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Date: 11/3/97 1:08pm
Subject: Murkowski question #9: 1.25% IAT case
A congressional question asks for justification for the IAT assumption that a "mere announcement" would increase e/gdp by 0.25 % (reflecting the choice of a 1.25% case over a 1.0 % case, I presume). CEA has the lead on this question. Based on the information they have before them, they may overlook the contribution of CCAP. As you know, the final interagency analysis of the CCAP was concluded in July and published as part of the U.S. Climate Action Report (CAR), 1997. The analysis concluded that the CCAP will likely deliver a 1.25% annual energy intensity improvement from 1990-2010. Both GDP and energy numbers are included in the CAR. As an additional reference, I have attached the final model outputs from DOE's Policy Office that were used in the CAR (this is a Word document). e/gdp in 1990 was 13,861 btu/$, shrinking to 10,767 btu/$ in 2010 (assuming continuation of CCAP at currently appropriated levels). Based on this information (which was not available during the early stages of the IAT), it seems that a 1.25 case is a conservative estimate of e/gdp improvements if the "announcement effect" is also included.

If you want me to track down the responsible party at CEA, let me know and I will be happy to do so. Otherwise, you may want to forward this yourselves and let me know that you have done so. Thanks.

P.S. Note that the IAT "1.25" case is not an average 1.25% e/gdp improvement. Instead, e/gdp was increased gradually from 1.0 to 1.25 over the 2000-2010 period (avg. e/gdp improvement is, therefore, more like 1.15% over the time period). This makes the 1.25 case conservative relative to the CAR, even without an "announcement effect".

CCAP CASE 4/26/97

TABLE 1: KEY ECONOMIC DATA AND ASSUMPTIONS

	1990	2000	2005	2010	2015	2020	2025
GDP (BILLIONS 1987$)	4897	6144	6833	7480	8046	8642	n/a
GDP (BILLIONS 1995$)	6084	8005	8902	9745	10483	11259	n/a
POPULATION (MILLIONS)	250	276	287	299	311	324	n/a
DISPOSABLE INCOME (BILLIONS 1987$)	3525	4470	4972	5494	5949	6350	n/a
HOUSING STOCK (MILLIONS)	94.0	103.0	108.8	114.7	120.6	125.4	n/a
COM. FLOOR SPACE (BILL SQ FT)	64.3	72.3	75.4	78.5	81.9	85.3	n/a
INDUSTRIAL PROD INDEX (1990=100)	100.0	123.0	137.8	151.9	163.0	174.0	n/a

TABLE 2: PRIMARY ENERGY CONSUMPTION AND PRODUCTION (QUADS)

	1990	2000	2005	2010	2015	2020	2025
PRIMARY ENERGY CONSUMPTION							
OIL	33.51	37.65	39.69	41.30	42.64	43.82	n/a
GAS	19.42	23.95	25.37	27.15	29.99	30.21	n/a
COAL	19.01	20.99	21.50	22.23	22.50	23.23	n/a
NUCLEAR	6.16	7.34	7.34	6.39	4.67	3.80	n/a
RENEWABLE	6.23	6.97	7.51	7.73	8.12	9.28	n/a
METHANOL	0.00	0.01	0.03	0.03	0.03	0.02	n/a
NET ELECTRICITY IMPORTS	0.01	0.14	0.12	0.11	0.09	0.09	n/a
TOTAL	84.33	97.04	101.56	104.93	108.04	110.44	n/a
ENERGY INTENSITY (BTU/$GDP in 1995$)	13861	12123	11408	10767	10306	9809	n/a
PRIMARY DOMESTIC ENERGY PRODUCTION AND IMPORTS							
PRODUCTION							
OIL	17.74	14.54	13.34	12.77	11.86	10.82	n/a
GAS	18.34	20.82	21.86	23.09	25.49	25.36	n/a
COAL	22.46	23.26	24.10	25.20	25.83	26.92	n/a
NUCLEAR	6.16	7.34	7.34	6.39	4.67	3.80	n/a
RENEWABLE	6.93	6.97	7.51	7.73	8.12	9.28	n/a
TOTAL	71.63	72.93	74.15	75.18	75.97	76.18	n/a
NET IMPORTS							
OIL	15.43	23.11	26.28	28.38	30.55	32.66	n/a
GAS	1.47	3.00	3.39	3.93	4.36	4.71	n/a
COAL	-2.88	-2.22	-2.54	-2.90	-3.26	-3.62	n/a
ALCOHOL/OTHER	0.09	0.15	0.15	0.13	0.12	0.11	n/a
TOTAL	14.12	24.04	27.28	29.55	31.76	33.87	n/a
ADJUSTMENTS							
OIL	-.30	0.00	0.00	0.00	0.00	0.00	0.00
GAS	-.30	0.00	0.00	0.00	0.00	0.00	0.00
COAL	-.45	0.00	0.00	0.00	0.00	0.00	0.00
OTHER	-.37	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	-1.42	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL ENERGY SUPPLIED	84.33	96.97	101.44	104.73	107.73	110.04	n/a

TABLE 3: ENERGY PRICES BY SECTOR

	1990	2000	2005	2010	2015	2020	2025
ENERGY PRICES (1995$/ MILLION BTU)							
RESOURCE PRICES							
REFINER CRUDE	4.12	3.14	3.39	3.50	3.68	3.82	n/a
WELLHEAD GAS	1.85	1.80	1.90	1.92	2.04	2.32	n/a
MINEMOUTH COAL	1.11	0.84	0.80	0.77	0.72	0.71	n/a
RESIDENTIAL							
DISTILLATE	8.39	7.76	8.15	8.28	8.45	8.59	n/a
OTHER LIQUID FUELS	11.99	11.18	11.67	11.82	12.04	12.22	n/a
NATURAL GAS	6.17	6.03	6.05	5.94	6.06	6.33	n/a
ELECTRICITY	25.24	23.82	23.22	22.78	21.86	21.71	n/a
COMMERCIAL							
DISTILLATE	6.13	5.48	5.85	5.96	6.13	6.28	n/a
RESIDUAL FUEL OIL	3.75	2.90	3.15	3.22	3.39	3.54	n/a
NATURAL GAS	5.14	4.98	5.04	4.96	5.08	5.35	n/a
ELECTRICITY	22.98	21.40	20.93	20.41	19.53	19.40	n/a
INDUSTRIAL							
DISTILLATE	6.16	5.48	5.87	5.99	6.16	6.31	n/a
RESIDUAL FUEL OIL	3.38	2.76	3.00	3.07	3.25	3.39	n/a
OTHER LIQUID FUELS	5.94	6.55	7.02	7.17	7.38	7.55	n/a
NATURAL GAS							
BOILER	2.94	2.79	2.86	2.87	2.99	3.27	n/a
NON-BOILER	2.94	2.79	2.86	2.87	2.99	3.27	n/a
STEAM COAL	1.63	1.35	1.34	1.24	1.19	1.18	n/a
ELECTRICITY	15.49	14.29	13.84	13.71	13.08	12.99	n/a
TRANSPORTATION							
GASOLINE	10.25	10.96	11.32	11.12	11.29	11.44	n/a
DIESEL	9.30	9.23	9.39	9.32	9.49	9.63	n/a
RESIDUAL FUEL OIL	3.26	2.58	2.82	2.92	3.09	3.23	n/a
JET FUEL	6.23	5.78	6.28	6.33	6.50	6.64	n/a
ELECTRICITY	15.62	14.42	14.64	14.07	13.44	13.35	n/a
UTILITY SECTOR							
OTHER LIQUID FUELS	3.55	2.74	2.99	3.12	3.29	3.43	n/a
NATURAL GAS	2.56	2.26	2.33	2.35	2.54	2.88	n/a
STEAM COAL	1.54	1.41	1.26	1.17	1.12	1.11	n/a
NUCLEAR	0.65	0.38	0.40	0.42	0.40	0.38	n/a
AVERAGE ELEC. PRICE	21.09	19.70	19.11	18.71	17.92	17.80	n/a
ENERGY PRICES (1995$/PHYSICAL UNIT)							
RESOURCE							
WORLD OIL PRICE ($/BBL)	23.87	18.20	19.67	20.33	21.33	22.16	n/a

WELLHEAD NATURAL GAS ($/MCF)	1.91	1.85	1.96	1.98	2.11	2.39	n/a
MINEMOUTH COAL ($/TON)	23.93	17.96	17.12	16.52	15.42	15.31	n/a
END-USE AVERAGE PRICE ELECTRICITY (C/KWH)	7.20	6.72	6.52	6.38	6.11	6.07	n/a
AVERAGE PRICE GASOLINE ($/GAL)	1.28	1.37	1.42	1.39	1.41	1.43	n/a

TABLE 4: END-USE ENERGY CONSUMED BY FINAL CUSTOMERS (QUADS)

	1990	2000	2005	2010	2015	2020	2025
CONSUMPTION BY SECTOR							
RESIDENTIAL	9.65	10.96	11.01	11.21	11.62	12.00	n/a
COMMERCIAL	6.53	7.44	7.66	7.78	7.96	8.18	n/a
INDUSTRIAL	24.84	28.09	29.53	30.38	31.28	31.78	n/a
TRANSPORTATION	22.55	26.75	28.82	30.43	31.82	33.16	n/a
TOTAL END-USE CONSUMPTION	63.57	73.23	77.02	79.80	82.68	85.11	n/a
TRANSM. & DIST. LOSSES	-20.76	-23.81	-24.54	-25.13	-25.36	-25.33	n/a
TOTAL PRIMARY CONSUMPTION	84.33	97.04	101.56	104.93	108.04	110.44	n/a
ENERGY USED BY FINAL CONSUMER (EXCL. INPUTS TO UTILITIES)							
OIL	32.30	36.99	39.16	40.70	41.81	43.09	n/a
NATURAL GAS	16.43	19.54	20.43	21.19	22.08	22.37	n/a
COAL	2.91	2.66	2.54	2.46	2.44	2.48	n/a
ELECTRICITY	9.26	11.27	11.99	12.62	13.41	14.08	n/a
RENEWABLE	2.67	2.77	2.87	2.81	2.90	3.06	n/a
METHANOL	0.00	0.01	0.03	0.03	0.03	0.02	n/a
TOTAL END-USE CONSUMPTION	63.57	73.23	77.02	79.80	82.68	85.11	n/a
TRANS. & DIST. LOSSES	-20.76	-23.81	-24.54	-25.13	-25.36	-25.33	n/a
TOTAL PRIMARY CONSUMPTION	84.33	97.04	101.56	104.93	108.04	110.44	n/a

TABLE 5: OIL CONSUMPTION AND PRODUCTION (MILL. BARRELS/DAY)

	1990	2000	2005	2010	2015	2020	2025
INDIGENOUS OIL PRODUCTION							
LOWER 48	4.81	3.79	3.47	3.23	2.73	2.26	n/a
ALASKA	1.77	1.11	0.78	0.71	0.65	0.59	n/a
ENHANCED OIL RECOVERY	0.77	0.76	0.74	0.65	0.54	0.59	n/a
TAR SANDS	0.00	0.00	0.00	0.00	0.00	0.00	n/a
SHALE OIL	0.00	0.00	0.00	0.00	0.00	0.00	n/a
NATURAL GAS LIQUIDS	1.56	1.85	1.99	2.18	2.55	2.54	n/a
TOTAL OIL PRODUCTION	8.91	7.50	6.98	6.78	6.48	5.99	n/a
OTHER SOURCES							
NET OIL IMPORTS	7.17	10.67	12.14	13.10	14.10	15.08	n/a
STOCK CHANGES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OTHER	0.76	0.84	0.88	0.91	0.95	0.97	n/a
TOTAL IMPORTS & STOCK CHANGES	7.93	11.51	13.02	14.02	15.05	16.05	n/a
TOTAL PRIMARY OIL CONSUMPTION	16.84	19.01	20.00	20.80	21.52	22.04	n/a
OIL TRANSFORMATION							
TO ELECTRICITY	-0.54	-0.29	-0.23	-0.26	-0.36	-0.31	n/a
TO GAS	-0.00	-0.04	-0.04	-0.04	-0.04	-0.04	n/a
TOTAL END-USE OIL CONSUMPTION	16.30	18.64	19.69	20.46	21.09	21.65	n/a

TABLE 6: GAS CONSUMPTION AND PRODUCTION (TRILLION CU. FT.)

	1990	2000	2005	2010	2015	2020	2025
INDIGENOUS PRODUCTION OF CONVENTIONAL GAS							
LOWER 48	17.81	20.20	21.20	22.39	24.72	24.59	n/a
NORTH ALASKA	0.00	0.00	0.00	0.00	0.00	0.00	n/a
TOTAL CONVENTIONAL GAS PRODUCTION	17.81	20.20	21.20	22.39	24.72	24.59	n/a
ADDITIONAL SOURCES OF CONVENTIONAL GAS							
PIPELINE	1.45	2.62	2.76	3.08	3.44	3.74	n/a
LNG	0.00	0.30	0.53	0.73	0.79	0.83	n/a
STOCK CHANGE	-0.51	0.00	0.00	0.00	0.00	0.00	0.00
OTHER	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL IMPORTS AND OTHER	0.94	2.91	3.29	3.81	4.23	4.57	n/a
TOTAL CONVENTIONAL GAS CONSUMPTION	18.75	23.11	24.49	26.21	28.94	29.16	n/a
TRANSFORMATION TO OR FROM GAS							
SYNTH FROM OIL	0.10	0.06	0.06	0.06	0.06	0.06	n/a
SYNTH FROM COAL	0.00	0.05	0.06	0.07	0.07	0.07	n/a
TOTAL SYNTHETICS	0.10	0.11	0.12	0.13	0.13	0.13	n/a
TO ELECTRICITY	-2.79	-4.28	-4.80	-5.78	-7.67	-7.60	n/a
TOTAL GAS USED BY FINAL CONSUMERS	16.06	18.80	19.67	20.39	21.17	21.46	n/a
TOTAL PRIMARY GAS CONSUMED	18.85	23.22	24.61	26.34	29.08	29.30	n/a

TABLE 7: COAL CONSUMPTION AND PRODUCTION

	1990	2000	2005	2010	2015	2020	2025
COAL PRODUCTION AND CONSUMPTION (QUADS)							
TOTAL PRIMARY PRODUCTION	22.46	23.26	24.10	25.20	25.83	26.92	n/a
NET IMPORTS	-2.88	-2.22	-2.54	-2.90	-3.26	-3.62	n/a
STOCK CHANGES	-0.45	0.00	0.00	0.00	0.00	0.00	0.00
OTHER	-0.12	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL PRIMARY CONSUMPTION	19.01	21.04	21.56	22.30	22.57	23.30	n/a
TRANSFORMATION TO ELECTRICITY	16.10	18.32	18.96	19.77	20.05	20.75	n/a
TO SYNTHETIC FUELS	0.00	0.08	0.10	0.12	0.12	0.12	n/a
COAL USED BY FINAL CONSUMERS	2.91	2.64	2.51	2.42	2.40	2.44	n/a
COAL PRODUCTION AND CONSUMPTION (MILLION SHORT TONS)							
TOTAL PRIMARY PRODUCTION	1029.0	1095.2	1134.8	1186.6	1215.4	1266.2	n/a
NET IMPORTS	-103.0	-84.7	-97.0	-110.7	-124.4	-138.2	n/a
STOCK CHANGES	-31.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER	-0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL PRIMARY CONSUMPTION	895.0	1010.4	1037.9	1075.9	1091.0	1128.1	n/a
TRANSFORMATION TO ELECTRICITY	774.0	875.5	905.9	944.8	958.1	991.2	n/a
TO SYNTHETIC FUELS	0.0	3.6	4.5	5.4	5.4	5.4	n/a
COAL USED BY FINAL CONSUMERS	121.0	131.3	127.5	125.7	127.5	131.4	n/a

TABLE 8: RENEWABLE ENERGY CONSUMPTION AND PROD. (QUADS)

	1990	2000	2005	2010	2015	2020	2025
RENEWABLE INPUTS TO ELECTRICITY GENERATION							
HYDROPOWER	2.94	3.13	3.15	3.16	3.17	3.18	n/a
GEOTHERMAL	0.32	0.53	0.60	0.63	0.64	0.63	n/a
BIOMASS/MSW	0.26	0.46	0.77	0.96	1.16	2.02	n/a
SOLAR THERMAL	0.01	0.02	0.03	0.03	0.04	0.05	n/a
PHOTOVOLTAIC	0.00	0.00	0.01	0.01	0.03	0.10	n/a
WIND	0.02	0.07	0.09	0.12	0.18	0.24	n/a
TOTAL	3.55	4.20	4.64	4.92	5.21	6.22	n/a
RENEWABLE ENERGY USED BY FINAL CONSUMERS							
BIOMASS WOOD	2.56	2.71	2.73	2.57	2.47	2.42	n/a
INDUSTRIAL HYDRO	0.01	0.01	0.01	0.01	0.01	0.01	n/a
ETHANOL	0.00	0.02	0.08	0.17	0.37	0.56	n/a
SOLAR	0.06	0.02	0.02	0.02	0.02	0.02	n/a
GEOTHERMAL	0.01	0.01	0.02	0.04	0.04	0.05	n/a
PHOTOVOLTAIC	0.00	0.00	0.00	0.00	0.00	0.00	n/a
WIND	0.00	0.00	0.00	0.00	0.00	0.00	n/a
TOTAL	2.75	2.77	2.87	2.81	2.90	3.06	n/a
PRIMARY RENEWABLE TOTAL	6.30	6.97	7.51	7.73	8.12	9.28	n/a

** Industrial cogeneration fuel consumption included with final consumers, not electricity generation.

TABLE 9: ENERGY CONSUMPTION IN BUILDINGS

	1990	2000	2005	2010	2015	2020	2025
RESIDENTIAL ENERGY USE (QUADS)							
OIL	1.27	1.27	1.21	1.16	1.14	1.12	n/a
NATURAL GAS	4.52	5.15	5.08	5.13	5.22	5.26	n/a
COAL	0.06	0.06	0.05	0.04	0.04	0.03	n/a
ELECTRICITY	3.15	3.89	4.09	4.28	4.64	5.01	n/a
RENEWABLES	0.65	0.58	0.59	0.59	0.58	0.58	n/a
TOTAL	9.65	10.96	11.01	11.21	11.62	12.00	n/a
COMMERCIAL ENERGY USE (QUADS)							
OIL	0.91	0.75	0.74	0.72	0.70	0.69	n/a
NATURAL GAS	2.70	3.13	3.21	3.26	3.33	3.42	n/a
COAL	0.09	0.08	0.08	0.08	0.07	0.07	n/a
ELECTRICITY	2.82	3.45	3.61	3.70	3.83	3.97	n/a
RENEWABLE	0.01	0.03	0.03	0.03	0.03	0.03	n/a
TOTAL	6.53	7.44	7.66	7.78	7.96	8.18	n/a
PHYSICAL UNITS							
RESIDENTIAL							
OIL (MMBD)	0.66	0.60	0.57	0.55	0.54	0.53	n/a
GAS (TCF)	4.38	5.00	4.93	4.97	5.06	5.10	n/a
ELECTRICITY (BKWH)	924.0	1140.8	1199.3	1255.4	1360.1	1467.0	n/a
COMMERCIAL							
OIL (MMBD)	0.48	0.35	0.34	0.33	0.32	0.32	n/a
GAS (TCF)	2.62	3.03	3.11	3.17	3.23	3.32	n/a
ELECTRICITY (BKWH)	826.0	1009.6	1057.3	1083.1	1121.5	1162.2	n/a

TABLE 10: ENERGY/NON-ENERGY CONSMPTN. IN INDUSTRIAL (QUADS)

	1990	2000	2005	2010	2015	2020	2025
ENERGY USE (EXCLUDING NON-ENERGY FEEDSTOCKS)							
OIL	4.63	4.73	4.81	4.79	4.77	4.86	n/a
GASES	7.45	9.16	9.84	10.24	10.63	10.62	n/a
COAL	1.71	1.72	1.68	1.68	1.74	1.85	n/a
ELECTRICITY	3.23	3.84	4.15	4.42	4.67	4.78	n/a
RENEWABLE	2.00	2.14	2.18	2.02	1.93	1.89	n/a
TOTAL	19.01	21.59	22.66	23.15	23.74	24.01	n/a
NON-ENERGY USE							
ASPHALT	1.17	1.16	1.20	1.24	1.27	1.30	n/a
OTHER	2.53	3.25	3.56	3.88	4.18	4.45	n/a
SUBTOTAL	3.70	4.41	4.76	5.12	5.45	5.75	n/a
GASES	1.07	1.29	1.38	1.45	1.49	1.49	n/a
METALL. COAL	1.05	0.81	0.73	0.66	0.59	0.53	n/a
TOTAL	5.82	6.51	6.87	7.23	7.53	7.77	n/a
ENERGY & NON-ENERGY USE							
OIL	8.33	9.13	9.58	9.91	10.23	10.61	n/a
GAS	8.52	10.45	11.22	11.69	12.11	12.11	n/a
COAL	2.76	2.52	2.41	2.34	2.33	2.38	n/a
ELECTRICITY	3.23	3.84	4.15	4.42	4.67	4.78	n/a
RENEWABLE	2.00	2.14	2.18	2.02	1.93	1.89	n/a
TOTAL PRIMARY	24.83	28.09	29.53	30.38	31.28	31.78	n/a

TABLE 11: ENERGY CONSUMPTION IN TRANSPORTATION (QUADS)

	1990	2000	2005	2010	2015	2020	2025
OIL	21.81	25.83	27.64	28.91	29.74	30.68	n/a
MOTOR GASOLINE	13.58	15.64	16.27	16.41	16.75	17.18	n/a
DIESEL	3.83	4.71	5.18	5.63	5.78	6.03	n/a
JET FUEL	3.14	3.86	4.33	4.70	4.83	4.87	n/a
RESIDUAL FUEL	1.03	1.30	1.46	1.65	1.77	1.90	n/a
LPG	0.01	0.05	0.12	0.21	0.30	0.39	n/a
OTHER	0.22	0.26	0.28	0.30	0.31	0.31	n/a
METHANOL	0.00	0.01	0.03	0.03	0.03	0.02	n/a
ETHANOL	0.00	0.02	0.08	0.17	0.37	0.56	n/a
NATURAL GAS	0.68	0.80	0.93	1.11	1.41	1.57	n/a
ELECTRICITY	0.06	0.09	0.15	0.22	0.28	0.33	n/a
COAL	0.00	0.00	0.00	0.00	0.00	0.00	n/a
TOTAL CONSUMPTION	22.55	26.75	28.82	30.43	31.82	33.16	n/a
ADDITIONAL DATA -- TRANSPORTATION SECTOR							
LIGHT DUTY VEHICLES							
OPERATING VEHICLES (MILLIONS)	186.7	211.3	228.1	242.5	255.6	267.4	n/a
VEHICLE MILES (BILLIONS)	1940	2373	2639	2885	3148	3368	n/a
FLEET EFFICIENCY (EPA ESTIMATED MPG)	22.2	24.7	25.9	27.1	28.0	28.7	n/a
FUEL CONSUMPTION (QUADS)	12.72	14.98	15.94	16.66	17.41	18.23	n/a
HEAVY DUTY VEHICLES							
OPERATING VEHICLES (MILLIONS)	4.4	4.8	5.1	5.4	5.7	6.0	n/a
VEHICLE MILES (BILLION)	151	181	199	211	224	238	n/a
FLEET EFFICIENCY (ON ROAD MPG)	5.60	5.79	5.80	5.81	5.83	5.83	n/a
FUEL CONSUMPTION (QUADS)	3.64	4.34	4.75	5.03	5.34	5.66	n/a

