FOIA Number: 2017-1095-F

FOIA MARKER

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

Collection/Record Group: Clinton Presidential Records

Subgroup/Office of Origin: Council of Economic Advisers

Series/Staff Member: Subject Files

Subseries:

OA/ID Number: 21610

FolderID:

Folder Title:
Non-Administration Testimonies - Global Climate Change [Binder] [1]

Stack:	Row:	Section:	Shelf:	Position:
S	21	4	11	3

13 - Global Climate Change
Non-Administration Testimony
Administration Economic Analysis
Sectoral Analysis

13

Enclosures filed in
Oversize Attachments # 21610

NARA 18794

Non-Administration Testimonies

Global Climate Change

Joe Aldy
CEA

Clinton Presidential Records
Digital Records Marker

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

This marker identifies the place of a publication.

Publications have not been scanned in their entirety for the purpose of digitization. To see the full publication please search online or visit the Clinton Presidential Library's Research Room.

AMERICAN COUNCIL FOR CAPITAL FORMATION

CONGRESSIONAL TESTIMONY

April 23, 1998

Climate Mitigation Policy and U.S. Economic Growth

ACCF Senior Vice President and Chief Economist Dr. Margo Thorning testified as a committee-invited witness on April 23, 1998, before the Subcommittee on National Economic Growth, Natural Resources, and Regulatory Affairs of the House Committee on Government Reform and Oversight. The executive summary and full text of the ACCF's testimony are presented here.

EXECUTIVE SUMMARY

OVERVIEW

We commend Chairman McIntosh and the Subcommittee on National Economic Growth, Natural Resources, and Regulatory Affairs for their focus on the critical issue of the effect of climate change policy on U.S. economic growth. Studies sponsored by the ACCF Center for Policy Research, the public policy research affiliate of the American Council for Capital Formation, show that near-term limitations on the increase in U.S. carbon emissions will reduce growth in U.S. GDP and household income and increase income inequality with little or no environmental benefits. Adopting a thoughtfully timed climate change policy—based on science and improved climate models—would both enhance U.S. and global economic growth and lead to long-term stabilization of carbon concentrations in the atmosphere.

MACROECONOMIC EFFECTS OF CO_2 EMISSION LIMITS

The Kyoto Protocol to the United Nations Framework Convention on Climate Change, which the United States negotiated in December, 1997, calls for industrial economies such as the United States, Canada, Europe, and Japan to reduce their collective emissions of six greenhouse gases by an average of 5.2 percent from 1990 levels by 2008–2012. The U.S. target is a 7 percent reduction from 1990 levels. Many experts believe that the Kyoto agreement has potentially serious consequences for all Americans, and that these consequences have not been fully analyzed and understood.

■ *Impact on Economic Growth.* Recent macroeconomic studies sponsored by the ACCF Center for Policy Research have estimated the economic impact of stabilizing carbon dioxide (CO_2) emissions at 1990 levels (this was the Administration's original, pre-Kyoto, emission reduction target). Thus, the results of studies by top climate change scholars such as Professor Gary W. Yohe of Wesleyan University, Dr. Lawrence M. Horwitz of Primark Decision Economics, and Senior Vice President Mary H. Novak of WEFA, Inc., are lower-bound, conservative estimates of the Kyoto agreement's impact since the agreement calls for the United States to reduce its emissions about 30 percent more than was modeled.

The studies show that stabilizing CO_2 emissions at 1990 levels would require a carbon tax (or tradable permit price) of $200 to $260 per ton. As a result, output would fall as prices rise for carbon-using goods, and U.S. GDP growth would decline in the range of 1.0 to 4.0 percent annually.

ACCF 25 ✦ YEARS

The mission of the American Council for Capital Formation is to promote economic growth through sound tax, regulatory, and environmental policies. For more information about the Council or for copies of this testimony, please contact the ACCF, 1750 K Street, N.W., Suite 400, Washington, D.C. 20006-2302; telephone 202/293-5811; fax 202/785-8165; e-mail info@accf.org; Web site http://www.accf.org.

Testimony of Dr. Thomas Gale Moore
Senior Fellow
Hoover Institution
Stanford University

On the Economics of the Kyoto Protocol

Before the House Subcommittee on National Economic Growth, Natural Resources, and Regulatory Affairs

April 23, 1998

My testimony today is based on *Climate of Fear: Why We Shouldn't Worry about Global Warming*, which the Cato Institute published yesterday. Members of the subcommittee and other interested people will be able to find additional material on the costs and possible benefits of meeting the Kyoto agreement in my book.

As an economist, I have accepted the forecasts by the Intergovernmental Panel on Climate Changes (IPCC) of climate change that would result from continued greenhouse gas emissions under a "business-as-usual" scenario. Many of my friends in the scientific community are skeptical that warming will be as great as predicted; some contending that there is no credible scientific evidence that climate change is occurring. Certainly the satellite data fail to show that the climate is warming. Nevertheless, I have assumed that the climate would warm by 4.5° Fahrenheit by the end of the next century, the 1990 forecast of the IPCC for 2050. In its most recent reports, the IPCC has reduced its prediction to only 3.6° for the year 2100. In effect, the IPCC's best guess of temperatures is down by one-third from its 1990 prediction. Whatever warming takes place is expected to occur mainly at night and in the winter. There will be more warming towards the poles and less in tropical and semi-tropical regions.

The amount of buildup of greenhouse gases in the atmosphere is uncertain. The IPCC is forecasting that CO_2 levels will double by 2100. On the other hand a recent article in the *Journal of Political Economy*, a major economic journal, concluded that the

costs of solar power are declining so fast that 90 percent of the world's coal supplies will never be used. Consequently, the concentration of carbon dioxide in the atmosphere will top out sooner than expected. Any warming will be modest, will peak at the middle of the next century, and then will decline, even without carbon taxes or steps to curtail greenhouse gas emissions.[1]

Predicting the future, however, tends to be risky. We can have no real idea about the fuels that will be used to run our economy one hundred years from now. Americans may be running the economy on solar power or perhaps on hydrogen, or perhaps on something else. We cannot be sure. One hundred years ago, oil was considered useful only for lighting. Wood, charcoal, or coal supplied heat. The motor car had just been invented and transportation was still largely a matter of foot or horse.

Nevertheless, the Congress and the public must decide whether action to stem the emission of greenhouse gases is currently warranted. To make a rational decision, they must weigh the possible effects on Americans of continuing business-as-usual compared with the certain costs of restricting the emissions. The Congress may also want to consider the burden of acting or not acting on the rest of the world.

We have a good bit of evidence on the effects of a warmer-wetter world. As the attached charts show, the globe's climate has fluctuated greatly over time; but over the last 100 million years, it has gradually cooled (see chart 1). The last intergalcial period, about 125 thousand years ago, was considerably warmer than today (see chart 3). Since the last ice age, about 10,000 years ago, the earth has enjoyed two periods that were warmer than the present (see chart 4).

The Climatic Optimum

About 4,000 to 9,000 years ago, as chart 4 shows, the world enjoyed what historians of climate have dubbed "The Climatic Optimum." According to their best estimates, the earth was about 4° warmer than currently, a little higher than the average of the various predictions for global warming by the end of the next century.[2] Tree lines reached farther north and farther up mountains. Rain fell regularly in the Sahara desert. Plants and animals thrived and so did people. During this period many cultures shifted from the Stone Age to the Bronze Age.

Although the climate cooled a bit after 3000 B.C., it stayed relatively warmer than the modern world until some time after 1000 B.C., when chilly temperatures became more common. During the Climatic Optimum, Europe enjoyed mild winters and warm summers with a storm belt far to the north. Not only was the region less subject to severe storms, but the skies were less cloudy and the days, sunnier.

Notwithstanding the less stormy weather, rainfall was more than adequate to produce widespread forests. Western Europe, including parts of Iceland and the Highlands of Scotland, was mantled by great woods.[3] The timber, until average temperatures dipped temporarily for about 400 years between 3,500 B.C. and 3,000 B.C., consisted of warmth-demanding trees, such as elms and linden in North America and oak and hazel in Europe. Those species have never regained their once dominant position in Europe and America. Not only did Europe enjoy a benign climate with adequate rainfall; but the Mediterranean littoral, including the Middle East, apparently received considerably more moisture than it does today.[4] The Indian subcontinent and China were also much wetter during this period.[5]

Compared to the cooler periods in the last few thousand years, the Sahara was much wetter and more fertile during the Climatic Optimum.[6] Cave paintings from the epoch depict hippopotamuses, elephants, crocodiles, antelopes, and even canoes.[7] The water level in Lake Chad, about 14° north of the equator in central Africa, was some 30 to 40 meters, that is, 90 to 125 feet higher, than it is today, indicating much greater precipitation. Ruins of ancient irrigation channels in Arabia, probably from the warmest millennia, indicate that they derived their water from sources well above current water supplies, attesting to a wetter climate.[8] With the cooling that started after 3000 B.C., North Africa dried up and the abundance of life disappeared.

In Europe, the Climatic Optimum led to an expansion of civilization, as witnessed by the construction of cities and a technological revolution. The Bronze Age replaced the New Stone Age.[9] The more benign climate with less severe storms encouraged travel by sea.

During this warm period, trade flourished. People from ancient Denmark shipped amber along the Atlantic coast to the Mediterranean. As early as 2000 B.C., the Celts were

apparently sailing from Cornwall and Brittany to both Scandinavia and southern Italy. Astrological monuments built around this time, such as Stonehenge, indicate that the skies were less cloudy than now.[10] The glaciers in the Alps during the late Bronze Age were only about 20 percent of the size of the ice in the nineteenth century, and merchants made their way through the Brenner Pass, the dominant link between northern and southern Europe. Northern Europeans exchanged tin for manufactured bronze from the south. Alpine peoples mined gold and traded it for goods crafted around the Mediterranean. Baltic amber even found its way to Scotland.

During the warm period prior to 3000 B.C., China experienced much warmer temperatures. Midwinters, in particular, were as much as 9° hotter and rice was planted a month earlier than is now common.[11] Bamboo, valued for food, building material, writing implements, furniture, and musical instruments, grew much farther north — about 3° in latitude — than is now possible.[12] Chinese archaeologists have found evidence in a district near Sian that the climate 5,000 to 6,000 years ago was warmer and wetter than the present.

Prior to 2500 to 1750 B.C., northwestern India, which is now very dry, enjoyed greater rainfall than it does in the twentieth century.[13] In the Indus Valley, the Harappas created a thriving civilization that reached its apogee during the warmest and wettest periods, when their farmers were growing cereals in what is now a desert.[14] The area was well watered with many lakes. That civilization disappeared around 1500 B.C. at a time when the climate became distinctly drier.[15]

The Little Climatic Optimum

From around A.D. 800 to 1200 or 1300, the globe again warmed considerably and civilization prospered. This Little Climatic Optimum generally displays many of the same characteristics as the first Climatic Optimum (see chart 5).[16] Virtually all of northern Europe, the British Isles, Scandinavia, Greenland, and Iceland were considerably warmer than at present. The Mediterranean, the Near East, and North Africa, including the Sahara, received more rainfall than they do today.[17] North America enjoyed better weather during most of that period. In the early part of this epoch, China experienced

higher temperatures and a milder climate. From western Europe to China, East Asia, India, and the Americas, mankind flourished as never before.

The timing of the medieval warm spell, which lasted no more than 300 years, was not synchronous around the globe. For much of North America, for Greenland, and in Russia, the climate was warmer between 950 and 1200.[18] The warmest period in Europe appears to have come later, roughly between 1150 and 1300, although parts of the tenth century were quite warm. Evidence from New Zealand indicates peak temperatures from 1200 to 1400. Data on the Far East is meager but mixed. Judging from the number of severe winters reported in China, the climate was somewhat warmer than normal in the ninth, tenth, and eleventh centuries, colder in the twelfth and thirteenth, and very cold in the fourteenth. Chinese scholar Chu Ko-chen reports that the eighth and ninth centuries were warmer and received more rainfall but that the climate deteriorated significantly in the twelfth century.[19]

Europe

The warm period coincided with an upsurge of population almost everywhere, but numbers are available only for Europe. For centuries during the cold damp Dark Ages, the population of Europe had been relatively stagnant. Towns had dwindled to a few houses clustered behind city walls. In Europe after the climate improved, cities grew in size; new towns were founded; and colonists moved into relatively unpopulated areas.

With a more pleasant climate, people spent longer periods outdoors; food supplies were more reliable. Even the homes of the peasants would have become warmer and less damp. The draining or drying up of marshes and wetlands reduced the breeding grounds for mosquitoes that brought malaria. Overall the infant and childhood mortality rate must have fallen, spawning an explosion in population.

The twelfth and thirteenth centuries witnessed a profound revolution which, by the end of the thirteenth century, had transformed the landscape into an economy filled with merchants, vibrant towns, and great fairs. Crop failures became less frequent; new territories were brought under control. With a milder climate and a more reliable food supply, the population mushroomed.[20]

The warmth of the Little Climatic Optimum made territory farther north cultivable. In Scandinavia, Iceland, Scotland, and the high country of England and Wales, farming became common in regions that neither before nor since have yielded crops reliably. In Iceland, oats and barley were cultivated. Scotland flourished during this warm period with increased prosperity and construction.[21] In Norway, farmers were planting farther north and higher up hillsides than at any time for centuries. Greater crop production meant that more people could be fed, and the population of Scandinavia exploded.[22] The rapid growth in numbers in turn propelled and sustained the Viking explorations and led to the foundation of colonies in Iceland and Greenland. Greenland savored weather that was 4° to 7° warmer than at present; settlers could bury their dead in ground that is now permanently frozen.

The increasingly warm climate was reflected in a rising sea level. People were driven out of the lowlands and there was a large-scale migration of men and women from those areas to places east of the Elbe, into Wales, Ireland, and Scotland. Flemish dikes to hold back the sea date at least from the early eleventh century.

In addition to the land north of the Alps, the warmer, rainier climate benefited southern Europe, especially Greece, Sicily, and southern Italy. All of the *Mezzogiorno* in the Middle Ages did well.[23] Christian and Muslim lands achieved great brilliance. Cordova, Palermo, Constantinople, and Cairo all thrived, engendering great tolerance for contending religions.[24] Christian communities survived and prospered in Muslim Cairo and Cordova.

In *A History of Knowledge*, Charles Van Doren contends that "the ... three centuries from about 1000 to about 1300 became one of the most optimistic, prosperous, and progressive periods in European history."[25] All across Europe, the population went on an unparalleled building spree, erecting at huge cost spectacular cathedrals and public edifices. Byzantine churches gave way to Romanesque, to be replaced in the twelfth century by Gothic cathedrals. During this period construction began on the Abbey of Mont-St-Michel (1017), St. Mark in Venice (1043), Westminster Abbey in London (1045), the Cathedral of our Lady in Coutances (1056), the Leaning Tower at Pisa (1067), the Cathedral of Santiago de Compostela in northern Spain (1078), the Cathedral

of Modena (1099), Vézélay Abbey in France (1130), Notre-Dame in Paris (1163), Canterbury in England (1175), Chartres (1194), Rouen's cathedral in France (1201), Burgos's cathedral in Castile (1220), the basilica of Saint Francis in Assisi (1228), the Sainte Chapelle in Paris (1246), Cologne Cathedral (1248), and the Duomo in Florence (1298).

Virtually all the magnificent religious edifices that we visit in awe today were started by the optimistic populations of the eleventh through the thirteenth centuries, although many were not finished for centuries. In southern Spain, the Moors laid the cornerstone in 1248 for perhaps the world's most beautiful fortress, the Alhambra. In the middle of the thirteenth century, as well, the Franks founded a fort, Mistra, near ancient Sparta, which later became a Byzantine city known for its art and culture.

Economic activity blossomed throughout the continent. Banking, insurance, and finance developed; a money economy became well established; manufacturing of textiles expanded to levels never seen before. Farmers were clearing forests, draining swamps, and expanding food production to new areas.[26] In England, virtually all the churches and chapels that had originally been built of wood were reconstructed in stone between the twelfth and fourteenth centuries.[27]

Starting in the eleventh century, European traders developed great fairs that brought together merchants from all over Europe. At their peak in the thirteenth century, they were located on all the main trade routes and not only served to facilitate the buying and selling of all types of goods but functioned as major money markets and clearinghouses for financial transactions. The fourteenth century saw the waning of those enterprises, probably because the weather became so unreliable and poor that transport to and from those locations with great stocks of goods became impractical.

During the High Middle Ages of the twelfth and thirteenth centuries, technology grew rapidly. New techniques expanded the use of the water mill, the windmill, and coal for energy and heat. Sailing improved through the invention of the lateen sail, the sternpost rudder, and the compass. Governments constructed roads and contractors developed new techniques for the use of stone in construction. New iron casting techniques led to better tools and weapons. The textile industry began employing wool,

linen, cotton, and silk and, in the thirteenth century, developed the spinning wheel. Soap, essential for hygiene, came into use in the twelfth century. After the tenth century, mining, which had declined since the Romans, at least partly because the cold and snow made access to mountain areas difficult, revived.

Farmers and peasants in medieval England launched a thriving wine industry south of Manchester. Good wines demand warm springs free of frosts, substantial summer warmth and sunshine without too much rain, and sunny days in the fall. Winters cannot be too cold — not below zero Fahrenheit for any significant period. The northern limit for grapes during the Middle Ages was about 300 miles above the current commercial wine areas in France and Germany. These wines were not simply marginal supplies but of sufficient quality and quantity that, after the Norman Conquest, the French monarchy tried to prohibit British wine production.[28]

Europe's riches and a surplus of labor enabled and emboldened its rulers to take on the conquest of the Holy Land through a series of Crusades starting in 1096 and ending in 1291. The Crusades were stimulated at least in part by a mushrooming population and an economic surplus large enough to spare men to invade the Muslim empire. A major attraction of the First Crusade was the promise of land in a "southern climate."[29]

The Arctic

From the ninth through the thirteenth centuries, agriculture spread into northern Europe and Russia where it had been too cold to produce food before. In the Far East, Chinese and Japanese farmers migrated north into Manchuria, the Amur Valley, and northern Japan.[30] As mentioned above, the Vikings founded colonies in Iceland and Greenland, a region that may have been greener than historians have claimed. It was also during this period that Scandinavian seafarers discovered "Vinland" — somewhere along the east coast of North America. The subsequent Mini Ice Age cut off the colonies in Greenland from Europe, and they eventually died out.

The Eskimo population apparently expanded throughout the Arctic area during the medieval warm epoch.[31] Starting with Ellesmere Land around A.D. 900, Eskimo bands and their culture spread from the Bering Sea into the Siberian Arctic. Two centuries later,

these people migrated along the coast of Alaska and into Greenland. During this period the Eskimos' main source of food came from whaling, which had to be abandoned with the subsequent cooling.

The Far East

As noted above, the warming in the Far East seems to have preceded that in Europe by about two centuries. Chinese economist Kang Chao has studied the economic performance of China since 200 B.C. In his careful investigation, he discovers that real earnings rose from the Han period (206 B.C. to A.D. 220) to a peak during the Northern Sung Dynasty (A.D. 961 to 1127).[32] This coincides with other evidence of longer growing seasons and a warmer climate. Chao reports that the number of major floods averaged fewer than four per century in the warm period of the ninth through the eleventh centuries while the average number was more than double that figure in the fourteenth through the seventeenth centuries of the Mini Ice Age.[33] Not only floods but droughts were less common during the warm period. The era of benign climate sustained about three major droughts per century, while during the later cold period, China suffered from about thirteen each hundred years.

The wealth of this period gave rise to a great flowering of art, writing, and science. The Little Climatic Optimum witnessed the highest rate of technological advance in Chinese history. During the 300 years of the Sung Dynasty, farmers invented 35 major agricultural implements — that is, over 11 per century, a significantly higher rate of invention than in any other era.[34] In the middle of the eleventh century, the Chinese became the first to employ movable type.[35]

During the Northern Sung Dynasty Chinese landscape painting with its exquisite detail and color reached its apogee.[36] Adam Kessler, curator of the Los Angeles County Museum of Natural History, dates the earliest Chinese blue-and-white porcelain to the twelfth century.[37] The Southern Sung produced pottery and porcelains unequaled in subtlety and sophistication. Literature, history, and scholarship flourished as well. Scholars prepared two great encyclopedias, compiled a history of China, and composed essays and poems. Mathematicians developed the properties of the circle. Astronomers

devised a number of technological improvements to increase the accuracy of measuring the stars and the year.[38]

Japan also prospered during the Little Climatic Optimum. In the Heian Period (A.D. 794 to 1192), the arts thrived as emperors and empresses commissioned vast numbers of Buddhist temples. Murasaki Shikibu, perhaps the world's first female novelist, composed Japan's most famous book, *The Tale of Genji.* Other classical writers penned essays: Sei Shonagon, another lady of the court, wrote *Makura-no-Soshi* (the Pillow Book). The Japanese aristocracy vied in composing the best poems. All of this reveals a prosperous economy with ample food stocks to support a leisured and cultivated upper class.

