to 1.25/1.75 by 2010).

Component	Drop in E/GDP (percent)	
	CEA	IAT
Time Effect (AEEI)	0.45 (23%) (1) in graph	2.31 (67%) (3) in graph
Price Effect (CEA)	3.1 (87%) from regression	-
Price + Other	-	1.14 (33%) implicit
Total	3.55 (6) in graph	3.45 (5) in graph

Energy Efficiency Improvements



Literature Review:

The Economics of U.S. Global Climate Change Policy

-- Draft 3 --

June 25, 1997

I. Abstract

This survey attempts to illustrate what economists generally think about global climate change policy decisions facing the United States. A framework for thinking broadly about how immediate decisions fit into broad policy goals is presented. Economists have estimated a surprisingly broad range of costs for protecting the climate, and it is useful to normalize these estimates around the policy target of a percentage reduction of emissions from baseline. Though other indicators are available, we focus on GDP and the change in prices to get an understanding for the broad impacts a given policy target may have. This still produces a rather large range in estimates of economic impacts, but several key assumptions and uncertainties explain most of that range. Other indicators, such as employment, consumption, and distributional impacts can provide a more nuanced and robust picture of the economic impacts of different policy choices.

II. Introduction -- thinking broadly about GCC policy decisions

The U.S.' ultimate objective with respect to climate change (according to Article 2 of the Framework Convention on Climate Change) is to stabilize "greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." US policies in this area must ultimately be evaluated according to how they reach that and other [domestic] policy goals. However, scientists, experts, and the international community do not currently know what level of greenhouse gas concentrations might be safe. There is only consensus that it is significantly below where our current emissions will take us if we continue business as usual. Therefore, at some point, we will need to dramatically reduce our emissions of greenhouse gases.

Stabilizing atmospheric concentrations of GHG's at some level could be accomplished through a number of different emissions reduction scenarios. [figure showing various paths with same ultimate concentrations] As long as emissions fall in the future, emissions could be allowed to rise in the near term; alternatively, early reductions can reduce the need for drastic future reductions. Shifting emissions reductions into the future allows time for a gradual adaptation of the energy capital stock, developing low cost and low carbon technology substitutes, removing carbon from the atmosphere via the carbon cycle, and, since the economy yields a positive return on

capital, future reductions can be made with a smaller commitment of today's resources. Others argue there are already significant supplies of low-cost abatement options and that consistent and gradual reductions would be less costly because of the inertia of the economic system. While there is no firm consensus on this debate, most economists believe there is room to allow emissions to grow at least for the next few decades before serious reductions are necessary. There is also some consensus on the need to take low-cost medium-term actions that can reduce the costs of substantial reductions in future emissions should they become necessary. The next section presents the range of economic estimates of what those costs may be over a range of policy goals.

III. Immediate Options -- broad range of estimated impacts

Economists have been studying the costs of climate change policies since the issue was first seriously debated. They have developed numerous models, methodologies, and techniques, and produced hundreds of cost estimates -- from losses of 11 percent GDP to gains of 2.5 percent GDP. Recent work by Repetto and Austin (1997) has attempted to put order into the chaos of these estimates by normalizing them across a number of dimensions -- primarily the percentage reduction in emissions from baseline. The remainder of this paper draws heavily on Repetto and Austin's work, though we have drawn from the vast economic literature on this issue as well.

Repetto and Austin analyzed the results of 162 estimates from 16 of the most reputable and widely used models. Each model is unique in how it represents the economy, and different simulation "runs" reflect either different policy assumptions or different abatement targets. Each simulation generates a predicted economic impact and a corresponding percentage change in emissions in some future year. These variables are measured with reference to a baseline scenario, particular to each model, predicting what would happen in that year if no carbon tax or equivalent policy were adopted.

Economists typically measure economic impacts in terms of GDP losses and price increases. These measures are not ideal. If predicted economic adjustment involves an initial slump from which the economy then recovers, a better measure would be discounted loss of income or consumption over the entire period. Furthermore, GDP loss is not a true measure of economic wellbeing -- it does not measure the nonmarket value of environmental quality or give a sense of distributional impacts. Nevertheless, GDP losses and price impacts are useful in getting a sense of the big picture of the impacts of various emissions reduction policies.

A. GDP impacts

Under worst case assumptions, the adverse economic impacts of a carbon tax or equivalent policy would be severe, reaching 6 percent of GDP for a 50% reduction in projected baseline emissions by 2020. With different assumptions, the costs look less ominous. For example, assuming that backstop energy sources exist improves the predicted economic impact substantially -- by about one percent of GDP for a 50% emissions reduction. By changing only five assumptions -- backstop energy sources,

allowing efficient long-run adjustment in the economy, greater substitution possibilities, joint implementation, and revenue recycling -- there would be modest positive impacts on GDP relative to the business-as-usual scenario to reach the same level of abatement.

The range of impacts estimated by Reppetto and Austin for stabilizing emissions at 1990 levels in 2010 is between a loss of 2.4% and a gain of 2.4% of GDP by 2020.

[Figure 1 -- REPPETTO & AUSTIN SCATTER -- Predicted GDP impacts on US economy]

B. Changes in prices

Since most greenhouse gas emissions come from energy usage, policies to reduce emissions will necessarily affect the price of energy. Indirectly, these increased prices will be transmitted throughout the economy as energy is an input in the production of nearly everything. Models frequently estimate an "implicit carbon tax" which is the equivalent tax on carbon that would be needed to reach a given level of emission abatement (see Figure 2). Economists have studied the effect of carbon taxes on the price of various energy sources, and indirectly on goods and services.

[Figure 2 -- REPPETTO & AUSTIN SCATTER -- Predicted carbon tax with emissions reductions targets]

Carbon Tax	Price Change -- Dollars (Percentage change)			
	Coal	Oil	Gasoline	Natural Gas
10	6.49 (33%)	1.3 (8%)	0.03 (2%)	0.16 (9%)
50	32.45 (167%)	6.5 (42%)	0.14 (12%)	0.80 (44%)
100	64.90	13.0	0.27	1.60
150	97.35	19.5	0.41	2.40
200	129.80	26.00	0.54	3.20

These increases in energy prices translate to higher energy input prices to the production of many goods. A study using the DRI model Among non-energy sectors, price impacts of a \$100 carbon tax range from 15.7 percent for cement to 1 percent or less

for service industries. Airline prices may increase 2.9 percent due to the rise in jet fuel prices and other indirect effects.

[FIGURE of price impacts on other consumer goods and services]

IV. Key Assumptions that Explain Range

In their analysis, Repetto and Austin find that 80 percent of the variation in estimated economic impacts can be attributed to several key assumptions about the nature of the policy being modeled and how the economy works. These assumptions are discussed below.