	1990	2000	2005	2010	2015	2020	2025
AIR TRAVEL							
PASSENGER REV. MILES (BILLIONS)	472	786	904	1011	1058	1090	n/a
FLEET EFFICIENCY INDEXED TO 1990	1.00	1.10	1.11	1.12	1.14	1.16	n/a
FUEL CONSUMPTION (QUADS)	3.20	3.87	4.34	4.71	4.84	4.88	n/a
RAILROADS							
RAIL FREIGHT TON-MILES	1034	1210	1323	1408	1491	1585	n/a
FUEL EFFICIENCY INDEXED TO 1990	1.00	1.10	1.12	1.14	1.23	1.34	n/a
FUEL CONSUMPTION (QUADS)	0.57	0.64	0.69	0.71	0.70	0.69	n/a
WATERBORNE							
FUEL CONSUMPTION (QUADS)	1.57	1.93	2.12	2.34	2.48	2.63	n/a
PIPELINE							
FUEL CONSUMPTION (QUADS)	0.68	0.72	0.72	0.69	0.76	0.76	n/a
OTHER MODES							
FUEL CONSUMPTION (QUADS)	0.17	0.25	0.27	0.29	0.29	0.30	n/a

TABLE 11P: TRANSPORTATION ENERGY CONSUMPTION (PHYS. UNITS)

	1990	2000	2005	2010	2015	2020	2025
OIL (MMBPD)	10.96	12.96	13.81	14.37	14.73	15.15	n/a
MOTOR GASOLINE	7.08	8.16	8.49	8.56	8.74	8.96	n/a
DIESEL	1.80	2.21	2.43	2.65	2.72	2.84	n/a
JET FUEL	1.51	1.88	2.11	2.29	2.35	2.37	n/a
RESIDUAL FUEL	0.45	0.57	0.64	0.72	0.77	0.83	n/a
LPG	0.01	0.03	0.06	0.11	0.15	0.19	n/a
OTHER	0.11	0.13	0.14	0.15	0.15	0.16	n/a
METHANOL (MMBPD)	0.00	0.01	0.03	0.03	0.02	0.02	n/a
ETHANOL (MMBPD)	0.00	0.01	0.06	0.12	0.27	0.42	n/a
NATURAL GAS (TCF)	0.67	0.78	0.90	1.08	1.37	1.52	n/a
ELECTRICITY (BKWH)	17.58	25.75	42.53	63.49	81.65	95.33	n/a
COAL (MMT)	0.00	0.00	0.00	0.00	0.00	0.00	n/a

ADDITIONAL DATA -- TRANSPORTATION SECTOR

LIGHT DUTY VEHICLES							
OPERATING VEHICLES (MILLIONS)	186.7	211.3	228.1	242.5	255.6	267.4	n/a
VEHICLE MILES (BILLIONS)	1940	2373	2639	2885	3148	3368	n/a
FLEET EFFICIENCY (EPA ESTIMATED MPG)	22.2	24.7	25.9	27.1	28.0	28.7	n/a
FUEL CONSUMPTION (MMBOE)	2193	2583	2748	2872	3002	3142	n/a
HEAVY DUTY VEHICLES							
OPERATING VEHICLES (MILLIONS)	4.4	4.8	5.1	5.4	5.7	6.0	n/a
VEHICLE MILES (BILLION)	151	181	199	211	224	238	n/a
FLEET EFFICIENCY (ON ROAD MPG)	5.60	5.79	5.80	5.81	5.83	5.83	n/a
FUEL CONSUMPTION (MMBOE)	628	749	818	868	920	977	n/a

	1990	2000	2005	2010	2015	2020	2025
AIR TRAVEL							
PASSENGER REV. MILES (BILLIONS)	472	786	904	1011	1058	1090	n/a
FLEET EFFICIENCY INDEXED TO 1990	1.00	1.10	1.11	1.12	1.14	1.16	n/a
FUEL CONSUMPTION (MMBOE)	552	668	748	812	834	841	n/a
RAILROADS							
RAIL FREIGHT TON-MILES	1034	1210	1323	1408	1491	1585	n/a
FUEL EFFICIENCY INDEXED TO 1990	1.00	1.10	1.12	1.14	1.23	1.34	n/a
FUEL CONSUMPTION (MMBOE)	98.3	111.2	118.2	123.2	121.1	119.1	n/a
WATERBORNE							
FUEL CONSUMPTION (MMBOE)	270.7	332.8	365.9	402.6	426.9	453.3	n/a
PIPELINE							
FUEL CONSUMPTION (MMBOE)	117	124.3	123.3	118.6	130.7	131.6	n/a
OTHER MODES							
FUEL CONSUMPTION (MMBOE)	29.3	43.1	46.5	50.0	50.9	51.7	n/a

TABLE 12: PRIMARY INPUTS TO EL. GEN. & EL. SALES (QUADS)

	1990	2000	2005	2010	2015	2020	2025
PRIMARY INPUTS TO UTILITIES AND NON-UTILITIES							
OIL	1.20	0.66	0.52	0.60	0.83	0.72	n/a
GAS	2.99	4.42	4.94	5.96	7.91	7.84	n/a
COAL	16.10	18.32	18.96	19.77	20.05	20.75	n/a
NUCLEAR	6.16	7.34	7.34	6.39	4.67	3.80	n/a
RENEWABLE	3.55	4.20	4.64	4.92	5.21	6.22	n/a
TOTAL PRIMARY INPUTS	30.00	34.94	36.41	37.64	38.68	39.32	n/a
ELECTRICITY LOSSES	20.73	23.81	24.54	25.13	25.36	25.33	n/a
NET ELEC. IMPORTS	0.01	0.14	0.12	0.11	0.09	0.09	n/a
TOTAL ELEC. SALES	9.26	11.27	11.99	12.62	13.41	14.08	n/a
(BKWH)	2713	3302	3515	3698	3932	4128	n/a

TABLE 13: UTILITY & NON-UTILITY NET SUMMER CAPACITY (GW)

	1990	2000	2005	2010	2015	2020	2025
OIL/GAS STEAM	144.50	123.29	110.24	102.37	93.04	78.45	n/a
OIL/GAS TURBINE	50.80	75.28	107.94	115.90	126.21	135.89	n/a
GAS/OIL COMB. CYCLE	11.20	37.86	58.66	62.58	68.99	72.53	n/a
TOTAL OIL	62.20	33.74	35.93	41.15	51.83	61.91	n/a
OIL STEAM	37.40	22.44	19.74	17.97	16.49	14.35	n/a
OIL TURBINE	24.80	11.29	16.19	23.18	35.34	47.56	n/a
TOTAL GAS	144.30	212.44	277.74	287.04	312.29	341.21	n/a
GAS STEAM	107.10	100.84	90.50	84.40	76.55	64.10	n/a
GAS COMBINED CYCLE	11.20	37.86	58.66	62.58	68.99	72.53	n/a
STIG/ISTIG	0.00	9.66	36.36	46.74	74.89	114.09	n/a
GAS TURBINE	26.00	63.98	91.75	92.72	90.87	88.33	n/a
GAS FUEL CELLS	0.00	0.05	0.33	0.42	0.76	1.88	n/a
WB/SB TURBINES	0.00	0.04	0.14	0.19	0.23	0.28	n/a
TOTAL COAL	302.17	298.02	302.39	305.76	310.33	319.96	n/a
PULVERIZED COAL	302.17	297.15	298.36	298.78	298.83	297.48	n/a
AFB	0.00	0.54	2.06	3.07	4.26	6.36	n/a
IGCC	0.00	0.33	1.61	2.67	4.28	8.31	n/a
COAL ISTIG	0.00	0.00	0.35	1.25	2.96	7.80	n/a
TOTAL NUCLEAR	99.60	99.35	99.37	86.50	63.25	51.39	n/a
LIGHT WATER	99.60	99.35	99.34	86.38	63.01	50.98	n/a
ADVANCED LT WATER	0.00	0.00	0.03	0.12	0.24	0.41	n/a
TOTAL RENEWABLES	103.99	111.30	116.73	120.92	127.29	147.05	n/a
HYDROPOWER	76.37	79.36	79.73	79.83	80.12	80.40	n/a
PUMPED & OTHER STORAGE	18.80	20.00	20.00	20.00	20.00	20.00	n/a
GEOTHERMAL	3.01	3.47	3.57	3.63	3.67	3.62	n/a
PHOTOVOLTAIC	0.00	0.01	0.31	0.47	1.16	4.04	n/a
SOLAR THERMAL	0.34	0.63	0.93	1.07	1.21	1.37	n/a
BIOMASS WOOD & WASTE	3.72	4.35	5.85	6.32	6.54	6.52	n/a
BIOMASS IGCC	0.00	0.29	1.87	3.07	4.30	12.76	n/a
ATS BIOMASS IGCC	0.00	0.00	0.95	2.55	4.19	10.10	n/a
WIND	1.75	3.21	3.51	3.99	6.11	8.23	n/a
TOTAL CAPACITY	712.26	754.8	832.2	841.4	865.0	921.5	n/a

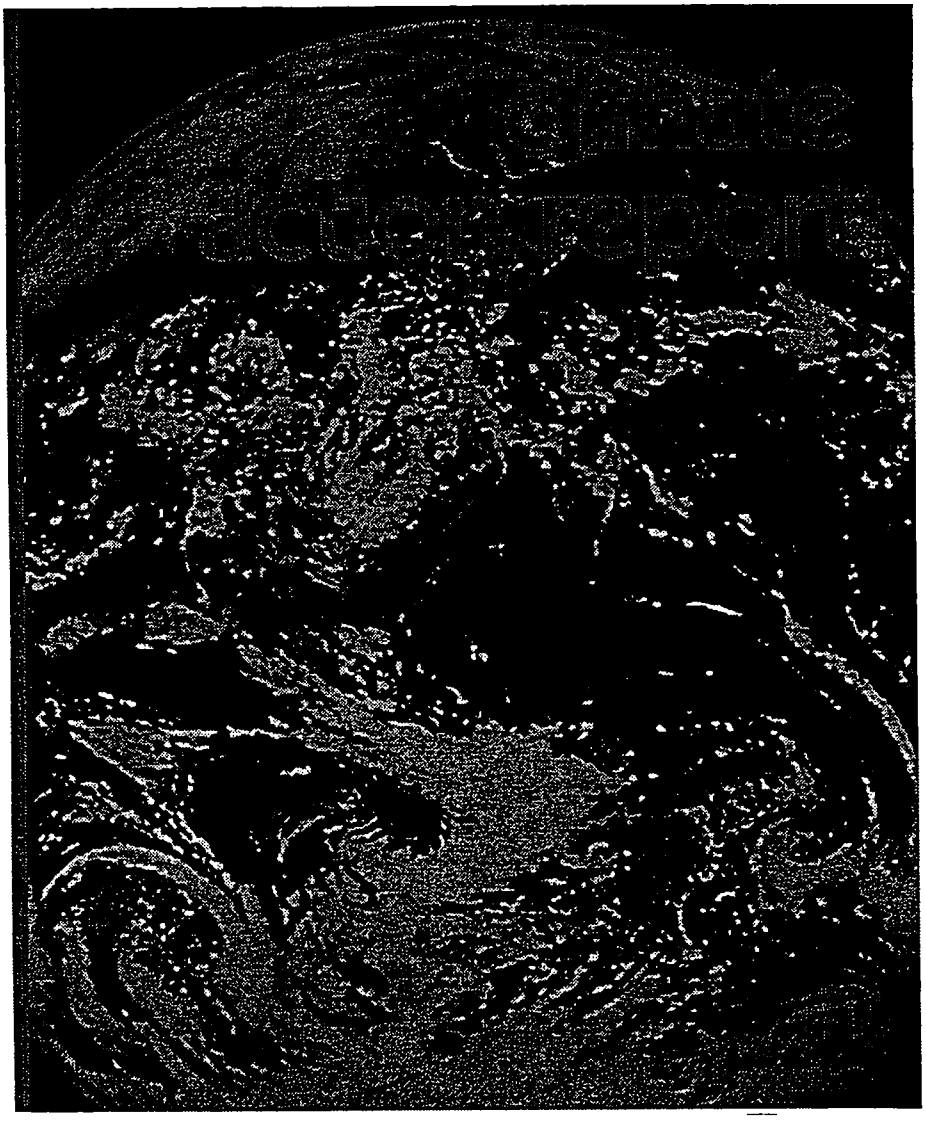
TABLE 14: UTILITY & NON-UTILITY GENERATION (THOUSAND GWH)

	1990	2000	2005	2010	2015	2020	2025
TOTAL OIL	118.0	63.1	50.9	58.9	82.2	73.2	n/a
OIL STEAM	104.7	51.0	34.1	33.8	36.5	25.4	n/a
OIL TURBINE	12.8	8.3	9.6	15.2	30.1	29.0	n/a
OIL COMBINED CYCLE	0.5	3.0	4.5	5.7	7.5	7.3	n/a
OIL STIG/ISTIG	0.0	0.8	2.8	4.2	8.1	11.5	n/a
TOTAL GAS	272.0	466.8	569.6	710.5	1018.8	1101.5	n/a
- PC PLANT COFIRING	0.0	5.4	0.0	0.0	0.0	0.0	n/a
- GAS BACKUP FOR SOLAR	0.0	0.1	0.5	0.6	0.8	1.0	n/a
- GAS BACKUP FOR WIND	0.0	0.0	0.0	0.0	0.0	0.0	n/a
GAS STEAM	234.0	229.0	156.2	158.7	169.5	113.6	n/a
GAS COMBINED CYCLE	24.0	147.1	219.4	278.6	366.7	356.9	n/a
STIG/ISTIG	0.0	37.5	136.0	208.1	398.1	561.4	n/a
GAS TURBINE	14.0	47.1	54.5	60.8	77.3	53.9	n/a
GAS FUEL CELLS	0.0	0.4	2.4	3.1	5.6	13.8	n/a
TOTAL COAL	1561.0	1790.5	1856.3	1940.1	1974.6	2060.7	n/a
PULVERIZED COAL	1561.0	1784.1	1826.6	1888.5	1889.0	1894.3	n/a
BIOMASS & MSW	0.0	0.0	0.0	0.0	0.0	0.0	n/a
AFB	0.0	3.9	15.1	22.5	31.4	46.6	n/a
IGCC	0.0	2.5	12.0	19.9	32.0	61.8	n/a
COAL ISTIG	0.0	0.0	2.6	9.3	22.1	58.0	n/a
TOTAL NUCLEAR	577.0	687.6	687.8	598.7	437.9	355.8	n/a
LIGHT WATER	577.0	687.6	687.6	597.9	436.1	352.8	n/a
ADVANCED LT WATER	0.0	0.0	0.2	0.9	1.7	3.0	n/a
TOTAL RENEWABLES	318.6	362.3	398.6	427.9	460.5	581.8	n/a
HYDROPOWER	285.1	303.1	305.2	306.3	307.4	308.5	n/a
PUMPED & OTHER STORAGE	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	n/a
GEOTHERMAL	15.5	20.9	21.8	22.1	22.4	22.1	n/a
PHOTOVOLTAIC	0.0	0.0	0.7	1.1	2.6	9.2	n/a
SOLAR THERMAL	0.7	1.5	2.6	3.0	3.5	4.0	n/a
BIOMASS WOOD & WASTE	17.1	30.2	40.6	43.9	45.3	45.2	n/a
BIOMASS IGCC	0.0	2.1	14.0	22.9	32.2	95.4	n/a
ATS BIOMASS IGCC	0.0	0.0	7.1	19.1	31.4	75.5	n/a
WIND	2.2	6.5	8.6	11.5	17.7	23.8	n/a
TOTAL GENERATION	2846.6	3370.3	3563.2	3736.3	3974.0	4173.0	n/a

TABLE 15: CARBON EMISSIONS BY END-USE SECTOR & SOURCE
(Million Metric Tons per Year)

	1990	2000	2005	2010	2015	2020	2025
RESIDENTIAL							
PETROLEUM	24.0	24.2	22.9	22.1	21.7	21.2	n/a
NATURAL GAS	65.1	74.6	73.6	74.3	75.6	76.2	n/a
COAL	1.6	1.4	1.3	1.1	1.0	0.9	n/a
ELECTRICITY	162.2	189.8	194.6	206.2	224.0	235.3	n/a
TOTAL	252.9	290.0	292.4	303.8	322.3	333.6	n/a
COMMERCIAL							
PETROLEUM	18.0	14.8	14.6	14.2	13.8	13.6	n/a
NATURAL GAS	38.8	45.3	46.4	47.3	48.3	49.6	n/a
COAL	2.4	2.2	2.1	1.9	1.8	1.7	n/a
ELECTRICITY	145.2	167.9	171.6	177.9	184.7	186.4	n/a
TOTAL	204.4	230.3	234.7	241.3	248.6	251.3	n/a
INDUSTRIAL							
PETROLEUM	99.3	97.9	100.5	101.3	102.1	104.6	n/a
NATURAL GAS	118.5	145.2	155.9	162.4	168.3	168.3	n/a
COAL	68.5	64.9	61.9	60.1	60.1	61.2	n/a
ELECTRICITY	166.3	187.1	197.1	212.7	225.2	224.8	n/a
TOTAL	452.6	495.1	515.4	536.5	555.7	559.0	n/a
TRANSPORTATION							
PETROLEUM	422.7	499.6	534.7	559.3	575.3	593.4	n/a
NATURAL GAS	9.8	11.6	13.4	16.1	20.5	22.8	n/a
COAL	0.0	0.0	0.0	0.0	0.0	0.0	n/a
ALCOHOL FUELS	0.0	0.0	0.0	0.0	0.0	0.0	n/a
ELECTRICITY	3.1	4.3	6.9	10.4	13.4	15.3	n/a
TOTAL	435.6	515.5	555.1	585.8	609.3	631.5	n/a
TOTAL CARBON EMISSIONS (DELIV. CONSUMPTION BASIS)							
PETROLEUM	564.0	636.4	672.7	696.9	712.9	732.9	n/a
NATURAL GAS	232.2	276.8	289.3	300.0	312.8	316.9	n/a
COAL	72.5	68.5	65.3	63.2	62.9	63.8	n/a
ALCOHOL FUELS	0.0	0.0	0.0	0.0	0.0	0.0	n/a
ELECTRICITY	476.8	549.1	570.1	607.3	647.4	661.8	n/a
TOTAL	1345.5	1530.9	1597.5	1667.4	1735.8	1775.5	n/a
ELECTRIC GENERATORS							
PETROLEUM	26.6	13.8	10.9	12.4	17.1	14.6	n/a
NATURAL GAS	41.2	64.0	71.6	86.3	114.5	113.6	n/a
STEAM COAL	409.0	471.3	487.6	508.6	515.7	533.6	n/a
TOTAL	476.8	549.1	570.1	607.3	647.4	661.8	n/a
TOTAL CARBON EMISSIONS (PRIMARY BASIS)							
PETROLEUM	590.6	650.3	683.6	709.3	729.9	747.5	n/a
NATURAL GAS	273.4	340.8	361.0	386.3	427.3	430.5	n/a
COAL	481.5	539.8	552.9	571.7	578.6	597.4	n/a
ALCOHOLS	0.0	0.0	0.0	0.0	0.0	0.0	n/a
TOTAL	1345.5	1530.9	1597.5	1667.4	1735.8	1775.5	n/a

INTL. BUNKER FUEL	20.8	26.8	30.1	33.9	36.4	39.0	n/a
TOTAL U.S. NET	1324.7	1504.1	1567.4	1633.5	1699.4	1736.4	n/a



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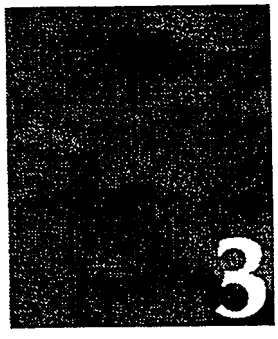
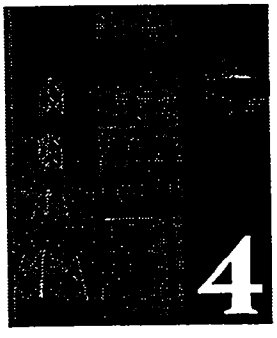


3 Greenhouse Gas Inventory



4 Mitigating Climate Change

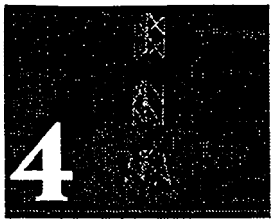
contents

The *Climate Change Action Plan* (CCAP), announced by President Clinton and Vice President Gore in October 1993, responds to the threat of global climate change and moves the U.S. economy toward environmentally sound economic growth into the next century.

Studies have shown that there are profitable, low-cost opportunities throughout the United States for reducing greenhouse gas emissions. However, many of these opportunities have gone unrealized, frequently because of informational, regulatory, financial, and institutional barriers that prevent widespread investment in energy efficiency. The CCAP is applying innovative solutions that are beginning to overcome many of these barriers, aligning market forces with the environmental imperative to reduce greenhouse gas emissions. Although originally focused on important early reductions by the year 2000, the CCAP is building emission reductions that grow over time and provide even larger benefits in later years.

The 1993 CCAP consists of over forty programs that are combining a variety of public- and private-sector approaches aimed at reducing emissions profitably while stimulating greater energy efficiency, commercializing renewable-energy technologies, and improving U.S. industrial, agricultural, and forest productivity. Through CCAP programs the United States is:

mitigating climate change

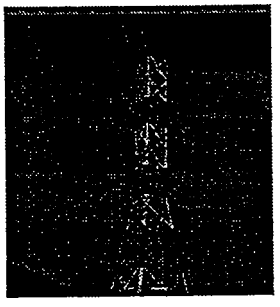


- *Preserving the Environment*—The 1993 CCAP is comprehensively addressing all major greenhouse gases in all sectors of the economy. Additional environmental benefits include preventing ozone and particulate air pollution and reducing solid and hazardous wastes.
- *Enhancing Economic Growth*—A successful CCAP will reduce energy costs, improve productivity, and generate larger markets for energy-efficient products and services.
- *Building Partnerships*—The CCAP relies heavily on the active voluntary participation of the private sector and other partners to reduce greenhouse gas emissions and generate larger markets for energy-efficient products and services.
- *Involving the Public*—Federal agencies solicited the public's views while developing the CCAP and while preparing this evaluation of the CCAP.
- *Encouraging International Emission Reductions*—Because climate change is a global rather than a national issue, the 1993 CCAP established the U.S. Initiative on Joint Implementation and the U.S. Country Studies Program to help other countries reduce their greenhouse gas emissions cost-effectively.

This chapter summarizes the progress of existing and new CCAP programs and related programs not included in the 1993 CCAP. It then evaluates individual CCAP programs and presents detailed projections of their reductions of carbon dioxide, methane, and other greenhouse gas emissions and the effects of those reductions for 2000, 2010, and 2020. The final portion of this chapter discusses the U.S. Initiative on Joint Implementation.