Over the four hundred years between A.D. 800 and 1200, the peoples of the Indian subcontinent prospered as well. Society was rich enough to produce colossal and impressive temples, beautiful sculpture, and elaborate carvings, many of which survive to this day.[39] The Lingaraja Temple, one of the finest Hindu shrines, as well as the Shiva Temple, date from this period.[40] Seafaring empires existed in Java and Sumatra, which reached its height around 1180. Ninth-century Java erected the vast stupa of Borobudur; other temples — the Medut, Pawon, Kelasan, and Prambanan — originate in this era. In the early twelfth century, the Khmers, predecessors of the Cambodians, built the magnificent temple of Angkor Wat.[41] In the eleventh century, Burmese civilization reached a pinnacle. In or around its capital, Pagan, between 931 and 1284, succeeding kings competed in constructing vast numbers of sacred monuments and even a library.[42] Today the area is a dusty plain littered with the crumbling remains of about 13,000 temples and pagodas built in a more hospitable era.

Archaeologists studying the compositions of forests in New Zealand have found that the South Island enjoyed a warmer climate between A.D. 700 and 1400, about the time that Polynesians were colonizing the South Pacific Islands and the Maoris were settling in New Zealand.[43]

The Americas

Less is known about civilizations in the Americas during the Little Climatic Optimum or even how the prevailing weather changed. Much of the currently arid areas

of North America, however, were apparently wetter during this epoch. The Great Plains east of the Rocky Mountains, the upper Mississippi Valley, and the Southwest received more rainfall between A.D. 800 and 1200 than they do now.[44] Radiocarbon dating of tree rings indicates that warmth extended from New Mexico to northern Canada. In Canada, forests extended about sixty miles north of their current limit.[45]

Starting around A.D. 800 to 900, the indigenous peoples of North America extended their agriculture northward up the Mississippi, Missouri, and Illinois river basins. By 1000 they were farming in southwestern and western Wisconsin and eastern Minnesota.[46] They grew corn in northwestern Iowa prior to 1200 in an area that is now marginal for rainfall.[47] When colder, drier weather set in after 1150 to 1200, Indian settlements on the northern plains of Iowa were abandoned. After that time, the natives substituted bison hunting for growing crops. In general, the land east of the Rocky Mountains enjoyed wetter conditions from 700 to 1200 and then turned drier as colder Arctic weather intruded more frequently.

The Anasazi civilization of Mesa Verde flourished during the warm period; but the cooling of the climate around 1280, at the end of the medieval warmth, probably led to its disappearance.[48] That climatic shift brought drier conditions to much of the region, leading to a retreat from the territory and forcing the Pueblo Indians to shift their farming to the edge of the Rio Grande River.

Around 900, the Chimu Indians in South America developed an extensive irrigation system on Peru's coast to feed their capital of between 100,000 to 200,000 souls, a huge number for the era.[49] The Toltec civilization, which occupied much of Mexico, reached its apogee in the thirteenth century.[50] By 1200, the Aztecs had built the pyramid of Quetzalcoatl near modern Mexico City.[51] The Mayas' civilization, however, reached a peak somewhat earlier, before 1000, and declined subsequently for reasons that remain unclear. It is possible that the warming after 1000 led to additional rainfall in the Yucatan, making the jungle too vigorous to restrain and causing a decline in farming while at the same time improving agricultural conditions in the Mexican highlands and farther north into what is now the southwestern United States.

Thus warmer times brought benefits to most people and most regions, but not all. As is always the case with a climatic shift, the changes benefited some while affecting other adversely. Change is disruptive; at the same time, it produces new ideas and new ways of coping with the world. Nevertheless, for most of the known globe, the Little Climatic Optimum of the ninth through the thirteenth centuries brought significant benefits to the local populations. Compared with the subsequent cooling, it was nirvana.

The Mini Ice Age

The Little Ice Age is even less well defined than the medieval warm period. Climatologists are generally agreed that, at least for Europe, North America, New Zealand, and Greenland, temperatures fell, although with many ups and downs, after 1300 to around 1800 or 1850, when they began to rebound. There was a cold period in the first decade of the fourteenth century, another around 1430, and yet another in 1560. The end of this period of increasingly harsh temperatures could have been as early as 1700, around 1850, or even as late as 1900 for Tasmania. The worst period for most of the world occurred between 1550 and 1700.[52] One reasonable interpretation of the data is that the world has been cooling since around 4500 B.C., with a temporary upswing during the High Middle Ages.

Europe and Asia cooled substantially from around 1300 to 1850, especially after 1400, with temperatures falling some 2° to 4° below those of the twentieth century. This indicates that temperatures may have dipped by as much as 9° in the two hundred years from 1200 to 1400, a drop of about the same magnitude as the maximum rise forecast from a doubling of CO_2. Those frigid times did bring hardships; and, as reported above, world population growth slowed. For much of these centuries, famine and disease stalked Europe and Asia.

The Mini Ice Age, especially the century and a half between 1550 and 1700 — the exact timing varied around the globe — produced low temperatures throughout the year, as well as considerable variation in weather from year to year and from decade to decade. It included some years that were exceptionally warm.[53] The polar cap expanded, as did the circumpolar vortex, driving storms and cold weather to lower latitudes. Although much of Europe experienced greater wetness than during the earlier warm

epoch, it was more the product of less evaporation because of the cold than of excessive precipitation.

The expansion of the circumpolar vortex produced some of the greatest windstorms ever recorded in Europe and, not so incidentally, changed history. A terrible tempest destroyed the Spanish Armada in 1588. Fierce gales wracked Europe in December 1703 and on Christmas Day 1717.[54] The contrast between the cold northern temperatures that moved south and the warm subtropical Atlantic undoubtedly generated a fierce jet stream.

As early as 1250, floating ice from the East Greenland Ice Cap was hindering navigation between Iceland and Greenland.[55] Over the next century and a half, the prevalence of icebergs became worse; and by 1410 sea travel between the two outposts of Scandinavia ceased. For about 350 years, from the third quarter of the fifteenth century to 1822, no ships found their way to Greenland and the local population perished.[56]

Harvest failures in the last quarter of the thirteenth century heralded the deteriorating climate in Europe. Compounding the insufficiency was a shift of land from farming, made riskier by the change in climate, to enclosure and sheep rearing.[57] Average yields, already low by modern standards, worsened after the middle of the thirteenth century.[58] One of the first severe bouts of cold, wet weather afflicted Europe from 1310 to 1319, leading to large-scale crop failures.[59] Food supplies deteriorated sharply, generating famine for much of Europe in 1315-18 and again in 1321.[60] Harvest deficits and hunger preceded the Black Death by 40 years.[61] For much of the continent, "the poor were reduced to eating dogs, cats and even children."[62] This scanty food output contributed to a decline in population that was aggravated by disease. The history of many villages shows that they were abandoned before, not after, the beginning of the plague. By 1327, the population in parts of England — especially those later devastated by the plague — had fallen by 67 percent.[63] People poorly nourished were quickly carried off by disease. Between 1693 and 1700 in Scotland, seven out of the eight harvests failed and a larger percentage of the population starved than died in the Black Death of 1348-50.[64]

In two terrible years, 1347 and 1348, famine struck northern Italy, followed by the Black Death, which decimated most of the populace not already dead from lack of food.[65]

Bubonic plague spread across the Alps after 1348, killing in the next two years about one-third of northern Europe's people. Life expectancy fell by ten years in a little over a century, from 48 years in 1280 to 38 years in the years 1376 to 1400.[66] Crops often failed; peasants abandoned many lands that they had cultivated during the earlier warm epoch. Between 1300 and 1600, the growing season shrank by three to five weeks with a catastrophic impact on farming.[67] In Norway and Scotland, the population declined and villagers deserted many locales well before the plague reached those areas.[68] The capitals of both Scotland and Norway moved south before both areas lost their autonomy.

The cooling after 1300 probably contributed significantly to the virulence of the bubonic plague, the greatest disaster ever to befall Europe. By 1348 rodents carrying fleas infested with bubonic plague had marched or been carried from the Crimea into Europe. Historians have estimated that as many as one-third of all the people in Europe died in the raging epidemic that swept the continent.[69] This outburst of the plague, like a similar one in the sixth century, occurred during a period of increasing coolness, storminess, and wet periods, followed by dry hot ones. The unpleasant weather is likely to have confined people to their homes, where they were more likely to be exposed to the fleas that carried the disease. In addition, the inclement weather may have induced rats to take shelter in human buildings, exposing their inhabitants to the bacillus.

The end of the medieval warmth had devastating effects on populations that lived at the edge of habitable lands. Historians, for example, have estimated the population of Iceland in the last decades of the eleventh century at about 77,000; early in the fourteenth, it still numbered over 72,000. By 1800, after several hundred years of coolness and stormy weather, the poor conditions had more than halved the number of Icelanders to 38,000.[70]

The terrible climate in Europe after the thirteenth century brought a halt to the economic boom of the High Middle Ages. Innovation slowed sharply.[71] For the next 150 years, except for military advances, technological improvements ceased. Population growth not only ended but, with starvation and the Black Death, fell. Without the drive of additional numbers of people, colonial enterprise ceased and no new lands were reclaimed or towns founded. The economic slump of 1337 brought on the collapse of the

great Italian bank, Scali, leading to one of the first recorded major financial crises.[72] Construction on churches and cathedrals halted.

The Mini Ice Age at its coldest devastated the fishing industry. From 1570 to 1640, during the most severe period, Icelandic documents record an exceptionally high number of weeks with coastal sea ice. Between 1615 to 1828, with the exception of a few years, fishermen from the Faeroe Islands suffered from a lack of cod, which need water warmer than 36° Fahrenheit to flourish. During the worst period, 1685 to 1704, fishing off southwest Iceland failed totally.[73] In the very icy year of 1695, Norwegian fishermen found no cod off their coast.

The Modern World

Clearly climate is far from the only influence on man's well being. Governments that extort too much from their people impoverish their countries. A free and open economy stimulates growth and prosperity. War and diseases can prove catastrophic. At the same time, a change in climate has frequently been a cause of war or aided the spread of disease. A shift to more arid conditions, for example, impelled the Mongols to desert their traditional lands to invade richer areas. A cold, wet climate can also confine people to close quarters, abetting contagion. Moreover, a shift toward a poorer climate can lead to hunger and famine, making disease more virulent.

With the growth in wealth and resources, the influence of climate on human activities has declined. Primitive man and hunter-gatherer tribes were at the mercy of the weather, as are societies that are still bound almost totally to the soil. A series of bad years could be devastating. If, as was the usual case until very recently, transportation is costly and slow, even a regionalized drought or an excess of rain in one area can lead to disaster, even though crops may be plentiful a short distance away. Thus variation in the weather for early man had a more profound influence on his life and death than do fluctuations in temperature or rainfall in modern times when economies are more developed. Because of modern transportation, even poor agricultural states today are less at the mercy of weather than were such people in earlier centuries. Since the advent of the Industrial Revolution, climate has basically been confined to a minor role in human activity.

The Economic Costs (Benefits?) of a Warmer World

Casual analysis of the economic effects of climate change demonstrates that most modern industries are relatively immune to weather. Climate affects principally agriculture, forestry, and fishing, which together constitute less than two percent of U.S. GDP. Manufacturing, most service industries, and nearly all extractive industries remain unaffected by climate shifts. Factories can be built in northern Sweden or Canada or in Texas, Central America, or Mexico. Higher temperatures will leave mining largely untouched; oil drilling in the northern seas and mining in the mountains might even benefit. Banking, insurance, medical services, retailing, education, and many other services can prosper as well in warm climates (with air-conditioning) as in cold (with central heating). Fuel consumption for heating will decline while that for air-conditioning will increase. Transportation will benefit generally from a warmer climate since highway transport would suffer less from ice and snow. Air travel would be subject to fewer weather-related delays; air transport costs, which are higher in cold weather, would be reduced. Bad weather in the summer has fewer disruptive effects and passes quickly; fewer storms and less fog will make shipping less risky. Construction would experience fewer holdups from weather.

Inhabitants of the advanced industrial countries would scarcely notice a rise in worldwide temperatures. As modern societies have developed a larger industrial base and become more service oriented, they have grown less dependent on farming, thus boosting their immunity to the vagaries of the weather. A few services, such as tourism, may be susceptible to temperature or precipitation changes: a warmer climate would be likely to shift the nature and location of pleasure trips. Skiers might have to go farther north or higher up the mountains to find reliable snow; the season could be shortened. Since ski resorts often suffer more from lack of snow than from weather that is too warm, increased participation may partially offset earlier springs and later falls. Nevertheless, as a skier I am unhappy with the thought that good snow may be found only farther north or at higher elevations. Most Americans who enjoy outdoor sports, however, do so in the summer. Golfers, hikers, backpackers, canoers, or just picnickers will be able to delight in their

favorite outdoor activity during more of the year. White water rafters will also have the bonus of greater stream flows resulting from more rainfall.

Warmer conditions might also mean that fewer northerners would feel the need to vacation in Florida or the Caribbean. On the other hand, new tourist opportunities might develop in Alaska, northern Canada, and other locales at higher latitudes or upper elevations.

Agriculture

Food output depends largely on agriculture, an industry that would be particularly sensitive to any climate change. Water availability, soil composition, technology, sunshine, and temperature all affect crop production. Warm climates have longer growing seasons and higher productivity. Wetter areas, holding other factors constant, are more productive than dry, unless the latter are irrigated. Climate change, if it takes place, is most likely to lead to a warmer climate, especially in higher latitudes where it will have a strong beneficial effect on the length of the growing season. Climatologists predict that a warmer world would enjoy more rainfall. Although models are unable to forecast where rainfall will increase, most places should experience at least a little more. The net result of warming and enhanced precipitation would be to boost farm output.

In addition, carbon dioxide is an essential ingredient for plant growth and its concentration in the atmosphere is rising. This gas boosts photosynthetic capacity and also water-use efficiency. According to peer-reviewed research, a doubling of carbon dioxide would on average boost growth by 52 percent.[74] At the same time, the improved water-use capacity of plants will mean that less rainfall would be needed to grow crops, thereby economizing on irrigation and perhaps offsetting partially any local reduction in rainfall.[75] As a consequence, a boost in carbon dioxide would have a strong beneficial effect on food production.

Evidence exists that rising levels of CO_2 have already boosted plant growth worldwide. Tests at Mauna Loa in Hawaii have not only documented a rise in the level of carbon dioxide in the atmosphere, from 316 parts per million in 1959 to 360 ppm in 1996, but have shown a marked seasonal pattern which has become more pronounced.[76] The levels of CO_2 in the atmosphere begin to fall in the northern spring as the new growth of

plants absorbs the gas and reach a low by early fall. As plant growth ceases and leaves fall in autumn, CO_2 levels rebound to a mid-winter high. The amplitude of this pattern has been increasing, at least since 1960, by about 0.5 percent annually.[77] This would suggest that plant growth worldwide has been on the upswing.

Additional evidence that agricultural has benefited comes from Dr. Ranga B. Myneni, a biologist at Boston University, and his colleagues who have found that, since 1980, plant growth, during the summer months, has become more vigorous north of the 45th parallel.[78] Inasmuch as there has been no measurable warming over this period—some areas have warmed while others have not — the result must stem from increased CO_2 concentrations. They report that the growing season has lengthened by 12 days and that plant growth has become 10 percent more energetic. Similar reports have come from Australia where researchers have discovered that warmer weather, more rainfall, and perhaps greater CO_2 have led to bumper crops.[79]

In 1994 two scientists, Paul Knapp and Peter Soulé, compared a site in central Oregon that had been extensively surveyed in 1960 with its flora fourteen years later. The region was almost inaccessible; climate had remained constant; human activity, given its remoteness, was negligible. They reported that the site had become much greener, with large increases in trees, perennial grasses, and western juniper. After systematically excluding all other factors, they concluded that the rise in CO_2 had boosted growth.[80]

Many studies have examined the relationship between warming and agricultural output. In a cautious report, the United States Department of Agriculture reviewed the likely influence of global warming on crop production and world food prices. The study, assumed that farmers failed to make any adjustment to mitigate the effects of warmer, wetter, or drier weather — such as substituting new varieties or alternative crops and increasing or decreasing irrigation. Nor did it include the fertilizing effect of CO_2. Thus it underestimated the increase in crop yields that would result from continued increases in greenhouse gas emissions. Nevertheless, the authors conclude:

> The overall effect on the world and domestic economies would be small as reduced production in some areas would be balanced by gains in others, according to an economic model of the effects of climate change on world agricultural markets. The model ... estimates *a slight increase* in world output and a *decline*

in commodity prices under moderate climate change conditions.[81] [Emphasis added]

Economists Robert Mendelsohn, William Nordhaus, and Daigee Shaw researched the relationship between climate and land values in the United States.[82] After holding land quality, the proximity to urban areas and the nearest coast, and income per capita constant, they found that climate explained over two-thirds of the value of crop lands. They concluded that, for the lower 48 states, a rise in average temperature of about 5°F and an 8 percent increase in rainfall stemming from global warming would, depending on the model used, reduce the value of output between 4 and 6 percent or boost the value of output slightly. This result ignores the effect of increased CO_2 on farm output and thus understates the rise in agricultural product.

Forests

Forestry is another sector subject to change as a result of an increase in CO_2 and world temperatures. Canadian agricultural economists, examining the effect of warming and a doubling of CO_2 on forestry production, concluded that increased carbon dioxide would boost productivity by 20 percent and that overall the harvest of timber in Canada would climb by about 7.5 percent.[83] Although their research applies only to our northern neighbor, it seems reasonable to infer that timber output in the United States could be more than maintained at current levels. If the climate changes, forest managers can shift to types of trees that fit the new environment.

Brent Sohngen of Ohio State University and Robert Mendelsohn of Yale School of Forestry and Environmental Studies have estimated that the U.S. timber market would benefit from climate change from less than 1 percent to more than 10 percent of the current value of American forests.[84] British researcher J. L. Innes of the Forestry Commission in Surrey, UK, reports that, over the last 100 years, forests have expanded "in areas as far apart as southern Patagonia and northern Finland. As growth ... is primarily controlled by temperature, it seems likely that climatic change is involved."[85] The IPCC has projected that global forest area could increase as much as 9 percent.[86]

Species Extinction

Some species, we don't know how many or which, may find that changes in the weather make it too difficult for them to reproduce and survive. Although extinction is always distressing, paleontologists estimate that perhaps 99 percent of all species that have ever flourished are no longer in existence. Far from being a catastrophic event, the loss of a species is quite normal. Some environmentalists claim that we are losing species at unprecedented rates; but, given the really catastrophic decimation 65 million years ago when a six and a half mile wide comet wiped out from 60 to 75 percent of all species on the planet, including the dinosaurs, the current losses seem insignificant.

Of the 1354 endangered species listed since 1966 by the Department of Interior, only one-half of one percent have become extinct. Although those plants and animals listed do not necessarily represent a random sample of all living beings, they are presumably some of the most visible of those threatened and thus would be expected to have a higher mortality rate than non-listed species. That they have suffered so few casualties over the last 30 years scarcely indicates a wholesale loss of species.

A wetter, warmer climate should be conducive to the evolution of additional species. Tropical areas teem with more different animals and plants than are native to temperate climates. For example, Lake Malawi in East Central Africa is home to more than 500 different species of fish, most of which are unique to that lake. [87] The Great Lakes, which are nearly nine times the size of Lake Malawi, contain only 173 different types of fish. In addition, the proliferation of plants, stemming from an atmosphere enriched with carbon dioxide, would provide more and better fodder for animals. Almost all species should benefit.