A. Technology

1. Energy efficiency improvements

Engineering studies suggest that from 20-25 percent of existing carbon emissions could be eliminated at an overall cost savings, and that additional savings could be had at low costs (IPCC 1996, NAS 1991, OTA 1991). These inefficiencies persist because of energy market imperfections, such as different incentives between landlords and tenants, energy subsidies, or incomplete information. However, these savings may be overstated if the management costs of locating and implementing energy investments are overlooked or the differences in product and service characteristics of various energy -conversion technologies were ignored. Two recent studies quantify annual federal energy subsidies at between \$4.9 - \$14.1 billion and \$21-\$36bn respectively (Alliance to Save Energy, 1993; US EIA, 1992). A study on the effects of removing U.S. energy subsidies concluded that significant reductions in CO₂ could be achieved at no cost to the economy (Shelby, 1995).

2. Rate of technological change with higher energy prices

Many models incorporate constant rates of technological change and diffusion even with higher energy prices. However, technological changes do react to market incentives provided either by regulation or by energy prices. Government policies can "induce" technological change (Binswanger and Ruttan, 1978), and rising energy prices will induce more rapid development of energy-saving innovations -- some go so far as to say rising energy prices are the most effective way of stimulating such innovation (Grubb et al., 1995). Models which take this effect into account estimate lower economic costs of abatement (Goulder & Schneider, 1996).

3. Social rate of return for energy-efficiency R&D

Economic studies in a broad number of industries indicates an average social rate of return for R&D of 63.8% (Decanio letter) -- significantly higher than private rates of return. This indicates that there is a potential to improve welfare by increasing aggregate R&D, including R&D in energy efficiency technologies. If there are further

environmental benefits to energy efficiency R&D, there is even more reason to increase this type of R&D, and therefore lower the ultimate costs of reducing GHG emissions.

B. Substitution effects, fuel switching, and backstop technologies

Policies to reduce CO₂ emissions will implicitly raise the prices of fuels and products in proportion to their carbon content. These higher prices will prompt firms and households to substitute less carbon intensive energy sources, methods of production, and products for similar high carbon intensive goods. The easier these substitution effects are, the lower the ultimate costs of reducing emissions. Some models are so disaggregated that they essentially do not allow any substitution, which raises costs of meeting any emission target. Others allow instantaneous and costless substitution across a wide range of outputs and inputs.

One specific example, and critical element, of the importance of substitution effects is in backstop technologies. Alternative, low carbon energy sources do exist. They are not currently cost-effective, but will become so in the future as carbon energy sources become more expensive and technology makes them less expensive. The availability of these backstop non-carbon energy technologies has a large impact on the costs of meeting whatever emission reduction goal. Model simulations (IPCC, 1996) estimated the effect of more optimistic backstop technologies in an “accelerated R&D” scenario (cost of non-electric backstop reduced from \$100 to \$50, and electric backstop reduced from 75 to 50 mills/kWh). They find that GDP losses for a 20% emission reduction scenario were reduced by approximately 65%.

C. Flexibility

Flexibility in formulating national responses over time and space (where/when flexibility) can reduce costs by allowing emission abatement to be carried out wherever and whenever it is lowest in cost.

1. Emission budgets & banking

Multi-year emission budgets allow nations (if used internationally) or domestic entities to smooth their compliance costs over many years. Firms and nations can choose optimal emissions path to meet their individual abatement costs over time. In the same way that choice of overall emissions path is critical to the costs of stabilizing GHG concentrations, flexibility among parties is also important in meeting national or international targets. Model simulations (Cohan et al., 1994 -- IPCC) find that delaying the target date from 2010 to 2015 for stabilizing U.S. emissions at 20% below 1990 levels can reduce costs as much as 20%. This area has not been studied sufficiently.

2. Emissions Trading

Emissions trading is currently the mechanism of choice for international and domestic implementation of GHG emissions reductions policies. Theoretically, trading

programs encourage abatement to happen wherever it is lowest cost. Firms with high abatement costs can buy permits from firms with lower abatement costs and both firms may gain from the trade. This flexibility with regard to where emissions reductions take place is called "where" flexibility. Models estimating the value of this type of flexibility range between 20% and 90% of total costs (see table) when trading takes place among all nations. However, if trading is only permitted among Annex 1 nations, the gains are likely to be less -- Perroni and Rutherford estimate carbon taxes 6% lower with Annex 1 trading to reach 20% below 1990 levels by 2020.

While an international emissions trading system is good to lower the costs of regulation, there are some drawbacks. McKibbin & Wilcoxon (1997) point out that a trading system may be good for stabilization at a certain level, but is not necessarily an optimal mechanism for reducing the growth of emissions, that monitoring and enforcement costs may be high, and that there will be large wealth transfers between countries with corresponding changes in exchange rates, trade balances, and international capital flows.

Value of Trading and JI

Study	Scenario	Value of International Where Flexibility
Manne (1993)	CO2 emissions reduced by 2% per year relative to BAU	PV of \$550 billion
Martins et al. (1993) GREEN	CO2 emissions reduced by 2% per year relative to BAU	GDP losses reduced by 27%
Edmonds et al. (1995)	Stabilize CO2 at 1990 levels	50% reduction in cost
Rose and Stevens 1994	Various	20% to 50% reduction in costs
Manne & Richels (1997)	Emissions pathway to stabilize concentrations @ 550ppmv	90% of total costs

Gains from Tradable permits w/world

Model	Tax Ratio (tax w/trade over tax w/out trade)	GDP Loss Ratio (GDP loss w/trade over GDP loss w/out trade)
ERM	0.84	0.84
GREEN	0.71	0.53
Global 2100	0.95	0.89
CRTM	0.76	n/a

3. Joint implementation

JI would provide even more "where" flexibility as nations can search out lowest cost abatement options throughout the world. Joint implementation of projects between Annex I nations and the rest of the world may have even more problems with transaction costs as it may require very difficult calculations (baselines, off-site effects, etc.) which would be highly uncertain. (Richards, 1996) There is further the moral hazard problem, in which both investing parties and the host country parties have a common interest in exaggerating emissions reduction claims (Roland and Haugland, 1995; Selrod et al 1995)

D. Revenue recycling

Policies to reduce GHG emissions can potentially to generate large revenues which can be used to offset the general deflationary impacts of the policies by themselves. The evaluation of such policies, therefore, depends on what is done with the revenues generated through it. When those revenues are returned to the economy through lower taxes, lump-sum payments, or deficit reduction, it is called revenue recycling. Since the existing tax structure is highly distortionary (reducing incomes by more than a dollar for every dollar of tax revenue collected) economists have thought that if revenues can be recycled by reducing these distortionary taxes, a "double dividend" may be reaped by not only correcting the climate change market failure, but also by reducing the costs of other distorting taxes. This would imply that carbon reduction policies may be beneficial regardless of their effects of climate change. However, the distortionary effect of carbon taxes (implicit or otherwise) depends on the size of the energy market, the price sensitivity of energy demands, the structure of pre-existing energy taxes, and other conditions. Work by Goulder (1992, 1993, 1995) and Bovenberg and de Mooij (1994) finds that, with respect to personal income taxes, revenue recycling only partly offsets total costs. Economists have not come to a consensus on the double dividend debate. Irregardless of the final outcome of this debate, the argument is more a case for reform of the tax system than for the introduction of a climate change policy (Bohm, 1995a). Other taxes or revenue generating policies may more effectively raise public revenues than carbon policies.