Projected Impacts of the CCAP in the Year 2000

- 76 MMTCE of annual reductions in greenhouse gas emissions, equivalent to the emissions from 60 million cars.
- $10 billion of annual energy bill savings for consumers and businesses, shifting the nation's resources away from unnecessary energy expenditures.
- 2 quadrillion Btus of energy conserved annually, equivalent to over 300 million barrels of oil, or 100 million tons of coal, or two trillion cubic feet of natural gas.
- 100,000 tons of annual nitrogen oxide reductions, improving air quality and protecting public health.



Action Plan Summary Review

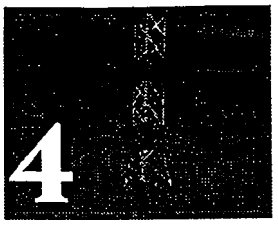
In late 1995, the United States initiated a review and update of the 1993 *Climate Change Action Plan* (CCAP). An interagency review group, chaired by the White House Council on Environmental Quality, included participants from the Environmental Protection Agency (EPA) and the Departments of Energy (DOE), Commerce (DOC), Transportation (DOT), and Agriculture (USDA).

Of the twenty-five submissions the group received in response to a public notice in August 1995, some comments addressed a broad range of analytical issues concerning the CCAP review, while others suggested

Highlights of CCAP Program Successes

Many CCAP programs have been highly successful at stimulating participation and achieving measurable energy and cost savings, as well as reducing greenhouse gas emissions.

- Thousands of efficient ENERGY STAR® labeled products are widely available, including computers, home appliances, and residential heating and air-conditioning equipment. In 1996, ENERGY STAR products saved consumers and businesses over $400 million on their energy bills, while reducing greenhouse gas emissions by 1.1 million metric tons of carbon (MMTCE)—equivalent to the emissions that would be generated by about 900,000 cars.
- Companies representing nearly 10 percent of U.S. industrial energy, and utilities representing over one-half of U.S. electric generation use, have pledged to reduce greenhouse gas emissions through the Climate Wise and Climate Challenge programs, respectively.
- Over 2,300 partners in the ENERGY STAR Buildings and Green Lights programs have invested over $1 billion in energy-efficiency improvements, saving over $250 million on their energy bills in 1996.
- As part of its work with more than 125 communities and 35 states, Rebuild America is reducing the $6.5 billion energy bill at colleges and universities across the country.
- USDA programs under the CCAP have led to the planting of trees on 54,634 hectares (135,000 acres) of land.
- In 1996, partners in EPA's Natural Gas STAR program reduced methane leakage from natural gas pipelines by over 1.0 MMTCE.
- Over 1,600 organizations have joined the Motor Challenge program, whose clearinghouse has been responding to more than 800 calls a month for information and technical assistance.
- Companies representing over 90 percent of U.S. primary aluminum production have joined EPA in the Voluntary Aluminum Industrial Partnership.



additional actions for inclusion in the 1993 CCAP update. Comments were also received during a public hearing on September 22, 1995, and a draft version of this review was made available in the *Federal Register* for comment in August 1995.

The comments from the public and the interagency review have formed the basis for this evaluation of the CCAP. The interagency review has reassessed the impacts of all CCAP actions and provides a new, integrated assessment of the 1993 CCAP. As requested in the guidelines of the United Nations Framework Convention on Climate Change (FCCC), this evaluation extends projections to the year 2020, although uncertainties become greater in more distant years.

Each federal agency maintains a set of performance measures and goals for the CCAP programs it administers, to track and assess each program's progress. As part of the interagency review, each agency has reevaluated its performance targets through the end of 1996 and has reassessed the future impact of its programs in light of recent funding cuts.

Based on continual dialogue with program partners and the public, agencies now have much better information with which to evaluate the potential effectiveness of their programs. As part of the interagency review effort, revised program performance estimates were integrated and modeled to determine the comprehensive impact of these programs on fossil fuel emissions.

Evaluation of Plan Actions

The CCAP evaluation built on the work of implementing agencies to track and evaluate their programs. Each federal agency maintains a set of performance measures and goals for the CCAP programs it administers, which is used to track and assess progress for each program on an ongoing basis.

DOE's Office of Energy Efficiency and Renewable Energy conducts a rigorous process to assess both potential benefits of climate change programs and progress on an ongoing basis. Initiated by DOE in the earliest stages of CCAP, this performance, progress, and outcomes activity has been subsumed by subsequent requirements for all government programs under the National Government Performance and Results Act. Specifically, DOE estimates expected carbon emission reductions and other benefits of each program using a variety of methods and conducts an extensive peer review of the estimates and results. In addition, DOE sets annual performance goals and measures progress toward those goals—including tracking partner accomplishments—for each program. This information is incorporated in the DOE Performance Agreement with the President. Specific program goals and accomplishments are available from the individual programs. For example, the *1996 Rebuild America Fall Forum Proceedings* were published, illustrating a number of partner successes. Likewise, DOE published the *Climate Challenge Annual Report*, which includes an account of program achievements.

EPA has established a similar set of rigorous performance measures and goals. EPA monitors and evaluates program accomplishments based on extensive information collection efforts. For example, the Green Lights program has detailed information on investments and energy savings from over fourteen thousand completed energy-efficiency pro-

jects that have been made by Green Lights partners, and continually uses the information to improve the program's performance and more accurately assess its future potential. In addition to tracking greenhouse gas emission reductions, EPA monitors technology markets, energy savings, energy-efficiency investments, and partner participation. Targets and projected impacts are based on a combination of work with experts in related fields, partner input, and program experience. EPA's performance measures are included in the National Government Performance and Results Act, as well as in periodic public reports, including the upcoming annual report of EPA's Atmospheric Pollution Prevention Division. Appendix A of this report contains further information on each program's targets, accomplishments, and contacts.

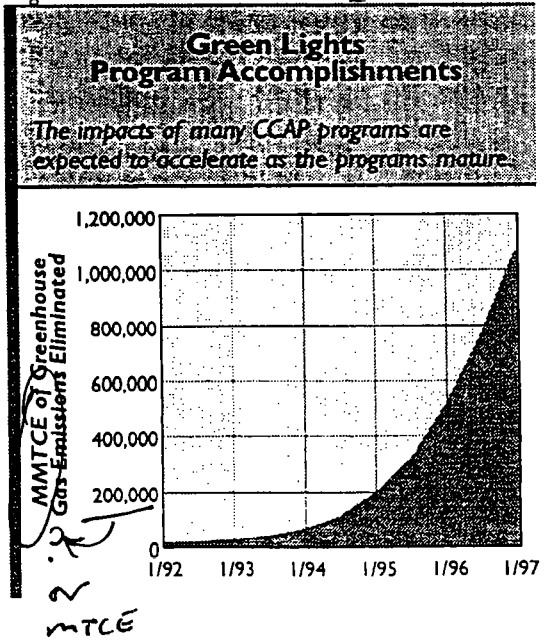
As part of the interagency review, each agency has comprehensively reevaluated its performance targets and has reassessed the future impact of its CCAP programs. Agencies reviewed program performance through the end of 1996 and considered the impact of recent funding cuts. Based on continual dialogue with program partners and the public, agencies now have much better information with which to evaluate the possible future effectiveness of the programs than they did in the past. Revised program performance estimates were integrated and modeled to determine the comprehensive impact of these programs on fossil fuel emissions.

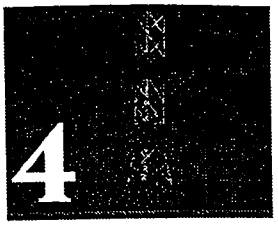
Overview of Progress Toward Meeting CCAP Goals

Many 1993 CCAP programs have been successful at establishing partnerships and achieving measurable energy and cost savings. Over five thousand organizations from around the country are participating in CCAP programs, and new partnerships are being formed at a brisk pace. Because of the time needed to develop the programs, build partnerships, and allow partners to make cost-effective investments, it takes most of the programs three to five years to begin to achieve substantial carbon reductions. For example, Figure 4–1 shows the rapidly increasing accomplishments of one of the older voluntary programs—Green Lights, which was launched in 1991. Other, newer programs are following similar pathways, with major reductions expected by 2000 and even greater reductions by 2010 and beyond.

However, for two reasons the 1993 CCAP will not achieve its objective of reducing greenhouse gases to 1990 levels by the year 2000. First, due to such factors as lower-than-expected fuel prices and higher-than-expected economic growth and electricity demand, the analysis used to develop the

Figure 4-1





1993 CCAP significantly underestimated the reductions needed to return emissions to 1990 levels by the year 2000. And second, the 1993 CCAP programs have not been fully funded, limiting their effectiveness.

As stated in the 1993 CCAP: "A substantial degree of uncertainty accompanies any attempt to project future emission levels. The analysis supporting the plan represents a best estimate under the most likely scenario, but we recognize that these estimates could vary by a significant degree under other plausible assumptions." The factors that have contributed to higher baseline emission projections are discussed in more detail later in this chapter.

The 1993 CCAP estimated that, assuming full funding, the programs would achieve reductions of 108.6 MMTCE in the year 2000. In 1996 and 1997, however, only 60 percent of the funding requested by the President for the CCAP programs was approved by Congress, as shown in Table 4-1. Based on current funding levels, the revised CCAP is expected to reduce emissions by 76 million metric tons of carbon equivalent (MMTCE) in the year 2000—or 70 percent of the reductions projected in the 1993 CCAP. By the year 2000, the CCAP is expected to save $10 billion in annual energy bills (1995 dollars).

The 1993 CCAP is projected to achieve reductions of about 169 MMTCE in the year 2010 and about 229 MMTCE in 2020. Annual energy savings are projected to grow to $50 billion in the year 2010 (1995 dollars). The projected impact of the CCAP on U.S. greenhouse gas emissions, based on current funding levels, is shown in Figure 4–2. Consistent with the level of uncertainty in the 1993 CCAP, and the difficulty with forecasting longer-term impacts, the analysis supporting the revised CCAP (i.e., this *Climate Action Report*) represents the best estimate of what the programs can achieve. This estimate assumes continuation of funding at least at current levels, as well as continued, aggressive program implementation. President Clinton once again is requesting full funding of CCAP programs for 1998 to achieve greater reductions in greenhouse gas emissions.

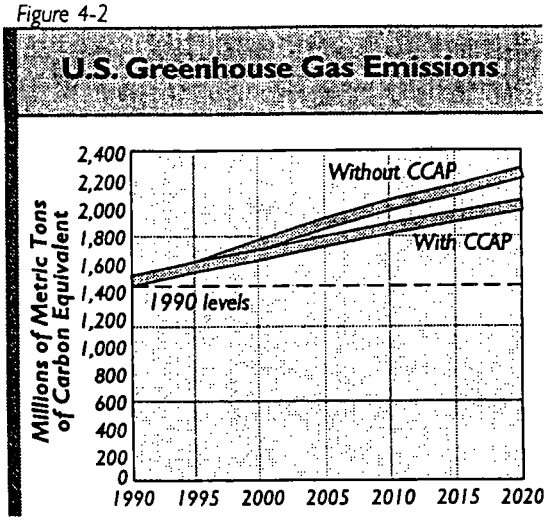
Several additional factors contribute to the new projections of CCAP program impacts, including: revised utility forecasts (which alter the impact of projected electricity savings on greenhouse gas emissions);

Table 4-1

Action Plan Funding
(Millions of Dollars)

Agency	FY 1995		FY 1996		FY 1997		FY 1998
	President's Request	Appropriation	President's Request	Appropriation	President's Request	Appropriation	President's Request
Department of Energy	$208	$73	$185	$69	$144	$69	$109
Environmental Protection Agency	123	102	138	83	142	86	149
Others	13	9	13	6	19	8	8
Total	$344	$184	$336	$158	$305	$163	$266

Figure 4-2



revised estimates of the relative impact of some gases on global warming (i.e., global warming potentials); and a better understanding of what each program can achieve. Furthermore, legislative riders to recent budget bills have prevented the timely implementation of energy appliance standards (Action 7) and have precluded DOT from pursuing its tire-labeling program (Action 22).

Additions to the Action Plan

In addition to reviewing progress of existing programs, this *Climate Action Report* (CAR) contains six new programs. These actions cover a range of areas, from substantially reducing long-lived perfluorocarbon emissions to expanding market opportunities for energy-efficient light bulbs and windows.

Environmental Stewardship Initiative

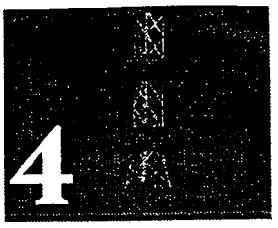
This initiative significantly expands activities under Action 40 of the 1993 CCAP (Narrow the Use of High GWP Chemicals). It is designed to limit emissions of perfluorocarbons and hydrofluorocarbons, which are potent greenhouse gases, in the three following industrial applications: semiconductor production, electrical transmission and distribution systems, and magnesium casting.

Emission reductions are believed to be possible through inexpensive and cost-effective means. In all cases, the principles of pollution prevention are being applied to reduce emissions. EPA has initiated a cooperative effort with the semiconductor industry and has begun talks with the electrical and magnesium industries. The combined effect of these new environmental stewardship programs is expected to result in 6.5 MMTCE of reduced emissions by 2000, and 10.0 MMTCE by 2010.

Construction of Energy-Efficient Commercial and Industrial Buildings

Despite the wide availability of reliable, energy-efficient technologies and building designs, most builders and architects are not taking advantage of these energy cost-saving opportunities. Several barriers in the current buildings market are perpetuating the construction of inefficient buildings. Most notably, builders and designers usually do not own and operate their buildings and are therefore not responsible for paying the energy bills. Increasing the construction costs to achieve long-term energy savings, even when there is a quick payback of only a couple of years, is not feasible, unless purchasers and financiers of buildings have clear and reliable information regarding the cost savings they can expect.

Through their Rebuild America and Energy Star Buildings programs, DOE and EPA will work with the financial community and with builders, architects, owners, occupants, and operators to encourage the construction of energy-efficient commercial and



industrial buildings. DOE and EPA will also develop a system to differentiate buildings that offer energy cost savings from inefficient buildings. This action is expected to lead to savings of 1.1 MMTCE by 2010.

Expand Markets for Next-Generation Lighting Products

This action will expand markets for energy-efficient lighting products through coordinated federal programs primarily targeting residential lighting. It is based on a comprehensive strategy to convert incandescent lighting to energy-efficient alternatives by delivering a portfolio of lighting products to meet a range of needs over an extended time horizon. The action's objectives are to promote the use and improvement of compact fluorescent lighting (CFL) products; encourage the conversion of high-energy-using fixtures to dedicated CFL fixtures; and fill a key product gap with a low-cost, drop-in replacement for standard incandescent light bulbs. This action is expected to reduce greenhouse gas emissions by 0.2 MMTCE in 2000 and 0.7 MMTCE in 2010.

Superwindow Collaborative

This initiative aims to double the energy efficiency of the average window sold in 2005. It would improve the heating properties of windows sold in cooler climates by increasing their average R (insulating) value, and the cooling properties of windows sold in warmer climates by switching from clear to spectrally selective cool glazings. The strategy is to work with a variety of groups to create the market pull for these products and then help all manufacturers, both small and large, respond to the new market opportunities. This action is expected to yield savings of 0.4 MMTCE by 2010.

Fuel Cells Initiative

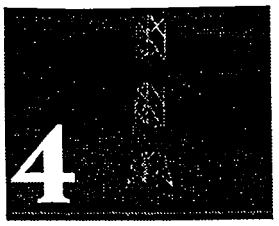
DOE is developing a low-cost 50-kilowatt fuel cell that uses reformed natural gas to produce hydrogen fuel to power commercial buildings. While DOE also sponsors fuel cell development as part of its advanced automotive technology program, this action is part of DOE's Space Conditioning program. Four contracts are in place that focus on research and development of fuel cells for buildings: membrane research, natural gas reforming, catalyst development of carbon monoxide tolerance, and bipolar plate development. This action is expected to lead to savings of 0.3 MMTCE by 2010.

Green Power Network

Accessible through DOE's Office of Energy Efficiency and Renewable Energy home page, the Internet-based Green Power Network provides and exchanges information on successful green power programs to encourage electricity suppliers and customers to form green power supply and buyer groups. Green Power Network includes links to utilities, power marketers, public entities, and consumer and environmental organizations that have already developed or are interested in developing green power programs. No emission reductions have been estimated for this action.

Pollution-Prevention Programs Outside of the Action Plan

Although not part of the CCAP, several additional federal policies and programs, state and local government initiatives, and



local governments have developed strong energy programs. These initiatives benefit from their two decades of experience as the implementors of the Low-Income Weatherization Assistance Program and the State Energy Program.

State government initiatives address all sectors of the economy and include education and information, technical assistance, energy audit, and research and development programs, as well as financial incentives for efficiency or renewable-energy investments. These initiatives helped to create the widespread energy-efficiency expertise and awareness of services that provided the basis for important demand-side management programs.

Several states have implemented commercial building codes that exceed current national model codes or have added features such as post-construction confirmation of the energy performance of buildings. Local governments may have their own energy offices or may encourage more efficient energy use though their buildings, transportation, economic development, or other support offices.

To build upon state and local initiatives and all of the CCAP's actions, federal officials and state energy offices, environmental agencies, and utility commissions are developing new working relationships. The intent is for the federal government to provide support to states and localities to build expertise in climate change policy issues and to provide a central federal point of contact for greenhouse gas mitigation efforts. States have been involved in the implementation planning process from the beginning, bringing their considerable expertise to these issues, particularly as related to energy efficiency and renewable technologies.

Thirty-five states currently operate industrial and commercial efficiency programs. They have significant expertise working with builders, manufacturers, utilities, public utility commissions (who regulate utilities and natural gas distribution companies), and building owners. For example, many utility demand-side management programs have been initiated through the joint efforts of utilities and state energy offices. State programs have helped hundreds of industrial and commercial energy users to convert from fossil fuels to low-cost biomass and other renewable technologies, have organized photovoltaic technologies to work in new applications, and have coordinated with state regulatory commissions and utilities to implement integrated resource planning, opening up new opportunities for efficiency and renewable technologies.

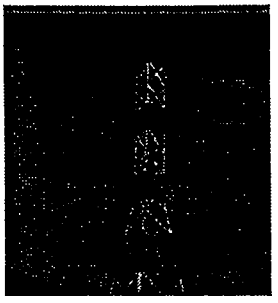
State and Local Outreach Program

EPA's State and Local Climate Change Outreach Program provides similar support. Its "one-stop shopping" efforts are designed to encourage states and localities to develop and implement cost-effective greenhouse gas reduction strategies in addition to those identified in the 1993 CCAP. The outreach program builds capacity in climate change issues and helps integrate CCAP with other planning efforts, such as the Clean Air Act Amendments of 1990, EPAct, and ISTEA. The program provides technical and financial assistance to states and localities to conduct greenhouse gas inventories, to develop state and city action plans to reduce greenhouse gas emissions, to study the impacts of climate

change, and to demonstrate innovative mitigation policies. Other efforts include providing training workshops and guidance documents.

To date, thirty states have prepared or have nearly completed inventories, and twenty have completed or are developing action plans. Forty-one cities have joined the Cities for Climate Protection Campaign, and nearly twenty states and localities have completed projects that range from telecommuting demonstrations to studies of the impact of sea level rise on land use and development policies.

The CCAP did not quantify the impact of the program on emissions because its primary purpose is to build climate change capacity and expertise at the state and local levels. Several successful demonstration projects, however, have been expanded and/or continued, and their reduction potentials have been estimated. Current projections are that the program will reduce greenhouse gas emissions by approximately 1.9 MMTCE in 2000 and 4.2 MMTCE in 2010.



Carbon Dioxide Programs

Carbon dioxide (CO_2) accounted for 85 percent of net U.S. greenhouse gas emissions in 1995. Investing in energy efficiency is the most cost-effective way to reduce CO_2 emissions, often providing energy cost savings that exceed the added first cost of advanced technologies. CCAP combines an array of public–private partnerships to stimulate the deployment of existing energy-efficient technologies and accelerate the introduction of innovative technologies. The goal of these programs is to cut CO_2 emissions, while enhancing productivity domestically and U.S. competitiveness abroad. The following discussion of CCAP programs and initiatives is broken out by economic sector.

The 1993 CCAP included three foundation programs that have broadly involved key sectors in efforts to reduce greenhouse gas emissions. Large portions of the electric utility and industrial sectors have pledged greenhouse gas reductions through the Climate Challenge and Climate Wise programs, respectively. And many state and local governments are working with the federal government on their own greenhouse gas action strategies through the State and Local Outreach Program.

The projected contributions of these programs have been quantified for the first time in this *Climate Action Report*. Because partners in the foundation programs have the flexibility to comprehensively include all of their activities to reduce greenhouse gas emissions, they sometimes include actions taken in conjunction with other programs or actions already anticipated in the 1993 CCAP's development (i.e., in the CCAP's emissions "baseline"). No additional emission reductions were quantified for the foundation programs in the CCAP due in part to the uncertainty regarding the specific activities associated with these commitments. Now, however, the programs have better information on the actions that their partners have pledged and have calculated the expected additional emission reductions from these actions.

Residential and Commercial Sector Actions

In 1995, commercial and residential buildings accounted for 35 percent of total U.S. energy consumption, including 65 percent of all electrical generation (U.S. DOE/EIA 1996a). CCAP programs are working with commercial building owners to reduce energy waste and realize the economic potential of energy-efficiency opportunities. Programs have demonstrated that many existing buildings can achieve average energy savings of 35 percent through an integrated systems approach to energy effi-

ciency. As a result of these programs, companies are lowering their overhead, improving their productivity, and increasing their competitiveness.

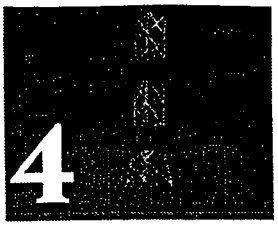
CCAP also targets key opportunities in the residential sector, such as the energy efficiency of heating and cooling equipment, home appliances, and lighting and the design of building exteriors. The residential programs include a mix of partnerships with businesses and utilities, as well as new standards and building codes. A typical home built fifteen years ago can be upgraded to save as much as 40 percent of its energy use at a profit to homeowners.

Some significant changes to the commercial and residential programs have been implemented to maximize program effectiveness and respond to changing circumstances. Building on the success of the Green Lights program (Action 2), EPA has integrated the program with its newer Energy Star Buildings program (Action 1). Another program, "Golden Carrot" Market-Pull Partnerships (Action 6), was originally intended to pool utility rebates and use other innovative partnerships to commercialize energy-efficient technologies. However, utility funding of energy-efficiency initiatives has begun to decline since the 1993 CCAP was released. To fulfill the goals of Action 6, EPA and DOE are promoting successful ENERGY STAR® consumer labeling programs, and DOE is facilitating advanced high-efficiency appliances into the marketplace. Finally, DOE has integrated two actions—Home Energy Rating Systems (Action 8) and Residential Energy Efficiency (Action 11)—into its Energy Partnerships for Affordable Housing program. One action—State Revolving Funds for Public Buildings (Action 3)—was canceled due to lack of funding.

Rebuild America *(Action 1)*

DOE is working with community partnerships to identify and achieve cost-effective investments in public housing, commercial, and multifamily residential buildings through improved energy efficiency. Rebuild America programs are based on local needs and priorities, which provides community leaders a high level of flexibility in their program design. Any assembly of companies and organizations may form a partnership. Rebuild America helps its partners by providing a customized set of products and services designed to meet their community's special needs. The partners also receive both local and national recognition for their innovative approaches to community-wide programs. Rebuild America program representatives work with partners' teams to ensure the assistance provided will be timely and effective.