A number of environmentalists have argued that all species are valuable since any one might be the source of a chemical substance that could cure cancer, stop infections, or ease pain. Given the number of closely related species that manufacture many of the same types of compounds, given the number of synthetic drugs and current pharmaceuticals which may produce similar therapeutic effects, and given the cost of finding, testing, and marketing any new chemical produced by a single species,

economists have concluded that the value of such a plant or animal in the wild is virtually nil.[88]

Sea Level Rise

The IPCC concludes that a 4.5° warmer world would lift sea levels by six inches to three feet, with the central estimate being about one and a half feet by the year 2100.[89] Rising sea levels would, of course, impose costs on low-lying regions, including a number of islands and delta areas. For the United States — assuming a three-foot rise in sea level, at the high end of predictions for the year 2100 — economists have estimated the costs of building dikes and levees and of the loss of land at $7 to $10.6 billion annually, or less than 0.2 percent of GDP.[90] For some small island nations, of course, the problems could be much more severe and their hardships should be addressed.

Heating and Cooling Expenses

Warming will reduce the costs of home and office heating while increasing the expense of air-conditioning. The Department of Energy has estimated that even with higher outlays for the cooling, a warming of 4.5°F would bring net savings for Americans of $12.2 billion.[91]

Human Amenities

Do people prefer the summer or the winter? Do humans enjoy warm weather or cold? What proportion of vacationers in the winter go south and what proportion go to ski resorts? The answer is obvious: people call warm weather "clement" and enjoy warm, sunny days. When people retire, they often move south. According to a 1966 survey of Americans turning 50 in 1996, almost 40 percent planned to move when they retired and the most important criterion in selecting their destination (40 percent) was a "more favorable climate."[92] People retire to Florida, not Minnesota.

The difference in average temperatures between New York and Atlanta is actually greater than the rise forecast for the end of the next century. In spite of or because of the hotter climate in Georgia, millions of New Yorkers have moved south, perhaps to root for the Braves, but more likely to escape the ice and snows of the Empire State. Doctors have

been known to recommend that their patients move for their health and Duluth is not usually what they have in mind.

In my research, which will appear shortly in *Economic Inquiry*, I investigated the wages workers were willing to forego in order to enjoy a more clement climate. The result implies that, depending on the particular model, the gain from a warmer climate could be as little as $30 billion or as much as $100 billion.[93]

Mortality and Morbidity

The historical evidence shows that warmer weather has typically brought longer lives and a spurt in population. Colder weather has reduced health and devastated human beings. Nevertheless, many researchers, environmentalists, and politicians are forecasting that rising world temperatures in the next century will have devastating effects on human health.[94] Referring to the world as a whole, Working Group II of the Intergovernmental Panel on Climate Change asserted that "climate change is likely to have wide-ranging and mostly adverse impacts on human health, with significant loss of life."[95] The authors of the IPCC report feared that increases in heat waves would cause a rise in deaths from cardio-respiratory complications. They also foresaw a rise in vector-borne diseases, such as malaria and dengue and yellow fevers. The report did acknowledge briefly that, in colder regions, there would be fewer such deaths.

Most of the causes of premature death have nothing to do with climate. Worldwide the leading causes are chronic diseases — accounting for 24 million deaths in 1996 — such as maladies of the circulatory system, cancers, mental disorders, chronic respiratory conditions, and musculoskeletal disorders, none of which has anything to do with climate but everything to do with aging.[96] Another 17 million, most of them in poor countries, succumbed in the same year to disorders caused by infections or parasites, such as diarrhea, tuberculosis, measles, and malaria. Many of those diseases are unrelated to climate; most have to do with poverty.

Diarrhoeal diseases, such as cholera and dysentery, killed 2.5 million people out of the 52 million who died worldwide in 1996. Through the provision of fresh water and proper sanitation, those diseases are easily preventable. Although a warmer climate might make the environment more hospitable for such afflictions as cholera, dysentery, and

typhoid, in areas without good sanitation or clean water, chlorination and filtration could halt their spread.

Both the scientific community and the medical establishment maintain that the frightful forecasts of an upsurge in disease and early mortality stemming from climate change are unfounded, exaggerated, or misleading and do not require action to reduce greenhouse gas emissions. *Science* magazine reported that "predictions that global warming will spark epidemics have little basis, say infectious-disease specialists, who argue that public health measures will inevitably outweigh effects of climate."[97] It added, "Many of the researchers behind the dire predictions concede that the scenarios are speculative."

The American Council on Science and Health, a well-known health policy institute, has emphasized that limiting greenhouse gas emissions "would not be prudent. Fossil-fuel combustion ... is vital to high-yield agriculture and other practices that are fundamental to the well-being of the human population."[98] Its statement maintains: "The optimal approach to dealing with prospect of climate change would ... include improvement of health infrastructures (especially in developing countries)." The Council lists improvements in emergency responses to extreme weather events; intensive cost-effective control of insect vectors, especially in developing countries; improvement in drinking water and sanitation in developing areas as measures that should be carried out regardless of whether the global climate changes. The ACSH rejects specifically measures that "would impair economies and limit public-health resources."

In a forthcoming study I estimate that a warmer climate would reduce deaths by about 40,000 annually. If the lives saved reflect a random sample of the U.S. population, their value would be somewhere between $2 million and $10 million per life saved or between $80 billion and $1 trillion.[99] To be conservative and because most of the reduced numbers of deaths probably involve the very elderly, Table 1, below, values those lives at only $1 million each.

Not only should warmer weather extend lives, it should also reduce illnesses. A conservative estimate of the gain reflects simply the wage cost to people with jobs who are not at work because of illness. This neglects the gain to those not in the paid work

force and those who come to work even though they have a cold or the flu. I assume that a 4.5° warmer temperature would reduce illness by the same amount that it would reduce deaths (1.8 percent). Worker's compensation consequently would fall by the same percentage, producing savings of around three-quarters of a billion dollars.[100]

Overall Effects of Climate Change

Table 1 presents my estimates of the benefits and costs of global warming for Americans. Even though many potential advantages have not been included, the public would benefit by over $100 billion per year or roughly 1 percent of GDP. It seems almost indisputable that Americans would be better off at the end of the next century if temperatures were 4.5° hotter than today. For the United States, Europe, Japan, and other advanced countries, it is implausible to assume that climate change would have any significant negative effects. Transition costs, such as the building of dikes, the introduction of new crops, or the construction of irrigation facilities, may exist. For the most part, these costs are included in the estimates for Table 1. Despite those adjustment costs, most Americans would like a warmer climate.

Table 1
Annual Benefits (+) or Damages (-) from Global Warming for the United States ($ billions, 1990 dollars)

Activity	Cost - or Gain +
Agriculture	+
Forest loss	+
Species loss	-1.0
Sea level rise	
Construction of dikes, levees	-0.6
Wetland loss	-1.1
Dryland loss	-0.4
Energy for heating and cooling residential homes and businesses	+12.2
Human amenities	+10.0
Human life	+40.0
Human morbidity	+37.0
Migration	+0.2
Hurricanes	-0.8
Construction	+4.4
Leisure activities	+1.0
Water supply	+5.6
Urban infrastructure	+0.2
Air pollution	
Tropospheric ozone	-2.2
[Transportation]	+0.3
[Marine Resources]	+
Total	+104.8

Source: Moore 1998a

Thomas Schelling, in his 1991 presidential address to the American Economic Association, reported that for "developed countries, the impact on economic output will be negligible and unlikely to be noticed."[101] Most likely people would be oblivious of any change: they would simply enjoy the reduction in ice, snow, and cold.

Even the pessimists' estimates of the damages from global warming to both the U.S. and the world have been very small. For developed countries, these have ranged generally from 1 percent to 2 percent of GDP,[102] although Nordhaus's original estimate was for one-quarter of one percent of GDP.[103] It is generally agreed that poor countries will typically fare worse than the advanced market economies. The table below presents some of those estimates as given by the IPCC in terms of the expected loss of GDP.

Table 2

Estimates of Costs of Global Warming

Researcher and temperature increase	U.S.A.	World
Cline (4.5°) 1992	1.1%	n.e.
Nordhaus (5°) 1991	1.0%	n.e.
Frankhauser (4.5°) 1995	1.3%	1.4%
Titus (7°) 1992	2.5%	n.e.
Tol (4.5°) 1995	1.5%	1.9%
Moore (4.5°) 1998a	Gain of 1.0%	n.e.

n.e. indicates *no estimate.*

Source: IPCC Working Group III 1995, pp. 203 & 205, and Moore 1998a.

Costs and Benefits

Let us assume that the IPCC is right and that, by the year 2100, greenhouse gas concentrations in the atmosphere will rise significantly, driving up worldwide temperatures by about 4.5° Fahrenheit. In all probability, if this warming does take place, most people will be better off. On the other hand, if we take the pessimists' view, the costs to the United States might be as high as 1.5 percent of our GDP, although most estimates of the damage from climate change are considerably less than that figure (see Table 2). DRI estimates the cost to Americans of reducing greenhouse gas emissions to 1990 levels as 2.3 percent of GDP, a very bad benefit/cost ratio.

The IPCC's Working Group III reviewed various estimates of GDP losses, not including DRI's, from stabilizing emissions at 1990 levels and concluded that the average projected loss would be 1.5 percent of US GDP by the year 2050, with the costs increasing more or less linearly with time.[104] The IPCC's forecast of a 3.6° increase in temperatures is for the end of the next century, not the middle. If we assume that the temperature will go up by only half as much over the following fifty years, from 2050 to 2100, (actually, temperatures should rise more in the second half of the century than in the first half because of lags between carbon buildup and ocean temperatures), then the cost to the United States in 2050 from warming would be, at most, only 0.75 percent. This means that using the IPCC's own numbers, the costs of holding CO_2 to 1990 levels of 1.5 percent would be twice the gain from preventing any climate change!

But the benefit/cost calculus is even worse! Returning worldwide emissions, including those of the US, to 1990 levels, will *not* stabilize greenhouse gas *concentrations*. Since more CO_2 will be added annually for many decades to the atmosphere than the sinks can absorb, the buildup would only slow; consequently temperatures would continue to go up but by less than if no steps were taken to reduce CO_2 emissions. Instead, therefore, of saving the full 0.75 percent of our GDP by keeping emissions at 1990 levels, we would be saving much less, perhaps half as much or 0.375 percent of our GDP, hardly anything worth worrying about.

Of course, meeting the Kyoto protocol's goals would be more costly than simply reducing greenhouse gas emissions to 1990 levels. Having the major industrial countries of the world reduce their emissions by an overall 5 percent will not prevent climate change. Thus the costs of Kyoto are even greater than the IPCC indicated and any benefits are smaller than those that the pessimists suggest might come from eliminating climate change. Again the costs of acting greatly outweigh even the pessimists' estimates of the cost of business-as-usual.

The Chair of the Council of Economic Advisers, Janet Yellen, testified on March 4 on the costs of the Kyoto protocol. She made a valiant attempt to depict the burden of meeting the December agreement as a minor fluctuation in energy prices. After asserting the need to be conservative, she described the rosiest possible scenario on every issue. She testified that the costs of meeting the Kyoto targets might amount only to $7 to $12 billion per year! Without any of the backup analysis, it is difficult to know the source for her miraculous numbers.

Her estimates of the low cost of meeting Kyoto targets are highly dependent on trading and on what is called joint implementation. In Kyoto both these ideas were strongly resisted. The compromise eventually struck by tired delegates included approving the concepts while leaving the details to be worked out in Buenos Aires this coming fall. In theory trading would reduce costs, but it would require an international body to oversee and verify any reductions.

Since Russia and the former East Bloc countries have witnessed the collapse of their heavy, energy intensive industries and would therefore be able to claim credits, it is

usually predicted that American companies will buy their credits from those former Warsaw pact nations. No numbers currently exist, however, on how much each of these states has cut its emissions; it is assumed that the governments will come up with some estimate of CO_2 reductions and sell those savings. As a result, U.S. companies will be buying certificates giving them the right to emit carbon dioxide from producers who have already lowered emissions; consequently greenhouse gases will not be cut further. But American firms will be paying handsomely for those certificates.

Two Brookings Institution economists estimated that the US proposal of tradable certificates would require that US companies spend around $27 billion or more annually to purchase the rights to emit carbon from Third World or former Soviet bloc countries.[105] That sum is nearly four times the US government's annual budget for foreign economic aid.

Dr. Yellen dismissed the Department of Energy's report that higher energy prices would "devastate" six of our major industries, chemicals, petroleum refining, paper and allied products, iron and steel, aluminum, and cement. She argued that energy constitutes only 2.2 percent of total costs of US industry but failed to note that many industries spend much more on fuel and electricity than such trivial percentages would suggest.

The conclusion of the DOE report is worth quoting at length:

> Higher fuel costs imposed on domestic energy intensive industries would result in an increase in production costs in these industries. The consensus of the six working groups ... is that imports from non-participating countries would displace a significant amount of US industrial output and employment. A substantial amount of existing capacity in several of these industries would become non-competitive. Future investment in plant and equipment would be redirected from the US ... towards non-participating countries. *This conclusion is more general: all participating countries that agree to binding constraints will experience an economic decline relative to non-participating countries.* (emphasis added).[106]

In total, Janet Yellen estimated that, with trading, participation of major Third World countries, a continuation in reduction in carbon dioxide emissions per dollar of GDP, the inclusion of sinks, and somewhat higher energy prices, costs would be cut by 90 to 95 percent. Without these unlikely savings, her figures indicate that the cost would

be between 1 and 3.4 percent of GDP. She ignores the conclusion of the DOE that major industries would move abroad. Thus the administration's own numbers show that acting now would be foolish.

Conclusions

In summary, global warming will bring both benefits and drawbacks. As mentioned in *Climate of Fear: Why We Shouldn't Worry about Global Warming*, I have calculated the costs and benefits of climate change and conclude that, were the globe to warm by 4.5° Fahrenheit, the United States would, on net, gain by at least $100 billion annually or roughly 1 percent of GDP. Most Americans, probably most Europeans, the Japanese, and the Russians would be somewhat better off in a warmer world.

Small low-lying island states or countries particularly subject to sea flooding, such as Bangladesh, could experience substantial losses. As humane people, we should do our best to mitigate their problems. Providing them with dikes, levees, and infrastructure would be much more effective and also less costly for the industrialized countries than attempting to slow greenhouse gas emissions. Fostering economic policies in those countries that will enable them to deal with natural disasters is the best solution for them and for us. Rich countries can weather natural disasters — earthquakes, floods, droughts, a colder climate, or whatever problems a warmer climate may create — much more easily than poor countries. Richers is safer; warmer is better; acting now is foolish.

References

Baker, J.T. and L.H. Allen, Jr. 1994. Assessment of the Impact of Rising Carbon Dioxide and other Potential Climate Changes on Vegetation, *Environmental Pollution* 83, pp. 223-235.

Bartlett, Robert. 1993. *The Making of Europe: Conquest, Colonization and Cultural Change 950-1350*, Princeton: Princeton University Press.

Carruth, Gorton. 1993. *The Encyclopedia of World Facts and Dates*, New York: Harper Collins.

Chakravorty, Ujjayant, James Roumasset, and Kinping Tse. 1997. "Endogenous Substitution among Energy Resources and Global Warming," *Journal of Political Economy*, 105 (6): 1201-1234.

Chao, Kang. 1986. *Man and Land in Chinese History: An Economic Analysis*, Stanford CA: Stanford University Press.

Cheetham, Nicolas. 1981. *Mediaeval Greece*, New Haven: Yale University Press..

Claiborne, Robert. 1970. *Climate, Man, and History*, New York: W. W. Norton.

Cline, William. 1992.*The Economics of Global Warming*. Washington, DC: Institute for International Economics.

Committee on Science, Engineering, and Public Policy, National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. 1991. *Policy Implications of Greenhouse Warming: Scientific Assessment*. Washington, DC: National Academy Press.

Donkin, R. A. 1973. Changes in the Early Middle Ages, Chapter 3 in H. C. Darby, ed. *A New Historical Geography of England*, Cambridge: University Press.

Frankhauser, S. 1994. "The Social Costs of Greenhouse Gas Emissions: An Expected Values Approach," *Energy Journal*, 15(2): 157-184.

Giles, Bill 1990. *The Story of Weather*, London: HMSO.

Gimpel, Jean. 1983. *The Cathedral Builders*, trans. by Teresa Waugh, London: Pimlico. edition.

Gore, Albert. 1992. *Earth in Balance*. Boston: Houghton Mifflin,.

Innes, J.L. 1994. Climatic Sensitivity of Temperate Forests, *Environmental Pollution*, 83, pp. 237-243.

Intergovernmental Panel on Climate Change. 1992.*Climate Change 1992, The Supplementary Report to the IPCC Scientific Assessment*, Prepared by Working Group I, edited by J.T.Houghton, B.A. Callander and S.K. Varney. Cambridge: Cambridge University Press,.

Intergovernmental Panel on Climate Change. 1995a.*The Economic and Social Dimensions of Climate Change*, Working Group III, Edited by James P. Bruce, Hoesung Lee, and Erik F. Haites, Cambridge: Cambridge University Press.

Intergovernmental Panel on Climate Change. 1995b. *Second Assessment Report, Summary for Policy Makers: Impacts, Adaptation and Mitigation Options*, Prepared by Working Group II, Cambridge: Cambridge University Press.

Intergovernmental Panel on Climate Change. 1995c.*Summary for Policymakers: The Economic and Social Dimensions of Climate Change*, Prepared by Working Group III, Cambridge: Cambridge University Press.

Intergovernmental Panel on Climate Change. 1996. *Scientific-technical analyses of Impacts, Adaptations, and Mitigation of Climate Change*, Vol 2 of *Climate Change 1995: IPCC Second Assessment Report*, Working Group II, Cambridge: Cambridge University Press.

Kane, Sally, John Reilly, & James Tobey. 1991. *Climate Change: Economic Implications for World Agriculture*, Resources and Technology Division, Economic Research Service, U.S. Department of Agriculture, Agricultural Economic Report No. 647 (October).

Keegan, John. 1993. *A History of Warfare*, New York: Alfred A. Knopf.

Kesseler, Adam T. 1994. Exciting Discoveries of Chinese Porcelain, Letter to the Editor, *The Wall Street Journal*, (May 31).

Knapp, P.A. and P.T. Soulé. 1996. Vegetation Change and the Role of Atmospheric CO Enrichment on a Relict Site in Central Oregon: 1960-1994, *Annals of the Association of American Geographers*, 86, no. 3, pp. 387-411.

Ko-chen, Chu. 1973. A Preliminary Study on the Climatic Fluctuations During the last 5,000 years in China, *Scientia Sinica*, 16(2) (May).

Lamb, Hubert H. 1968. *The Changing Climate*, London: Methuen.

Lamb, Hubert H. 1977. *Climatic History and the Future*, Princeton: Princeton University Press, Vol. 2 1985.

Lamb, Hubert H. 1982. *Climate, History and the Modern World*, New York: Methuen.

Lamb, Hubert H. 1988. *Weather, Climate & Human Affairs: A Book of Essays and Other Papers*, London and New York: Routledge.

Langer, William L. 1968. *An Encyclopedia of World History: Ancient, Medieval, and Modern Chronologically Arranged*, 4th edition, Boston: Houghton Mifflin.

McKibbin, Warwick J. And Peter J. Wilcoxen. 1997. *A Better Way to Slow Global Climate Change*, Brookings Policy Brief No. 17..

McNeill, William H. 1963. *The Rise of the West: A History of the Human Community*, Chicago: The University of Chicago Press.

Mendelsohn, Robert, William D. Nordhaus, and Daigee Shaw. 1994. The Impact of Global Warming on Agriculture: A Ricardian Analysis, *The American Economic Review*, 84(4) (September): 753-771

Mitchell, George J. 1991.*World on Fire: Saving an Endangered Earth*. New York: Charles Scribner's Sons.

Moore, Thomas Gale. 1998a. *Climate of Fear: Why We Shouldn't Worry about Global Warming*, Washington, DC: Cato.

Moore, Thomas Gale. 1998b. Health and Amenity Effects of Global Warming, *Economic Inquiry*, forthcoming.

Myers, Norman. 1977. "The Rich Diversity of Biodiversity Issues," Chapter 9 in Reaka-Kudla, Marjorie L., Don E. Wilson, and Edward O. Wilson, eds *Biodiversity II: Understanding and Protecting Our Biological Resources*, Washington DC: Joseph Henry Press.