E. Avoided costs of climate change

Models used to estimate the costs of climate change policies are mostly adapted energy planning or economic forecasting models. These models do not incorporate the benefits of preventing climate change -- the costs of doing nothing. Global warming may bring with it changes in precipitation, weather patterns, ecological habitats, water availability, severe weather events, and cause sea levels and mean temperatures to rise. As the economy adapts to these physical changes, there will be direct impacts to transition to new patterns of production and living, as well as indirect effects those changes will have on the rest of the economy. Reducing GHG emissions can reduce these impacts on the economy and therefore lower costs of reducing emissions.

However, estimating and modeling these avoided costs is extremely hard and subject to much uncertainty. Recent work by the EPA studied the effect of various climate change scenarios on a subset of market impact categories. The study finds aggregate impacts on national income could range from -2.0 percent to +1.2 percent by the year 2080. Previous studies for the IPCC report using different methodologies and different sets of impact categories estimate losses between 1.0 percent and 2.5 percent annual GDP by 2060. These aggregate estimates hide significant variability in impacts across regions, economic sectors, and industries.

F. *Avoided costs of other environmental damages*

By discouraging coal and other fossil fuel consumption, a carbon tax would reduce emissions of such air pollutants as carbon monoxide, sulfur and nitrogen oxides, and toxic trace pollutants in exhaust gases. Most of these pollutants are already regulated, but such regulation usually takes the form of a maximum rate of emissions per million BTUs. By reducing BTUs generated by fossil fuel consumption, emissions of these pollutants would inevitably fall, reducing damages to health, visibility, materials, and crops. Studies in Europe and the U.S. have estimated that the non-climate benefits of a carbon tax may be as large or larger than the benefits from avoiding climate change (Ekins, 1995; Jorgensen et al., 1995). The benefits from reducing air pollution damages could offset 30 to 100 percent of carbon abatement costs (IPCC). Since most models do not incorporate these avoided costs, they overestimate the impacts of climate policies.

G. *Imperfect regulatory regimes*

Transaction costs are important for evaluating the claims of tradable permit systems (both domestically and internationally). There are three potential sources for transaction costs in permit markets -- (1) search and information, (2) bargaining and decision, (3) monitoring and enforcement. If these costs raise barriers to the efficient conduct of trading, the potential cost-savings of the regime will not be met. Theoretical work by Stavins (1995) shows that equilibrium permit allocations and aggregate control costs are sensitive to the original permit allocation; this implies that if there are large transaction costs, it might be better for initial permits to be auctioned off rather than allocated through the political system or grandfathered. There is reason to believe that any international or domestic GHG trading program or JI regime will have significant transaction costs.

V. Other Indicators Add Detail

A. *Distributional effects*

Broad macroeconomic economic impacts can hide severe impacts on regions, industries, and households that are highly dependent on fossil fuels and have limited ability to adjust to price changes. Carbon taxes are believed to be regressive, with a \$100 per ton carbon tax creating a 10.1 percent burden for the lowest income households, but

only a 1.5 percent burden for the top decile (Poterba 1991). If households are arranged by expenditures, however, the burden seems less regressive, accounting for 3.7 percent to 2.3 percent of total expenditures for bottom and top deciles respectively. In the long run, distributional impacts will also depend on changes in employment, wages, and asset prices. Overall economic models taking these factors into account indicate carbon taxes would have only modest distributional impacts from mildly progressive to mildly regressive (Jorgensen et al., 1992). Again, distributional impacts depend on how revenues generated are used.

The energy industry in general, and coal in particular, would experience the greatest impacts from emissions reduction policies. Coal output may decrease by 25% and prices increase by 35 % for stabilizing at 1990 levels by 2020. (Jorgensen et al, 1992). Regionally, the impacts of policies would hit coal mining states disproportionately high. However, the costs of global warming would also hit regions differently (coastal areas would be hit harder), so the distribution impacts of a carbon tax may be no worse than the effects of global warming.

B. Consumption

DRI (Horwitz, 1996) -107 Bn 1992\$ in 2010; \$100 carbon tax

C. Employment

Study	Scenario	Employment Relative to Baseline (thousands)	Unemployment Rate (% above baseline)
EPRI (1994)	\$100 carbon tax	-500	.18
	\$200	-1100	.39
Horwitz, 1996 (DRI model)	\$100 carbon tax	-520 (average, 1,000 peak)	0.5

D. International Dimensions

1. Investment and international trade flows

There may also be international trade gains. Given the size of the collective Annex I market, a policy induced fall in energy consumption would restrain world fuel prices, improving U.S. terms of trade as a net oil-importing economy.

2. Reallocation of carbon-based industries to LDCs -- Leakage

Unilateral policy among a group of countries may only have limited effect on the global emissions of greenhouse gases depending on how non-cooperating nations react. Leakage can undermine the purpose of instituting emissions reductions by affecting

international market forces in a way that emissions in non-cooperating countries increase. This can occur through two methods; first, the comparative advantage in production of carbon-intensive goods would shift to non-cooperating nations. As a result, production of such goods would shift to non-cooperating nations, whose emissions would increase. Secondly, as world demand for carbon-intensive fuels decreases world prices for those fuels, the use of such fuels outside the coalition would increase. Leakage rates (the increase in emissions by noncooperating countries over the reduction in emissions by cooperating countries) have been estimated with a number of models, and techniques. Results range between small negative leakage rates (Oliviera-Martins, et al 1992) and 100% (Horton, et al., 1992). The difference in modeling results can largely be attributed to how the models handle substitution between goods and the mobility of capital. Research in the US suggest that cost differences created by international differences in environmental policies have minor impacts on trade and investment flows (Repetto, 1995). Other than it is a potentially serious problem, there is no consensus amongst economists regarding the possible magnitude of leakage.