To date, over 125 community partnerships have been formed in thirty-five states and territories. When the upgrades to their floor space are completed, they will result in annual financial savings for building owners and occupants of $1.2 billion and annual energy savings of 100 trillion Btus. The 1993 CCAP projected emission reductions from this action and expansion of the Energy Star Buildings program (below) would be 3.1 MMTCE in 2000. The actions have been realigned to reflect the integration of the Green Lights and Energy Star Buildings programs. Current projections for Rebuild America are 1.6 MMTCE in 2000 and 6.3 MMTCE in 2010.



Green Lights and Energy Star Buildings *(Actions 1 and 2)*

Since the Green Lights program's inception in 1991, EPA has entered into more than 2,300 partnerships with corporations, small business, utilities, nonprofit organizations, and other groups that agree to upgrade lighting equipment with more energy-efficient systems. These lighting system upgrades save, on average, 50 percent of the energy used for lighting, and they provide an average rate of return of 35 percent. Partners have already invested over $1 billion in lighting upgrades, and have made commitments for much larger investments.

EPA's newer Energy Star Buildings program, launched in 1995, leads a building owner through a more comprehensive, five-stage strategy to capitalize on system interactions intended to maximize energy savings at minimum cost. In the 1993 CCAP, the expansion of these programs was expected to yield greenhouse gas reductions of approximately 3.6 MMTCE in 2000. Current projections for the expansion of the programs are 3.3 MMTCE in 2000 and 16.3 MMTCE in 2010. The full programs are expected to achieve even larger reductions.

Cost-Shared Demonstrations of Emerging Technologies *(Action 4)*

DOE has sponsored cost-shared demonstrations of emerging energy-efficient technologies, such as a new laundry waste-water filtration and recycling system. As part of a DOE-initiated consortium of hotel and motel chains, Red Lion Inns hosted a project to test and evaluate the new water- and energy-conserving system. National recycling of 60 percent of the hot water at large institutional laundries can save 20 trillion Btus per year (costing $35 million) and reduce annual demand for water and sewage treatment by 85 billion gallons. Annual chemical cost savings may reach $250 million. Additional demonstrations in progress include innovative sulfur lamp technology in Postal Service and Air Force facilities, advanced dedicated compact fluorescent fixtures and controls for guest rooms in cooperation with Holiday Inns, and evaluation of new horizontal-axis clothes washers in a variety of commercial, institutional, and residential settings.

Combined with Action 5, below, these programs were projected in the 1993 CCAP to yield reductions of approximately 3.8 MMTCE in 2000. Funding for these programs has been significantly reduced from originally anticipated levels. Current projections are that there will be no significant reductions by 2000, with 1.0 MMTCE in reductions in 2010.

Operation, Maintenance, and Training for Commercial Building Facility Managers and Operators *(Action 5)*

DOE will use training programs and the educational infrastructure of the trades in its work to develop an operation and maintenance training curriculum highlighting energy. Once in place, training will be available to new and experienced operators to keep them informed about energy-efficiency improvements for a highly transitory career field. DOE also draws upon the experience of the Federal Energy Management Program, state energy offices, low-income weatherization providers, utilities, and other successful programs currently underway, such as Rebuild America.

Combined with Action 4, these programs were projected in the 1993 CCAP to yield reductions of 3.8 MMTCE in 2000. Funding for these programs has been significantly reduced from originally anticipated levels. Current projections are that there will be no significant reductions by 2000, with 1.0 MMTCE in reductions in 2010.

ENERGY STAR® Products *(Action 6)*

EPA and DOE are using the ENERGY STAR® label to promote products and services that save energy and money and help the environment. The goal of the ENERGY STAR® programs is to increase the market share of energy-efficient products by encouraging consumers to purchase products and homes displaying the ENERGY STAR® label. Over 500 manufacturers currently participate in these programs and are offering over 13,000 product models that qualify for the ENERGY STAR® label. In addition, more than 200 builders and developers have committed to build over 15,000 Energy Star Homes across the nation.

DOE launched "Energy Star Retailer" to promote energy-efficient appliances through point-of-purchase information, product labeling, sales force training, and corporate advertising. DOE also established a program to promote ENERGY STAR® appliances in new homes, initially in cooperation with the manufactured housing industry in the Northwest. DOE is also facilitating volume purchases of efficient appliances that "raise the bar" for ENERGY STAR® levels by demonstrating emerging technologies with buyers' groups. Volume purchases have already resulted in a new apartment-sized refrigerator that is 31 percent more efficient than federal minimum standards, and commitments from public housing authorities to purchase 71,000 of these refrigerators in 1997.

The 1993 CCAP projected this action would yield reductions of approximately 5.0 MMTCE in 2000. Current projections are 4.3 MMTCE in 2000 and 19.4 MMTCE in 2010.

Residential Appliance Standards *(Action 7)*

any overlap w/ Energy Star?

DOE maintains and improves the efficiency standards for eleven product categories of residential appliances. In so doing, it works with manufacturers, trade associations, environmental groups, utilities, retailers, government agencies, and others in the public rulemaking process.

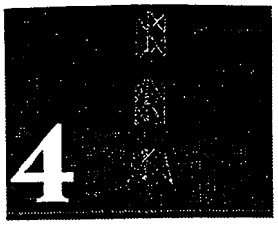
A congressional moratorium imposed on new standards during 1996 has ended, and DOE expects to issue final rules for improved efficiency standards for refrigerators and room air conditioners before the end of 1997. An Advanced Notice of Proposed Rulemaking for clothes washers is also due out soon.

The 1993 CCAP projected this action would yield reductions of approximately 6.8 MMTCE in 2000. Due to delays in implementing the standards, current projections are 0.2 MMTCE in 2000 and 3.7 MMTCE in 2010.

Energy Partnerships for Affordable Housing *(Actions 8 and 11)*

any overlap w/ Energy Star Buildings?

This action is designed to improve the energy efficiency and affordability of public and privately owned single-family and multifamily housing throughout the nation. Begun as a joint initiative between DOE and the Department of Housing and Urban Development (HUD), Energy Partnerships for



Affordable Housing seeks to establish voluntary collaborations with state and local governments, utilities, and the housing development and financing industries to provide resource-efficient and affordable housing in both new and renovated buildings.

Major program components include: (1) formal partnerships with local public housing authorities to improve large portions of the housing they own and operate; (2) work with community-based housing providers, builders, architects, and associations to incorporate energy- and resource-efficient whole-building criteria design scenarios throughout their communities; (3) close collaboration with retailer program efforts to foster appliance efficiencies; and (4) development of an infrastructure to overcome barriers to energy-efficiency financing through the use of Home Energy Rating Systems.

The major goal of this action is to create local and community partnerships that will collectively commit to installing energy-efficiency improvements in at least one million housing units by 2000. Supporting activities to reach this goal include technical assistance made available to community-based housing providers for the application of whole-building design, rehabilitation specifications that can achieve 20–30 percent efficiency gains over current practice, and assistance to seven pilot states to overcome barriers to financing. Current participants in the action include public housing authorities in Chicago, Atlanta, and Boston; Habitat for Humanity and other community-based housing providers; Home Energy Rating System providers in Alaska, Arkansas, California, Colorado, Mississippi, Vermont, and Virginia; and associations at both national and local levels.

The 1993 CCAP jointly evaluated Actions 8 through 11, which were expected to achieve reductions of 4.4 MMTCE in 2000. Because funding for these programs has been significantly reduced from originally anticipated levels, current projections for them are 0.4 MMTCE in 2000 and 3.3 MMTCE in 2010.

Cool Communities *(Action 9)*

DOE is working with American Forests and the USDA Forest Service to designate "Cool Communities" across the United States. The Cool Communities program provides national recognition to participants and a framework for strategic tree planting and surface-color lightening projects intended to improve local environments. Pilot Cool Communities nationwide are saving money and energy while building civic pride, involving citizens, and winning grants. DOE is working with manufacturers to develop, test, and label reflective surfaces and coatings.

The 1993 CCAP jointly evaluated Actions 8 through 11, which were expected to achieve reductions of 4.4 MMTCE in 2000. Because funding for these programs has been significantly reduced from originally anticipated levels, current projections for them are 0.4 MMTCE in 2000 and 3.3 MMTCE in 2010.

Update State Building Codes *(Action 10)*

Energy standards and guidelines for buildings are effective means of improving energy efficiency because they eliminate inefficient construction practices and technologies. DOE's increased emphasis on successful adoption of these practices has resulted in five hundred training sessions;

more than ten thousand copies of "MEC-check" building code software distributed to more than twenty states; responses to more than 250 requests per month; and nearly four million dollars in financial assistance to twenty-eight states and territories to update and implement their energy-efficient building codes and standards.

The program is on target with thirty-four states meeting EPAct requirements for residential energy codes. In 1996 five new states adopted residential energy codes that meet or exceed the national model energy code. DOE is working with ten states to help them become early adopters of portions of the next generation of the building industry's commercial building consensus standard. In addition, DOE has developed a simple computer program and package compliance approach for assessing compliance with low-rise commercial building standards.

The 1993 CCAP jointly evaluated Actions 8 through 11, which were expected to achieve reductions of 4.4 MMTCE in 2000. Because funding for these programs has been significantly reduced from originally anticipated levels, current projections for them are 0.4 MMTCE in 2000 and 3.3 MMTCE in 2010.

Industrial Sector Actions

The nation's industries were responsible for 42 percent of energy consumption in 1995, including 34 percent of electricity generated. Industry accounts for 34 percent of U.S. CO_2 emissions from fossil fuel consumption. About two-thirds of these emissions results from producing steam and process heat, while the remaining third results from electricity use and related emissions from electric utilities. A small number of major manufacturing groups—primary metals, petroleum refining, chemicals, pulp and paper—account for about two-thirds of industrial energy use and 19 percent of gross domestic product. The 1993 CCAP establishes working partnerships with U.S. industry to help improve energy efficiency and productivity.

The 1993 CCAP's portfolio of industrial programs has been revised to adjust to reduced funding levels and other factors. Although DOE decided to eliminate the Adoption of Energy-Efficient Process Technologies (Action 14), which would have created one-stop shops to disseminate clean technology information through state agencies, Climate Wise is now performing a similar function. Golden Carrot Industrial Programs (Action 13) has been merged into Motor Challenge (Action 12) in response to stakeholder comments for enhanced program access. Reduce Pesticide Use (Action 18) has been terminated due to lack of funding.

Climate Wise *(Foundation Program)*

Climate Wise is working with U.S. industrial companies to turn energy efficiency and environmental performance into a corporate asset. Jointly sponsored by EPA and DOE, Climate Wise works with companies to develop a comprehensive set of cost-effective actions to reduce greenhouse gas emissions. Over 250 companies, representing more than 7 percent of U.S. industrial energy use, are taking such actions as: improving industrial processes, optimizing boiler efficiency, improving air-compressor system performance, eliminating waste heat, launching

cogeneration systems, and switching to less carbon intensive fuels. Participating companies already expect to save more than $300 million by 2000 from cost-effective emission reduction actions.

In addition to economic savings, Climate Wise companies receive technical assistance in the form of Action Plan Workshops, Business-to-Business Peer Exchange Working Sessions, consultation assistance through the DOE national labs and through the "Wise Line" Technical Assistance Hotline, and on-site energy and waste assessments through DOE Industrial Assessment Centers. One of the foundation programs in the CCAP, Climate Wise serves as an umbrella program encouraging participation in the full range of CCAP initiatives.

The 1993 CCAP did not quantify the emission reductions expected from this program. Current projections are 1.8 MMTCE in 2000 and 3.7 MMTCE in 2010.

Motor Challenge *(Action 12)*

This voluntary partnership program between DOE and industry promotes the adoption of a systems approach to developing, purchasing, and managing motors, drives, and motor-driven equipment that will increase energy efficiency, enhance productivity, and improve environmental quality. Since two-thirds of the industrial sector's electricity use is for motors, industrial motors use over 20 percent of all U.S. electricity generation.

As of October 1996, over sixteen hundred organizations have joined the program. Motor Challenge Showcase Demonstrations, Industry Partnerships, Allied Partnerships, and Excellence Partnerships are exceeding initial program expectations. DOE has selected twenty-nine ongoing showcase demonstrations, representing an industry investment of $10 million. The estimated annual energy savings represents 100 million kilowatt-hours per year—the equivalent of electricity supplied to over five thousand houses a year. The Showcase Demonstrations bring together motor system users, equipment manufacturers, utility companies, and state energy offices to host the design, engineering, installation, and operation of these projects using technology and engineering to optimize electric motor systems. By 2000, Motor Challenge will generate energy cost savings of $250 million.

The 1993 CCAP projected emission reductions of 8.8 MMTCE in 2000 from this action. Because funding for this program has been significantly reduced from originally anticipated levels, current projections are 1.8 MMTCE in 2000 and 5.8 MMTCE in 2010.

Industrial Assessment Centers *(Action 15)*

Since 1978, DOE has sponsored energy audits for small and medium-sized manufacturers. In 1993, the agency teamed with EPA to expand the Energy Analysis and Diagnostics program to include industrial assessments that result in productivity improvements and waste reduction as well as energy savings. While funding to expand this program under the 1993 CCAP has not been appropriated, the base program is quite active. Industrial Assessment Center program engineering faculty and student teams perform approximately thirty assessments in each of thirty centers each year, for a total of seven thousand energy assessments since 1978, The program has also distributed a "Life Cycle

Costing" manual and "Self Assessment" work book for both small and large plants.

The 1993 CCAP projected emission reductions from the expansion of the Industrial Assessment Centers of 0.5 MMTCE. Due to lack of incremental funding, no emission reductions are currently projected for the intended expansion. However, projected emission reductions for the base program (outside of CCAP) are 1.4 MMTCE in 2000 and 1.9 MMTCE in 2010.

Waste Minimization *(Action 16)*

The United States is expanding voluntary source-reduction, pollution-prevention, and product-recycling programs through three programs. The 1993 CCAP projected emission reductions of 4.2 MMTCE from these programs. Current projections are 4.1 MMTCE in 2000 and 7.0 MMTCE in 2010.

National Industrial Competitiveness Through Energy, Environment, Economics Program. NICE^3 is a DOE cost-shared grant program. In partnership with states and private companies, DOE catalyzes cleaner production and manufacturing processes, reduces wastes in industry, conserves energy and energy-intensive feedstocks, and improves industrial competitiveness. With fiscal year 1997 funds, thirteen projects were selected to produce the next wave of cost-effective, pollution-prevention technologies that will spawn further innovation as project successes come to fruition. The total federal value of current projects is approximately $25 million, with an average private-sector cost share of over $3.50 of private investment per federal dollar. Successful projects are experiencing a 60 percent annual rate of return.

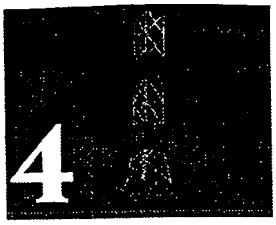
Waste Wi$e. This program addresses three critical environmental and natural resource challenges now facing the country: the reduction of greenhouse gas emissions, the sustainable use of natural resources, and the economical disposal of solid waste. Waste Wi$e has engaged over five hundred businesses to set voluntary waste-prevention and recycling goals that they can achieve cost-effectively and report on progress toward achieving those goals. Waste Wi$e is opening membership to tribal, state, and local governments for the first time in 1997.

While 1996 results are not yet available, in 1995, Waste Wi$e partners conserved nearly 344,000 tons of materials through waste prevention—a 40 percent increase over 1994 reported figures. In addition, partners quadrupled the reported amount of materials collected for recycling to over four million tons. Partners also helped create stronger markets for collected recyclables by purchasing more than two million tons of recycled-content products in 1995.

Expansion of Recycling Technology. This USDA Forest Service program is developing technology to remove barriers to the use of recycled wood and fiber in durable structural products suitable for the housing markets.

Transportation Sector Actions

The combustion of fossil fuels to move people and goods consumed 27 percent of the nation's energy in 1995. The expected increase in demand for transportation services over the next decade will hamper efforts to reduce greenhouse gas emissions and will continue to contribute to urban air



pollution and to U.S. reliance on foreign oil. Transportation will be the fastest-growing source of CO_2 emissions through the year 2000. The 1993 CCAP contains a package of initiatives to address growth in transportation sector emissions by slowing the growing demand for vehicle travel and enhancing the market for more efficient technologies and cleaner fuels.

Because the transportation sector represents such a significant source of CO_2 emissions, the 1993 CCAP called for establishing a process to develop measures that would significantly reduce greenhouse gas emissions from personal motor vehicles, including cars and light trucks. The goal of this process was to identify regulatory and nonregulatory measures that would improve fuel efficiency in new vehicles by an amount equivalent to 2 percent per year over ten to fifteen years.

To implement this commitment, President Clinton established a Policy Advisory Committee to Assist in the Development of Measures to Significantly Reduce Greenhouse Gas Emissions from Personal Motor Vehicles. Despite an extensive effort involving representatives from key public- and private-sector interests, this process failed to produce consensus recommendations. As a result, emission reductions from the transportation sector remain a significant challenge to returning total net emissions to 1990 levels.

Cash Value of Parking *(Action 19)*

This action is a change in the Internal Revenue Code section relating to the taxation as income of employer-provided parking. Its goal is to reduce vehicle travel and traffic congestion by providing employees a powerful new incentive to car pool, take transit, or find other ways to get to work. The change requires some employers to offer a cash allowance as an option to tax-exempt parking subsidies as a condition of the tax exemption. Legislation to implement the change was introduced in 1994 as part of the General Agreement on Tariffs and Trade legislation but was not enacted. The 1993 CCAP jointly evaluated Actions 19 through 21, expecting them to achieve reductions of 6.6 MMTCE in 2000. Current projections for these programs are 4.6 MMTCE in 2000 and 10.9 MMTCE in 2010.

Innovative Transportation Strategies *(Action 20)*

what has been done to date

This action is expected to broaden the arsenal of strategies available to cities and states seeking to meet the joint challenges of clean air and urban mobility. EPA, in consultation with DOT, is drafting guidance documents that identify the air quality benefits of innovative transportation strategies to reduce vehicle miles traveled.

The United States is aggressively promoting innovative pollution control strategies, concentrating on market mechanisms, such as parking charges, emission-based fees, accelerated vehicle scrapping, and transportation subsidies, to encourage people to drive less. Some states have experimented with innovative programs, such as congestion pricing tolls and mass transit finance. New technologies, such as virtual offices (completely portable communications and computing equipment), smart cars and transit vehicles, and advanced traveler information systems, will be encouraged. This initiative has the potential to reduce the costs of complying with clean air regulations and improve

the quality of life of transportation users through increased choice and enhanced environmental quality.

In the 1993 CCAP, Actions 19 through 21 were jointly evaluated and were expected to achieve reductions of 6.6 MMTCE in 2000. Current projections for these programs are 4.6 MMTCE in 2000 and 10.9 MMTCE in 2010.

what's been done to date

Telecommuting Program *(Action 21)*

DOT, in collaboration with other agencies, is implementing a federal government pilot telecommuting program that reduces commuter travel by encouraging work-at-home arrangements and by using existing telework centers, which provide generic office facilities closer to employees' homes. Telecommuting is believed to have a large potential for application, based on rapid technological advance in computers and computer links and on the growth of information workers as a proportion of the total labor force.

In April 1994 the Secretary of Transportation issued a formal departmental policy on telecommuting, and in June 1996 President Clinton directed executive departments and agencies to develop plans and expand their abilities to offer employees opportunities to telecommute. In addition, the federal government is promoting increased use of telecommuting by state and local governments and private industry.

In the 1993 CCAP, Actions 19 through 21 were jointly evaluated and were expected to achieve reductions of 6.6 MMTCE in 2000. Current projections for these programs are 4.6 MMTCE in 2000 and 10.9 MMTCE in 2010.

Fuel Economy Labels for Tires *(Action 22)*

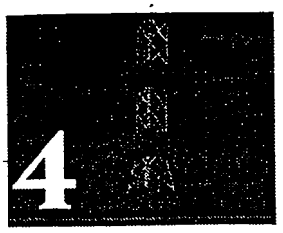
DOT will increase vehicle fuel economy by establishing tire labels for the replacement tire market. These labels will be based on a measure of their impacts on vehicle fuel economy (due to rolling resistance). In 1996 and 1997, Congress specifically restricted DOT from issuing tire labeling standards. The Administration still intends to pursue this measure. The 1993 CCAP expected this action to achieve reductions of 1.5 MMTCE in 2000. Current projections for the action are 0.7 MMTCE in 2000 and 4.8 MMTCE in 2010.

now?

Energy Supply Actions

The energy industry is entering an era of unprecedented change due to market and regulatory shifts. The EPAct and actions taken by the Federal Energy Regulatory Commission (FERC) have heightened competition in a variety of energy markets, increasing the efficiency of energy supply. Requirements under the Clean Air Act have prompted a shift to cleaner fuels, such as natural gas. And federal research and development into new energy technologies continues to help the industry increase the efficiency of generating and distributing electricity and meet environmental and market challenges.

The 1993 CCAP includes a number of actions that build on the EPAct, Clean Air, and FERC actions to reduce the amount of CO_2 emitted from energy production and use. The intent is to increase the use of natural gas, encourage the commercial application of renewable-energy resources, make



more efficient use of U.S. hydroelectric resources, and reduce the amount of energy lost in electricity transmission.

Among fossil fuels, natural gas emits the least amount of CO_2 per unit of energy provided, and renewable-energy sources (such as solar, wind, geothermal, and biomass energy) emit no CO_2. Nuclear power, which currently provides 22 percent of the electricity generated in the United States, will continue to play a key role in limiting CO_2 emissions from electricity production.

Newer technologies can also increase the efficiency of generating and distributing electricity. Increased efficiency lowers the amount of greenhouse gases emitted by reducing the amount of fuel required to generate and deliver electricity to customers. Action 23 (Increasing Natural Gas Share of Energy Use Through Federal Regulatory Reform) and Action 31 (Transmission Pricing Reform) are not expected to achieve any measurable reductions over baseline energy forecasts.

Climate Challenge *(Foundation Program)*

Through this joint, voluntary effort to reduce, avoid, or sequester greenhouse gases, individual electric utilities are entering into agreements with DOE whereby they are committing to make efficiency improvements in end use, distribution, transmission, and generation; increase their use of energy-efficient electrotechnologies; switch to lower-carbon fuels, such as natural gas, nuclear, or renewable energy; implement transportation actions, including greater use of natural gas-powered and electric vehicles; undertake forestry actions; recover methane from landfills and coal seams; and use fly ash as a Portland cement substitute.

Climate Challenge has 118 Participation Agreements, representing 634 of the over 800 utilities that have expressed interest in the program, and 70 percent of 1990 electricity generation and utility carbon emissions. The utility industry developed nine Climate Challenge initiatives for widespread utility participation. The initiatives include $52 million committed to the Envirotech initiative to accelerate commercialization of renewable-energy technologies; to the Earth Comfort program to increase annual sales of energy-efficient geothermal heat pumps from 40,000 to 400,000; and to the Utility Forest Carbon Management Program, with over $2 million committed to funding several domestic and international forestry projects. Other initiatives include EV America, Tree Power, and the International Donated Equipment Initiative.