Myneni, R. B., C. D. Keeling, C.J. Tucker, G. Asrar, and R.R. Nemani. 1997. Increased Plant Growth in the Northern High Latitudes from 1981 to 1991, *Nature*, 386 (April 17).

Nicholls, Neville. 1997. Increased Australian wheat yield due to recent climate trends, *Nature* vol 387 (May 29).

Nordhaus, William. 1991. To Slow or Not to Slow: The Economics of the Greenhouse Effect. *The Economic Journal* 101 (July): 920-937.

Rosenthal, Donald H., Howard Gruenspecht, and Emily A. Moran. 1995. Effects of Global Warming on energy Use for Space Heating and cooling in the United States, *The Energy Journal*, 16, no. 2, pp. 77-96

Schelling, Thomas C. 1992. Some Economics of Global Warming *The American Economic* Review, 82 (March): 1-14.

Shindell, Sidney and Jack Raso. 1997. *Global Climate Chnage and Human Health*, American Council on Science and Health, New York, NY.

Simpson, R. David, Roger A. Sedjo, and John W. Reid. 1996. Valuing Biodiversity for Use in Pharmaceutical Research, *The Journal of Political Economy*, 104 (1) (February):163-185.

Sohngen, Brent and Robert Mendelsohn. 1996. *Integrating Ecology and Economics: The Timber Market Impacts of Climate Change on U.S. Forests*. Report Prepared for the EPRI Climate Change Impacts Program.

Sutherland, Ronald J. 1997. *The Impact of Potential Climate Change Commitments on Energy Intensive Industries: A Delphi Analysis*, Argonne National Laboratory, (February 5).

Taubes, Gary. 1997. Apocalypse Not, *Science*, (November 7): 1004-06.

Titus, J.G. 1992. The Cost of Climate Change to the United States, in *Global Climate Change: Implications Challenges and Mitigation Measures*, edited by S.K. Majumdar, L.S. Kalkstein, B. Yarnal, E.W. Miller, and L.M. Rosenfeld, Easton, PA: Pennsylvania Academy of Science.

Tol, R.S.J. 1995. The Damage Costs of Climate Change: Toward more comprehensive Calculations, *Environmental and Resource Economics*, 5, pp. 353-374.

U.S. Department of Commerce. Various years. *Statistical Abstract of the United States*, Washington: Government Printing Office.

Van Doren, Charles. 1991. *A History of Knowledge: Past, Present, and Future*, New York: Ballantine Books.

Van Kooten, G.C. 1990. Climate Change Impacts on Forestry: Economic Issues, *Canadian Journal of Agricultural Economics* 38, pp. 701-710.

Wittwer, S. H. 1997. The Global Environment: It's Good for Food Production, *State of the Climate Report*, P.J. Michaels, ed., New Hope Environmental Services, Western Fuels Association, Arlington, VA.

World Health Organization. 1997. *World Health Report*, Geneva, Switzerland.

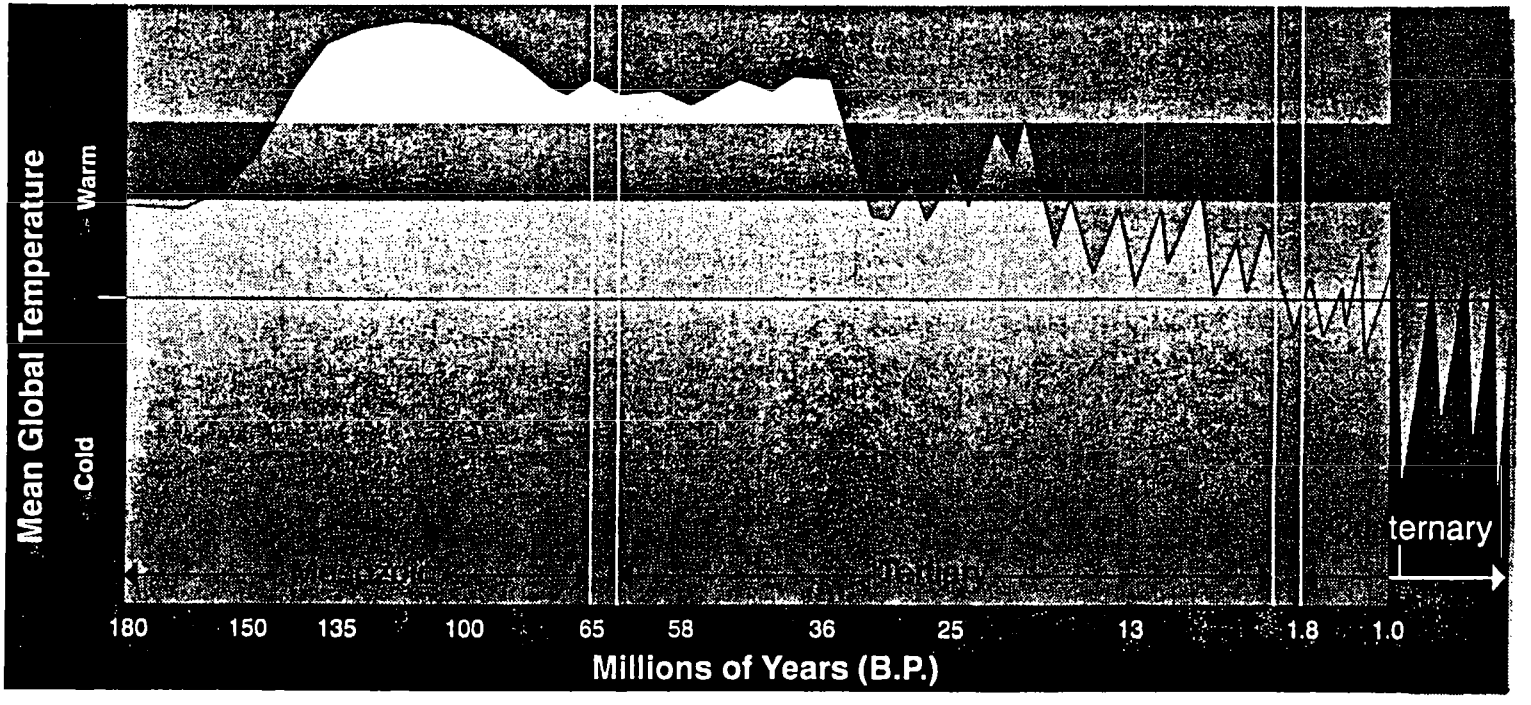
Footnotes

[1] Chakravorty et al 1997.
[2] Lamb (1988): 22.
[3] Giles, 1990: 133.
[4] Claiborne 1970: 324.
[5] Lamb 1982: 120.
[6] Lamb 1988: 21.
[7] Giles 1990: 115-116.
[8] Lamb 1977: 270.
[9] Lamb 1982: 126.
[10] Lamb 1977: 254.
[11] Lamb 1982: 124.
[12] Ko-chen 1973: 228 & 229.
[13] Lamb 1977: 251.
[14] Lamb 1977: 389.
[15] Claiborne 1970: 295.
[16] Lamb 1968: 64.
[17] Lamb 1968: 64-65.
[18] Lamb 1977: 435.
[19] Ko-chen 1973: 235.
[20] Donkin, 1973: 90.
[21] Lamb 1977: 437.
[22] Claiborne 1970: 348-364.
[23] Cheetham 1981: 37.
[24] Cheetham,1981: 35-36.
[25] Van Doren 1991: 111.
[26] Bartlett 1993: 2.
[27] Donking 1973: 110-111.
[28] Lamb 1977: 277.
[29] Keegan, 1993: 291.
[30] McNeill 1963: 559.
[31] Lamb 1977: 248.
[32] Ko-chen 1986: 219.
[33] Chao 1986: 203.
[34] Ko-chen 1986: 195.
[35] Carruth 1993: 151.
[36] Langer 1968: 366.
[37] Kesseler 1994: A17.
[38] Langer 1968: 367.
[39] McNeill 1963: 559.
[40] Carruth 1993: 151.
[41] Langer 1968: 372.
[42] Deland 1987: 9, 29-32.
[43] Lamb 1977: 430-431.
[44] Lamb 1988: 42.
[45] Lamb 1988: 42.
[46] Lamb 1977: 249.
[47] Lamb 1982: 177.
[48] Gore 1992: 78.
[49] Carruth 1993: 142-143.
[50] Langer 1968: 386.
[51] Carruth 1993: 168.

[52] Lamb 1977: 463.
[53] Lamb 1977: 465-466.
[54] Lamb 1988: 158.
[55] Lamb 1988: 159.
[56] Lamb 1988: 159.
[57] Lamb 1977: 7.
[58] Donkin 1973: 91.
[59] Lamb 1977: 454.
[60] Donkin 1973: 90.
[61] Lamb 1977: 266.
[62] Lamb 1977: 7.
[63] Lamb 1977: 454.
[64] Lamb 1977: 471.
[65] Langer 1968: 317.
[66] Lamb 1982: 189.
[67] Lamb 1988: 32.
[68] Lamb 1988: 36.
[69] Lamb 1977: 262.
[70] Lamb 1977: 265.
[71] Gimpel 1983: 150.
[72] Gimpel 1993: 151.
[73] Lamb 1988: 153-54, 155.
[74] Wittwer 1997: 12.
[75] Baker and Allen 1994.
[76] Wittwer 1997: 10.
[77] Wittwer 1997: 11.
[78] Myneni et al. 1997.
[79] Nicholls 1997.
[80] Knapp and Soulé 1996.
[81] Kane et al. 1991
[82] Mendelsohn et al.,1994.
[83] Van Kooten 1993: 704.
[84] Sohngen and Mendelsohn 1966.
[85] Innes 1994: 230.
[86] IPCC 1996.
[87] Myers 1977: 127.
[88] Simpson et al. 1996.
[89] IPCC 1995b: 188.
[90] Cline 1992: 109.
[91] Rosenthal, Gruenspecht, and Moran 1995.
[92] *USA Today*, May 13, 1996: B1.
[93] Moore 1998b.
[94] Committee on Science, Engineering, and Public Policy, et al. 1991; Mitchell 1991; Cline 1992; Gore 1992; IPCC 1992.
[95] IPCC. 1995b: SPM-10.
[96] World Health Organization 1997.
[97] Taubes 1997.
[98] Shindell and Raso. 1997.
[99] Moore 1998b.
[100] Sources are from The Statistical Abstract of the United States 1994, table 631, p. 404 and table 660, p. 427.
[101] Schelling 1992: 6.
[102] IPCC 1995a: 184.

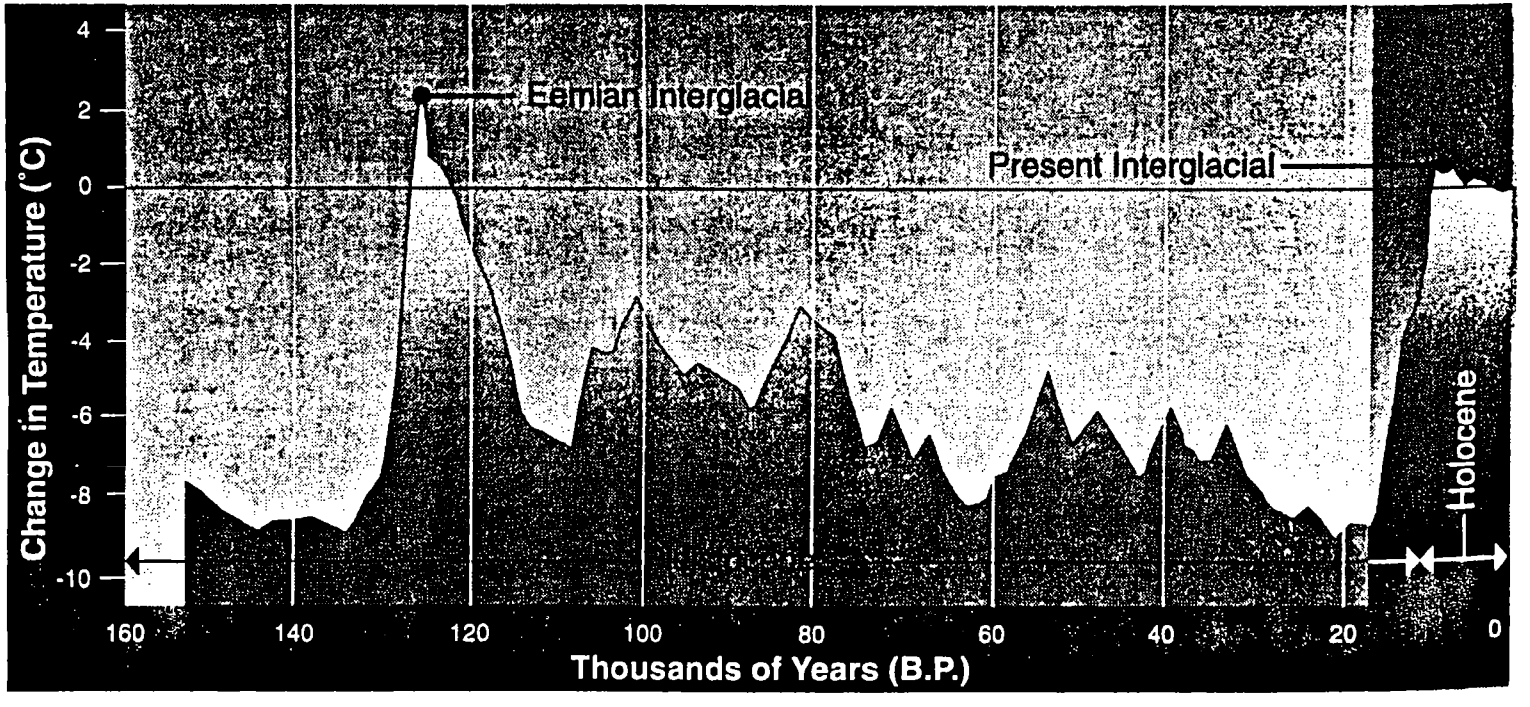
[103] Nordhaus 1991: 932.
[104] IPCC 1995c: 307.
[105] McKibbin and Wilcoxen 1997.
[106] Sutherland 1997.

1

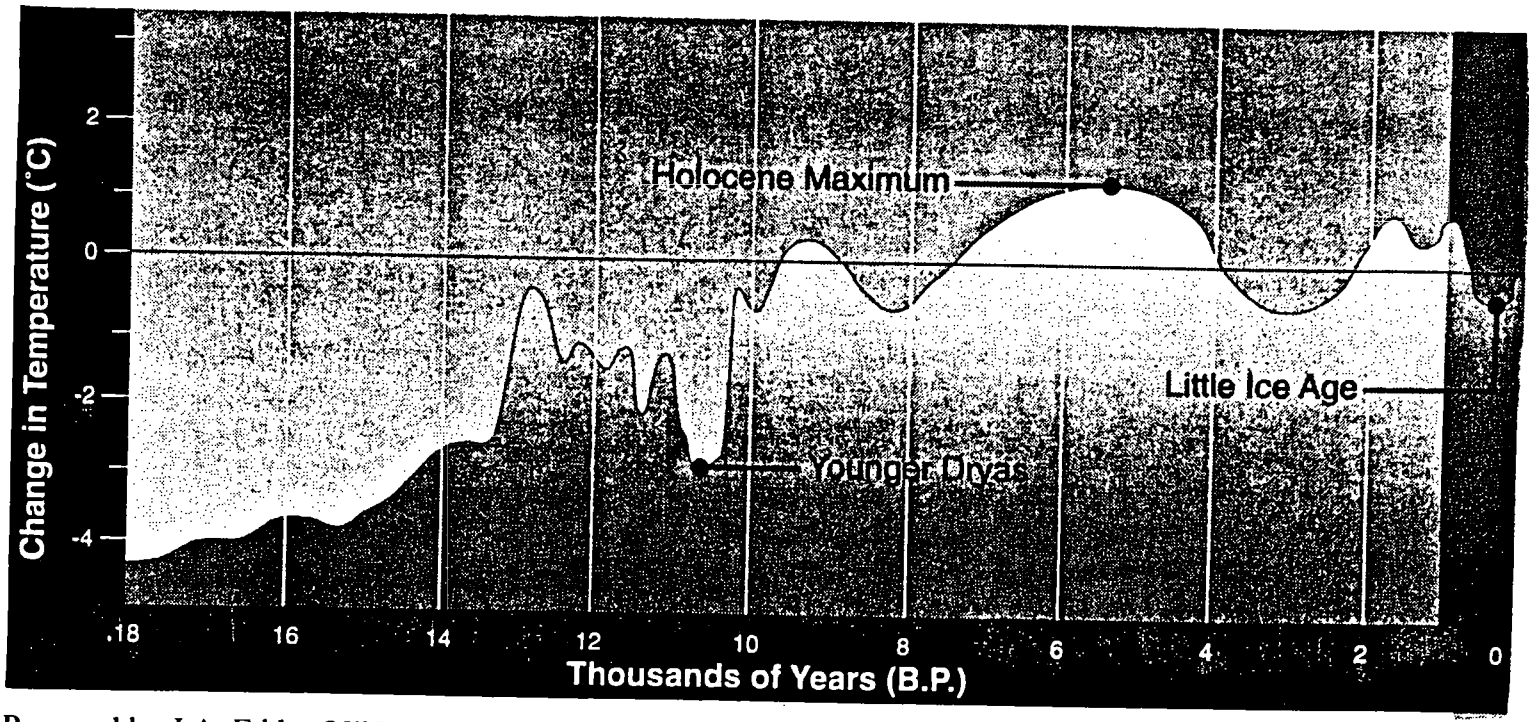


Prepared by J.A. Eddy, OIES, and R.S. Bradley, University of Massachusetts
Earthquest, Spring 1991, Vol. 5, No. 1

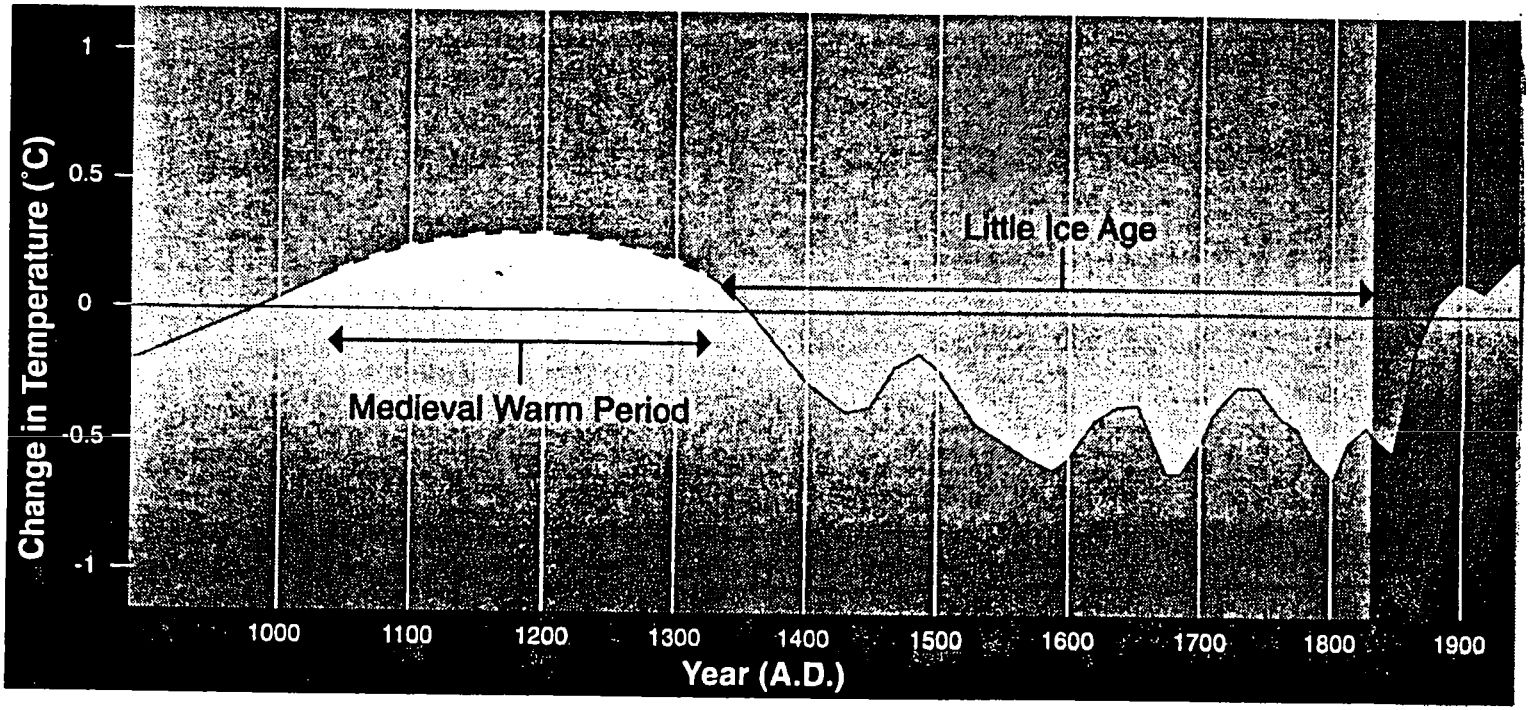
3



Prepared by J.A. Eddy, OIES, and R.S. Bradley, University of Massachusetts
Earthquest, Spring 1991, Vol. 5, No. 1



Prepared by J.A. Eddy, OIES, and R.S. Bradley, University of Massachusetts
Earthquest, Spring 1991, Vol. 5, No. 1



Prepared by J.A. Eddy, OIES, and R.S. Bradley, University of Massachusetts
Earthquest, Spring 1991, Vol. 5, No. 1

STATEMENT OF

JAY HAKES

ADMINISTRATOR, ENERGY INFORMATION ADMINISTRATION

DEPARTMENT OF ENERGY

before the

ENERGY and NATURAL RESOURCES COMMITTEE

UNITED STATES SENATE

MARCH 25, 1999

- - - DRAFT - - -

Mr. Chairman and Members of the Committee:

I appreciate the opportunity to appear before you today to discuss the Energy Information Administration's (EIA) analysis of carbon emissions from energy and the potential impacts of the Kyoto Protocol.