Study	Conditions	Leakage Rate
Whalley-Wigle; Pezzey, 1992	20% reductions in EU	80%
Whalley-Wigle; Pezzey, 1992	20% OECD reductions	70%
GREEN; Oliveira-Martins, et al., 1992	Stabilization @ 1990, EU	11.9% in 1995, 2.2% in 2050
GREEN; Oliveira-Martins, et al., 1992	stabilization @ 1990, OECD	3.5% in 1995; 1.4% in 2050
Hanslow, et al., 1995	20% reduction in Annex I	3.8%

E. International transfers for emission permits

Rough, back of the envelope, estimates by McKibbin and Wilcoxon (Brookings paper) estimate the U.S. would purchase nearly \$24 to \$48 billion dollars worth of carbon permits every year. They assume the U.S. may need to import permits equal to 20 percent of 1990 emissions, or 238 million tons. At permit prices between \$100 and \$200, that would amount to \$24 to \$48 billion dollars worth of permits, which would increase the U.S. trade deficit by 25 to 50 percent. However, this assumes it would be worth it to acquire nearly 51% of our permits abroad at \$100. Many models estimate that a significant abatement opportunities (even all that is needed to reach 1990 levels) exist at prices below \$100.

VI. References

Date: July 3, 1997

To: Judi Greenwald
White House Climate Change Task Force

From: Jeffrey Frankel, CEA
Tom Rhoads, CEA

RE: CEA Comments on Climate Change Sectors Summary Paper

CEA has the following concerns and editorial comments for Jeffrey Hunker's paper on the sectoral implications of climate change policy prepared for the Assistant Secretaries Group.

- Generally: Tables 1-6.
AEO97 does not provide actual data for emissions and energy consumption for 1997. The figures reported in the current document as 1997 data are merely estimates based on projections in AEO97 for emissions and energy consumption growth and should be reported as such.
- Page 1: Paragraph beginning "Total U.S. greenhouse gas emissions..."
The draft U.S. Climate Action Report (U.S. CAR) indicates that U.S. GHG emissions in 1995 were 1,559 MMTCe with gross emissions of 1,676 MMTCe. The current document reports figures inconsistent with those from U.S. CAR (1,557 MMTCe and 1,674 MMTCe, respectively). Consistent reporting of data across documents is required.
- Page 2: Table 1.
The heading of the third column should read:
"Percentage of Total ~~1995~~ 1997 Emissions"
- Page 4: Table 4.
The title of Table 4 should read as follows:
"Total 1997 and 2015 2010 Building Energy Consumption By End-Use (in Quads)"
- Page 4: Paragraph beginning "Currently, numerous opportunities exist..."
"By tightening the building shell...consumers can experience ~~substantial monetary gains~~ through greater savings as a result of lower in their monthly utility bills."
- Page 5: Barriers to Adoption section
"Despite the ~~proven~~ cost effectiveness of these and other energy efficiency technologies, it is clear that ~~they~~ these technologies are not ~~widely~~ always adopted by consumers. This is perhaps due to a number of institutional, organizational, and other barriers. The existence or availability of a financially attractive technology sometimes does not by itself..."
- Page 7: Economic Modeling Results for the Industrial Sector section

The IPCC Working Group III report details many mitigation cost studies that estimate economic losses due to reducing CO₂ emissions. Admittedly, there is no consensus in the economic literature regarding the effects of reducing CO₂ emissions. However, the real possibility that a mitigation strategy will cause economic losses is an issue that must be stressed in the current document. As it stands, the current document provides a significantly one-sided description of the possible positive effects of reducing CO₂ emissions. Including greater detail on the available literature that estimates economic losses from reducing CO₂ emissions will provide a more accurate picture of the current state of economic research.

- Page 8: Paragraph beginning “A second and central concern...”
“...producers might lose market share to competitors from non-Annex I countries (those countries not characterized by industrialized economies) under a climate treaty that affects Annex I but not ~~Annex II~~ non-Annex I countries.”
- Page 19: Paragraph beginning “As state-by-state restructuring takes place...”
“Cost reduction ~~will~~ is expected to continue to occur through R&D advances....”
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“Percentage of Total ~~1995~~ 1997 Emissions”

Date: July 3, 1997

To: Alicia Munnell
Jeff Frankel

From: Tom Rhoads

RE: CEA Comments on Climate Change Sectors Summary Paper

Jeffrey Hunker wrote a paper on the sectoral implications of climate change policy for the Assistant Secretaries Group. I have noted some concerns and various editorial comments.

I can write a memo in your names to the White House Climate Change Task Force that provides these comments and any others that you may have. Dirk Forrister has indicated that the deadline for comments is today.

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Emissions treaty flawed?

Critics say pending global warming agreement
would ravage industries

From Correspondent Bob Carden
May 1, 1997: 9:34 p.m. ET

WASHINGTON (CNNfn) - A treaty currently being negotiated to control global warming calls for keeping carbon dioxide emissions at 1990 levels through 2010, but critics charge the agreement could devastate several U.S. industries.

— "It has to be a global solution," said William O'Keefe, vice president of the American Petroleum Institute, who attacked the treaty for unfairly punishing the United States.

— "If the developed countries are the only ones who take action, we will encourage business to take its capital overseas.

— "And when capital goes overseas, jobs go overseas," O'Keefe said.

— A preliminary report by the Department of Energy found the treaty's curbs on carbon dioxide emissions would reduce energy consumption -- but would ravage the oil, iron, steel and chemicals industries. The United Nations is hammering out the agreement, which will not apply to developing nations like India and China, drawing criticism from executives like O'Keefe. (1.4MB QuickTime movie)

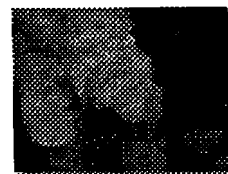
— Industry experts claim the treaty will slow economic growth by 1 percent each year, costing at least 500,000 jobs.

— But environmentalists say the industry is full of hot air.

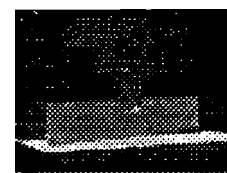
— "Through increased energy efficiency and introducing cleaner fuels, we can enhance performance and reduce emissions at the same time," said David Lashof, senior scientist at the Natural Resources Defense Council.

— "We've done that in the past ... with sulphur-dioxide emissions. We've done it with pollution from automobiles," he said. "We can do it with carbon dioxide emissions."

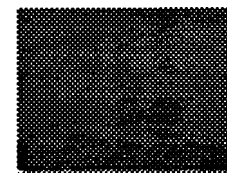
— Ongoing treaty negotiations are expected to culminate in a final agreement in December. In the interim, expect industry lobbyists to spend the coming months trying to convince the White House and Congress that the treaty would trade American jobs for what they see as a flawed agreement. ►



Emissions would have to stay at 1990 levels.



D.O.E. says U.S. industry would suffer.



Environmentalists want both growth and safe policies.

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Lesson From a Small Country

By Thomas E. Lovejoy

Tuesday, April 22 1997; Page A19
The Washington Post

Plainly it's a good thing when a developing nation embarks on raising its living standard. But the development often comes at a price. There may be some short-term benefits to be gained from depleting natural resources, but in the longer term it can leave the country worse off than before. Meanwhile, serious environmental damage may have occurred -- with effects not only on the country where it was done but on a global scale -- as in the case of deforestation and accompanying increases in "greenhouse" gases.