The 1993 CCAP did not quantify the impact of Climate Challenge on emissions. DOE estimates that pledged utility actions under the program will result in the reduction of approximately 45.5 MMTCE in the year 2000. The estimate is conservative, in that it does not include reductions not yet quantified, nor the effect of the nine utility industrywide initiatives. Furthermore, it does not include the emission reductions from several utilities that recently joined the program, nor recently increased commitments from existing members. The Administration conducted an analysis of the 45.5 MMTCE of pledged reductions and determined that about 7.6 MMTCE in reductions are beyond any actions included in the 1993 CCAP or in the Administration's Base Case energy forecast, and these reductions in the year 2000 were included as part of the CCAP impacts.

Of the year 2000 reductions for Climate Challenge utilities, about 29 percent (in terms of carbon-equivalent tonnage) are from improvements to existing nuclear power plants; 17 percent from improvements to existing fossil power plants; 17 percent from demand-side energy-efficiency efforts; 8 percent from methane recovery, forestry carbon sequestration, and recycling of coal combustion fly ash; 7 percent from renewable energy; and 22 percent from a broad range of miscellaneous projects, including such areas as improvements to transmission, district heating and cooling, and a range of unspecified activities.

The emission reductions under Climate Challenge will continue to increase as additional utilities join the program, and as existing members add to their existing commitments. Thus, these significant annual reductions are expected to continue well into the next century. Because the Climate Challenge plans do not currently extend beyond 2000, these additional benefits have not been quantified for this analysis. However, given that participation levels are growing, and that most utilities appear to be meeting or expanding upon their commitments, it is reasonable to expect that the Climate Challenge savings would continue at least at the 2000 levels.

Promote Seasonal Gas Use for Control of Nitrogen Oxides *(Action 24)*

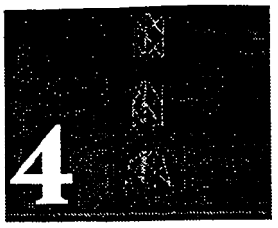
Natural gas, an abundant domestic fuel, emits 15 percent less CO_2 per unit of energy provided than oil and 30 percent less than coal. Encouraging the use of natural gas as a pollution control strategy under the Clean Air Act will lower the cost of combating the severe tropospheric ozone pollution problem plaguing many of our cities in a way that also reduces greenhouse gas emissions.

As part of that effort, EPA recently issued guidelines to urge state and local pollution control agencies to allow the use of natural gas in the summer in existing coal- and oil-fired power plants as a strategy to reduce nitrogen oxide (NO_x) emissions. EPA will examine additional regulatory options where shifts to cleaner fuels could provide environmental benefits and cost savings. The 1993 CCAP expected this action to reduce emissions by 2.2 MMTCE in 2000. Current projections are that the program will reduce greenhouse gas emissions by approximately 0.5 MMTCE in 2000. No reductions are expected in 2010 below baseline forecasts.

High-Efficiency Gas Technologies *(Action 25)*

The United States will accelerate the commercialization of high-efficiency gas fuel cell technologies, through joint ventures with utilities, research organizations, and technology developers to fund demonstrations and market-entry initiatives. Fuel cells are an ultra-high-efficiency and environmentally benign method of producing electricity and by-product thermal energy. This technology provides a means of converting a fuel's chemical energy into electrical energy without a combustion process.

The 1993 CCAP projected this action would lead to reductions of 0.6 MMTCE in the year 2000. Because funding for this program has been significantly reduced from originally anticipated levels, current projections are that the program will reduce greenhouse gas emissions by 0.1 MMTCE in 2010, with no reductions expected in 2000.



Renewable Energy Commercialization *(Action 26)*

DOE strives to commercialize renewable energy by working with U.S. renewable energy companies, electric utilities, and other end users in cost-shared partnerships that share development risk and advance toward agreed-upon cost-reduction targets. Potential buyers of renewables are encouraged to work directly with the renewables industry and DOE to form market-pull partnership consortia to advance common goals toward accepted commercialization targets. These groups include the Utility PhotoVoltaic Group, Solar II (solar thermal central receiver) Commercialization Consortium, Utility Biomass Energy Commercialization Association, Utility Wind Interest Group, USH$_2$0 (Solar Hot Water) Consortium, and Geothermal Heat Pump Consortium. These buyer-led groups work directly with their respective renewable-energy industry and with DOE cost-sharing at appropriate stages, such as for hardware demonstration projects.

These efforts were expanded under the 1993 CCAP, which expected their combined effect to lead to 2.2 MMTCE of reductions in the year 2000. However, because funding for this program has been significantly reduced from originally anticipated levels, current projections are that the program will reduce greenhouse gas emissions by approximately 0.3 MMTCE in 2000 and 5.6 MMTCE in 2010.

Expanded Utility Integrated Resource Planning (IRP) Assistance *(Action 27)*

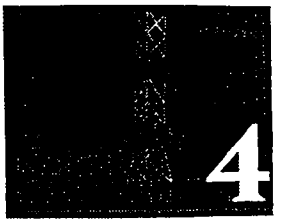
In 1994, the expanded IRP program emphasized outreach and education, putting IRP tools in the hands of state and regional regulators, legislators, and utility managers. Core program activities—including an Education Voucher program, an Electric Utility Restructuring Partnership, and an IRP in Public Power Project—exceeded program goals. More than 230 educational vouchers were awarded, and more than thirty seminars were sponsored before Congress discontinued funding the program in fiscal year 1996.

The 1993 CCAP expected this action would reduce emissions by 1.4 MMTCE in 2000. Although the program achieved many of its goals before being terminated, the full emission reduction goals will not be achieved. The reductions that will occur have been accounted for in the baseline energy forecast.

Profitable Hydroelectric Efficiency Upgrades *(Action 28)*

As proposed, this initiative would enable nonfederal developers to invest in environmentally sound upgrades at existing federal hydroelectric projects and to sell the incremental power thus generated at market rates. Significant technological potential exists for increasing generation at hydroelectric facilities, but institutional barriers have complicated efforts to make these profitable efficiency upgrades. Nonfederal investments will increase generation from hydroelectric facilities, reducing the need for fossil-fuel-fired generation. Furthermore, lease payments to the federal government will help reduce the federal deficit. Implementing legislation is currently being drafted.

The 1993 CCAP projected the combined effect of these initiatives would lead to 2.0 MMTCE of reductions in 2000. In the current review, no reductions were attributed to this action due to the uncertainty of enacting implementing legislation.



Energy-Efficient Distribution Transformer Standards *(Action 29)*

In 1992, EPAct required DOE to determine if standards are warranted for distribution transformers. In July 1996 the Oak Ridge National Laboratory prepared a report entitled *Determination Analysis of Energy Conservation Standards for Distribution Transformers,* which was peer reviewed by manufacturers of transformers, steel, and aluminum and by utilities, associations, and energy-conservation public interest groups. The report revealed that all energy-conservation cases that were analyzed are technically feasible, appear to be economically justified, and have the potential for significant energy savings. Based on the energy conservation cases analyzed, the potential savings range from 3.6 to 13.7 cumulative quads over the period 2000–2030. The study methodology consisted of four major elements: development of a data base, development of conservation options, assessments of energy-conservation options, and incorporation of feedback from stakeholders. DOE plans to publish a determination notice this year of its decision as to whether efficiency standards are warranted for distribution transformers.

The 1993 CCAP expected the combined effect of Actions 29 and 30 would reduce emissions by 0.8 MMTCE in 2000. Current projections are that the programs will reduce greenhouse gas emissions by approximately 0.5 MMTCE in 2000 and 1.4 MMTCE in 2010.

ENERGY STAR® Distribution Transformers *(Action 30)*

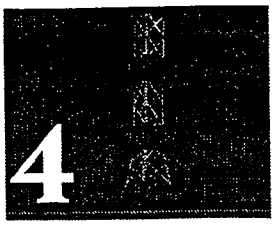
In 1991, about 7.4 percent of U.S. electric generation was lost while being distributed from power plants to consumers, and approximately 50 billion kilowatt-hours are lost every year in the delivery of electricity from distribution transformers. Stemming transmission and distribution losses will decrease the amount of electricity that needs to be generated to meet electricity demands, thus reducing CO_2 emissions.

The United States is implementing an ENERGY STAR® labeling program to encourage electric utilities to invest in high-efficiency transformers that reduce transformer losses. Participating utilities agree to purchase only qualifying equipment designated with the ENERGY STAR® logo and to accelerate the replacement of higher-loss transformers where economically warranted. EPA is also distributing information regarding energy-efficient transformers to utilities and state regulatory bodies and is helping participating utilities organize group purchases of energy-efficient transformers to obtain lower prices.

The 1993 CCAP expected the combined effect of Actions 29 and 30 would reduce emissions by 0.8 MMTCE in 2000. Current projections are that the programs will reduce greenhouse gas emissions by approximately 0.5 MMTCE in 2000 and 1.4 MMTCE in 2010.

Land-Use Change and Forestry Actions

Trees, plants, and soils absorb and store CO_2 from the atmosphere. In 1995, the annual sequestration by these natural systems (sometimes called carbon "sinks") reduced U.S. net greenhouse gas emissions by 117 MMTCE. When humans affect the biosphere through changes in land use and forest man-



agement activities, they alter the natural balance of greenhouse gas emissions.

Most CO_2 emissions occur as the result of burning fossil fuels. Additional CO_2 emissions occur when the carbon stored in the biosphere is released—for example when trees are harvested and logging residual decomposes. Protecting the carbon stored in these forest reservoirs, therefore, can prevent CO_2 emissions from occurring. The United States has already taken significant steps to protect carbon sequestered in forests. Lower harvests in old-growth forests help prevent CO_2 emissions. The shift toward ecosystem management also favors timber harvest methods that inflict less damage, and helps retain carbon on forest lands. Sink protection actions are very cost-effective methods for limiting net CO_2 emissions.

The 1993 CCAP includes several programs to maintain carbon sequestered in forest ecosystems. These programs were projected to provide about 9 percent of the emission reductions needed to reach the greenhouse gas target in 2000, or a total of approximately 10.0 MMTCE in additional annual sequestration. Due to funding cuts of CCAP initiatives, only 0.4 MMTCE in additional annual sequestration is expected by 2000. By 2010, it is anticipated that 2.2 MMTCE will be sequestered annually due to the 1993 CCAP. In addition to Actions 43 and 44, several other actions previously discussed lead to increased carbon sequestration in U.S. forests. In particular, efforts to enhance recycling will limit use of forest products, and Cool Communities' shade tree planting will increase carbon sinks.

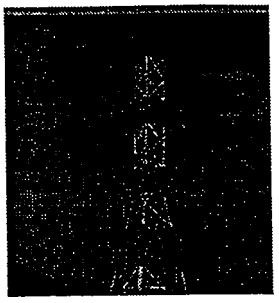
Reduce Depletion of Nonindustrial Private Forests *(Action 43)*

No funding has been provided for this activity beyond the baseline activity that existed prior to the 1993 CCAP.

Accelerate Tree Planting in Nonindustrial Private Forests *(Action 44)*

In cooperation with the state foresters, USDA's Forest Service is working to increase tree planting on poorly stocked and nonstocked nonindustrial private forest land by 94,294 hectares (233,000 acres) within five years. To accomplish this, the federal government will expand technical assistance and reimburse up to 75 percent of the costs of tree planting. Accelerated planting programs increase carbon uptake and could provide significant economic and environmental benefits over the long term.

The 1993 CCAP projected this measure would reduce net emissions by sequestering an additional 0.5 MMTCE in the year 2000. Current projections are that the programs will reduce net emissions by sequestering an additional 0.4 MMTCE in 2000 and 2.2 MMTCE in 2010.



Methane and Other Greenhouse Gas Programs

Although carbon dioxide accounts for the largest share of greenhouse gas emissions in the United States, other greenhouse gases have significantly higher global warming potentials. For example, over a 100-year time horizon, methane is 21 times more effective than CO_2 at trapping heat in the atmosphere, nitrous oxide is 310 times more effective, and HFC-23 is 11,700 times more effective.

Methane

Methane comprised about 11 percent of the U.S. greenhouse gas emissions in 1995. The primary sources of methane emissions in the United States are landfills, domesticated livestock, coal mines, and natural gas systems. The 1993 CCAP includes specific measures for each of these sources.

Methane control options offer tremendous opportunities to reduce greenhouse gas emissions at low cost or even at a profit. In many cases, methane that would otherwise be emitted to the atmosphere can be captured and used to generate power, or can be significantly reduced through the use of cost-effective management methods.

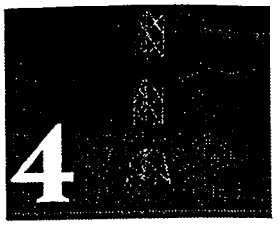
Without the 1993 CCAP, it is currently estimated that methane emissions would increase from 170 MMTCE in 1990 to 175.5 MMTCE in 2000. The 1993 CCAP projected that the combined effects of the methane actions would reduce emissions by 16.3 MMTCE in the year 2000. Current projections are that the actions will reduce greenhouse gas emissions by approximately 15.5 MMTCE in 2000 and 23.4 MMTCE in 2010.

Natural Gas STAR *(Action 32)*

Through EPA's Natural Gas STAR program, natural gas companies are overcoming barriers and adopting cost-effective technologies and practices that reduce emissions of methane. The program was launched in March 1993 with the transmission and distribution sectors and was expanded in March 1995 to include the production sector. To date, the program includes sixty-five corporate partners representing 65 percent of transmission company pipeline miles, 30 percent of distribution company pipeline miles, and 30 percent of U.S. natural gas production.

After becoming a partner, a company submits an implementation plan to EPA and implements the plan over the next three years. In addition to assisting with plan implementation, EPA provides partners with public recognition and works to remove unjustified regulatory barriers.

In 1996, the program reduced methane leakage from natural gas pipelines by over 1.0 MMTCE. The 1993 CCAP expected the expansion of the program would reduce



emissions by 3.0 MMTCE in 2000. Current projections are that the expansion of the program will reduce emissions by 3.4 MMTCE in 2000 and by 4.2 MMTCE in 2010. The full Natural Gas STAR program will achieve even larger results.

Landfill Methane Recovery
(Actions 33 and 34)

Landfills are the largest source of anthropogenic methane emissions in the United States. Because methane is a fuel, landfills also represent a tremendous energy resource. The New Source Performance Standards and Emissions Guidelines (Landfill Rule), promulgated under the Clean Air Act in March 1996, require large landfills to capture and combust their landfill gas emissions. Because of the CCAP, this rule was made more stringent, resulting in greater landfill gas recovery.

Through its Landfill Methane Outreach Program, launched in December 1994, EPA is encouraging U.S. landfills to capture and use their landfill gas emissions as a fuel source. This voluntary effort works hand-in-hand with EPA's Landfill Rule to promote cost-effective reductions in methane emissions. By providing reliable technical and economic information about the opportunities to use landfill gas as a fuel, connecting project partners, creating innovative financing opportunities, and demonstrating the many benefits of landfill gas-to-energy, the outreach program is helping landfills affected by the Landfill Rule to achieve the maximum benefit at the lowest cost.

The 1993 CCAP projected the combined effect of the outreach program and the increased stringency of the Landfill Rule would reduce emissions by 5.3 MMTCE in 2000. Current projections are that the programs will reduce emissions by 8.2 MMTCE in 2000 and 12.0 MMTCE in 2010.

Coalbed Methane Outreach Program
(Action 35)

In 1995, methane emissions associated with coal mining operations accounted for approximately 12 percent of U.S. methane emissions. Launched in the spring of 1994, the Coalbed Methane Outreach Program is reducing these emissions by: (1) working with the coal industry and other stakeholders to identify and remove obstacles to increased investment in coalbed methane recovery projects, and (2) raising awareness of opportunities for profitable investments.

Currently, at least thirteen U.S. mines are recovering and using methane. During 1995, at least five new or expanded-use projects were initiated at coal mines. These projects included introducing coalbed methane into the nation's natural gas pipeline supply, generating power from abandoned mine gas, and using methane to replace coal as a fuel source for drying at a coal mine preparation plant.

The 1993 CCAP projected the program would reduce methane emissions by 2.2 MMTCE in 2000. Current projections are that the program will reduce emissions by 2.6 MMTCE in 2000 and by 3.2 MMTCE in 2010.

RD&D for Coal Mine Methane
(Action 36)

In coordination with EPA, the National Mining Association, fuel cell and gas turbine manufacturers, private industry, and others, DOE's Office of Fossil Energy is supporting outreach, cost-shared demonstrations, and

market-entry projects to investigate and apply technologies for capturing and using methane emitted during coal mining. A feasibility study was completed and there is broad-based program support for the program. Fourteen proposals were submitted from the private sector in response to the Phase I solicitation for cost-shared projects. Of these, ten were selected and have coal-mine sites committed to methane recovery and use.

The 1993 CCAP projected this action would reduce methane emissions by 1.5 MMTCE in 2000. Funding for this program has been significantly reduced from originally anticipated levels. In the revised analysis, no emission reductions are projected.

RD&D for Landfill Methane *(Action 37)*

This action was terminated due to lack of funding for project demonstrations. However, EPA produced and disseminated technical manuals and expertise as part of its Landfill Methane Outreach Program (Action 34). The 1993 CCAP projected this action would reduce emissions by 1.0 MMTCE in 2000. In the revised analysis, no emission reductions are projected.

AgSTAR Program *(Action 38)*

Through this voluntary pollution-prevention program, EPA and USDA are working with livestock producers to capture the methane released from manure management systems. The captured methane is an on-farm energy resource that can offset energy costs and increase bottom-line profits. Using methane-recovery systems, it is technologically feasible to reduce total U.S. methane emissions from livestock manure by 50 percent. Collateral benefits include reducing surface- and ground-water pollution, odor management, and reducing fertilizer costs.

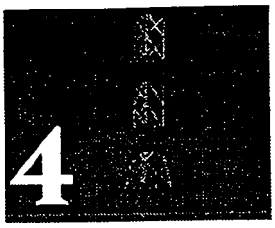
Launched at the White House Conference on Climate Change in the spring of 1994, AgSTAR currently has more than forty partners, representing over four hundred farms. The program also has more than fifty "allies," representing system and equipment manufacturers, educational institutions, state and local governments, consultants, and others.

The 1993 CCAP projected this action would reduce emissions by 1.5 MMTCE in 2000. Due to funding cuts, delays in initiating model farms, and changes in the industry, current projections are that the program will reduce emissions by 0.3 MMTCE in 2000 and 1.8 MMTCE in 2010.

Ruminant Livestock Efficiency Program *(Action 39)*

This collaborative effort between USDA and EPA reduces methane emissions resulting from the dairy and beef industries, which are responsible for more than 30 MMTCE of methane emissions annually. Methane is produced as part of a ruminant animal's normal digestive process, known as "enteric fermentation." Because the methane produced is actually wasted carbon from the feed, the amount of methane relative to the amount of beef or milk produced is a reliable indicator of the inefficiency of animal production.

This program encourages livestock producers to increase the efficiency of their animals and reduce methane emissions by improving grazing management, providing strategic feed supplementation, improving feed efficiency through the use of produc-



tion-enhancing agents, improving genetic characteristics and reproduction, and controlling diseases. The program also builds on existing efforts to remove market barriers and to create incentives for increased production of lower-fat milk and meat products.

The 1993 CCAP projected this action would reduce emissions by 1.8 MMTCE in 2000. Current projections are that the program will reduce emissions by 1.0 MMTCE in 2000 and 2.2 MMTCE in 2010.

Nitrous Oxide Programs

Nitrous oxide emissions, mostly from fertilizer and chemical manufacture, accounted for about 3 percent of U.S. greenhouse gas emissions in 1995. Without the 1993 CCAP, nitrous oxide emissions would be expected to increase by about 3 MMTCE from 1990 to 2000.

Improved Fertilizer Management *(Action 17)*

A new partnership with American farmers to improve the efficiency of fertilizer management will result in lower emissions of nitrous oxide from soil. This initiative will begin with the conduct of field experiments regarding bacterial denitrification and the testing of management options to improve the efficiency of nitrogen use. Demonstration projects and an outreach campaign using nationwide USDA outlets have been initiated.

The 1993 CCAP projected this action would reduce N_2O emissions by 4.5 MMTCE in 2000. Current projections are that the program will reduce emissions by 5.0 MMTCE in 2000, resulting in a net decrease in emissions between 1990 and 2000 of 2 MMTCE. A reduction of 5.0 MMTCE is projected for 2010.

Other Emission-Reduction Programs

Due to their high global warming potentials, long atmospheric lifetimes, and increasing emissions, hydrofluorocarbons (HFCs) are a growing contributor to the climate change problem. HFCs are also emitted as a by-product of HCFC-22 production (another CFC substitute). Perfluorocarbons (PFCs), emitted primarily during aluminum smelting, are also potent greenhouse gases. In addition, three halogenated substances not included in the 1993 CCAP—SF_6, NF_3, and CHF_3— produce significant greenhouse gas emissions. In 1995, all of the above gases comprised about 2 percent of U.S. greenhouse gas emissions, but emissions are projected to increase as their use as alternatives to ozone-depleting substances increases.

The United States is the first nation to articulate a national strategy to control HFC and PFC emissions. The strategy uses a combination of partnership efforts and regulatory mechanisms to minimize the future contribution of HFCs, PFCs, and halogenated substances to global warming, without disrupting the orderly and cost-effective transition away from CFCs.

Without the 1993 CCAP, emissions of these gases would be projected to grow from 24.4 MMTCE in 1990 to 62.4 MMTCE in 2000. The 1993 CCAP anticipated that the HFC and PFC programs would reduce emissions by 11.8 MMTCE in 2000. Currently, it is estimated that the HFC and PFC actions,

including the expansion of Action 40, will reduce emissions from these gases by 20.1 MMTCE in 2000, resulting in total emissions of 42.3 MMTCE in 2000.

Significant New Alternatives Program *(Action 40)*

EPA has used its authority under the Clean Air Act Amendments of 1990 to narrow the scope of uses allowed for HFCs and PFCs with high global warming potentials where better alternatives exist. Emission reductions are being achieved by means of the Significant New Alternatives Program under Section 612 of the amendments. EPA published a final rulemaking in March 1994 that has restricted the use of HFCs and PFCs in a variety of applications. EPA has published four updates to the rule, further extending the emission reductions

The 1993 CCAP projected this action would reduce emissions by 5.0 MMTCE in 2000. Current projections are that the program will reduce emissions by 6.4 MMTCE in 2000 and 23.1 MMTCE in 2010.

HFC-23 Partnerships *(Action 41)*

HFC-23, a potent greenhouse gas, is emitted as a by-product of HCFC-22 production. Through this program, EPA encourages companies to develop and implement technically feasible, cost-effective processing practices or technologies to reduce HFC-23 emissions. Through partnerships with EPA, the entire U.S. HCFC-22 industry has agreed to significantly reduce HFC-23 emission levels by 2000. HCFC-22 producers are developing and implementing processing practices or technologies to reduce HFC-23 emissions where technically feasible and cost-effective. HCFC-22 producers have also completed an assessment of 1990 HFC-23 emissions.

The 1993 CCAP projected this action would reduce emissions by 5.0 MMTCE in 2000. Current projections for 2000 are unchanged, and estimate a sustained reduction of 5.0 MMTCE through 2010.