EIA is an autonomous statistical and analytical agency within the Department of Energy. We are charged with providing objective, timely, and relevant data, analysis, and projections for the use of the Department, the Congress, and the public. We do not take positions on policy issues, but we do produce data and analysis reports that are meant to help policy makers decide energy policy. Because we have an element of statutory independence with respect to the analyses that we publish, our views are strictly those of EIA. We do not speak for the Department, nor for any particular point of view with respect to energy policy, and our views should not be construed as representing those of the Secretary of Energy or the Department's policy position. EIA's baseline projections on energy trends, however, are widely used by government agencies, the private sector, and academia for their own energy analyses.

Each year EIA publishes the *Annual Energy Outlook*, which provides projections and analysis of domestic energy consumption, supply, prices, and carbon emissions. These projections are not meant to be exact predictions of the future but represent a likely future, assuming known trends in demographics and technology improvements and also assuming current laws, regulations, and policies. In October 1998, EIA published the report *Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity*,[1] which is the focus of my testimony today. The report was done at the request of the House Committee on Science.

---

[1]Energy Information Administration, *Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity*, SR/OIAF-3 (Washington, DC, October 1998).

Carbon Emissions and the Kyoto Protocol

Carbon abatement is a highly complex issue, far more complicated than most other emissions reduction programs. Although comparisons are drawn between the sulfur dioxide (SO_2) reduction program for electricity generators and carbon reduction, there are several key differences. First, carbon emissions are an international issue. Assuming that climate change is a reality, the U.S. climate is equally affected by carbon emissions around the globe as by emissions in the United States. Also, there are a vast number of entities that emit carbon—homes, factories, vehicles, commercial facilities, and agricultural sources—unlike the relatively few electricity generators covered by the SO_2 reduction program in the first phase. Finally, unlike SO_2, there are not cost-effective means to remove and sequester carbon other than by natural processes at this time.

The Kyoto Protocol calls for the United States to reduce its total net emissions of six greenhouse gases, weighted for their global warming potential, by 7 percent relative to 1990 emissions levels. This reduction is to be achieved on average during the years 2008 to 2012. Much of the focus on emissions reduction is on the energy sector because energy use is the primary source of greenhouse gas emissions. In 1997, carbon emissions from the combustion of energy totaled 83 percent of all U.S. greenhouse gas emissions.[2] Reducing carbon emissions below 1990 levels would be a challenging task, as they had already increased 10 percent by 1997 and are projected with current policies to rise by 2010 to 33 percent over 1990.

Carbon emissions from energy can be reduced in several ways. First, there can be a shift from fossil to nonfossil fuels, such as nuclear power or renewable sources of energy. Second, energy use can shift from highly carbon-intensive fossil fuels to those with lower carbon intensity. For example, natural gas produces only about half the carbon emissions per unit of thermal output as coal. Also, energy consumers can use more energy-efficient technologies, thereby using less

[2]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 1997*, DOE/EIA-0573(97)(Washington, DC, October 1998).

energy to achieve the same level of energy service. Finally, consumers can reduce the level of energy services, for example, by traveling less or lowering their demand for heating and cooling.

EIA's analysis assumed that a price mechanism would be used to encourage more rapid development and adoption of energy-efficient technologies, the use of less carbon-intensive fuels, and a reduction in energy demand. The price mechanism is applied to fossil fuels relative to their level of carbon content. Although electricity itself emits no carbon, the carbon price is applied to the fuels used to generate electricity and is passed to consumers through the price of electricity. This price mechanism may take the form of a carbon tax, a carbon permit trading system, or a carbon permit auction. In addition to price incentives, reductions in carbon emissions could be achieved by regulatory or voluntary programs.

Within the Kyoto Protocol, there are a number of ways for the United States to achieve the overall target apart from energy-related carbon reductions. The Protocol recognizes that different countries may have different levels of opportunity for emissions reductions and allows emissions trading among the Annex I countries. Joint implementation projects are also allowed among the Annex I countries, whereby a nation can earn emissions credits by investing in projects that reduce emissions or enhance emissions-absorbing sinks, such as forests, in other Annex I countries. The Protocol also establishes a Clean Development Mechanism, under which Annex I countries can earn credits for projects that reduce net emissions in non-Annex I countries. Apart from these international activities, domestic investment in carbon absorption activities, such as reforestation, or in reducing the emissions of the other greenhouse gases covered by the Protocol may also lower the required reduction in carbon emissions.

These flexibility measures in the Protocol offer opportunities to reduce the cost of complying with the Protocol, but complicate the analysis. Rules and guidelines for the international trading, joint implementation, and the Clean Development Mechanism are not specified in the Protocol and will be finalized at some future international meeting. Also, the actual opportunities for low-cost investment in emissions abatement in other countries cannot be known with certainty or whether

other Annex I countries would be willing to sell emissions permits or would hold them for credit against future reductions. Finally, the role of sinks and other greenhouse gases in offsetting carbon reductions remains uncertain.

In addition to these difficulties, there are a number of other uncertainties in analyzing the Protocol. Different energy analysts have different opinions about the price elasticity of energy--how quickly energy consumers will react to changes in energy prices by changing their patterns of energy use or by purchasing different energy-using equipment and also whether consumers change their behavior in anticipation of future price increases. Unknown future policies may raise or lower the costs of the impacts. It is also not possible to foresee with certainty how energy-using technologies will develop in the future. Finally, the entire issue of climate change and greenhouse emissions reductions is relatively new, and measurement systems and methods of gauging how individual consumers or countries will respond to an international effort of this scope and magnitude will need to be further developed..

Analysis of the Kyoto Protocol

At the request of the Congressional committee, the EIA analysis is based upon the methodologies and assumptions in the *Annual Energy Outlook 1998* (*AEO98*),[3] with no changes in policy, regulatory actions, or funding for energy and environmental programs, since no specific policies had been advanced. The analysis was conducted using the National Energy Modeling System (NEMS), EIA's energy-economic model of domestic energy markets, which underlies the *AEO98* projections.

In most of the energy-producing and consuming sectors, NEMS includes explicit treatment of individual technologies and their characteristics, such as capital and operating costs, date of commercial availability, efficiency, and other relevant characteristics. Because of this detailed

[3]Energy Information Administration, *Annual Energy Outlook 1998*, DOE/EIA-0383(98)(Washington, DC, December 1998).

representation of technology, NEMS captures the most significant factors that influence the turnover of energy-using equipment and the choice of new technologies and is appropriate for the analysis of the transitional impacts of policies designed to influence the choice of new technologies. NEMS also represents consumer choice through empirically-derived price elasticities and behavioral characteristics.

Because more energy-efficient and less-carbon intensive technologies can significantly reduce energy consumption and carbon emissions, the rate of technological progress and its penetration is one of the major factors and key uncertainties in determining the cost of carbon reductions. In its analysis, EIA incorporates ongoing trends of technological progress for both energy consumption and production, taking into account the characteristics of current technologies and those technologies assumed to be available and cost effective within the forecast horizon. In general, higher energy prices do not alter the characteristics or availability of energy-using technologies but encourage more rapid adoption of more efficient or advanced technologies because consumers would have more incentive to purchase them. However, the turnover rate of the capital stock—homes, appliances, and automobiles—can be slow, limiting the speed with which new, more-efficient technologies can capture a significant share of the market.

Because of the uncertainties concerning the final implementation of the Protocol, EIA's analysis included the reference case of what is expected with current policies and six additional cases with a range of reductions for energy-related carbon emissions in the United States. In each case, the United States achieves its target of reducing net greenhouse gas emissions by 7 percent; however, different means are used to reach the target. The cases in the analysis implicitly assume different levels of international trading, other international activities, forestry and agricultural sinks, and offsets from other greenhouse gases, with the remaining reduction taken in energy-related carbon reductions. Each of these cases is compared to a reference case that assumes no enforced carbon reductions in order to analyze the energy and economic impacts of achieving the reductions.

The reference case of the analysis is based upon the reference case from the *Annual Energy Outlook 1998*, in accordance with the Congressional request. By 2010, energy-related carbon emissions are projected to increase from 1,346 million metric tons in 1990 to 1,791 million metric tons, 33 percent above 1990 levels. The six carbon reduction cases range from reducing emissions to an average of 24 percent above 1990 levels (1990+24%) between 2008 and 2010 to reducing emissions to an average of 7 percent below 1990 levels (1990-7%) over the same period (Figure 1). The 1990+24% case assumes that international trading and other activities offset most (77 percent) of the required reductions in carbon emissions from energy; however, the 1990-7% case essentially assumes that the 7-percent target in the Kyoto Protocol must be met by energy-related carbon emissions with no net offsets from sinks, other greenhouse gases, or international activities. In this case, carbon emissions from energy are reduced approximately 30 percent from reference case levels in 2010.

In each of the cases, the target is achieved on average for the years in the first commitment period, 2008 through 2012. Although the rationale for the averaging is not explicitly stated in the Protocol, the fact sheet issued by the Department of State on January 15, 1998, indicates that this flexibility smooths short-term fluctuations in economic performance or weather. Because the Protocol does not specify targets beyond the first commitment period, the target is assumed to hold constant through 2020, the end of the forecast horizon. The target is assumed to be phased in over a three-year period, beginning in 2005 since the Protocol indicates that demonstrable progress toward reducing emissions must be shown by 2005. This allows energy markets to begin adjustments to meet the reduction targets.

In 2010, the carbon prices necessary to achieve the carbon emissions reduction targets range from $67 per metric ton (1996 dollars) in the 1990+24% case to $348 per metric ton in the 1990-7% case (Figure 2). In the three cases with the more severe reductions, the carbon price escalates more rapidly through 2010 in order to achieve the reductions in the commitment period then declines by 2020 as cumulative investments in more energy-efficient and lower-carbon equipment, particularly in the electricity generation sector, reduce the marginal cost of compliance in the later

years of the forecast. The carbon prices represent the marginal cost of reducing carbon emissions to the specified level, reflecting the price the United States would be willing to pay in order to purchase carbon permits from other countries or to induce carbon reductions in other countries. In the absence of a complete analysis of international carbon markets, these carbon prices do not represent the international market-clearing price of carbon permits or the price at which other countries would be willing to offer permits.

Carbon fees raise the delivered prices of energy and lead to a decline in the overall intensity of energy use. Energy intensity, measured as primary energy consumed per dollar of gross domestic product (GDP), declines at an average annual rate of 1 percent between 2005 and 2010 in the reference case. In the carbon reduction cases, the rate of intensity improvement improves in the same period to between 1.6 percent a year in the 1990+24% case to 3.0 percent a year in the 1990-7% case (Figure 3).

In 2010, carbon reductions from electricity generation account for between 68 and 75 percent of the total carbon reductions due to lower electricity demand than in the reference case and the penetration of more efficient, less carbon-intensive generation technologies. Electricity generators are expected to respond more strongly to higher prices than end-use consumers because the industry has traditionally been cost-minimizing and factors future energy price increases into their investment decisions. In contrast, the end-use consumers are assumed to consider only current prices in making their investment decisions and consider factors other than price. Also, a number of more-efficient and lower-carbon technologies for electricity generation become economically available due to the carbon price.

In the electricity generation sector, fuel switching accounts for most of the carbon reductions. Relative to the reference case, the delivered price of coal to generators in 2010 is higher by between 153 and nearly 800 percent in the carbon reduction cases. Coal-fired generation accounts for more than half of all generation in 2010 in the reference case, but its share drops to between 42 percent and 12 percent in the carbon reduction cases. To replace coal plants, generators build

more natural gas plants, extend the life of existing nuclear plants, and, particularly in the more stringent reduction cases, dramatically increase the use of renewables as costs per megawatt decline with more penetration, especially biomass and wind energy systems. Improved generation efficiency and lower electricity sales also contribute to lower carbon emissions from generation. Across the carbon reduction cases, electricity sales in 2010 are reduced from between 4 and 17 percent relative to the reference case, as electricity prices increase between 20 and 86 percent above those in the reference case.

The slate of energy fuels used in the United States is projected to change from that in the reference case (Figure 4). The use of both coal and petroleum is reduced, and there is a greater reliance on natural gas, renewable energy, and nuclear power. Although the consumption of petroleum declines relative to the reference case, it increases slightly as a share because most petroleum is used in the transportation sector in which there are fewer fuel substitutes available.

Because of the high carbon content of coal, total domestic coal consumption is significantly reduced in the carbon reduction cases, mostly for electricity generation but also in the industrial sector. Coal exports are also lower in the carbon reduction cases due to lower demand for coal in the Annex I nations, further reducing domestic coal production.

Natural gas consumption for electricity generation is higher than in the reference case in 2010 by a range of 2 to 12 percent across the carbon reduction cases. Although the use of natural gas is lower in the end-use sectors due to demand reductions and efficiency improvements, this is more than offset by the increase in consumption for generation. Although meeting the levels of production that may be required will be a challenge for the industry, sufficient natural gas resources are available, and the potential increases in both drilling and pipeline capacity are within levels achieved historically.

Consumption of renewable energy, which results in no net carbon emissions, is projected to increase by between 2 and 16 percent in 2010 and by between 9 and 70 percent in 2020. Most of

this increase occurs in electricity generation, primarily with additions to wind energy systems and an increase in the use of biomass (wood, switch grass, and refuse), both of which significantly increase their share of total fuel consumption for electricity generation with higher carbon prices (Figure 5). Because additional renewable technologies become available and economic later in the forecast period, the share of renewable generation continues to increase through 2020, reaching as high as 22 percent in 2020, compared to 9 percent in the reference case.

In the reference case about half of the current nuclear plants are projected to retire by 2020. In accordance with the request, no new nuclear plants are allowed to be built in the carbon reduction cases, but extending the lifetimes of existing plants becomes more economical with higher carbon prices. In more stringent reduction cases, most existing nuclear plants are life-extended through 2020.

In 2010, the average price of gasoline increases by between 11 and 53 percent across the carbon reduction cases, compared to the reference case (Figure 6). Although carbon emissions from transportation are reduced due to lower travel and the purchase of more efficient vehicles, the transportation sector accounts for the lowest reductions of all the end-use demand sectors. This is a result of the continued dominance of petroleum although alternative-fuel vehicles increase their market share. New car efficiency improves with higher carbon prices, but vehicle turnover rates slow the improvement of the fleet. Total light-duty fleet efficiency rises from 20.5 miles per gallon in 2010 to only between 20.7 and 21.7 miles per gallon. The impact of carbon prices on the economy also lowers light-duty vehicle and airline travel and freight requirements and induces some efficiency improvements in the airline and freight sectors. Primarily due to lower demand in the transportation sector, petroleum consumption is reduced in all of the carbon reduction cases by between 2 and 13 percent in 2010 compared to the reference case. Because crude oil and petroleum product imports are reduced relative to the reference case, the dependency of the United States on imported petroleum is reduced from the reference case level of 59 percent to as little as 53 percent in 2010.

In both the residential and commercial sectors, higher energy prices encourage investments in more efficient equipment and building shells and reduce the demand for energy services. As a result, energy use per household and per square foot of commercial floorspace declines with higher carbon prices. Space heating, cooling, and ventilation account for the largest share of the demand reductions. More efficient lighting and office equipment and lower electricity demand for a variety of miscellaneous appliances, such as computers, televisions, VCRs, and telecommunications equipment also contribute to lower energy consumption. In the industrial sector, consumers replace productive capacity faster, invest in more efficient technology, and switch to less carbon-intensive fuels; however, total industrial output is also lower due to the impact of higher energy prices on the economy.

Apart from the impacts of the higher prices on energy markets, there are likely to be significant impacts on the macroeconomy. As energy costs rise due to the carbon prices, the rate of decline in energy consumption per dollar of GDP will accelerate. Other factors of production in the economy, including labor and capital, become relatively less expensive, and there will be some adjustments to substitute labor and capital for more expensive energy. Some economic potential is lost in that process. This will reduce the potential GDP for the United States, which is the long-run equilibrium path of the economy when all resources—labor, capital, and energy—are fully employed.

There are additional transitional costs that are likely to arise as energy price increases disrupt capital or employment markets. These short-run costs would impact the actual GDP but could be moderated by adjustments to Federal monetary and fiscal policies. The analysis assumes that a carbon permit trading system functions as an auction run by the Federal Government and that the revenues raised through the auction would be recycled back into the economy. Recycling of the funds would increase disposable income and encourage both consumption and investment, offsetting some adverse short-term effects on the economy. Two alternative fiscal policies were analyzed: one recycling the revenues through a lump sum rebate in the personal income tax and the other through the social security tax rates.

It is estimated that the loss in potential GDP will range from $13 billion to $72 billion (1992 dollars) in 2010. In an economy today of more than $7 trillion, which is expected to grow to more than $9.4 trillion in 2010, the percentage loss in output ranges from 0.1 percent to 0.8 percent in 2010. The loss in actual GDP is projected to range between $61 billion and $183 billion in 2010 if revenues are returned through a social security tax rebate and between $96 billion and $397 billion if they are recycled through personal income taxes. When viewed from the perspective of growth rates, the economy continues to grow, but at a slower rate between 2005 and 2010 (Figure 7). Although there is a slowing of economic growth initially, actual GDP returns to the potential path later in the forecast period, muting the economic impacts through 2020 (Figure 8).

The finding that economic growth slows only moderately in the transition period and slows only slightly when averaged to 2020 results from two factors. First, energy costs have become a smaller part of the overall economy than in the past, muting broader impacts of energy price increases. Second, revenues from the higher costs of energy can be recycled back into the American economy, as opposed to, for instance, going to foreign oil producers. The continued growth of the economy and of personal disposable income during the period of carbon reductions is one of the reasons that energy prices reach the high levels in our projections. With growing personal income, energy consumers will be more willing to pay higher energy costs to maintain desired life styles.