This is essentially a worldwide problem -- sometimes seen even in the poorer areas of developed nations -- and a complex one. But it is not a problem without solutions. One place where truly exciting progress has been made is in the small, progressive Central American country of Costa Rica.

Costa Rica has had an enviable history of democratic government ever since the legendary Don Pepe Figueres abolished the army shortly after taking office in 1948. It has a history of environmental concern and leadership, yet has had, and continues to have, its own share of environmental problems including a high deforestation rate. Since 1994, however, under the leadership of Don Pepe's son, Jose Maria Figueres, Costa Rica has launched an unparalleled effort to move toward sustainable development.

One area of major innovation is in energy consumption, the production of greenhouse gases and the problem of climate change. Costa Rica is attempting to phase out fossil fuels for power generation by 2010. This is easier there than it might be in other countries, because Costa Rica has an abundance of other means of producing power: good hydroelectric sites, wind sources and the geothermal potential that goes with living atop a string of volcanoes.

The country has already reduced power demand through an aggressive campaign that depended in part on the classic approach of raising the price, through a 15 percent national fuel tax. (Contrast that with the reluctance of the U.S. Congress even to contemplate a more modest BTU tax not many years ago.) Some of the revenues are being recycled into reforestation, thus preserving or restoring the resource base while avoiding or reducing carbon emissions as only forests can.

The carbon tax is linked to a 1996 forest law that pioneers the concept of "payment" for environmental benefits such as watershed protection and absorption of greenhouse gases. Of the water for hydroelectric generation, 87 percent comes from protected forests, and it would cost \$104 million to replace it with fossil fuel generation. Thus the savings of environmental protection offset its costs.

Costa Rica's latest -- and perhaps most exciting -- endeavor is to set itself up as a kind of world carbon bank, which works as follows: An entity in another nation, say, a private power company (or maybe a public agency operating power plants) is required by law or pressed by international convention to cut its carbon emissions or at least

keep them from increasing. If it is inconvenient or costly for the power company to do so in its own country, it may "purchase" reductions in some other country.

The power company (or public agency) might do this by building a non-emitting plant in Costa Rica, as the United States' Northeast Utilities has done with a 20-megawatt wind farm there. Or it might buy the equivalent of a conservation easement on a tract of Costa Rican forest, so that rather than being converted to pastureland or some other non-forested state, the land is maintained in its natural state as a capturer ("sequesterer") of carbon. Or it might simply pay for reforestation.

This system, known as "joint implementation" creates a "market in virtue" and, in theory at least, brings about pollution reductions at the lowest possible cost. Once the law requires countries and companies to reduce or limit emissions, they look around for ways to minimize costs, and this is where Costa Rica comes into the picture by offering itself as a means of achieving the pollution cuts.

Recently it has created a financial instrument that allows one to invest in pollution reduction through a type of bond that will eventually be tradable on commodity markets. For now, it provides funds to small landholders for reforestation or forest protection. This approach also permits generation of multiple income streams from the same tract of forest by activities that don't affect carbon storage such as ecotourism or extraction of minor forest products. The combined revenues constitute a powerful alternative to deforestation.

In the other area of innovation, Costa Rica's "alliance with nature" has already produced nature-oriented tourism on the scale of \$700 million a year and more than 100 private conservation areas, including a rain forest canopy tram and several butterfly farms. The most sophisticated aspect, however is the National Institute for Biodiversity (INBio). Founded and led by Rodrigo Gamez, INBio is a hub of activity engaged in systematic inventory of the flora and fauna in the 24 percent of the nation designated for permanent protection. This is all fed into an enormous databank and used by such pharmaceutical firms as Merck & Co. in the search for new medicines.

The generation of wealth from molecules in nature, thanks to organized data and the ability to return to the same individual tree that previously yielded a promising compound, already makes Costa Rica a country of choice at the dawn of the age of biotechnology.

This is not to say that all these initiatives have been without their problems or their critics. The carbon tax in particular has been unpopular, although polls indicate Costa Ricans are willing to pay more for water if guaranteed quality and quantity for their children and grandchildren. Figueres has, nevertheless, paid a price in abysmal popularity ratings for pursuing his visionary initiatives. He perseveres, however, convinced he should do the right thing for his country's economic growth and quality of life, and confident that this will in time be recognized.

The big issue is whether there will be continuity after the end of his constitutionally mandated single term in May 1998. It is unlikely that foreign supporters will walk away, because, as U.S. Interior Secretary Bruce Babbitt observes, "The world needs a Costa Rica to show the way."

Critics often say Costa Rica is a special case, an anomaly among Third World nations. It probably is -- and so is its brilliant, energetic and impulsive young president. But the entire world would do well to pay attention to the exciting experiments going on there, and take what it can from them.

The writer is counselor for biodiversity and environmental affairs to the secretary of the Smithsonian Institution.

The New York Times

Editorial

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April 24, 1997

No Ordinary Disaster

People living along the Red River in North Dakota began bracing for a flood as early as last winter. It was then that a cannonade of blizzards dumped more than three years' worth of snow in a period of just three months, the heaviest snowfalls in modern memory. Two months ago Gov. Edward Schafer declared a flood alert, and the Army Corps of Engineers joined residents to build dikes in preparation for the snowmelt. Their efforts proved futile and the Red River still had its way, inundating Grand Forks in one of the most spectacular disasters of recent years.

There is always an air of defeat surrounding a flood disaster, but the sense of shock is especially bitter in North Dakota, where the main error was that everyone worked hard to prepare for a flood twice as high as any in the river's history, only to discover last weekend that it was going to be nearly three times as high. At that moment it became frighteningly clear that even a few more feet of sandbags, stacked day and night by all the Army troops and volunteers in the world, were not going to do any good. The dikes, reaching more than 50 feet in many places, proved no match for the tsunami-like force of the river.

The National Weather Service says it is the kind of flood that happens once every 500 years. Unlike many other flood disasters of recent years, this one does not appear to have been caused by ill-conceived flood control projects, deforestation or other human factors. The devastation is almost entirely testimony to the force of nature. It was exacerbated by the fact that the Red River flows north to Lake Winnipeg in Canada, which is still frozen, blocking the river's progress. Unable to drain, the swollen river had no recourse but to spill sideways and force the evacuation of Grand Forks, a city of 50,000 that will probably remain under water for at least a week.

"This is not an ordinary disaster, if there is such a thing," said President Clinton, capturing the almost inconceivably bad luck of Grand Forks. He promised to increase emergency aid to \$488 million, but added, "I know that \$488 million or \$4 billion wouldn't make that go away."