Voluntary Aluminum Industrial Partnerships *(Action 42)*

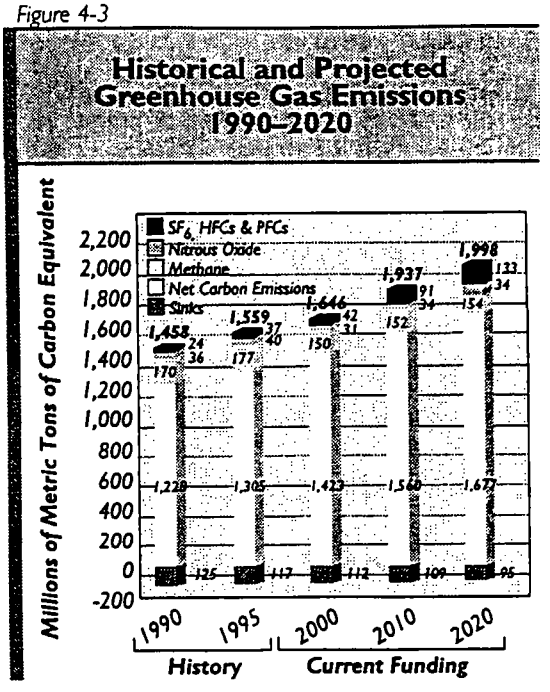
Carbon tetrafluoride (CF_4) and carbon hexafluoride (C_2F_6) are emitted as by-products of the primary aluminum production process. Both are potent greenhouse gases, with global warming potentials of approximately 6,500 and 9,200 times that of CO_2, respectively, and lifetimes that exceed 10,000 years.

EPA is partnering with primary aluminum producers to reduce CF_4 and C_2F_6 emissions where technically feasible and cost-effective. Because factors that cause these emissions are a sign of efficiency loss, focus by industry to reduce emissions will result in process enhancements. EPA estimates that emissions of CF_4 and C_2F_6 can be reduced by 30–60 percent industrywide. As of December 1995, twelve companies representing 94 percent of the U.S. primary aluminum production capacity have joined EPA in the Voluntary Aluminum Industrial Partnership.

CCAP projected this action would reduce emissions by 1.8 MMTCE in 2000. Current projections are that the programs will reduce emissions by 2.2 MMTCE in 2000 and 2.4 MMTCE in 2010.

4

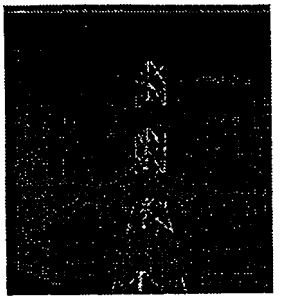
Figure 4-3



The results of this integrated analysis combined with a review of actual emission trends to date suggest that CCAP programs can be effective in reducing U.S. greenhouse gas emissions. CCAP actions reduce 4 percent of baseline emissions in 2000, 8 percent in 2010, and 10 percent in 2020. However, despite these substantial contributions, emissions will significantly exceed their 1990 levels in the year 2000.

- U.S. net greenhouse gas emissions in 1990 were 1,458 MMTCE.
- Estimated U.S. greenhouse gas emissions in 1995 were 1,559 MMTCE—6.9 percent above the 1990 level, and somewhat above the short-term increase projected in the first U.S. national communication, the 1994 *Climate Action Report*.
- The updated "point estimate" for greenhouse gas emissions in the year 2000, assuming continued funding support for CCAP actions described in this report, comparable to the 1997 levels approved by Congress is 1,646 MMTCE—188 MMTCE above the 1990 level.
- Under current funding levels, planned actions are estimated to reduce greenhouse gas emissions by 76 MMTCE in the year 2000, compared to what they would have been otherwise (the baseline).
- Due to estimated energy savings initiated by CCAP actions to reduce greenhouse gas emissions, approximately $10.3 billion and $51.1 billion are saved in energy fuel use in 2000 and 2010, respectively.
- If funding were higher, as originally envisioned in the 1993 CCAP, estimated emission reductions would be about 30–40 MMTCE greater.
- While reductions from CCAP programs increase over time, projected greenhouse gas emissions still continue to grow over time, reaching 1,837 MMTCE by 2010 and 1,998 MMTCE by 2020.

The emission projections presented here include the full effect of the "foundation" actions contained in the earlier 1993 CCAP. The three foundation actions scored are: Climate Challenge, Climate Wise Companies, and State and Local Outreach. Emission reduction estimates are sensitive to the order in which foundation actions and other CCAP programs are counted. If reductions resulting from the activities of program participants that can be reflected in other actions or in the baseline are excluded, the estimated "incremental" emission reductions associated with the foundations are estimated to provide



Projections and Effects of Policies and Measures

This section integrates the impact of U.S. climate change policies with revised and extended projections of greenhouse gas emissions and sequestration estimates. It serves as a starting point for a reevaluation of the effectiveness of the 1993 CCAP in meeting the goal of returning net U.S. emissions of greenhouse gases to their 1990 levels by 2000. Analyses of the individual actions (described earlier in this chapter) are integrated with revised forecasts of economic growth, energy prices, program funding, and regulatory developments to provide an updated comprehensive perspective on current and projected greenhouse gas emission levels. For convenience, the revised projections contained here will be referred to as the 1997 *Climate Action Report* (1997 CAR).

Any projection of future emissions, even for a period as short as four years, is subject to considerable uncertainty. Key factors that can increase emissions include more rapid growth in electricity demand, flat rather than slightly rising real energy prices, more rapid economic growth, and further cuts in CCAP funding or effectiveness. Key factors that can reduce emissions include slower growth, increased CCAP program efficacy, greater penetration of baseline energy-efficiency measures, higher energy prices, increased program funding levels, and relatively mild weather in 2000. A qualitative analysis of key uncertainties suggests that net greenhouse emissions in 2000 could exceed their 1990 level by 150–230 MMTCE.

Continued support for research and development efforts in the areas of energy-efficiency and renewable-energy technologies is another key element of the Administration's strategy to implement the 1993 CCAP's vision. These technologies can serve both U.S. economic and environmental interests by reducing costs and emissions, while also providing important export markets for U.S. firms and workers.

The first part of this section describes the current projections of greenhouse gas emissions for the years 2000, 2010, and 2020. It also compares the 1993 CCAP with 1997 CAR projections, the latter of which includes reductions from planned actions. The second part updates the "no action" baseline emission projections data and compares the data to the 1993 CCAP baseline. The last part provides new estimates of the overall impact of the 1993 CCAP that reflect initial implementation experience, changes in the market conditions under which actions operate, and the impact of the shortfall in action funding during recent fiscal years, as well as examines the effect of key uncertainties affecting projected emission levels.

Projected Greenhouse Gas Emissions: 1990–2020

Emissions of greenhouse gases are projected to rise at a decreasing rate between now and the year 2020 (Table 4–2 and Figure 4–3). Between 1990 and 2000, emissions increase by 12 percent; between 2000 and 2010, they increase by an additional 11 percent; and between 2010 and 2020, they increase by another 9 percent. The growth of overall greenhouse gas emissions is due to the continued but slowing growth in projected baseline emissions.

Among all gases, net carbon emissions increase the most in absolute terms, while emissions from halogenated gases increase the most in percentage terms. Net carbon emissions are projected to increase by 195 MMTCE between 1990 and 2000, by 137 MMTCE between 2000 and 2010, and 117 MMTCE between 2010 and 2020. The largest percentage increase in net carbon emissions, 16 percent, occurs between 1990 and 2000. (Net carbon emission is equal to gross domestic energy-related carbon emissions, minus international bunker fuel, plus Adjustments to U.S. Energy, plus emissions from Other Sources, minus sequestered carbon.)

Although the projected absolute increase in carbon-equivalent emissions for halogenated gases is relatively small compared to net carbon emissions, halogenated gases increase by 73 percent between 1990 and 2000, by 115 percent between 2000 and 2010, and by 46 percent between 2010 and 2020. The largest absolute increase for these gases was 49 MMTCE, which is projected to occur between 2000 and 2010.

Table 4-2

Historical and Projected 1997 CAR Greenhouse Gas Emissions (MMTCE)

Greenhouse Gas	Historical Emissions		Projected Emissions		
	1990	1995	2000	2010	2020
Net CO_2	**1,228**	**1,305**	**1,423**	**1,560**	**1,677**
Energy	1,327	1,391	1,504	1,634	1,737
Adjustments and Other Sources	26	31	31	35	34
Carbon Sequestration	-125	-117	-112	-109	-95
Methane	**170**	**177**	**150**	**152**	**154**
N_2O	**36**	**40**	**31**	**34**	**34**
HFCs, PFCs and SF_6	**24**	**37**	**42**	**91**	**133**
Total	**1,458**	**1,539**	**1,646**	**1,837**	**1,998**
Difference from 1990		**81**	**188**	**378**	**540**

Note: Projections assume timely receipt of legislative authority for parking cash-out. Program funding is based on funding proportional to current funding with respect to 1993 CCAP funding levels. Columns may not sum due to independent rounding.

emission reductions of 11 MMTCE in 2000, 10 MMTCE in 2010, and 12 MMTCE by 2020. However, the full emission reduction contribution of these programs, which includes all reductions achieved through the activities of program participants, is substantially larger.

Assessing Current Estimates of Greenhouse Gas Emissions

As in the 1993 CCAP, an analytical team was established composed of members from all relevant federal agencies. The team was charged with reevaluating all 1993 CCAP actions and to include new actions as appropriate. A set of inputs was developed so that the modeling effort could be undertaken to account for potential overlap and synergistic effects among actions.

Two modeling scenarios were created: a Baseline scenario and an Action Plan scenario. The Baseline scenario reflects expectations of private- and public-sector behavior based on legislation and federal programs already in effect. The Action Plan scenario combines all the policies contained in the baseline with the actions contained in the 1993 CCAP, as well as new actions developed since the publication of the original CCAP.

The projections contained in this section are derived from a set of specific assumptions about markets, technologies, and resources, such as growth rates in the gross domestic product (GDP) and world oil prices. Four main types of assumptions underlie the projections:

- *Economic factors,* including GDP growth rates, world oil prices, and other macroeconomic assumptions.
- *Energy resources,* including proven reserves and undiscovered resources.
- *Market behavior,* reflecting the demand and supply decisions of energy-market participants, as influenced by energy prices, regulation, and policy programs.
- *Technology factors,* which include information on the costs, performance, and commercial availability of energy-consuming, -converting and -producing technologies.

The Integrated Dynamic Energy Analysis Simulation (IDEAS) model was used as a tool for the integrated analysis of the energy-related actions. Table 4-3 presents a partial list of some of the key factors, containing both input assumptions and model results. This model has elements of both top-down and bottom-up modeling. The macroeconomic effects are combined with microeconomic, technology-specific representations of energy-service methods that link energy supply and demand through equilibrium market prices. Other sectors and gases were estimated independently.

Comparison of 1993 CCAP and 1997 CAR Greenhouse Gas Emissions

A comparison of the 1993 CCAP and the 1997 CAR reveals significant differences between the two sets of projections. These differences are caused by many factors, including the adoption of international accounting standards, the inclusion of newly identified greenhouse gases, updated global warming potential factors used to determine carbon-equivalent emissions, revised estimates of historical emissions, changes in baseline assumptions of emis-

Table 4-3

Major Assumptions and Model Results Underlying 1997 CAR Projections

Factors	1990	2000	2010	2020
Real GDP (billions of 1995 dollars)	6,380	8,005	9,745	11,259
Population (millions)	250	276	299	324
Residential Housing Stock (millions)	94.0	103.0	114.7	125.4
Commercial Floor Space (billion sq. ft.)	64.3	72.3	78.5	85.3
Industrial Production Index	100.0	123.0	151.9	174.0
Energy Intensity (Btu per 1995 dollar GDP)	13,217	12,123	10,767	9,809
Light-Duty Vehicle Miles Traveled (billions)	1,940	2,373	2,885	3,368
Heavy-Duty Vehicle Miles Traveled (billions)	151	181	211	238
New Heavy-Duty-Vehicle on-Road Fuel Efficiency (miles/gallon)	64	6.7	6.7	6.7
New-Car on-Road Fuel Efficiency (miles/gallon)	23.4	25.3	26.9	27.5
New Light-Duty-Truck on-Road Fuel Efficiency (miles/gallon)	17.4	19.0	20.1	21.3
World Oil Price (1995 dollars/barrel)	23.98	18.20	20.33	22.16
Wellhead Natural Gas (1995 dollars/1,000 cubic feet)	1.91	1.85	1.98	2.39
Minemoth Coal (1995 dollars/ton)	23.93	17.96	16.52	15.31
Average Price Electricity (cents/kilowatt-hour)	7.2	6.72	6.38	6.07
Average Price Gasoline (1995 dollars/gallon)	1.28	1.37	1.39	1.43

sions, and revised estimates of the results of emission-reduction actions based on new expectations for program funding and efficacy.

Overall, the estimate for greenhouse gas emissions is now expected to exceed its 1990 value by 188 MMTCE—190 MMTCE more than the difference projected in the earlier 1993 CCAP. Table 4-4 compares the 1993 CCAP estimates to the 1997 CAR estimates on a gas-by-gas basis and summarizes overall differences in the projections. These differences are explained in detail in the following sections focusing on growth in baseline emissions and integrated analysis of the projected growth in emissions.

Baseline Emissions Growth: Review and Update

A critical element of any update of the 1993 CCAP involves reviewing key assumptions used in developing the baseline projections of emissions. This baseline calculation attempts to project the level of greenhouse gas emissions in 2000 absent any 1993 CCAP actions. It necessarily involves critical assumptions about energy prices, economic growth, etc. In the context of this review, several key baseline assumptions have evolved—even in the short period since 1993—in ways that differ significantly from those of in the initial analysis.

Even with no change in the projected funding or effectiveness of actions to limit emissions, an objective of returning emissions in 2000 to their 1990 level can be affected by revisions to 1990 emissions data or changes in the projected "no action" baseline level of emissions in the year 2000. For this reason, developments that affect projected baseline emission levels must be addressed in an updated analysis of a greenhouse gas mitigation strategy.

This section updates the emissions baseline used in the 1993 CCAP analysis. Energy-

Table 4-4

Comparison of 1993 CCAP and 1997 CAR: Estimated Projected Greenhouse Gas Emissions (MMTCE)

Greenhouse Gas	1993 CCAP			1997 CAR			CCAP Gap/ CAR Gap
	1990	2000	CCAP Gap	1990	2000	CAR Gap	
Net CO_2	**1,237**	**1,261**	**24**	**1,228**	**1,423**	**195**	**171**
Energy	1,338	1,379	41	1,327	1,504	177	136
Adjustments & Other Sources	29	29	0	26	31	5	5
Carbon Sequestration	-130	-147	-17	-125	-111	14	31
Methane	**166**	**134**	**-31**	**170**	**150**	**-20**	**11**
N_2O	**39**	**31**	**-8**	**36**	**31**	**-5**	**3**
HFCs, PFCs and SF_6	**20**	**34**	**13**	**24**	**42**	**18**	**5**
Total	**1,462**	**1,459**	**-2**	**1,458**	**1,646**	**188**	**190**

Note: Projections assume timely receipt of legislative authority for parking cash-out. Program funding is based on funding proportional to current funding with respect to 1993 CCAP funding levels. Columns may not sum due to independent rounding.

related and industrial carbon dioxide emissions, other greenhouse gases, and forest carbon sequestration are addressed in separate discussions, each of which includes a review of emission trends through 2000.

The net effects of the updates in baseline greenhouse gas emissions are summarized in Table 4–5 and Figure 4–4. Overall, the increase in baseline greenhouse gas emissions from 1990 to 2000 is 157 million metric tons of carbon equivalent (MMTCE)— an 11 percent increase over the 1993 CCAP growth in baseline emissions. Of the components listed in Table 4-5, the energy-related emissions increase the most in absolute terms—102 MMTCE. However, in percentage terms energy-related carbon emissions increase by less than the overall percentage growth for all greenhouse gases. All greenhouse gases contribute to additional projected growth in baseline emissions.

The current baseline projections are higher than the 1993 CCAP baseline projections for the following reasons:

- Assumptions of energy use in the 1993 CCAP—including lower-than-expected energy prices, the expected mix of economic activity, increased electrification, and the technological characteristics of energy-using or -converting equipment—are different from those in the 1997 CAR. Some of these changes are the result of reductions in funding for baseline energy programs that improve energy efficiency, the failure to pass conservation measures included in the President's economic stimulus package, and the removal of federal speed limits. Taken together, changes in domestic energy-related carbon emissions are responsible for an increase of 102 MMTCE in the

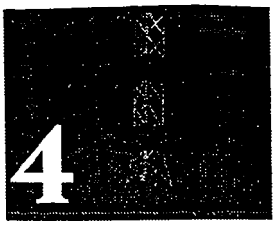


Table 4-5

Comparison of 1993 CCAP and 1997 CAR Estimated Historical and Projected Baseline Emissions (MMTCE)

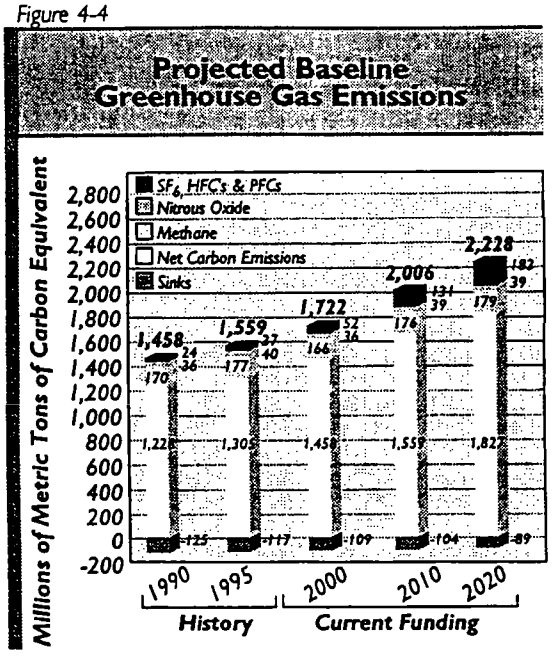
Greenhouse Gas	1993 CCAP			1997 CAR			CCAP Gap/ CAR Gap
	1990	2000	CCAP Gap	1990	2000	CAR Gap	
Total CO_2	**1,237**	**1,337**	**99**	**1,228**	**1,458**	**230**	**130**
Energy	1,338	1,445	107	1,327	1,536	209	102
Adjustments & Other Sources	29	29	0	26	31	5	5
Carbon Sequestration	-130	-137	-7	-125	-109	16	23
Methane	**166**	**150**	**-15**	**170**	**166**	**-4**	**11**
N_2O	**39**	**36**	**-4**	**36**	**36**	**0**	**4**
HFCs, PFCs and SF_6	**20**	**45**	**-25**	**24**	**62**	**38**	**13**
Total	**1,462**	**1,568**	**106**	**1,458**	**1,722**	**264**	**157**

Note: The Delta column is computed by subtracting the growth between 1990 and 2000 in the 1997 CAR from the growth between 1990 and 2000 in the 1993 CCAP. Columns may not sum due to independent rounding.

year 2000 over the projection in the 1993 CCAP.

- Congressional appropriations for fiscal years 1996 and 1997 sharply reduced CCAP programs, compared to the levels originally envisioned and requested in the President's budget. If this lower level of funding is maintained through 2000 and if current levels of program efficacy persist, projected emissions will be 30–40 MMTCE higher in the year 2000 than if the CCAP actions were fully funded.
- Changes in assumptions about increased emissions in the categories "Adjustments for U.S. Energy Territories" (includes U.S. Territories and unmetered gas) or "Other Sources" (includes cement production, gas flaring, and other industrial calcination processes) increase projected 2000 emissions by 5 MMTCE.
- Decreasing estimates of projected forest sinks, rather than rising sequestration of carbon in forests, increase projected 2000 emissions by 23 MMTCE over the projection in the 1993 CCAP.
- Higher projected baseline emissions from methane, due in part to revised estimation techniques of agricultural methane emissions, contributed to an increase of 11 MMTCE.
- Higher projected baseline emissions from nitrous oxides increased projected emissions by 4 MMTCE.
- Higher projected baseline emissions of halogenated greenhouse gases, including newly identified gases, increased projected emissions by 13 MMTCE.

Figure 4-4



The Projected Baseline for Carbon Emissions

The current baseline estimate of gross energy-sector carbon emissions in the year 2000 is 1,567 MMTCE, which is 107 MMTCE higher than the year 2000 baseline value used in the 1993 CCAP. Three components are combined to estimate gross energy sector carbon emissions: gross domestic energy-related emissions (for fuel purchased in the United States), subtractions for international bunker fuels, and additions for adjustments for other sources and international territories. By far, the largest change occurred in projected gross domestic energy-related carbon emissions. However, the baseline was also affected by slight revisions to historical emission estimates and revised accounting for fuels used in international transport (international bunkers). The projected change in adjustments for other sources and territories is insignificant (1 MMTCE) and will not be discussed.

The current energy baseline was roughly calibrated to the 1997 *Annual Energy Outlook* (U.S. DOE/EIA 1996a). The primary factors affecting baseline levels of projected energy use and related emissions are the economic and technical assumptions that underlie the projection methodology. Changes in each of these areas since issuance of the original CCAP have caused the projected difference in the growth of energy-related emissions between 1990 and 2000 to be 107 MMTCE higher than projected in the 1993 CCAP.

Changes in Economic Assumptions. As outlined in Table 4–6, the primary reason for the projected increase in carbon emissions between the 1993 CCAP and the 1997 CAR is the change in the projected energy prices. The increase caused by lower projected fossil-fuel prices is aggravated by an increase in expected population growth and disposable income, but is somewhat offset by decreases in expected industrial production growth and commercial floor space, compared to the 1993 CCAP.

Energy Prices. Since the issuance of the 1993 CCAP, most major forecasters of energy prices have significantly revised their expectations of fossil fuel prices downward, especially for natural gas and coal. Projections of fossil energy prices used in developing the updated baseline are significantly lower than those used in 1993—the projected world oil price in 2000 is 13 percent lower, the natural gas wellhead price is 25 percent lower, and the average minemouth price of coal is 30 percent lower. Figure 4–5 compares the original and updated energy price baselines, the latter estimates based on actual energy price data through 1995.

Table 4-6

Comparison of Assumptions: 1990–2000 Annual Growth Rates and Differences

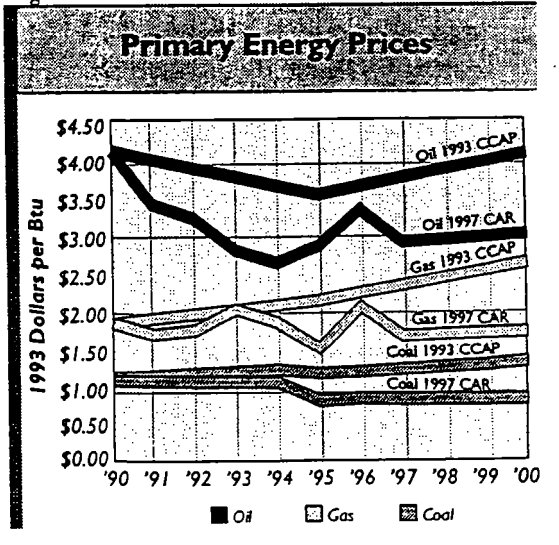
Factors	Annual Growth Rates		MMTCE Difference
	1993 CCAP	1997 CAR	
Weighted Average Fossil-Fuel Price	1.6%	-1.1%	39
Electricity Price	0.4%	-0.6%	5
Industrial Production	2.5%	2.1%	-13
Commercial Floor Space	1.3%	1.2%	-3
Population	0.7%	0.9%	1
Disposable Income	1.6%	2.4%	4
Total			33

Lower energy price forecasts increase projected energy use and emissions by reducing the incentive for conservation and increased energy efficiency. The switch to a lower price trajectory increases projected baseline energy consumption and carbon emissions by roughly 2.6 percent, or 39 MMTCE.