Figure 1

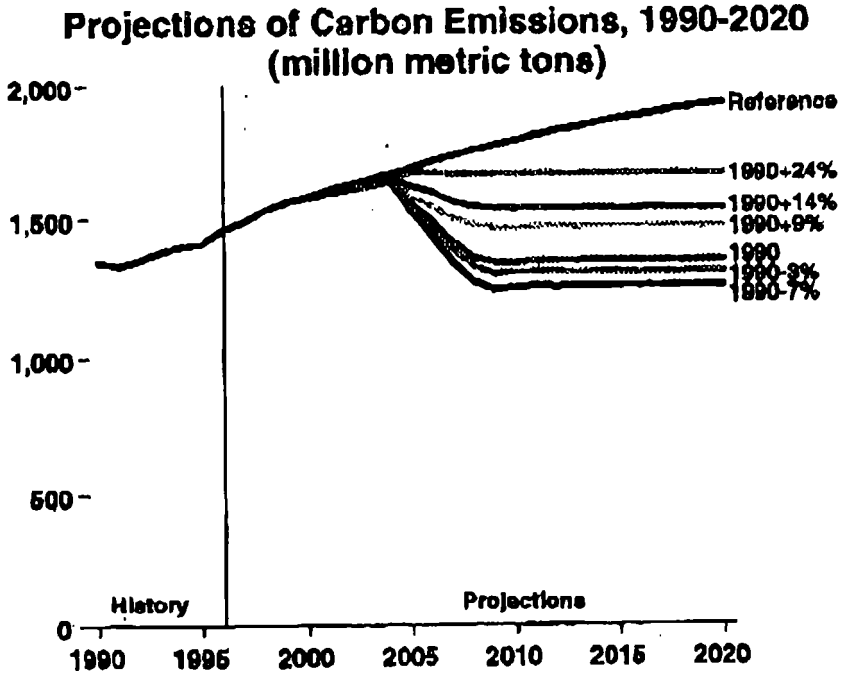


Figure 2

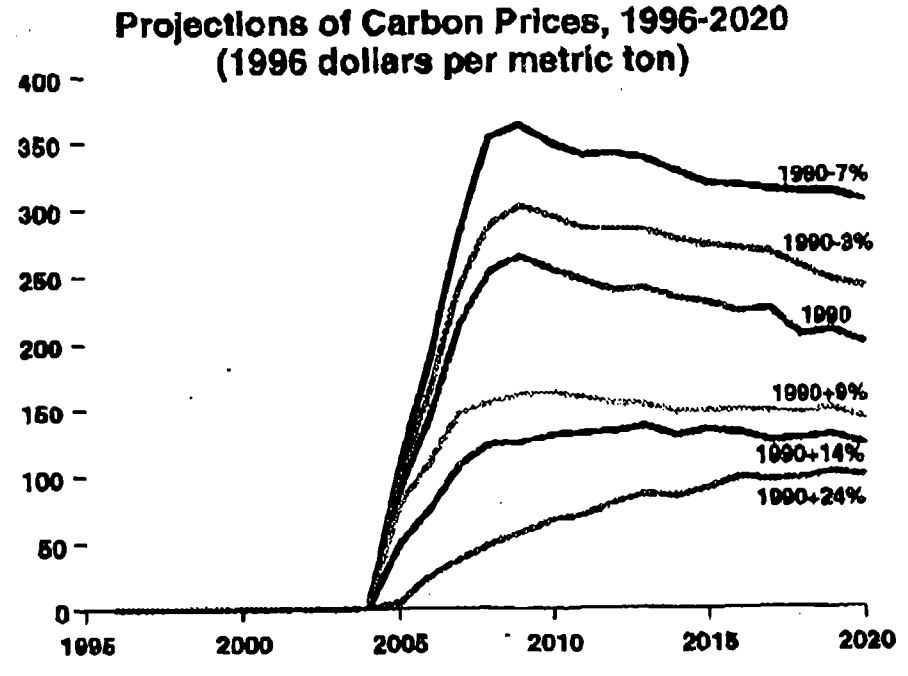


Figure 3

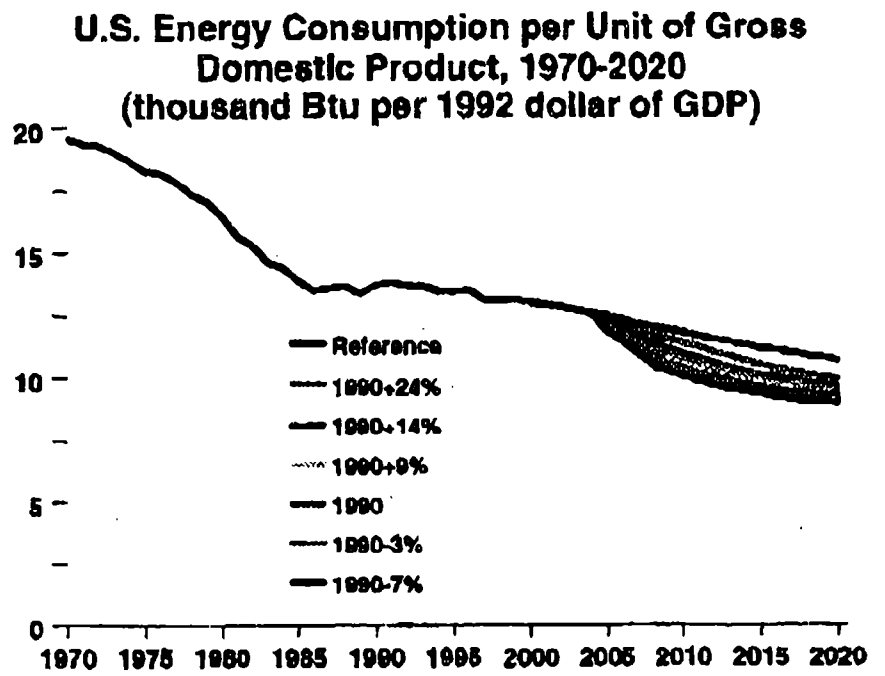


Figure 4

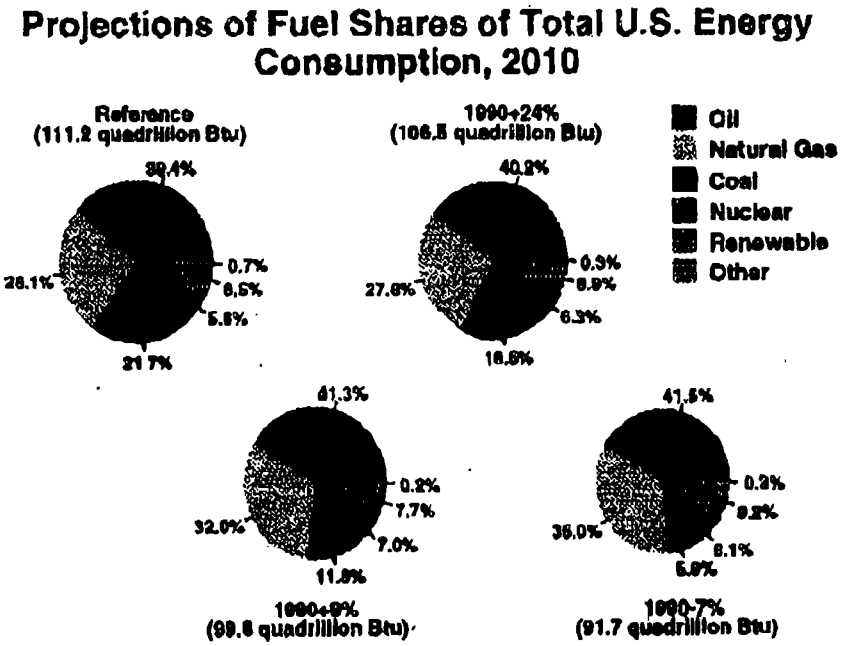


Figure 5

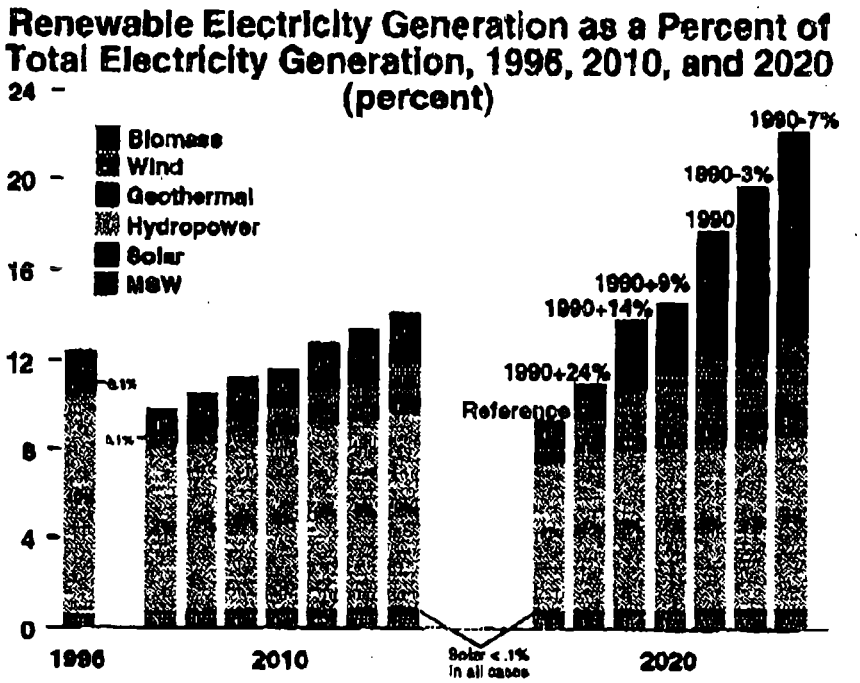


Figure 6

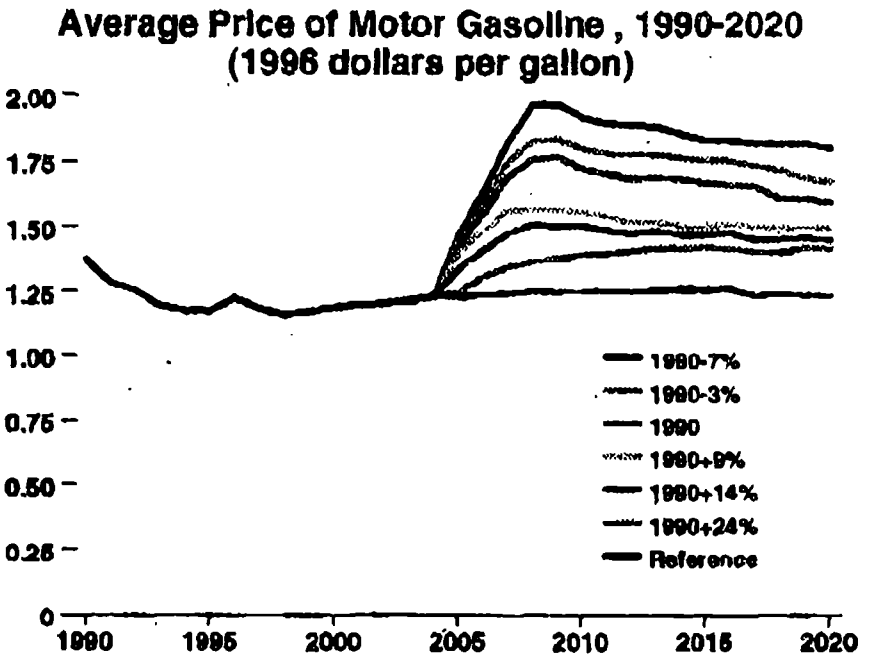


Figure 7

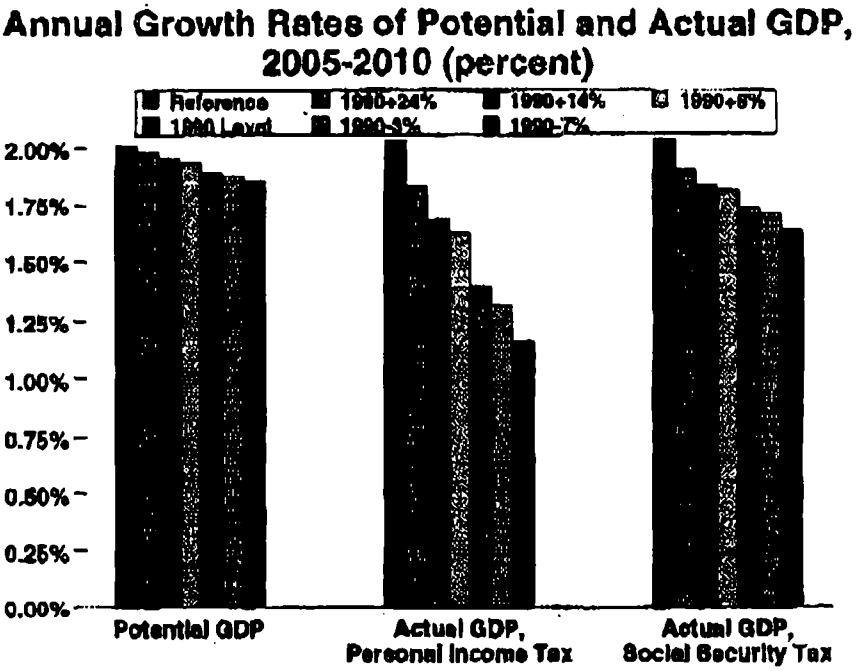
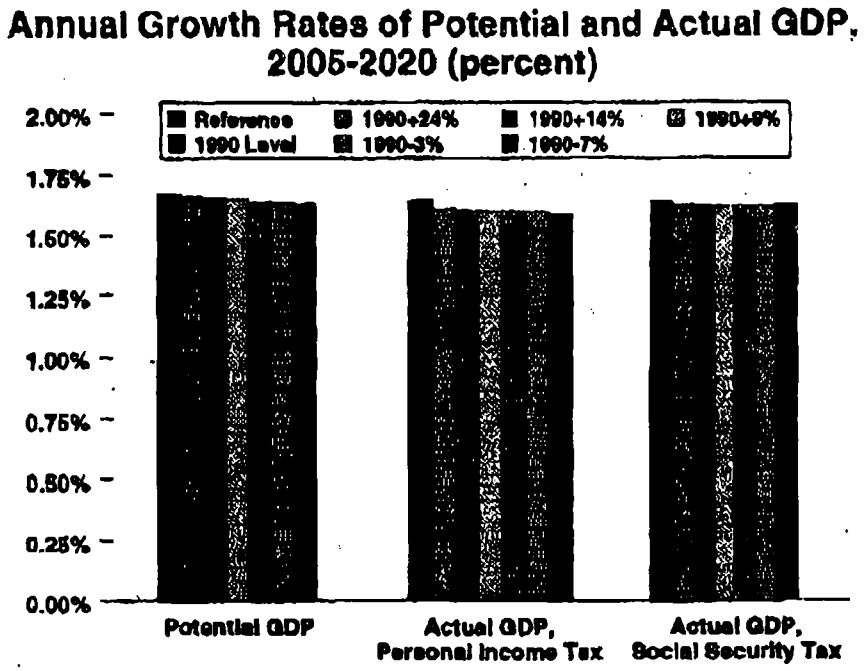


Figure 8



The Kyoto Protocol: Severe Economic Consequences

Agriculture Would Suffer Significant Losses

Testimony of Mary H. Novak
Senior Vice President, WEFA, Inc.
Senate Committee on Agriculture, Nutrition, and Forestry

Despite the uncertainty about the significance of global warming and the projected high costs of plans to reduce carbon emissions, the Administration has proposed signing the Kyoto Protocol, an international agreement to reduce greenhouse gas emissions.

Disavowing the growing skepticism in the scientific community that global warming is occurring, the Administration has announced its intention to sign the Kyoto Protocol to legally bind the U.S. to reduce future greenhouse gas emissions. The Kyoto protocol (summarized below) would commit the U.S. to a costly effort to reduce GHG emissions 7% below the 1990 level.

Summary of the Kyoto Protocol

- The Administration has committed the U.S. to reduce greenhouse gas emissions 7% below 1990 levels by 2010.
- Other Annex 1 nations have committed to reducing greenhouse gas emissions. The European Union (EU) nations agreed to reduce emissions to 8% below 1990 levels, under the proviso that they would work under an EU "bubble".
- The protocol contains no commitments for developing countries to reduce greenhouse gas emissions. In addition, the developing countries did not agree on a voluntary process for reducing or limiting their emissions.
- Emissions trading as a concept is in the protocol. However, trading is limited to Annex I Parties only. Further, all the details, such as the principles, modalities, rules, guidelines, verification, reporting and accountability are left to be worked out at future meetings. In an Annex I-only trading system, the main sellers will be Russia and Ukraine.
- Joint Implementation (JI) is now linked to a Clean Development Mechanism (CDM), a new UN body that will certify JI projects. Participating companies will contribute a share of the profits from their JI projects to this body to cover administrative costs and to help developing countries with the costs of adaptation to climate change.
- Compliance issues have been left to future discussions.

Implementing the Kyoto Protocol would mean sharply higher prices for energy and electricity. Higher energy costs would not only reduce US living standards, but would give developing countries a competitive advantage over the US and other developed economies.

Implementing the Kyoto Protocol would mean sharply higher prices for energy and electricity. The Kyoto Protocol does not require developing nations to participate in reducing GHG emissions. Therefore, higher energy costs in the U.S. would not only reduce U.S. living standards, but would give developing countries--such as Mexico, China, Korea, Indonesia, Brazil and others--a competitive advantage over the U.S. and other developed economies.

WEFA, Inc. estimates that a carbon fee of approximately $265 per metric ton would be required to reduce 2010 emissions 7% below 1990 levels. As a result of the carbon fees:

- Total output in the U.S. (GDP) would fall more than 3.0% below baseline projections.
- The U.S. would lose nearly 2.5 million jobs.
- The output losses in the agriculture industry would exceed 2% per year.

Reducing Carbon Emissions Below 1990 Levels: Uncertain Benefits and High Costs

The Science: Is Global Warming Occurring?

Implementing the Kyoto Protocol, which would entail large economic losses and dislocations, can only be justified to forestall certain catastrophic environmental consequences.

Is global warming occurring? Noted scientists from leading academic institutions have recently expressed the view that there is little conclusive evidence that the earth is warming, noting:

- Man-made greenhouse gases (GHG) account for only 3% of the greenhouse gases in the atmosphere.
- Satellite temperature records since 1979 show no warming, but do show a statistically significant cooling trend.
- The observed global temperature increase of 1 degree over the last century is well within the range of natural variation. Most of that increase occurred prior to 1940.
- 50-70% of temperature change since 1890 can be accounted for by changes in solar radiation.

The scientific basis for the Kyoto Protocol needs to be revisited given the weighing-in of pre-eminent scientists that there is little evidence of a warming trend.

All scientists would agree that the increase in greenhouse gases in the atmosphere requires intensive research, but a growing number of scientists are calling for a longer term assessment of the impact this increase in GHG concentrations may have on the environment. Results from very recent studies suggest that natural variation in the earth's temperature may play a greater than expected role in observed temperature changes. If so, this should reduce concerns over man's role in global warming.

Technology is the Answer, Timing is Key

Reviewing the scientific evidence to ensure the necessity of reducing U.S. dependency on carbon-based energy, and looking for a longer-term solution will allow the economic growth needed to meet this or another potentially catastrophic change.

The Kyoto Protocol calls for early actions to reduce greenhouse gas emissions. Implementing the Protocol would require significant reductions in energy use. Energy plays an important role in creating and sustaining economic prosperity. Breaking the link between energy and economic performance would require substantial innovation. A vast amount of technological improvement is expected in the business-as-usual predictions. Meeting this near-term target by doubling, perhaps tripling, this rate of improvement in energy efficiency will be extremely costly.

Reviewing the scientific evidence to ensure the necessity of reducing U.S. dependency on carbon-based energy, and looking for a longer-term solution will allow the economic growth needed to meet this or another potentially catastrophic change.

Reducing Carbon Emissions: Severe Economic Consequences

WEFA, Inc. is currently performing an analysis of the Kyoto Protocol, updating a

prior study[1] of the much less ambitious goal of the U.S. reducing carbon emissions to the 1990 level. Due to the high degree of uncertainty in measuring non-carbon emissions much less reductions in this category, WEFA has chosen to analyze the economic cost of reducing carbon emissions from the energy sector to achieve the 7% reduction goal under the Kyoto Protocol and earlier to meet the Administration's goal of stabilizing carbon emissions at 1990 levels.

WEFA has assumed intra-country tradable permits at the first point of purchase Analytically, the intra-country tradable permits are similar to a carbon tax or fee.

The results measure the minimum economic impact of imposing a carbon emission abatement policy.

For these analyses, WEFA has assumed intra-country tradable permits at the first point of purchase Analytically, the intra-country tradable permits are similar to a carbon tax or fee. As a fee/tax directly associated with the emissions to be controlled represents the marginal cost of abatement, it theoretically is the least-cost means of reducing carbon emissions. Given that carbon permit fees/taxes are the most efficient means of reducing carbon emissions, the results measure the minimum economic impact of imposing a carbon emission abatement policy.