There will be time in the months ahead to assess whether something more might have been done to make the flood predictions more accurate so that official planning could have fashioned more effective defenses. Are there better ways to measure the depth of the snow, with gauges or satellite reconnaissance, so that the resulting snowmelt's volume can be predicted more accurately? Are there better means to judge where and when a river will crest?

The people along the Red River will have to reassess whether they need more permanent dikes to prevent a recurrence of the disaster. For now, the most urgent task is to drain Grand Forks and get people back to their homes and places of work. They will resume their lives alongside a river that will more than ever command their fear and respect.

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Letters

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April 30, 1997

Did Global Warming Cause Red River Flood?

☐ [Letters Index](#)

To the Editor:

You are correct to point out that the flooding of the Red River in North Dakota is an event that occurs once every 500 years ("No Ordinary Disaster," editorial, April 24). Overlooked in your editorial, however, is that although no single flood or storm can as yet be tied to global warming, an increase in the frequency of flooding is consistent with the scientific modeling on the impacts of climate change.

Burning fossil fuels (coal, oil and gas) causes global warming and climate change. If our current energy policies continue unabated, 1-in-500-year events like the Red River flood could become more frequent, endangering human health and the environment.

Although you are correct in asking whether better flood prediction is needed, you should also ask why the Clinton Administration has taken virtually no policy steps to stop global warming, an underlying threat. These steps would include stopping new oil development, shifting subsidies from fossil fuels to clean, renewable energy and pushing for early action by 2005 in international negotiations for a legally binding treaty on climate change.

Another place to start would be to use Federal relief funds earmarked to rebuild the flooded areas so that they will rely on renewable sources of energy rather than on fossil fuels.

KALEE KREIDER

Dir., Greenpeace Climate Campaign Washington, April 26, 1997

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OPINION

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Commentary: Natural disasters should serve as a wake-up call

Al Gore

Earlier this month I traveled to the Upper Midwest to see the devastating flooding along the Red River. This flood is the latest in a series of natural disasters to plague the United States in recent years -- taking lives, destroying livelihoods and costing billions of dollars. These events have been nothing less than tragedies for thousands of families. The Clinton administration is doing everything in its power to help alleviate people's suffering and rebuild damaged communities.

But these recent disasters also must be a wake-up call for those who care about the future of our country. We cannot say with certainty that these events are caused by the onset of global climate change, but they are consistent with its predicted effects, and they should remind us all of the seriousness of the problem and the need to do something about it.

Scientists around the world now overwhelmingly agree that humans are influencing the global climate by increasing atmospheric concentrations of carbon dioxide and other gases, largely by burning greater amounts of fossil fuels. What could this mean for the United States? With better scientific data, the picture is becoming clearer.

The effects of climate change are likely to include rising sea levels and local shifts in temperature and precipitation patterns. A one-foot rise in sea levels could erode beaches by 100-150 feet, inundate many coastal lowlands and threaten communities along the coasts. Rising temperatures could double the number of heat-related deaths in dozens of U.S. cities. Higher temperatures are likely to mean extended ranges for infectious diseases like malaria and dengue fever. And of course, many scientists predict an increase in catastrophic weather events such as floods, storms and droughts.

As daunting as this challenge seems, the issue also represents a tremendous opportunity. We must commit ourselves to using energy more efficiently, to developing and deploying new technologies, and to the widespread use of renewable, less polluting energy sources. Many of these technologies save consumers money, and U.S. companies are the leading suppliers. For example, our work with the big three automobile makers is leading to a car three times more efficient than today's models. By promoting better technology, we can keep America at the forefront of the growing market for environmental technologies, already worth \$400 billion each year.

The United States cannot solve global climate change by ourselves, of course. That is why we are actively involved in international negotiations aimed at reaching a global agreement to reduce the risk of global climate change. Specifically, the administration believes industrialized countries should assume realistic and legally binding emissions-reduction targets, to be implemented nationally with the maximum amount of flexibility possible. Based on these principles, we hope to forge an accord that addresses climate change while providing for continued economic growth and maintaining U.S. competitiveness in the world.

The emissions of carbon dioxide and other greenhouse gases are intimately interwoven within the fabric of our civilization -- and as we move nationally and globally on this issue, we must remember that global climate change is a problem without immediate or easy solutions.

Star Tribune Online

Opinion

However, there is reason for hope. America's environmental laws -- the Clean Water Act, Clean Air Act, the National Environmental Policy Act, the Endangered Species Act -- are only a generation old. Yet already we have cleaner water, healthier air and safer food in most places. We have cut lead levels in children's blood by 70 percent, and toxic emissions from factories in half. Twenty-five years ago, Lake Erie was dead, and now it is a thriving resource.

Since President Clinton and I came into office, we have created a new national monument protecting 1.7 million acres of spectacular red rock canyonlands and completed as many toxic waste site clean ups in three years as were completed in the previous 12. We committed \$1.5 billion over seven years to help restore the Florida Everglades. We led the way to a worldwide agreement to phase out the use of 12 dangerous pollutants such as PCBs and DDT. And just weeks ago we completed ratification of a historic treaty to protect Antarctica.

During the second term, we will double the pace of Superfund work to clean up 500 of the worst toxic dumps by 2000. We are expanding right-to-know laws to give people the information they need to protect their neighborhoods from toxic pollution. We will strengthen the standards that protect our children from air pollution. And as Congress works to balance the budget, it must do so without compromising public health and environmental protection.

Global climate change and other environmental issues require concerted effort and dedicated attention over an extended period of time. The United States and other nations must negotiate the best possible climate treaty and adopt stronger national environmental safeguards. Scientists must continue to provide the best possible data to inform our actions. Business must develop the right technologies for the next century. Perhaps most importantly, each and every one of us must make environmental protection a part of our daily lives.