Electricity Prices. In addition to the decrease in electricity prices caused by the decrease in primary energy prices, the U.S. electric power industry has been undergoing a major restructuring. The move to a more competitive industry has resulted in expectation of lower electricity prices. Although the projections contained in this report do not explicitly attempt to capture completely the move to a competitive electric power industry, the expectation of lower prices, as manifested in the 1997 *Annual Energy Outlook* has been captured. As a result, electricity prices are expected to slightly decrease, in contrast to the increase expected just a few years ago. Based on these revised expectations, projections of baseline gross energy-related carbon emissions are about 5 MMTCE higher in the year 2000. This increase is in addition to the increase projected for the change induced by lower fossil fuel prices.

Industrial Production. Energy-related carbon emissions are sensitive not only to the level of economic activity, which was basically unchanged between the 1993 CCAP and the 1997 CAR, but also to the composition of that activity. The updated baseline incorporates the assumption that a larger share of economic activity will occur in the services sector of the economy and a smaller share will occur in the more energy-intensive manufacturing, agriculture, mining, and construction sectors. As a

Figure 4-5



consequence, industrial output is now projected to grow at 2.1 percent per year during the 1990s, rather than 2.5 percent as projected in the 1993 CCAP. This change reduces projected emissions by 13 MMTCE.

Other Economic Assumptions. Although relatively minor compared to the change in energy prices or industrial production, expectations for some of the other macroeconomic variables that shape the projections have changed.

- For example, shortly after the 1993 CCAP was published, the U.S. Census Bureau significantly revised its population forecast, assuming higher immigration and birth rates. As a result, more energy is consumed in the residential and transportation sectors—an increase of about 1 MMTCE in the year 2000. The increase is modest because the 1993 CCAP projection of households did not change.
- In another area, disposable income has been rising and is expected to rise more rapidly than assumed just a few years ago, increasing energy use in the transportation sector and, thus, carbon emissions. The change in disposable income is responsible for additional emissions of approximately 4 MMTCE.
- Slightly offsetting these two effects is the decrease in the projected growth of commercial floor space, which was estimated differently from the 1993 CCAP. This decrease results in a reduction of 3 MMTCE in carbon emissions.

The net result of these three changes in economic assumptions is an increase in gross energy-related carbon emissions of about 2 MMTCE in the year 2000.

Changes in Technical Assumptions. Most of the changes in projected energy-related carbon emissions between the 1993 CCAP and the current update are the result of changes in technical assumptions used in the analysis (Table 4-7).

Increased Electrification. In the 1993 CCAP, the Administration baseline projected electricity sales to grow at 1.0 percent a year between 1990 and 2000. The current baseline estimate projects electricity sales to grow faster, at a rate of 2.2 percent per year between 1990 and 2000. For reference, electricity sales grew at 2.2 percent a year between 1990 and 1996, even including electricity-saving actions initiated in the 1993 CCAP. The higher rate of growth in electricity sales results in an increase in carbon emissions of 63 MMTCE. Some of the projected increase in electricity sales is thought to have occurred as a result of a decrease in program funding of energy-efficiency programs. Table 4–8 illustrates the differences in projected

Table 4-7

Impacts of Changes in Technical Assumptions in the Year 2000

Category	MMTCE Difference
Increased Electrification	63
Utility Technology Modifications	5
Feedstocks Carbon Coefficient	- 5
Other Nonelectric Changes	12
Total	75

Table 4-8

Changes in Projected Baseline Electricity Growth Rates by Sector: 1990–2000

Sector	History (1990–1996)	1993 CCAP	1997 CAR	MMTCE Difference
Residential	2.7%	1.0%	2.3%	19
Commercial	2.8%	0.0%	2.1%	31
Industrial	1.4%	1.4%	1.9%	13
Total	2.2%	1.0%	2.2%	63

electricity growth rates by sector. The largest sectoral differences between projected electricity sales in the 1993 CCAP baseline and the 1997 CAR baseline occur in the commercial sector (31 MMTCE), followed by the residential (19 MMTCE) and industrial (13 MMTCE) sectors.

Utility Technology Modifications. Two changes made since the 1993 CCAP have increased carbon emissions in the utility sector beyond those accounted for in changes in projected electricity sales: an increase in the assumed heat rate of gas combined-cycle plants and more conservative assumptions regarding the technological characteristics of renewable generating technologies. Although the heat rates of natural gas-fired plants are projected to increase from what they are today by the year 2000, the projected improvement will not be as large as originally envisioned. These two changes are somewhat offset by an assumed improvement in nuclear plant availability, resulting in a net increase in utility sector carbon emissions of approximately 5 MMTCE.

Changes in Carbon Coefficients for Feedstocks. Two changes were made to more accurately account for carbon emissions associated with industrial feedstocks: a decrease in the percentage of carbon sequestered in natural gas feedstocks and a change in the carbon coefficient associated with petroleum feedstocks. Together, these changes accounted for a decrease of about 5 MMTCE in the 1997 CAR compared to the 1993 CCAP.

Other Nonelectric Changes. A number of other changes were made to the assumptions used in the 1993 CCAP to more accurately reflect current energy market conditions. Together, these changes account for an increase in energy-related carbon emissions of 12 MMTCE. An example of such a change is the recently enacted National Highway System bill, which removes current restrictions on state discretion to set speed limits on highways built or maintained with federal funds. This statutory change increases projected transportation sector energy use and emissions due to decreases in fuel economy as average speed increases. A review of state speed limit practices prior to enactment of this restriction and the relationship between fuel economy and speed suggests this legislative action will increase projected emissions in 2000 by 4 MMTCE.

Miscellaneous Policy and Funding Changes. The energy baseline used in the 1993 CCAP assumed adoption of the Administration's economic stimulus package, which was under consideration at the time but was subse-

quently not adopted by Congress. The package contained many conservation and energy-efficiency measures. The elimination of these programs in the updated baseline raises projected emissions by about 4 MMTCE.

Congressional action on fiscal year 1996 appropriations has also affected the baseline (as well as the effectiveness of actions discussed later in this section). Assuming congressional cuts of ongoing government energy-efficiency programs are continued, carbon emissions will increase by another 7 MMTCE in 2000. A component of this is a reduction in DOE's Weatherization Assistance Program and Federal Energy Management Program, which increase projected emissions in 2000 by 2.5 MMTCE.

Emission Accounting Changes. Subsequent to issuance of the 1993 CCAP, international guidance for consistent reporting of national emission inventories was developed. To maintain consistency with these guidelines, the 1997 CAR excludes emissions resulting from the combustion of international bunker fuels (fuels delivered to marine vessels, including warships and fishing vessels, and aircraft used for international transport). This change reduces estimated carbon emissions in 1990 by 22 MMTCE and projected carbon emissions in 2000 by 27 MMTCE. Because emissions from international bunkers are projected to be larger than the quantity estimated for 1990 historical usage, adoption of the agreed methodology that excludes these emissions reduces the projected growth in emissions by 5 MMTCE relative to the methodology used in the 1993 CCAP.

Projected Baseline for Methane and Other Greenhouse Gas Emissions

Greenhouse gases other than carbon dioxide—such as methane, nitrous oxide, halogenated and perfluorinated compounds (HFCs and PFCs), and sulfur hexaflouride (SF_6)—comprised more than 15 percent of U.S. greenhouse gas emissions in 1990. Important information affecting the baseline emission estimates for these gases has become available since issuance of the original 1993 CCAP.

New projections of HFC emissions have been developed based on more recent information about the production and use of substitutes for chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) being phased out under international obligations to protect the stratospheric ozone layer. This modification, together with a slight revision for 1990 estimated emissions (-3 MMTCE), increase the projected growth in HFC emissions from 1990 to 2000 by about 22 MMTCE.

The inclusion of additional halogenated gases (i.e., SF_6, NF_3, and CHF_3), as well as the identification of nitric acid production as a new source for nitrous oxide, increases baseline growth in greenhouse gas emissions from 1990 to 2000 by about 6 MMTCE.

The IPCC has revised the global warming potentials (GWPs) used to express emissions of other gases in carbon-equivalent terms (Table 4–9). Thus, a fixed amount of emissions of a greenhouse gas other than carbon dioxide is now believed to make either a larger or a smaller contribution to global warming.

The 1993 CCAP had projected noncarbon greenhouse gases to increase by about 6

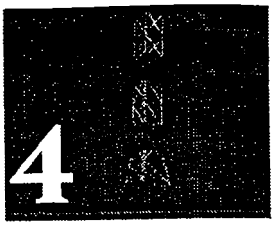


Table 4-9

Global Warming Potentials (GWPs)

Greenhouse Gas	Old GWPs GWPs	Revised GWPs*
Methane	22	21
N_2O	270	310
CF_4	10,000	6,500
C_2F_6	5,000	9,200
HFC-23	10,000	11,700

* *The GWP values reported here reflect contributions to radiative forcing over 100 years. The IPCC also reports GWPs for 20- and 500-year periods.*

MMTCE in the baseline between 1990 and 2000. The current baseline estimate projects these gases to increase by about 34 MMTCE. Together, these changes are estimated to increase the overall growth in greenhouse gas emissions from 1990 to 2000 by about 28 MMTCE. The revised baselines for methane, nitrous oxides, and HFCs and PFCs follow.

Methane Emissions. The primary U.S. sources of methane emissions are landfills, domesticated livestock, coal mines, and natural gas systems. The baseline forecast for methane has been revised from a decrease of about 15 MMTCE to a decrease of about 4 MMTCE from 1990 to 2000. Most of the changes in baseline projections are due to an increase in some methane sources, particularly agricultural methane emissions. As a result, baseline methane emissions are projected to comprise about 10 percent of U.S. greenhouse gas emissions in the year 2000.

Similar to what was envisioned in the 1993 CCAP baseline, EPA issued a final landfill rule in 1996 that will cut methane emissions in half by 2000. The landfill rule more than offsets expected growth from the other sources. This baseline after the year 2000 is consistent with recent trends in U.S. methane emissions, which have increased by 4 percent over the last five years. During this period, methane emissions from coal mining have fluctuated with changes in production levels at eastern U.S. coal mines, including a major coal strike in 1993. The net result of the change in the baseline assumptions is an increase of about 11 MMTCE for methane emissions in the year 2000 compared to the 1993 CCAP.

Nitrous Oxide Emissions. Baseline N_2O emissions represent about 2.1 percent of U.S. greenhouse gas emissions in the year 2000. Major N_2O sources include nitrogen fertilizer use, automobile combustion, and adipic and nitric acid production. New information about N_2O emissions includes:

- The estimate for N_2O emissions from fertilized soils has been revised downward by about 6 MMTCE for 1990. However, this change does not affect the growth in baseline emissions because emissions from this source are expected to remain fairly constant during the 1990s.
- Nitric acid production is newly recognized as a source of N_2O production. Adding this source increases the 1990 baseline by 3 MMTCE and the 2000 baseline by about 3.5 MMTCE.

N_2O emissions in the baseline are projected to remain at 1990 levels in 2000. Emissions were projected to decrease by 4 MMTCE in the 1993 CCAP. N_2O emissions have increased only slightly over the last five years, although 1994 shows significantly

higher emissions from fertilizer use, as farmers planted more acreage and increased fertilizer use to replace nutrients lost in significant flooding that occurred in 1993. In the future, emissions from fertilizer use should return to prior levels, and the results of industrial emission-reduction activities should become apparent.

HFC and PFC Emissions. Hydrofluorocarbons (HFCs) and perfluorinated compounds (PFCs) are emitted in certain industrial applications and are being introduced as alternatives to the ozone-depleting substances phased out under the *Montreal Protocol* and Clean Air Act Amendments of 1990. These gases are projected to represent about 3 percent of U.S. greenhouse gas emissions in the year 2000, but emissions are projected to increase as their use as alternatives to ozone-depleting substances increases. The major source of HFCs is currently a by-product of HCFC-22 production, and the major source of PFCs is currently aluminum smelting.

New information about emissions of HFCs and PFCs since the 1993 CCAP increases the estimated baseline growth of greenhouse gas emissions from 1990 to 2000. The major changes include:

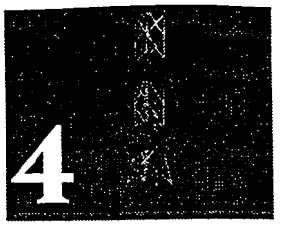
- Emissions from HFCs used as substitutes for CFCs are now expected to grow from negligible levels in 1990 to about 31 MMTCE in 2000, instead of the 23 MMTCE estimated for 2000 in the 1993 CCAP.
- Emissions of HFC-23, a by-product of HCFC-22 production, are expected to grow by about 3 MMTCE between now and 2000 and remain constant after that at about 15 MMTCE. HFC-23 was expected to grow by about 2 MMTCE in the baseline 1993 CCAP.
- PFC emissions from aluminum smelting stay constant at about 5 MMTCE throughout the baseline projection period.
- Significant emissions of three halogenated substances were not included in the 1993 CCAP: SF_6, NF_3, and CHF_3. The primary uses of SF_6 include electric utility transmission systems and magnesium production. In addition, emissions from the semiconductor industry's use of the SF_6, CF_4, and C_2F_6 were not included. These emissions total about 8 MMTCE in 1990 and 12 MMTCE by 2000.
- Higher global warming potentials increase the growth of HFC and PFC emissions in carbon-equivalent terms between 1990 to 2000 by about 2 MMTCE.

The growth in baseline emissions of HFCs and PFCs is beginning now and can be expected to continue through 2000 and beyond.

Projected Baseline for Forest Carbon Sequestration

The new baseline projections by USDA's Forest Service show decreasing annual carbon sequestration in U.S. forests from 1990 to 2000, compared to a slightly increasing sequestration rate in the original 1993 CCAP (see Table 4–4). The change in baseline reflects several developments:

- Estimated net forest growth in the Northeast is declining as the age of hardwood forests is increasing.



- Softwood removals in the South, once well below net growth, now exceed growth in all southern states.
- Reduced harvests in national forests in the West will increase carbon storage, but not enough to offset reduced sequestration in the eastern part of the country.

The latest Forest Service projections indicate a small reduction in total forest land because of continued net losses to nonforest use. While there was a small increase (one percent) in forest land between 1987 and 1992, this trend is expected to reverse because of losses to urban uses and because federal tree-planting programs for private landowners have experienced funding reductions.

- Reduced funding for the Forestry Incentives Program is reflected in the new baseline sequestration estimate for 2000 (125 MMTCE in 1990 and 109 MMTCE in 2000). FIP accounted for about 175,000 acres of tree planting annually in the past.
- The Agricultural Conservation Program was terminated in the 1996 Farm Bill. Active since 1936, in fiscal year 1994 ACP planted more than 12,140 hectares (30,000 acres) of trees. The net effect of reduced funding for FIP and ACP termination is that tree planting under federal programs is likely to decrease by 60,704 hectares (150,000 acres) or more annually. It is unlikely that new private tree planting will offset this impact.
- The Forest Service Stewardship Incentive Program's tree-planting budget has also been cut, lowering baseline carbon sequestration rates by 0.2 MMTCE.

The net effect of changes to the forest carbon sequestration baseline has been to increase greenhouse gas emissions by 23 MMTCE compared to the 1993 CCAP baseline.

Integrated Analysis of Growth in Emissions Between 1990 and 2000

Drawing on the review of individual actions presented in the first part of this chapter, this section presents aggregate emission reductions for the revised 1997 CAR. It then combines these projections of program impacts with the baseline information in that previous section to project emission levels for 2000. To facilitate comparisons, results are reported using the same groupings as in the 1993 CCAP.

As noted in the 1993 CCAP, the aggregate analysis of energy-related actions requires special attention, given the potential for significant interplay among actions, and between actions and the baseline. The updated aggregate action impact projections presented in this section reflect an integrated analysis of energy-related actions developed using the Integrated Dynamic Energy Analysis Simulation (IDEAS) model, the same tool used in the earlier analysis. Because many of the foundation actions include in their announced plans a substantial number of measures that also fall within the broad setting of other actions or baseline assumptions, particular care was taken to avoid double-counting within this analysis.

The sharp reductions from Administration funding requests in appropriations bills

enacted by Congress for fiscal year 1996 and 1997 would, especially if continued in future years, have a severe adverse effects on projected greenhouse gas emission levels in 2000 and beyond: (1) reductions in resources available to implement actions significantly diminish projected emission-reduction benefits in 2000 and (2) funding cuts in base renewable research and development and energy-efficiency programs can have potentially large impacts on emissions beyond 2000.

The Administration has consistently requested the funding needed to ensure climate change actions would contribute to U.S. policies to reduce greenhouse gas emissions. However, recent shortfalls in program funding have severely limited the nation's ability to reduce greenhouse gas emissions. A qualitative estimate of this impact suggests that reduced funding is responsible for about a 30–40 MMTCE decrease in overall savings in 2000 that could have been realized if funding were provided in the 1993 CCAP.

The updated "point estimate" of growth in emissions of 188 MMTCE between 1990 and 2000 in the current funding case reflects the combined effect of many changes from the 1993 CCAP, which projected a decrease of 2 MMTCE over the same period. Table 4–10 summarizes the factors contributing to the changing estimate of the emissions gap in the year 2000.

Nonetheless, climate change actions have produced measurable reductions in greenhouse gas emissions and could produce much more in the years to come if current funding levels are maintained. Table 4-11 reports the net reduction of projected actions' performance for the years 2000, 2010, and 2020. The 1993 CCAP performance projections are also provided to facilitate comparisons. The discussion that follows outlines the key forces driving differences

Table 4-10

Changes Between the 1993 CCAP and 1997 CAR for the Year 2000

Greenhouse Gas Category	Higher Baseline	Change in Funding or Effectiveness of Actions*	Total Shortfall
All Greenhouse Gases	**157.3**	**32.6**	**189.9**
Energy Carbon Emissions	101.7	34.4	136.1
Nonenergy Carbon Emissions	5.3	-0.7	4.6
Sinks	23.0	7.2	30.2
Methane	10.7	0.8	11.5
Nitrous Oxides	3.6	-0.8	2.8
HFCs, PFCs, and SF_6	13.0	-8.3	4.7
1993 CCAP Reductions Below 1990 Emissions			**2.4**
Amount Required to Return Emissions to 1990 Levels in the Year 2000			**187.5**

* *The overall reductions in this column would be even larger if foundation actions were not included here as in the 1993 CCAP.*

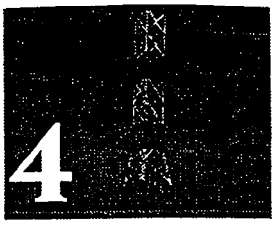


Table 4-11

Projected Emission Reductions From Climate Change Actions

Sector or Gas	1993 CCAP	1997 CAR		
	2000	2000	2010	2020
Total Energy Related	**66.0**	**31.6**	**94.9**	**144.7**
Commercial	10.6	5.1	24.8	40.7
Residential	16.3	5.2	28.1	37.3
Industrial	19.0	4.8	11.5	16.7
Transportation*	8.1	5.3	15.5	22.1
Supply	10.8	1.3	7.1	19.3
Foundation Actions**	0.0	10.9	9.1	11.9
Methane	**16.3**	**16.0**	**23.4**	**24.2**
HFCs, PFCs, and SF_6	**11.8**	**20.1**	**40.5**	**49.2**
Nitrous Oxides	**4.5**	**5.3**	**5.3**	**5.3**
Forest Sinks	**10.0**	**2.8**	**4.6**	**5.5**
Total Reduction	**108.6**	**76.0**	**169.3**	**229.5**

Note: Totals may not sum due to independent rounding or interactive effects.

** Assumes receipt of legislative authority for parking cash-out by the end of 1997.*

*** Foundation action partners provide additional reductions in almost all sectors and gases. These values only represent incremental savings not accounted for in other actions or baseline activities. They exclude 0.4 MMTCE for forest sequestration activities accounted for in forest sinks below.*

from the 1993 CCAP analysis for each major greenhouse gas and source category.

Energy-Related Actions

The projected decrease in natural gas prices and increased electricity sales compared to the 1993 CCAP have increased the projected market share for new natural gas-fired electric-generating capacity. Although the reduction in projected natural gas prices is beneficial from a climate change perspective because natural gas is a less carbon-intensive fuel per unit of energy than other fossil fuels and because natural gas technologies tend to be more efficient, it reduces the efficacy of climate change policies designed to reduce electricity use.

Many of the 1993 CCAP actions reduce carbon emissions through their impact on electricity demand. Changes in the marginal fuel used for generation has important implications for translating electricity savings into carbon reductions. Marginal fuel is the fuel consumed to produce the last "unit" of electricity generated. In this instance, the unit is defined as the kilowatt-hour savings from electricity-related actions.

In the original 1993 CCAP, the marginal fuel mix for electricity production was 80 percent coal and 20 percent oil and natural gas in the year 2000. This resulted in carbon emissions decreasing by 0.28 MMTCE for every decrease in 1 billion kilowatt-hours of electricity (0.28 MMTCE/bkWh). In the cur-

rent estimates, due to an increased market share of natural gas-fired generation, coal accounts for 32 percent and natural gas and oil for the remaining 68 percent of marginal electricity production in the year 2000. As natural gas garners a greater market share of electricity production, the marginal carbon savings per unit of electricity reduced becomes smaller. In the 1997 CAR, the coefficient of reduction decreases from 0.20 MMTCE/bkWh in 2000 to 0.13 MMTCE bkWh by 2020. This change decreases carbon emission reductions by electricity-saving actions by 10 MMTCE in 2000.

Overall, due to funding shortfalls and other factors, carbon emission reductions from energy-related actions have decreased by 34 MMTCE in 2000 compared to the 1993 CCAP. However, after 2000, 1997 CAR-projected reductions are larger than those envisioned in the 1993 CCAP for 2000.

Methane

Overall, carbon-equivalent emission reductions of 16 MMTCE from methane-related actions in 2000 are about the same as the 1993 CCAP.

HFCs and PFCs

Action 40 (Narrowing the use of High GWP Chemicals) is being expanded to form partnerships with newly identified sources described in the beginning of this chapter. Increases in the global warming potentials for HFCs and PFCs have lead to increased effectiveness in Action 42 (Voluntary Aluminum Industrial Partnership Program).

Overall, HFC and PFC reductions are about the same as the 1993 CCAP in 2000. The addition of policies to reduce newly identified gases, such as the Environmental Stewardship Initiative, results in reductions in other gases exceeding the amount claimed in the 1993 CCAP.