International Trading of Carbon Emission Permits

The WEFA analyses do not include international trading of carbon emission permits. International trading of carbon emission permits could potentially reduce the cost of achieving carbon emission targets. In *concept* the Kyoto protocol allows inter-country trading of carbon emission permits. Details such as the principles, rules, verification, reporting and accountability are not addressed. Until these details are addressed it is not possible for trading to take place. Given the diverse and strongly held views about trading that were expressed in the negotiations leading to the protocol and that prevented the inclusion of trading rules in the protocol, it is unclear if and when an effective inter-country carbon emission trading program would be implemented. Further, the benefits that would actually be realized from such a program could be limited because trading would be limited to Annex I Parties only.

Given the diverse and strongly held views about trading that were expressed in the negotiations leading to the protocol and that prevented the inclusion of trading rules in the protocol, it is unclear if and when an effective inter-country carbon emission trading program would be implemented.

Working out these details to allow trading to actually take place will require overcoming difficult political, administrative and technical hurdles. To illustrate the difficulties of implementing such a system, the following briefly describes some of the details that need to be addressed.

- *Initial Allocation of Permits*: A carbon permit system would probably be implemented by issuing permits to the first seller of a product. Each country would have to determine who will get these permits and how. Permits could be issued by a lottery, auctioned off, or allocated based upon historic emissions. These permits will have substantial value and it is likely that the allocation of these permits will cause substantial political conflict within each country.
- *Verification*: Monitoring and inspection systems will have to be set up to assure that carbon emissions do not exceed the level allowed by the carbon permits owned. *Each owner* of a carbon permit would have to have a record keeping system with checks and balances that could be audited, to assure compliance with the permit system. Both physical audits of the business facilities and accounting systems would be required. If the owner of carbon permits is the government, the government would have to be audited. Controls would have be implemented to assure carbon based products are not imported from a non-participating

[1] "Global Warming: The Economic Cost of Early Action", WEFA, Inc. 1997. This two volume study on the National and State Impacts of the Administration's proposed plan for reducing greenhouse gas emissions was funded by the American Petroleum Institute, although the views expressed are strictly those of the authors.

country and sold on the black market. Given the potential magnitude of the carbon permit fees there will strong incentives to circumvent these fees.

- *Control of Permits:* Controls would have to be implemented to assure that countries do not issue more permits than allowed.
- *Record Keeping:* A central record system will have to be kept to track ownership of carbon permits. This system will have to assure seller is a legitimate owner of a carbon permit and track transactions as ownership changes.
- *Transactions costs*: While accomplishing the goals above, the administrative system must assure the cost of trading carbon emissions is low enough allow the possibility of substantial benefits from trading.

If these hurdles can be overcome it still is unknown how large the benefits from international trading of emission permits will be. As proposed in the Kyoto Protocol emissions trading is limited to Annex I Parties only. This will greatly reduce its cost effectiveness. Developing countries have resisted committing themselves to binding limits on their emissions. Yet developing countries have the least cost opportunities for reducing carbon emissions. If these countries do not participate in the plan, many businesses will move rather than pay for carbon permits. Also, the results of previous *intra*-country permit trading systems are unclear. The cost of SO_2 acid rain, emissions permits dropped substantially under a trading system. However, a very large part of the decline in these permits was a result of lower railroad rates, a result of de-regulation, which allowed low-sulfur Western coal to be transported to power plants at a low cost.

Reducing Carbon Emissions Below the 1990 Level: An Ambitious Goal

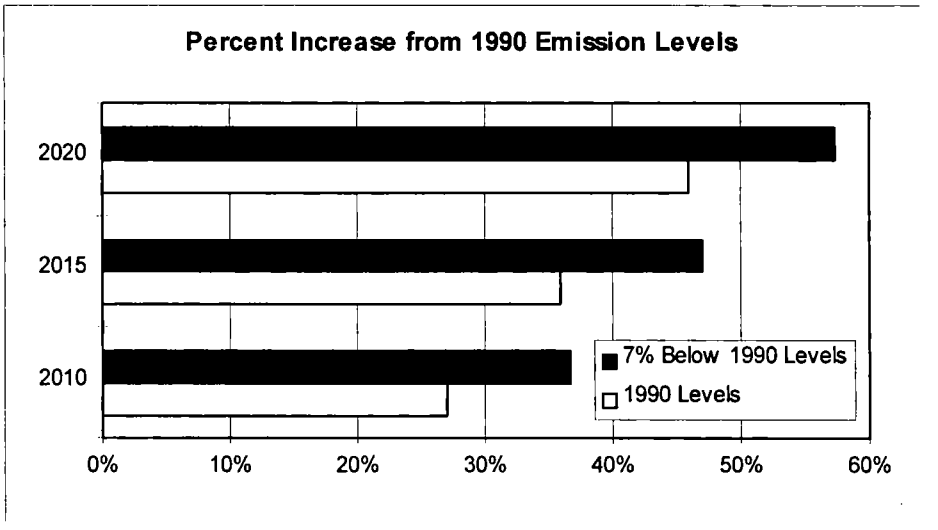
Despite projected improvements in energy efficiency of more than twice the rate during the previous decade and an increasing market share of fuels that emit less carbon, the WEFA baseline projections call for carbon emissions to be 27% above the 1990 levels by the year 2010 and 46% above the target chosen by the Administration by the year 2020. The Kyoto Protocol asks for even larger reductions. Baseline carbon emissions from the energy sector are 34% above the Kyoto target by 2010 and 53% above by 2020.

The baseline increase in carbon emissions is a result of continued economic and demographic growth as well as the retirement of nuclear plants. Achieving a dramatic reduction in carbon emissions would require substantial investments by both consumers and businesses to improve energy efficiency and to substitute low-carbon energy sources for higher carbon energy sources. Because energy-using equipment and facilities have a long life, a great deal of equipment would be replaced long before it would have been without carbon permit fees. These investments would require the diversion of funds from savings and/or investments, which would have provided other benefits such as education, health care, or new productive equipment, etc.

Carbon emissions in the baseline are projected to be 27% above 1990 levels by 2010 and 46% above by 2020.

Baseline carbon emissions are projected to by 34% above the Kyoto target by 2010 and 53% above by 2020.

U.S. Carbon Emissions from the Consumption of Energy



Achieving a dramatic reduction in carbon emissions would require substantial investments by both consumers and businesses. These investments would require the diversion of funds from education, health care and new productive equipment.

Consumers would invest in improvements to the thermal integrity of their homes and more energy efficient appliances. Businesses would invest in more energy efficient capital equipment and the improvement of process efficiency. Finally, utilities would replace coal fired power plants with fuels that have no or low carbon emissions.

Reducing Carbon Emissions Below the 1990 Level: A Pervasive Impact on the Economy and Lifestyles

Energy is a crucial resource, which affects all sectors of the U.S. economy.

Energy is a crucial resource, which affects all sectors of the U.S. economy. Expenditures on energy consumption account for approximately 7.5% of Gross Domestic Product (GDP). Individuals use energy for transportation, for basic needs such as home heating, air conditioning, cooking, lighting, as well as for other uses such as telephones, computers, televisions etc. In the commercial and government sectors, energy is used in schools, hospitals, state and federal government offices, business offices, retail establishments, and for mass transportation. In the industrial sector, energy is used to produce metals, chemicals, glass, and oil products.

Carbon Permit Fee Required to Reduce Emissions

(1996 Dollars per Metric Ton of Carbon)

	to 1990 Levels	to 7% Below 1990 Levels
2010	$200	$265
2015	$250	$310
2020	$300	$360

Consumers would see price increases dramatic price increase over baseline projections.

Requiring that consumers and businesses pay for a permit to consume energy effectively causes energy prices to increase. Consumers would see dramatic price increases over baseline projections.

Price Impact of Reducing Carbon to 1990 Levels by 2010
(Percent Difference from Baseline)

	2005	2010	2015	2020
Carbon Permit Fee ($96/metric ton)	**$100**	**$200**	**$250**	**$300**
Consumer Impacts				
Home Heating Oil	27.6	54.9	67.4	79.4
Natural Gas	24.5	50.0	63.4	79.2
Electricity	28.1	48.3	60.9	70.8
Motor Gasoline	18.0	35.6	43.1	50.1
Cents Per Gallon (96$)	21.9	44.2	54.7	65.1
Business Impacts				
Commercial Establishments				
Distillate Fuel Oil	37.1	73.7	90.1	105.9
Natural Gas	28.3	58.1	73.0	90.4
Electricity	29.5	51.8	65.7	76.7
Industrial Facilities				
Residual Fuel Oil	69.9	138.5	169.8	199.9
Natural Gas	46.4	90.7	110.2	131.7
Electricity	41.1	73.1	89.1	101.0
Trucking and Rail				
Diesel	21.1	42.1	51.8	61.3
Cents per Gallon (96$)	25.4	51.2	63.4	75.5

Consumers would see price increases of nearly 25% by 2005, and nearly 50% by 2010.

Commercial establishments, including hospitals and schools, as well as industrial facilities, would see electricity price increases of 52% by 2010.

Truckers and railroads would see their fuel costs rise by 25 cents per gallon by 2005.

These price increases would cause a major revaluation of resources (lowering the producer price of coal and petroleum, raising the producer price of natural gas) and act as a prolonged series of mini-shocks to the U.S. economy. As with the oil price shocks in the 1970s and early 1980s, inflation increases, economic activity is reduced, and unemployment rises. After 2010, the impact on inflation moderates, ultimately returning the index to baseline levels before 2020.

Underlying the loss of income, employment and output are major changes in lifestyles and severely impacted industries and regions.

The impact of these shocks are both pervasive and uneven. At a broad level, their impact can be measured by comparing the lost value of the economy's output and income as measured by GDP. Underlying the loss of income, employment and output are major changes in lifestyles.

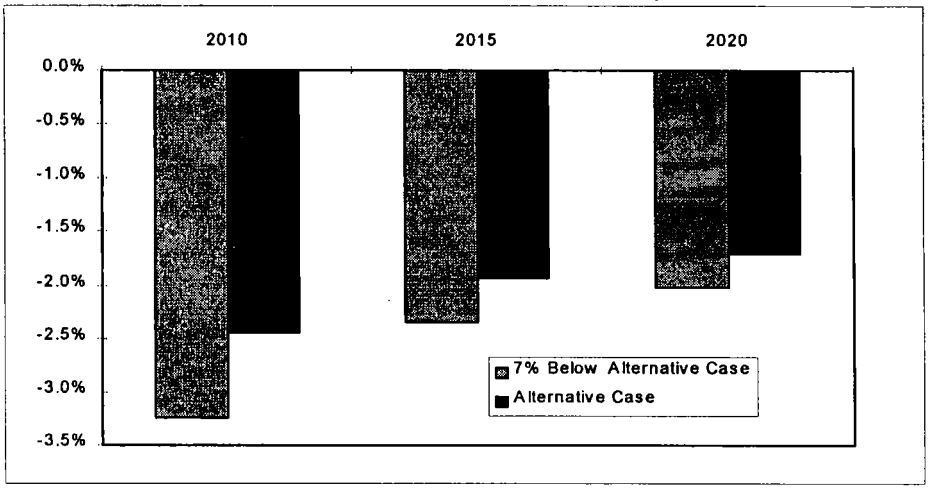
The Loss in GDP is Large

The lost GDP, just in the year 2010, exceeds 227 billion 1992 dollars, approximately equal to total federal, state and local expenditures on elementary and secondary education.

Under the Administration's carbon abatement proposal, real GDP would be 2.4% below the baseline 2010 estimate, and 1.7% below the 2020 estimate. These reductions amount to a huge economic impact. The lost GDP, just in the year 2010, is equal to 227 billion 1992 dollars, approximately equal to total federal, state and local expenditures on elementary and secondary education.

Under the Kyoto Protocol, the losses would be even greater. Preliminary estimates by WEFA report a loss of more than 3% of baseline real GDP by 2010, and the long run impact permanent loss of 2%.

Percent Differecne from Baseline GDP



Loss in GDP per Person is Significant

In the year 2010, the loss in GDP would cost each household $2,061 (in 1996$).

In the year 2010, the Kyoto Protocol would cost each household $37,390 (in 1996$).

On a per person or per household basis, the cost of adopting the Administration's carbon abatement policy results in an average real GDP loss in 2010 of $838 per person and $2,061 per household. Cumulatively, for the period 2001 to 2020, the loss of aggregate income (real GDP) per household would average almost $30,000 (in 1996$).

	Real GDP Loss per Household (1996$)	
	reduction to 1990 level	reduction to 7% below 1990 level
2005	$1,117	$1,463
2010	$2,061	$2,728
2015	$1,715	$2,083
2020	$1,585	$1,876
Cumulative Loss: 2001-2020	$29,464	$37,390

Some workers would lose their jobs through a weaker economic environment. All workers would face a slowing in their real wage growth as more workers compete for fewer jobs.

Consumers face an increase in the cost of energy, encouraging them to reduce spending on gasoline, electricity and natural gas. Some workers lose their jobs through a weaker economic environment while other workers lose relatively high paying manufacturing jobs and find only lower wage service jobs. All workers face a slowing in their real wage growth as more workers compete for fewer jobs. Hence, though the government compensates workers — through a refund of the fees collected to consume carbon-based energy resources — for their increased energy expenditures, total real disposable income falls due to reduced employment.

Reducing Carbon Emissions Below the 1990 Level: Higher Energy Costs Reduce Global Competitiveness Severely Impacting Industry

The most severely impacted industries would be: energy producing industries, industries that produce energy-intensive products, and industries that depend on export sales or face strong import competition.

The most severely impacted industries would be: energy producing industries, industries that produce energy-intensive products, and industries that depend on export sales or face strong import competition.

As the imposition of carbon limits is not borne equally by all countries — the developed economies face comparable energy price increases, but the developing countries do not — U.S. exports are relatively more expensive on the world market.

One key reason for the lower level of real GDP is reduced global competitiveness. Because the imposition of the carbon target and permit system is not borne equally by all countries — the developed economies of the OECD face comparable energy price increases, but the developing countries do not — U.S. exports are relatively more expensive on the world market, while the prices of many imported goods fall. As a consequence, exports are lowered dramatically, while imports are increased substantially. Real net exports — the difference between total exports and total imports of goods and services — are significantly lower after the imposition of the policy to limit carbon emissions. This effect would be particularly problematic for:

- the chemicals and paper industries, which are both energy–intensive and already subject to stiff price competition from new producers in developing countries,
- the textile and apparel industries, which have difficulty competing on price due to higher U.S. labor rates,
- the computer and electronic products industries, particularly from imports. (It is also worth noting that the trade deficit in this area, an emerging issue even in the baseline economic assessment, would escalate dramatically under the carbon emission stabilization case.)
- The agriculture industry would loss approximately 2% of output relative to baseline projections. Increased costs of fertilizers compounded by loss of international markets would hit this industry hard.

Statement of the
Global Climate Coalition
Before the
House Committee on Science
February 4, 1998

Constance D. Holmes
Chairman, Global Climate Coalition
Sr. Vice President, Policy, The National Mining Association

Mr. Chairman and members of the Committee, I am Connie Holmes, chair of the Global Climate Coalition (GCC). GCC has been actively engaged in both the international negotiations and the domestic debate on climate for over 8 years. Our members form the backbone of the American economy and represent more than 230,000 companies from manufacturing, agriculture, forest management, transportation, energy, utilities and mining. Our members range from the smallest companies to major industry.

At the outset, let me express our appreciation to the members of the House, and especially to you as chair of the House Climate Observer Group appointed by Speaker Gingrich. Your presence at the recent Kyoto negotiations was invaluable, Mr. Chairman and we hope that the Observer Group remains as active in 1998 as you were in 1997. I do not need to try to recount the Kyoto experience to you except to note that as unusual an event as it might have appeared to you and others, it was, in fact, very similar to the negotiating conference in Berlin in 1995 and the decisions that led to Kyoto. There is one major difference however, the outcome of Berlin was a mandate to negotiate. The outcome of Kyoto is a protocol that will ultimately be presented to the Senate and, if ratified, will be a legally binding treaty with which the American people must comply – no matter what the effects on our economy, our international competitiveness, our employment level or our national sovereignty.

The GCC welcomes this opportunity to offer the Committee its views on the Kyoto Protocol and its very real implications for the United States.

The members of the GCC accept that potential human induced climate change is a serious concern that needs to be addressed. The issue is not action versus no action. The issue is

what constitutes responsible action and the Kyoto Protocol is not responsible action. It is a flawed agreement and cannot be salvaged with bilateral Band-Aids or further negotiations in Bonn, Buenos Aires or elsewhere. It is not a global agreement and will not work. Thus, we recommend that the President not sign and that the Congress not approve the Kyoto Protocol.

The Protocol is flawed for several reasons.

First, the agreement reached in Kyoto on December 10-11, 1997 is not an effective or equitable climate policy and may never be regardless of U.S. efforts. Major elements remain to be negotiated, and until those elements are known and analyzed, the full impor of this proposed protocol can not be understood.

Just a few examples of the major decisions outstanding, and left to further negotiation illustrate the difficulty of obtaining a workable agreement: rules for international emissions trading; the rules for the Clean Development Fund; and the methodologies for measuring emissions from sources and removals by sinks. These will apparently be done as "decisions" of the Conference of the Parties since it is not possible to "amend" a protocol that is not yet in force. These COP decisions made by some 160 nations, which at the bottom line will be a big determining factor in US economic and energy policy in the future, may evade the Senate's review.

Compliance and enforcement are yet other questions that have been deferred until after ratification of the Protocol. So again, Congress is being asked to approve an incomplete package.

These are fundamental flaws, Mr. Chairman, whether or not the science of climate change gets any more certain.

Secondly, implementing the Kyoto Protocol would result in serious harm to the U.S. economy, to U.S. families, workers and businesses. These costs are spelled out later. Here it is important to note that the Kyoto Protocol would require the U.S. to cede to a UN bureaucracy the powers we now use to set the pace of our economic growth, ou

production of goods and services, and the creation of new jobs. This form on unilateral economic disarmament makes no sense.

Third, as costly as the regulatory regime that would be created by the Kyoto Protocol in its present form might be, it would produce little or no discernible environmental benefit, as the Chairman Emeritus of the UN Intergovernmental Panel on Climate Change, Bert Bolin, pointed out again in an article in SCIENCE on January 16, 1998.

Fourthly, even the Administration agrees that the Kyoto Protocol in its present form does not meet the requirements of S. Res. 98 with regard to participation by developing nations. Knowing that, the Administration had the choice of walking away from the negotiating table in Kyoto. Instead, it said it will not accept binding commitments until "meaningful" participation of developing nations is achieved. Mr. Chairman, you know from your own conversations with other delegates in Kyoto, the likelihood of that happening is extremely small. Nevertheless, the Administration has also announced, and the President reaffirmed in his State of the Union message, that it will start right now to take steps to meet the goals of the Kyoto Protocol regardless of S.Res.98. In light of this, one can only wonder how any more seriously developing nations will take future efforts by the Administration to obtain their participation. This is unlikely to be viewed as negotiating from a position of strength.

S. Res. 98 does not endorse binding commitments for the U.S. unless a protocol also includes binding commitments for all other parities. This is not a case of "rich" nations versus "poor" nations, some of whom are not particularly poor. A two-tier system, as currently envisioned by the Kyoto Protocol is unworkable, economically or environmentally.

The Kyoto Protocol is Fatally Flawed

As noted at the outset, the Kyoto Protocol is fatally flawed and may not be "fixable." It is the product of a negotiating process, begun three years ago in Berlin, that leaped from a false premise--that voluntary measures are a total failure--to an erroneous conclusion--that developed nations alone must take mandatory steps to limit greenhouse gas

emissions. Since Berlin, some Administration officials have privately admitted that the Berlin Mandate was a bad agreement. But now we have a protocol that will never produce cost-effective equitable policies.

- It sets a U.S. emissions target, which cannot be met without causing severe economic and social dislocation.
- It transfers power to UN bureaucrats who could intrude into U.S. legislative and Constitutional processes by controlling U.S. economic growth, limiting the conduct of foreign policy by exempting only those greenhouse emissions that occur from UN sponsored "multilateral operations."
- It prohibits Senate reservations and modification to the Protocol, and potential allows for future tightening of emissions targets without explicit Senate approval.
- Its costs are a "stealth tax" on American consumers and businesses and it creates a UN bureaucracy that likely would be dominated by countries quite willing to use provisions in the Kyoto Protocol to impose economic and social change on U.S. families, workers and businesses--for little, if any, environmental gain.