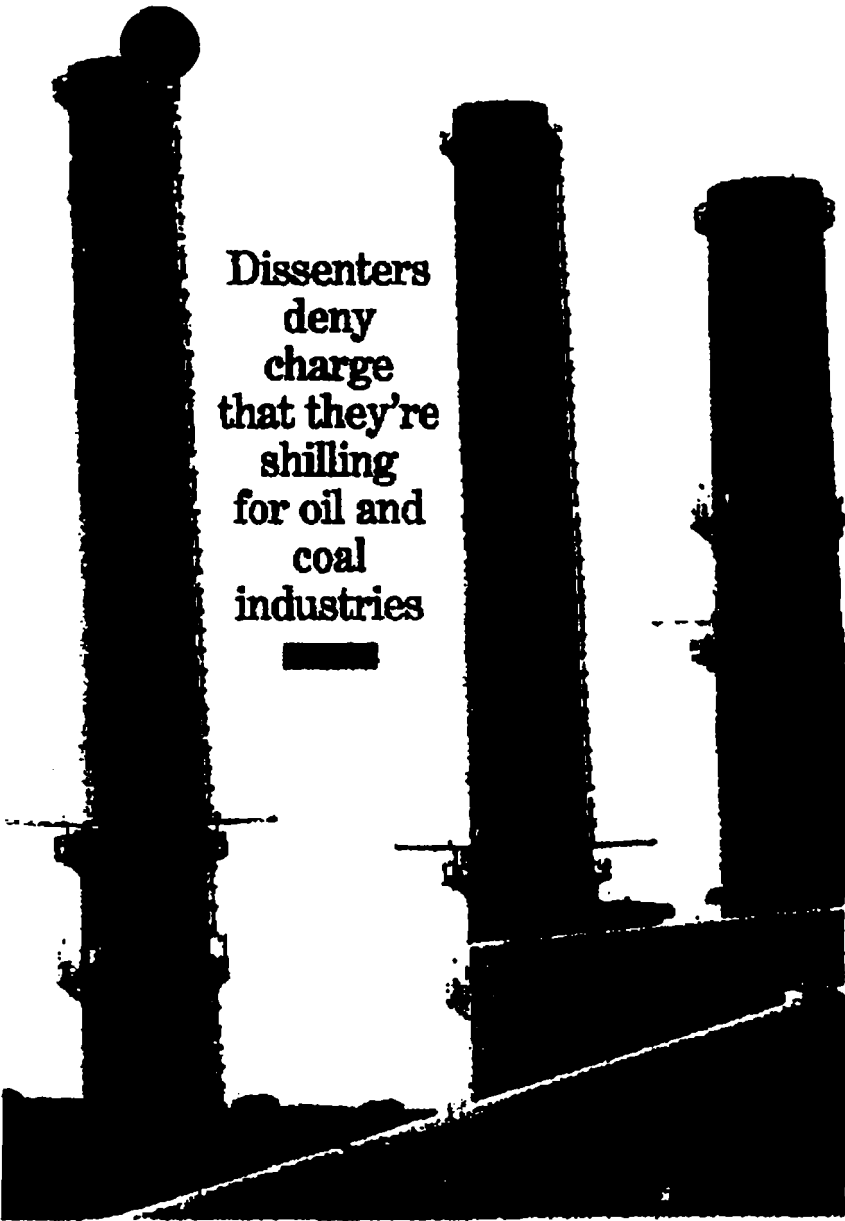
We all have a job to do -- and this is a tremendous time to do it.

-- Al Gore is vice president of the United States.

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 Star Tribune Online Opinion

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Dissenters
deny
charge
that they're
shilling
for oil and
coal
industries

GLOBE STAFF PHOTO / TOM LANDERS

Are skeptics winning debate on warming?

Tiny minority has undue influence, book says

By Scott Allen
GLOBE STAFF

They are a handful of scientists bucking the tide, arguing that global warming is unimportant — or maybe even beneficial — in a time of mounting scientific concern that the burning of fossil fuels is raising the Earth's temperature.

But this band of scientific skeptics, most with ties to the coal or oil industries and conservative organizations, is winning the political debate, argues Ross Gelbspan in a pointed new book, "The Heat is On: The High Stakes Battle Over Earth's Threatened Climate."

Using a combination of industry funding, media access and the support of the Republican-controlled Congress, doubters such as Patrick Michaels of the University of Virginia and Richard Lindzen of the Massachusetts Institute of Technology have convinced the public that there is far more doubt about the theory of global warming than really exists, argues Gelbspan, a former Boston Globe reporter and Pulitzer Prize winner who has covered environmental issues since 1972.

It is largely because of their efforts, Gelbspan contends, that the Clinton Administration has taken no serious steps to curb global warming despite alarming signs, such as last week's flooding of Grand Forks, N.D., that human pollution may have made the climate not only warmer, but also more unstable.

"Americans don't know what is happening to the climate [because] the oil and coal industries have spent millions of dollars to persuade them that global warming isn't happening," writes Gelbspan.

The industry campaign has included recruiting scientists to produce videos, news articles and expert testimony challenging the theory of global warming.

A group of utilities and coal companies to "reposition global warming as theory, rather than fact," by targeting a media campaign at "older, less-educated men" and "young, low-income women," Gelbspan found.

But, even before the book hits store shelves this week, scientists targeted by Gelbspan are crying foul. They say his book is little more than an attempt to intimidate researchers who sincerely question the severity of global warming.

GLOBAL WARMING

Are critics winning debate on warming?

GLOBAL

Continued from Page C1

"You are essentially telling people that if they express themselves, they are likely to end up in a crowd like Ross's," said meteorologist Lindzen of MIT, whose own research has concluded that the Earth's upper atmosphere tends to offset warming on the ground.

Lindzen, who has served on the advisory board of the Marshall Institute, a conservative think tank, called Gelbspan "a relatively despicable person" who made him look like an industry shill when he has received a tiny amount of money from coal and oil interests, and nothing in the past two years.

In reality, Lindzen said, the coal and oil industries are reluctant to join the fight over global warming

despite the potentially devastating costs to them.

Some environmentalists, too, say that the reasons for America's inaction on global warming have at least as much to do with the national passion for fossil fuels than the influence of a few scientific skeptics.

Despite the 1970s energy crisis and war in the oil-rich Persian Gulf in 1991, the US government has been reluctant to adopt policies to encourage a switch to other fuels. Why would global warming be more likely to prompt action, they ask?

Yet, the doubters are remarkably prominent in news accounts on global warming, especially considering that they number perhaps a dozen compared to a 2,000-scientist Intergovernmental Panel on Climate Change that has concluded that human activity appears to be changing

the Earth's climate.

Michaela, climatologist for the state of Virginia who publishes a coal-backed newsletter that regularly skewers global warming concerns, is cited in the media almost as much as Stephen Schneider of Stanford, a pioneering climate change researcher who wrote the first popular book raising concern about global warming. A Nexis search of US newspapers and magazines showed Michaela was cited 190 times to Schneider's 278 since 1980.

The skeptics "are having an impact disproportionate to their numbers," said Bud Ward, editor of the journalism newsletter, Environment Writer.

"That may in part reflect the merits of their arguments," he said. "More than that, it reflects their ability to portray themselves as a bigger part of the opposition than I think they in fact are."

Gelbspan's book, which expands on a 1995 article in Harper's Magazine, comes at a pivotal time in the debate over what, if anything, should be done about climate change.

Most nations are scheduled to meet in Kyoto, Japan, this December to sign an agreement that would stabilize or cut emissions of carbon dioxide and other so-called "greenhouse gases."

President Clinton says he supports the concept, but the Administration has been reluctant to name a reduction target or set a deadline. As a result, allies such as Britain are pressuring the United States to do more. Britain wants to cut emissions 10 percent below 1990 levels by 2010.