Nitrous Oxide

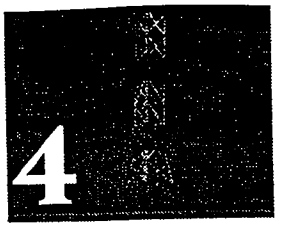
The revised global warming potential for nitrous oxide increases the carbon-equivalent measure of actions taken to reduce nitrous oxide by about 0.8 MMTCE in 2000.

Forest Sinks

Decreases in other federal tree-planting and technical assistance programs for forest landowners increases the potential for participation in this program.

Key Uncertainties Affecting Projected Emissions

Any projection of future emissions, even for a period as short as four years, is subject to considerable uncertainty. Key factors that can increase emissions include more rapid growth in electricity demand, flat rather than slightly rising real energy prices, more rapid economic growth, and further cuts in 1993 CCAP funding or effectiveness. Key factors that can reduce emissions include slower growth, increased CCAP program efficacy, greater penetration of baseline energy-efficiency measures, higher energy prices, increased program funding levels, and relatively mild weather in 2000. A qualitative analysis of key uncertainties suggests that net greenhouse emissions in 2000 could exceed their 1990 level by 150–230 MMTCE.



CCAP Program Funding Levels (+ or -)

The point estimate assumes that CCAP funding through 2000 reflects an extrapolation of fiscal year 1996 funding. Increases or decreases in 1993 CCAP program funding relative to the "current funding" level in fiscal years after 1996 would result in higher or lower levels of projected emissions in 2000.

Required Legislative Authority (-)

Included in the estimates of emission reductions are the assumed adoption of policies that require no additional funding, but require some congressional or regulatory action, such as tire-labeling and energy-efficiency standards. Many of the actions in this category are still assumed to occur, but their deployment has been adjusted to account for delay in their implementation. If legislative authority to initiate these programs is not received, emissions will be higher than projected.

Energy Prices (+ or -)

The relationship between energy prices and emissions is complex. Lower energy prices generally reduce the incentive for energy conservation. However, reductions in the price of natural gas relative to other fuels also encourages fuel switching that can reduce carbon emissions.

The energy price projections from the 1997 *Annual Energy Outlook* used in developing the updated emissions baseline are significantly lower than those used for the 1993 CCAP (U.S. DOE/EIA 1996a). However, real prices for oil and gas are still projected to rise at respective average annual rates of 1.1 percent and 2.5 percent between 1995 and 2000.

The *Annual Energy Outlook* also provides sensitivity scenarios to changes in oil prices. In the year 2000 high oil price scenario, emissions are lower by about 4 MMTCE than projections using the reference-case scenario oil price assumptions. In the year 2000 low oil price scenario, emissions are higher by about 13 MMTCE not using the reference case scenario.

Economic Growth (+ or -)

Higher economic growth increases the demand for energy services, such as vehicle miles of travel, square feet of lighted and ventilated space, and process heat used in industrial production. However, faster growth also reduces the average age of the capital stock, increasing its average energy efficiency. The energy-service demand and energy-efficiency effects of higher growth work in offsetting directions. The effect on service demand is the stronger of the two, so that levels of primary energy use are positively correlated with the size of the economy.

In addition to the reference case used in developing the updated baseline, the *Annual Energy Outlook* provides high and low economic growth cases.

- In the high-growth case, the percentage change increase in energy use is slightly more than half the percentage increase in the size of the economy. By 2000, the high-growth economy is 3.5 percent larger than the reference economy, but energy consumption is only 1.8 percent higher. In addition, carbon emissions are 33 MMTCE larger than the reference case.

- In the low-growth case, a 2.7 percent reduction in the size of the 2000 economy translates into a 1.9 percent reduction in primary energy use. In this case, carbon emissions were 28 MMTCE lower than the reference scenario in the year 2000.

Electricity Demand Growth (+)

While the annual rate of growth in electricity demand from 1995 to 2000 is appreciably higher in the present analysis than in the 1993 CCAP, there is a strong possibility of even faster growth. Regulatory changes to allow competition in wholesale and retail electricity markets could significantly lower prices to electricity end users, while at the same time reduce utility investments in demand-side management and other conservation activities.

If electricity demand grows at 2.1 percent annually (as projected by the Gas Research Institute), rather than by 1.9 percent (as projected in this analysis), carbon emissions will be about 7 MMTCE higher in 2000. The *Annual Energy Outlook* also evaluates a sensitivity that assumes electricity sales to grow at 3.3 percent annually between 1995 and 2000. In that scenario, emissions are 56 MMTCE higher in the year 2000.

Forest Carbon Sequestration (+ or -)

The estimates used here for annual carbon sequestration in U.S. forests include above-ground carbon plus harvested carbon in wood products and landfills. The tree carbon estimates are derived from two independent measurements of forest inventories and growth, and have standard errors of plus or minus 3 percent.

Estimates of other carbon stocks (e.g., forest floor and understory) are likely to be less certain, since there are no comprehensive, statistically valid inventories of nontree organic matter for large areas of the country. USDA estimates their uncertainty at plus or minus 15 percent.

Two other unquantified sources of uncertainty should also be noted. First, since changes in carbon stocks are small compared to the size of the stocks, the level of uncertainty for changes is expected to be higher than that for stocks. Second, estimates projected from historical data using econometric models will be less certain due to the unknown level of uncertainty for the assumptions made in the econometric models. Estimates for all years after 1992 are projected from 1992 data.

Weather (+ or -)

Energy use for heating and cooling is directly responsive to weather variation. The updated baseline assumes thirty-year average values for population-weighted heating- and cooling-degree days. Figure 4–6, which compares average population-weighted heating- and cooling-degree days with actual values for 1990, an unusually mild year, illustrates the importance of interannual weather variation for energy use and emissions. Under average weather conditions, primary energy consumption for heating and cooling in 1990 would have been 1.1 percent higher than its actual value, raising carbon emissions by roughly 16 MMTCE.

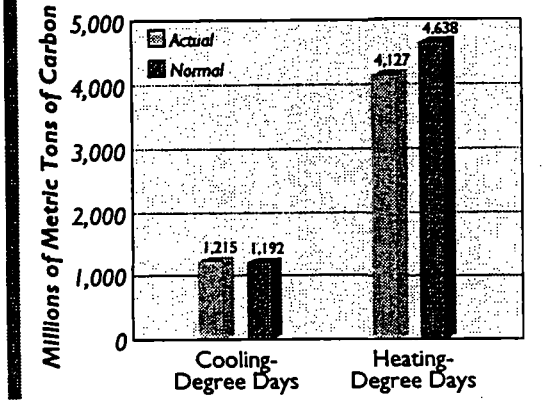
Unlike other sources of uncertainty, for which deviations between assumed and actual trends may become apparent over

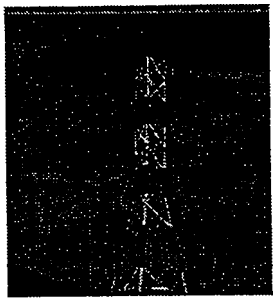
time, the effect of weather on energy use and emissions in any particular year is revealed only in that year. For the United States, a swing in either direction of the magnitude experienced in 1990 could raise or lower emissions by plus or minus 20 MMTCE relative to a year with average weather. While small relative to total emissions, a change of this magnitude is significant relative to the aim of returning emissions to their 1990 level. Some European countries, which also experienced low levels of energy use and emissions in 1990 due to mild winter weather, have opted to compare 1990 and 2000 emissions levels on a "climate-adjusted" basis in their first national communications.

Figure 4-6

Actual and Normalized Net Heating- and Cooling-Degree Days for 1990

In a normal year, CO_2 emissions would have been 1,339.3 MMTs. In 1990, they were 1,322.5 MMTs, or 1.25 percent lower.





Joint Implementation

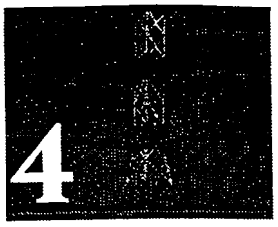
Cooperative efforts between countries or entities within them to reduce net greenhouse gas emissions offer significant potential to combat the threat of climate change and to promote sustainable development. Such "joint implementation" can achieve greater emission reductions than may otherwise be likely if each country pursued only domestic actions. It may also achieve these reductions more cost-effectively on a global basis. Joint implementation offers additional benefits, including:

- promoting technology cooperation with developing and transition economies;
- encouraging private-sector investment in developing economies and disseminating technologies that reduce greenhouse gas emissions;
- providing local health, environmental, and economic benefits in host countries; and
- testing and evaluating methods to measure, track, and verify emission reduction costs and benefits.

The concept of joint implementation was formally adopted in Article 4(2)(a) of the United Nations Framework Convention on Climate Change, which provides for Parties to the Convention to meet their obligation to reduce greenhouse gas emissions "jointly with other parties." In 1993, the United States announced a pilot joint implementation program, the U.S. Initiative on Joint Implementation (USIJI), as part of the U.S. *Climate Change Action Plan*. The USIJI program supports the development and implementation of voluntary projects, between U.S. and non-U.S. partners, that reduce, avoid, or sequester greenhouse gas emissions. Final ground rules for the USIJI program, published in the *Federal Register* in June 1994, describe the purpose of the pilot program, outline the time line for evaluation and reassessment of the program, define eligibility criteria for domestic and non-U.S. participants, establish an Evaluation Panel to review potential USIJI projects, and define criteria for acceptance of projects into the USIJI portfolio.

USIJI is the first and currently most developed joint implementation pilot program worldwide. To date, the program has received over sixty project proposals, resulting in twenty-five accepted projects in eleven countries. These projects apply a variety of technologies and practices, including wind, geothermal, hydroelectric, and solar energy; coal to natural gas fuel switching, methane gas capture; and sustainable forest management and preservation.

Projects accepted into the USIJI program are evaluated against the nine criteria, and the four other areas of consideration,



included in the USIJI Groundrules. These criteria are intended to identify projects that support the development goals of the host country while providing greenhouse gas benefits beyond those that would occur in the absence of the joint implementation activity. The criteria have been formulated to ensure that projects accepted into the program will produce real, measurable net emission reductions, which will be measured, monitored, verified, and reported.

The USIJI program is directed by an Interagency Working Group, chaired by the Department of State, which has the primary responsibility for policy development. The USIJI Evaluation Panel is co-chaired by the Environmental Protection Agency and the Department of Energy, and includes representatives from the Agency for International Development and the Departments of Agriculture, Commerce, Interior, State, and Treasury. The USIJI Secretariat, an interagency staff, supports the day-to-day operation of the USIJI program. Technical experts are drawn from a wide variety of organizations to assist the Secretariat in the proposal review process and to provide technical assistance to project developers.

Sample Joint Implementation Projects

Czech Republic—Decin Fuel Switching, Cogeneration, and Efficiency Improvements Project

The City of Decin in the Czech Republic is supplying both heat and potable hot water to local apartment blocks. This project has converted Decin's Bynov district heating plant from coal to natural gas. A cogeneration facility also has been built to provide steam and electricity. USIJI partners include the City of Decin, Center for Clean Air Policy, Wisconsin Electric Power Company, Commonwealth Edition Company, and NIPSCO Development Company.

Russian Federation—RUSAFOR Afforestation Project

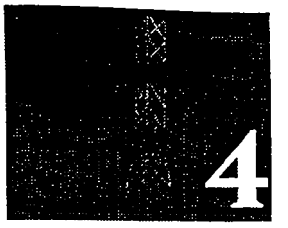
This project has planted seedlings on 506 hectares (1,250 acres) of marginal agricultural and burned forest land, will sequester greenhouse gas emissions, prevent soil erosion, and foster public participation in joint implementation activities. USIJI partners include the International Forestry Institute, Oregon State University, Russian Federal Forest Service, Sustainable Development Technology Corp., and the U.S. Environmental Protection Agency.

Costa Rica—Río Bravo Project

This project has two components: the purchase of land to add to existing protected areas and the implementation of sustainable forest management practices on the larger conservation area to produce economic benefits to the neighboring population. USIJI partners include CINergy, Detroit Edition Company, PacifiCorp, Programme for Belize, The Nature Conservancy, Utilitree, and Wisconsin Electric Power Company.

Costa Rica—Plantas Eólicas S.A. Wind Facility

This 20-megawatt wind electric plant will displace electricity currently generated by the burning of fossil fuels. USIJI partners include Charter Oak Energy, Inc., Merrill International, Ltd., and Plantas Eólicas, S.A.



The USIJI Secretariat offers a variety of technical services to support both the development and the implementation of USIJI projects:

- *Technical Assistance*—The USIJI Secretariat has assembled a team of technical experts to assist project partners in calculating emission reduction benefits, developing monitoring and verification plans, and identifying sources of project financing. Technical assistance can take the form of on-site consultations, technical guidance materials, and workshops and training seminars.
- *Capacity Building*—The USIJI Secretariat supports human and institutional capacity building in key countries, including co-sponsoring workshops, conducting training, providing project-specific technical assistance, and supporting the development of national joint implementation programs and offices.
- *Information Resources*—The USIJI Secretariat maintains a resource center that includes technical guidance documents, data bases, a fax-on-demand service, an information hotline, and an Internet site.
- *Public Recognition*—The USIJI Secretariat helps project participants increase the visibility of their participation in the program, including showcasing individual projects in international publications, conferences, and workshops; highlighting projects in the USIJI *International Partnership Reports*; and sponsoring awards and public recognition events.

The USIJI Secretariat will accept project proposals at any time and will provide limited technical assistance to project developers to help address USIJI project evaluation criteria and other considerations as specified in the USIJI Groundrules. A formal proposal evaluation and acceptance process is conducted three times a year.

Table 4-12

Summary of AIJ Projects Reported Under Annex I

Place and Title of Activity	Type of Project
Belize	
Río Bravo Carbon Sequestration Pilot Project	Forestry/Land Use—Forest management and conservation
BEL/MAYA Biomass Power Generation Project	Renewable Energy—Biomass
Bolivia	
Noel Kempff M. Climate Action Project	Forestry/Land Use—Forest management
Costa Rica	
Plantas Eólicas, S.A., Wind Facility	Renewable Energy—Wind; fuel switching
ECOLAND: Esquinas National Park	Forestry/Land Use—Forest management and conservation
KLINKIFIX: Klinki Forestry Project	Forestry/Land Use—Forest management
Project CARFIX: Sustainable Forest Management	Land Use
Tierras Morenas Windfarm Project	Renewable Energy—Wind
Aeroenergía Wind Facility Project	Renewable Energy—Wind
BIODIVERSIFIX: Forest Restoration	Forestry/Land Use—Tropical forest management and reforestation; wood
Doña Julia Hydroelectric Project	Renewable Energy—Hydropower
Czech Republic	
Fuel Switching and Cogeneration for Decin District Heating System	Energy Use
Equador	
Forest Conservation Bilsa Reserve	Forestry/Land Use—Forest management and conservation
Honduras	
Bio-Gen Biomass Power-Generating Project	Renewable Energy—Biomass
Phase 1, Guaimaca Site	
Phase 2, Sava Site	
Solar-Based Rural Electrification in Honduras	Energy Use
Indonesia	
Reduced-Impact Logging in Kalimantan	Forestry/Land Use—Forest management; wood
Mexico	
Scolel Té—Sustainable Land Management and Carbon Sequestration	Multicomponent Forestry
Halophyte Cultivation in Sonora	Renewable Energy—Biomass
Nicaragua	
El Hoyo Monte Galán Geothermal Project	Renewable Energy—Geothermal
Panama	
Commercial Reforestation of Chiriqui Province	Forestry/Land Use—Reforestation
Russian Federation	
District Heating Improvements in Zelenograd	Energy Efficiency—Industrial/HVAC
RUSAFOR: Saratov Afforestation Project	Forestry/Land Use—Afforestation
RUSAGAS: Fugitive Gas Capture Project	Energy Efficiency—Fossil fuels; natural gas; energy intensity
Reforestation in Vologda	Forestry/Land Use—Reforestation

Stage of Activity[1]	Project Life[2]	Greenhouse Gases[3] CO_2 (MTs)	Other (MTs)
In progress	40 yrs.	4,770,000	
Mutually agreed	30 yrs.	3,500,000	4,800 NO_x
In progress	30 yrs.	53,170,000	
In progress	15 yrs.	263,000	
In progress	15 yrs.	1,267,000	
Mutually agreed	40 yrs.	6,970,000	
In progress	25 yrs.	21,780,000	
In progress	15 yrs.	187,000	
In progress	20 yrs.	36,000	
In progress	50 yrs.	18,500,000	
In progress	15 yrs.	210,000	
In progress	25 yrs.	605,000	
In progress	25 yrs.	1,600,000	
Mutually agreed	Over 20 yrs.	2,300,000	
Mutually agreed	20 yrs.	17,000	
Mutually agreed	40 yrs.	207,000	
In progress	30 yrs.	843,000	
In progress	Soil carbon storage, over 10 yrs.	2,400	
Mutually agreed	35 yrs.	19,770,000	
Mutually agreed	25 yrs.	213,000	
Mutually agreed	30 yrs.	1,613,000	
In progress	60 yrs.	128,000	
Mutually agreed	25 yrs.		1,220,000 tons CH_4
Mutually agreed	60 yrs.	880,000	

[1] *The following definitions are used for these categories:*
- *Mutually agreed = Accepted USIJI proposal; all Parties involved (designated national authorities) have agreed on activity.*
- *In progress = Any stage of activity between "mutually agreed" and "completed."*
- *Completed = Project is finished or terminated.*

[2] *Project life refers to the estimated functional lifetime of the project, not necessarily the period over which greenhouse gas reductions are estimated to occur.*

[3] *Reduction estimates are made by project developers. The USIJI program does not accept these estimates per se, but will be monitoring and verifying emission reductions as they are attained.*

4

Uniform Reporting Format: National Program on Activities Implemented Jointly Under the Pilot Phase

I. Designated national authority for activities implemented jointly

Name (English):	U.S. Initiative on Joint Implementation
Acronym:	USIJI
Street:	1000 Independence Avenue, S.W.
Code:	PO-6
City:	Washington, D.C. 20585
Country:	U.S.A.
Telephone:	(202) 586-3288
Fax:	(202) 586-3485, -3486
E-mail:	csmt@igc.apc.org
Contact Person:	Dr. Robert K. Dixon, Director
Direct Telephone:	(202) 586-3003
Direct Fax:	(202) 586-3485, -3486
Direct e-mail:	rdixon@igc.apc.org

II. Description of program structure and features

The USIJI program is directed by an Interagency Working Group, chaired by the Department of State, which has the primary responsibility for policy development. The USIJI Evaluation Panel is co-chaired by the Environmental Protection Agency and the Department of Energy, and includes representatives from the Agency for International Development and the Departments of Agriculture, Commerce, Interior, State, and Treasury. The USIJI Secretariat, an interagency staff, supports the day-to-day operation of the USIJI program. Technical experts are drawn from a wide variety of organizations to assist the Secretariat in the proposal review process and to provide technical assistance to project developers. The USIJI Secretariat offers a variety of technical services to support both the development and the implementation of USIJI projects.

III. Process for obtaining approval

A. Briefly describe the procedure:

The USIJI Secretariat manages the proposal evaluation process. The evaluation schedule includes announcements of newly accepted USIJI projects in June 1997, October 1997, and February 1998. After project developers submit project proposals to the USIJI Secretariat, they are assigned to Proposal Managers on the USIJI Secretariat staff, who screen them for completeness. Project developers are contacted for additional information, clarification, and/or consultation, as necessary. Proposals are then distributed to technical reviewers for a thorough evaluation. Each proposal is reviewed by a team of experts familiar with the technology, country-specific issues, and environmental effects specific to that proposal.

Following technical review, Proposal Managers draft a Decision Memorandum for each proposal. Each Decision Memorandum includes discussion of how well each USIJI criterion is addressed by the proposal and a recommendation for acceptance or rejection by the Evaluation Panel. The Panel meets to review the recommendations present in the Decision Memoranda. Project developers are then notified in writing whether their project has been accepted by the USIJI Evaluation Panel. Project proposals that meet most, but not all, of the USIJI criteria are placed in an "in-development" category. In-development proposals are eligible to receive technical assistance and, once all USIJI criteria are met, may be reevaluated at a subsequent USIJI Evaluation Panel meeting.

Project proposals may be informally submitted to the USIJI Secretariat at any time for feedback from Secretariat staff. Once a proposal has been formally submitted to the USIJI Secretariat within proposal submission deadlines, the Secretariat will make every effort to complete the evaluation process within 90 days.

continued

B. List all criteria for national acceptance of an activity implemented jointly:

a. Criteria that support decision 5/CP.1:

1. Is acceptable to the government of the host country.
2. Involves specific measures to reduce or sequester greenhouse gas emissions initiated as a result of the USIJI program, or in reasonable anticipation thereof.
3. Will reduce or sequester greenhouse gas emissions beyond those referred to in 3. a. above and, if federally funded, is or will be undertaken with funds in excess of those available for such activities in fiscal year 1993.
4. Identifies associated environmental and developmental benefits and impacts.

b. Other criteria for national acceptance of AIJ:

1. Provides data and methodological information sufficient to establish a baseline of current and future greenhouse gas emissions:
   - in the absence of the specific measures of the project or
   - as a result of the specific measures of the project.
2. Contains adequate provisions for tracking the greenhouse gas emissions reduced or sequestered as a result of the project and, on a periodic basis, for modifying such estimates and for comparing actual results with those originally projected.
3. Contains adequate provisions for external verification of the greenhouse gas emissions reduced or sequestered by the project.
4. Provides adequate assurance that greenhouse gas emissions reduced or sequestered over time will not be lost or reversed.
5. Provides for annual reports to the Evaluation Panel on the emissions reduced or sequestered, and on the share of such emissions attributed to each of the participants—domestic and foreign—pursuant to the terms of voluntary agreements among participants.

4. Summary of activities

A. Summarize AIJ projects reported under Annex I (see Table 4–12).

B. Summarize non-AIJ activities.

Conferences/Workshops

- January 1995: *JI Southeast Asia Regional Workshop*, Bangkok, Thailand.
- March 1995: *JI Central and Eastern Europe Workshop*, Prague, Czech Republic.
- March 1995: *JI South American Regional Workshop*, Santiago, Chile.
- May 1995: *Middle East Regional Workshop*, Abu Dhabi, United Arab Emirates.
- May 1995: *USIJI Program Conference*, Arlington, Virginia, USA.
- June 1995: *JI Workshop for the Americas*, San Jose, Costa Rica.
- June 1996: Sponsored the regional *Southeast Asia Workshop on AIJ* in Jakarta, Indonesia.
- November 1996: Co-sponsored the *JI Capacity Building Workshop* in La Paz, Bolivia.
- January 1997: Co-sponsored the conference on *AIJ: Developing Country Perspectives* in New Delhi, India.
- April 1997: Co-sponsored the *JI Capacity Building Workshop* in Santiago, Chile.

Guidance Documents and Other Materials

- April 1996: U.S. submitted *Report on AIJ to the UN FCCC Secretariat.*
- March 1997: In conjunction with the IIEC, published and distributed a brochure and report: *Opportunity Knocks: The Export Market for Energy Efficiency and Renewable Energy Products and Services.*
- Published and distributed a USIJI Program Brochure, 6 editions of International *Partnerships Reports*, 2 USIJI Fact Sheets, a USIJI poster, and 4 sample USIJI proposals.
- Established a USIJI page on the Internet, *JI Online*, which can be accessed at http://www.ji.org
- Published a draft resource document: *USIJI Project and Proposal Development.*