Gelbspan's book argues that the United States is lagging, in part, because the skeptics are "draining the issue of all sense of crisis" with false assurances that global warming is, in the words of one critic, "pure media hype." That view, Gelbspan argues, perfectly serves the oil and coal industries.

Gelbspan produces documents showing that, beginning in the late 1980s, one large coal supplier, 400 million Western Fuels Association, started recruiting global warming skeptics to counter what the company called "what seemed generally

accepted about the potential for climate change."

Besides funding Michaela's new letter, Western Fuels also spent \$250,000 to produce a video, "The Greening of Planet Earth," which argued global warming could be good by extending the growing season.

"Skepticism is part of science. . . It is the pruning that keeps the tree growing straight."

BENJAMIN D. SANTER,
Lawrence Livermore National Laboratory

Lindzen, whom Gelbspan calls the most academically accomplished skeptic but an ideological extremist, appears in the video, as does Sherwood Idso, a physicist whose writings have appeared in a magazine published by the John Birch Society.

In addition, Western Fuels began using the skeptics as expert witnesses in state legislatures as well as Washington D.C.

The skeptics bristle at the idea that industry support affects their work.

"It is completely irrelevant as to who supports the work of these people," said Virginia atmospheric scientist S. Fred Singer, who says he gets no more than 10 percent of his income from the coal and oil industry.

And Michaela scoffed at the idea that the coal and oil industry could counter the \$2.3 billion spent annually on climate research by the US government.

"If those guys at about \$25,000 a year [in income from the fossil fuel industry] can beat back \$2.3 billion those guys must have an awfully cogent argument," said Michaela in 1995, referring to himself and two other global warming critics.

However, Gelbspan points out. Continued on next page

ON MOTHERS, DAUGHTERS AND THINNING HAIR



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The concern continues to grow

Continued from preceding page

that Michaels didn't disclose the industry backing for his newsletter until Environment Writer published the information. Gelboen believes the oil and coal industry has spent millions to promote the skeptics' views, including everything from Mobil's paid opinion pieces in major publications to direct public relations campaigns.

The doubters' views have been further amplified by their allies in the Republican-controlled Congress, who have called them to testify on an equal footing with leading federal climate change researchers.

After hearing from Michaels, Rep. Dana Rohrabacher (R-Calif.), chairman of the House Science Subcommittee, said he felt most of the concern about global warming was based on "unjustified scare scenarios." He later recommended deep cuts in US spending on climate research.

Yet, outside Congress, the international science community increasingly agrees that global warming is both real and worrisome.

The 2,000-scientist Intergovern-

mental Panel on Climate Change concluded in 1996 that a 1-degree Fahrenheit increase in global temperatures over the last century is at least partly the result of human fossil fuel burning. If nothing is done, the average temperatures could rise another 3.6 degrees by 2100, the group concluded.

This year, 2,000 economists, including six Nobel laureates, signed a statement arguing that the threat of global warming is serious enough to warrant "preventive steps."

Jerry Mahlman, an atmospheric scientist and director of the Geophysical Fluid Laboratory at Princeton University, told the House Science Committee flatly that global warming is a "harsh and inexorable reality."

Still, the skeptics correctly point out that there are huge uncertainties remain about how the climate system works. For instance, a study this month suggests that global warming causes earlier spring, meaning more green plants that then offset global warming. As a result, skeptics play a vital role in forcing climate researchers to prove their point.

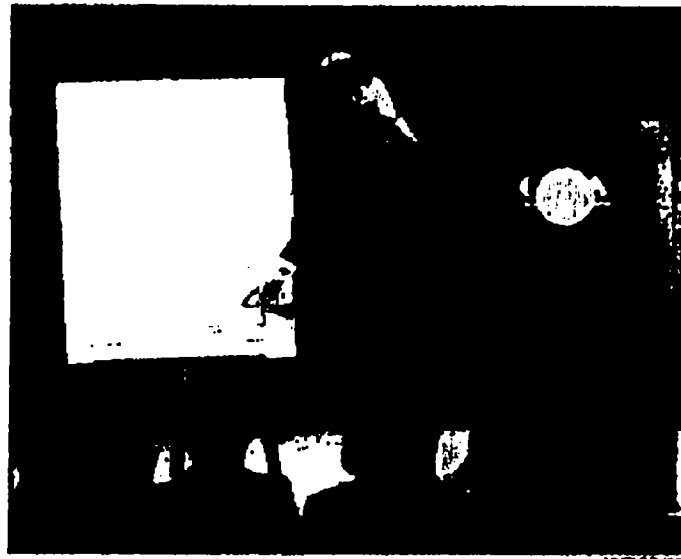
"Skepticism is part of science. . .

It is the pruning that keeps the tree growing straight," said Benjamin D. Santer of Lawrence Livermore National Laboratory in California, author of the part of the 1995 IPCC report that found human influence on the global climate.

What frustrates Santer and other scientists about some prominent global warming skeptics is that they often bypass the checks and balances of science, making sensational charges without subjecting their work to rigorous review.

While other climate researchers publish their works in scholarly journals such as *Science*, where papers are reviewed by other scientists before being published, skeptics are more likely to use letters to the editor, special interest publishing houses and other non-reviewed outlets for their findings.

For instance, Singer's major coup came in 1991 when he persuaded the aging Roger Revelle, father of climate change theory, to sign a paper downplaying the risk of rising temperatures. The article was published in the journal of the *Cosmos Club*, an obscure private organization, amid questions from Revelle's



Vice President Al Gore displays chart showing atmospheric temperature changes during address at environmental meeting last month.

family about why the ailing man would sign such a document. He died shortly afterward.

Likewise, Michaels' World Climate Report newsletter is a journal without independent scrutiny of his work. Prominent climatologist Thomas Wigley of the National Center for Atmospheric Research in

Colorado, said that Michaels made so many factual errors in congressional testimony that, were he to submit it for publication, "I would have to recommend its rejection."

Not all the skeptics avoid academic scrutiny. Santer said Lindzen's academic writings are influential. Singer is regarded as a "quali-

fied atmospheric scientist" by prominent Stanford biologist Paul Ehrlich, who has been heavily involved in global environmental issues.

But, on balance, said William Moomaw, a Tufts University professor of international environmental policy, "The skeptics have brought very little science to the table."

So why are they playing such an important role in the global warming debate?

Partly, said Ward, it reflects American journalist's tendency to accentuate extremes in their effort to get both sides of the story. "In this area of journalism, balance is the enemy of accuracy," Ward said.

And, in a way, the skeptics are just doing what environmentalists do everyday: trying to influence public opinion.

Willett Kempton, co-author of the book *Environmental Values in American Culture*, said it seems to work, especially among people who pay attention to the news.

"The people who think of [global warming] as more speculative tend to be the more educated, more newspaper reading, more critical thinkers," said Kempton, a University of Delaware professor.