Americans need to be informed. People need to know that the U.S. Energy Information Administration (EIA) estimates that 2010 U.S. carbon emissions will be 44% above the Kyoto target. And they need to know that compliance with the Protocol could:

o Cost the American economy about 3% of GDP or about $300 billion per year in lost economic activity by 2010.
o Cut the average household income $2,000--annually;
o Produce 2.5 million fewer jobs in 2010 than now projected;
o Reduce business investments by $35 billion/year; and
o At least double U.S. environmental compliance costs.
(Please see Appendix B.)

U.S. officials claim that "market-based instruments," such as Joint Implementation (JI) and emissions trading, will lower costs dramatically. But joint implementation barely survived as a concept in the Kyoto Protocol and then only among Annex One countries.

Projects within the developing world must now be accepted by a "Clean Development Mechanism". The final design of both JI and the CDM --and the issue of costs and credit--will be determined later by a new UN bureaucracy, which also must be created.

Emissions trading suffered a similar setback. Administration officials had argued that the sulfur dioxide trading program, a part of the Clean Air Act Amendment, provided an effective model for trading greenhouse gas emission permits. The SO2 program covers one gas, only part of one industry, and is entirely domestic. Further, the "jury is still out" with respect to permit costs. They are lower today than expected, but when phase two of the Clean Air Act takes effect in 2000 with broader more stringent restrictions on SO2 emissions, and when the emissions that have been "banked" are used, prices are likely to rise significantly.

Creating an effective international emissions trading program covering six gases and all household, commercial, industrial, agricultural, forestry and related sources of greenhouse gas emissions is a far greater challenge. The difficulties experienced by the UN weapons Inspection Program in one nation alone - Iraq - and the routine piracy of American intellectual property despite international trademark and copyright laws are better analogies of the prospects, and difficulties, of a UN emissions trading program.

Apparently, we are supposed to overlook the fact that no international body exists to allocate, monitor and enforce such a program. Nor, if everything fell perfectly in place, would the trading concept outlined in the Kyoto Protocol achieve its original goal--dramatically cutting costs as well as emissions. Instead, the Kyoto agreement limits trading to Annex I, or industrialized countries only. This means that the least costly opportunities to reduce emissions--opportunities located largely in developing countries--are off the table. As now envisioned, the trading program outlined in the Kyoto Protocol could cost the United States two or three times what the Electric Power Research Institute estimates would be case if all nations freely traded.

The GCC could list other concerns and cases of mission creep. But it's clear that, by the Administration's own standards, the Kyoto Protocol is deeply flawed and fundamentally inconsistent with its stated negotiating position. To remedy this situation, the GCC

strongly urges U.S. officials to set aside the Kyoto Protocol and start over. If key developing countries are not brought on board as meaningful participants in a new climate agreement, efforts to "fix" or "complete" the flawed Kyoto Protocol will divert us from the real goal of taking reasonable steps to prevent potential human interference with the climate system. Indeed, "fixing" the Kyoto Protocol can only lead to the systematic dismantling of the American economy.

Dismantling the U.S. Economy

Efforts to implement the Kyoto Protocol will prove enormously costly--and perhaps impossible. This is a statement of economic fact supported by analysis, historical experience and common sense.

An October 1997 Energy Information Agency study further demonstrated the high cost of unilateral U.S. economic disarmament. EIA's "Service Report: Analysis of Carbon Stabilization Cases" incorporates fairly optimistic assumptions about technology innovation and capital stock turnover. Its reference case is emissions stabilization- not a 7% reduction. It examines both domestic and a global trading option.

In a domestic emissions trading system, permits lead to higher energy prices in order to encourage people to consume less. How much would energy prices rise? Using EIA's October 1997 scenario of returning U.S. carbon emissions to 1990 levels would increase consumer and business--and government-- expenditures on energy in 2010 by about $190 billion (in 1995 dollars). This includes roughly a $46 billion increase in residential expenditures on energy, $29 billion by the commercial sector, $65 billion by the industrial sector, and $51 billion by the transportation sector.

In an international trading regime, those costs would come down somewhat but still remain substantial. Under EIA's global emissions trading scenario, the United States would likely send $10 to $12 billion--annually--to foreign countries in exchange for greenhouse emission permits to do the things we're already doing. And the Kyoto Protocol does not allow truly global emissions trading. Regardless of how the Kyoto trading regime is designed, American workers, consumers and businesses will have great difficulty paying for--or stomaching--a stealth tax that, in reality, is massive foreign aid

to a few countries. (The EIA report is attached as Appendix C.)

The closest example we have is the energy price shocks of the 1970s and early 1980s. During the 13 years between 1973 and 1985, real U.S. energy prices quadrupled. We experienced three recessions and GDP declined in four years. Because of these changes, energy use merely stabilized over a 10 year period as the ratio between carbon input and GDP declined about 2.3% per year **[See Appendix D]**. To cut U.S. emissions during a similar period of time ahead of us--from 1998 to 2010--the U.S. carbon to GDP ratio will have to decline 3.8% per year. Let me emphasize: to meet the Kyoto target, the U.S. carbon/GDP ratio must decline 70% more rapidly than in a period when real energy prices quadrupled and U.S. economic growth collapsed. In short, history informs us that if regulation or legislation is used, in the name of the Kyoto Protocol, to sharply increase the price of coal, home heating oil, gasoline and diesel and aviation fuels, the U.S. economy will be destabilized and a prolonged recession could follow. The gas lines and rationing of the 1970s pale by comparison.

It's worth repeating that government--not industry--analysts conducted this study. And it's worth remembering the impact on personal lives of the 1970 and 1980 energy price shocks. Some may try to avoid these unpleasant truths by saying that the EIA results are an isolated example, or that technology will find an answer. But that's not the case. EIA's latest report is supported, directly and indirectly, by other government and independent studies, including analyses by WEFA, Inc, DRI/McGraw-Hill and Charles River Associates, among other independent firms, as well as by noted professors at Harvard, Yale, the Massachusetts Institute of Technology and Stanford University.

Moreover, the Administration's own efforts to find acceptable "solutions" to limiting near-term U.S. greenhouse emissions supports industry's assertion that quickly switching from fossil fuels to non-carbon technologies would be very costly. Here is a quick summary of Administration efforts since the Berlin Mandate:

- On June 6-7, 1996, the Administration held a "Climate Change Analysis Workshop" in Springfield, Virginia. The government's Interagency Analytic Team released a study which argued that new technologies could

stabilize emissions by 2010 at no cost, while virtually eliminating corporate income taxes. A DOE study released at the same conference showed a near-term loss in GDP.

o In July, 1996 at the Second Meeting of the Conference of the Parties, then-Undersecretary of State Tim Wirth sought to remedy these discrepancies by announcing in Geneva that the Department of Commerce would lead the Administration's effort to resolve methodological differences and to provide Congress and industry the results of its analysis by the year's end.

o In late 1996, the Administration failed to release its promised Argonne National Laboratory study of climate policy impacts on six energy-intensive industries. Leaked to the press in April, 1997, the Argonne study showed "devastating" impacts on several key industries and a loss of jobs, capital and technology to overseas competitors.

o Shortly after resigning in 1997 as director of the government's interagency analytic team, Dr. Everett Ehrlich, stated in a *Washington Post* op-ed that gasoline pump prices would need to rise 25 cents a gallon to achieve stabilization.

o During July 17, 1997 testimony before the Senate Committee on Environment and Public Works, Dr. Janet Yellen, chair of the President's Council of Economic Advisers, said that "the effort to develop a model or set of models that can give us a definitive answer to the economic impacts of a given climate change policy is futile."

Nevertheless, some officials argue that a "Five Labs" study completed late last year demonstrates that technology--and a $25 to $50/ton carbon tax--could stabilize 2010 greenhouse emissions around 1990 levels. Setting aside the unrealistic assumptions regarding technology innovation and diffusion, stabilization is not what the Kyoto Protocol calls for--it requires the U.S. to cut--and keep--U.S. emissions 7% below 1990 levels in little more than a decade.

Common sense argues against a quick technology fix. Technology is a powerful tool. But inventions cannot be scheduled, development costs are not free, and the replacement of existing capital stock with more energy-efficient processes and equipment would take decades and cost trillions of dollars. The other options--rationing and/or sharply higher energy taxes--are as politically unacceptable as they are socially and economically destructive. The Global Climate Coalition believes that the Kyoto Protocol paints the United States into a corner.

Either approach--using taxes or rationing to sharply reduce energy use, or subsidizing some technologies while setting standards aimed at quickly phasing out some fuels while increasing the use of less carbon-intensive technologies or processes--would cause substantial harm to the U.S. economy. No doubt such policies would reduce emissions somewhat. But the economic and political costs of implementing policies that fulfilled the U.S. pledge in Kyoto would be enormous. And, even if Americans agreed to shoulder this burden indefinitely, draconian domestic policies would have little or no environmental impact. This would only happen if developing countries also took meaningful--and simultaneous--steps to limit their emissions.

Sound science and Senate Resolution 98 present a far better approach than the Kyoto Protocol to reducing any human risk to the climate.

Climate change is a bipartisan issue. It is bipartisan because scienctific fact doesn't have to answer to individual or party preferences. Climate change is a bipartisan issue as well because of the enormous economic and social costs associated with any attempt to radically alter U.S. energy patterns. Representatives of labor, agriculture, and business and industry groups recognize this, and worked hard in Kyoto to voice their opposition to a bad agreement. Members of this Committee, other House committees and the Senate also sent observers. Like you, the Global Climate Coalition regards climate change as a legitimate scientific, economic and policy issue. But somehow, we've gotten off the track.

One way back is to return to the science. Everyone present knows that the 1995 Intergovernmental Panel on Climate Change concluded that "the balance of evidence

suggests a discernible human influence on global climate." The two sentences in the report which precede this statement are never quoted, but they state: "Our ability to quantify the human influence on global climate is currently limited because the expected signal is still emerging from the noise of natural variability, and because there are uncertainties in key factors. These include the magnitude and patterns of long term variability and the time-evolving pattern of forcing by, and response to, changes in concentrations of greenhouse gases and aerosols, and land surface changes."

In 1997, the three lead authors of that chapter--Working Group I, Chapter 8--had this to say about the use of the one sentence of the report:

> "It's unfortunate that many people read the media hype before they read the chapter....I think the caveats are there. We say quite clearly that few scientists would say the attribution issue was a done deal." Dr. Benjamin Santer, Lawrence Livermore National Laboratory, *Science*, Vol. 276, May 16, 1997.
>
> "We're in a position here scientifically where we sort of see the smoking gun, if you wish, but we don't know whose prints are on the gun." Dr. Tim Barnett, Scripps Institute of Oceanography, Associated Press, October 6, 1997.
>
> "Just from a pure climate point of view, another 20 years of doing nothing is unlikely to mess things up." Dr. Tom Wigley, National Center for Atmospheric Research, *The New York Times*, September 9, 1997.

Additional quotes by leading scientists are included in **Appendix E.**

Climate change is a long-term issue, not an imminent crisis. Imposing a quick "fix" now on an uninformed and reluctant public runs the risk of depleting political resolve that later may be needed.

A far better approach than the Kyoto Protocol is set forth in Senate Resolution 98:

"(1) the United States should not be a signatory to any protocol to, or other agreement regarding, the United Nations Framework Convention on Climate Change of 1992, at negotiations in Kyoto in December 1997, or thereafter, which would–

(A) mandate new commitments to limit or reduce greenhouse gas emissions for the Annex I Parties, unless the protocol or other agreement also mandates new specific scheduled commitments to limit or reduce greenhouse gas emissions for Developing Country Parties within the same compliance period, or

(B) would result in serious harm to the economy of the United States; and

(2) any such protocol or other agreement which would require the advice and consent of the Senate to ratification should be accompanied by a detailed explanation of any legislation or regulatory actions that may be required to implement the protocol or other agreement and should also be accompanied by an analysis of the detailed financial costs and other impacts on the economy of the United States which would be incurred by the implementation of the protocol or other agreement."

By appropriately balancing economic and environmental concerns, S.R. 98 takes a long-range, global approach and calls on developing countries to agree to take meaningful action in similar compliance periods before the U.S. moves forward on this important issue.(See Appendix F.) The GCC supports this approach. We also support voluntary mitigation activities, continued research to reduce scientific uncertainties, further exploration of the benefits that might be realized under global JI and emissions trading programs, and open and public debate of this important policy issue.

Finally, we urge the President not to sign the Kyoto Protocol. The flaws in the agreement cannot be defended, explained or even remedied through further negotiations. Efforts to implement it would cause serious damage to the U.S. economy while providing little, if any, reduction in the risk that human activities are adversely and substantially affecting global climate.

Subcommittee on National Economic Growth,
Natural Resources, and Regulatory Affairs
Hearing: Kyoto Protocol: Is the Clinton-Gore Administration Selling Out Americans?
April 23, 1998
11:30 AM
2154 Rayburn House Office Building

WITNESS LIST

Panel I

Senator Chuck Hagel
Representative Ken Calvert
Representative Ralph Hall
Representative Joe Knollenberg
Representative Robert Wise
Representative Karen McCarthy
Representative George Miller
Representative Frank Pallone

Panel II

John Passacantando, President & Executive Director, Ozone Action
Daniel Lashof, Senior Scientist, Natural Resources Defense Council
Don Crawford, auto worker from Indiana
Sam Darwin, corn farmer from Alabama
Joyce Brinner, Principal, Standard & Poor's DRI
Mary Novak, Senior VP, WEFA, Inc.

Panel III

William A. Walaska, State Senator, State of Rhode Island Senate
Tom Alley, State Representative, Michigan House of Representatives
Beulah Coughenour, City-County Council Member,
Indianapolis/Marion County City-County Council
Robert Johnson, senior citizen from Maryland
Judy Kent, consumer and housewife from Virginia

Panel IV

Margo Thorning, Senior VP and Chief Economist, American Council for Capital Formation
Stephen Fuller, Professor of Public Policy & Regional Development, George Mason University
Thomas Gale Moore, Senior Fellow, Hoover Institution

Panel V

Edward Montgomery, Chief Economist, Department of Labor
Dan Reicher, Assistant Secretary for Energy Efficiency and Renewable Energy, DOE
David Gardiner, Assistant Administrator for Policy, Planning, & Evaluation, EPA

Panel VI

Harvey Ruvin, Clerk, Dade County Courthouse
Lloyd Eagan, Director, Wisconsin Bureau of Air Management
James Crossman, President, Financial Energy Management, Inc.
Dr. Paul Epstein, Director, Center for Health & Global Environment, Cambridge Hospital

NOTICE

PLEASE NOTE THE LOCATION CHANGE FOR THIS HEARING

TO: *Members of the Committee on Government Reform and Oversight Subcommittee on National Economic Growth, Natural Resources, and Regulatory Affairs*

There will be a hearing of the

NATIONAL ECONOMIC GROWTH, NATURAL RESOURCES, AND REGULATORY AFFAIRS SUBCOMMITTEE

on

THURSDAY, APRIL 23, 1998

at **11:30 A.M.**

In room **2154** *Rayburn House Office Building*

Topic of Hearing:

"The Kyoto Protocol: Is the Clinton-Gore Administration Selling Our Americans?"

**If you are in need of special accommodations based on a disability, please contact Andrew Wilder at least 4 business days prior to the hearing at (202) 225-4407 **

April 17, 1998

Subcommittee on National Economic Growth,
Natural Resources, and Regulatory Affairs
Hearing: Kyoto Protocol: Is the Clinton-Gore Administration Selling Out Americans?
April 23, 1998
11:30 AM
2154 Rayburn House Office Building

WITNESS LIST

Miller
Pallone
Gilchrest
McCarthy

Panel I
Senator Chuck Hagel
Representative Ken Calvert
Representative Ralph Hall
Representative Joe Knollenberg
Representative Charles Stenholm
Representative Robert Wise

Panel II
Edward Montgomery, Chief Economist, Department of Labor
Dan Reicher, Assistant Secretary for Energy Efficiency and Renewable Energy, DOE
David Gardiner, Assistant Administrator for Policy, Planning, & Evaluation, EPA
John Passacantando, President & Executive Director, Ozone Action
Daniel Lashof, Senior Scientist, Natural Resources Defense Council

Panel III
William A. Walaska, State Senator, State of Rhode Island Senate
Tom Alley, State Representative, Michigan House of Representatives
Beulah Coughenour, City-County Council Member,
Indianapolis/Marion County City-County Council

Panel IV
Don Crawford, auto worker from Indiana
Sam Darwin, corn farmer from Alabama
Robert Johnson, senior citizen from Maryland
Judy Kent, consumer and housewife from Virginia

Panel V
Mary Novak, Senior VP, WEFA, Inc.
Margo Thorning, Senior VP and Chief Economist, American Council for Capital Formation
Joyce Brinner, Principal, Standard & Poor's DRI
Stephen Fuller, Professor of Public Policy & Regional Development, George Mason University
Thomas Gale Moore, Senior Fellow, Hoover Institution

Panel VI
Harvey Ruvin, Clerk, Dade County Courthouse
Lloyd Eagan, Director, Wisconsin Bureau of Air Management
James Crossman, President, Financial Energy Management, Inc.
Dr. Paul Epstein, Director, Center for Health & Global Environment, Cambridge Hospital

mandated seven percent reduction: and 4) the impact that energy price increases would have on U.S. growth, trade competitiveness, and employment.

The hearing will consist of six panels. These will include a citizen panel, an economics expert panel, a state and local elected official panel, and a panel with officials from the Department of Energy, the Environmental Protection Agency, the Department of Labor, and representatives of environmental groups.

OPTIONAL FORM 99 (7-90)

FAX TRANSMITTAL

To Julie		# of pages ▸	
Dept./Agency		From Alys	
Fax #	348-1163	Phone #	
NSN 7540-01-317-7368	5099-101	Fax #	GENERAL SERVICES ADMINISTRATION

April 20, 1998

MEMORANDUM FOR MEMBERS OF THE SUBCOMMITTEE ON NATIONAL ECONOMIC GROWTH, NATURAL RESOURCES, AND REGULATORY AFFAIRS

FROM: David McIntosh DHM

SUBJECT: Briefing Memorandum for April 23, 1998 Hearing
"Kyoto Protocol: Is the Clinton-Gore Administration Selling Out Americans?"

On Thursday, April 23, 1998, at 11:30 a.m., in Room 2154 Rayburn House Office Building, the Subcommittee on National Economic Growth, Natural Resources, and Regulatory Affairs will hold a hearing entitled, "Kyoto Protocol: Is the Clinton-Gore Administration Selling Out Americans?" The purpose of this hearing is to examine the potential impact of the Kyoto Protocol on the U.S. economy and energy system.

On December 11, 1997, the Parties to the United Nations Framework Convention on Climate Change agreed to the Kyoto Protocol. This Protocol imposes legally binding targets and timetables on 39 developed nations (out of a total of 167 nations) for reducing emissions of six greenhouse gases. With respect to the obligations of developed countries, this Protocol imposes the greatest burdens on the United States. At Kyoto, the Clinton-Gore Administration committed the U.S. to reducing its emissions by seven percent below 1990 levels. The Protocol exempts developing countries from any restrictions regardless of their level of economic development or the quantity of greenhouse gases they emit. Huge emission producers like China, India, South Korea, Brazil, and Mexico are exempted.

Many experts believe that the Kyoto Protocol could have potentially serious consequences for Americans and that these consequences need to be fully analyzed and understood prior to Senate ratification. This hearing will provide Subcommittee members the opportunity to consider the economic implications for our country of implementing this agreement. In particular, it will permit members to examine such issues as: 1) the need to limit or reduce greenhouse gas emissions of developing countries, as well as developed nations; 2) the amount by which the U.S. would have to cut its domestic fossil fuel consumption in order to achieve its obligations under the treaty; 3) the energy prices that would be required to achieve the

Statement of Chairman David M. McIntosh
Subcommittee on National Economic Growth,
Natural Resources, and Regulatory Affairs
on
"Kyoto Protocol: Is the Clinton-Gore Administration
Selling Out Americans?"
April 23, 1998

The purpose of today's hearing is to examine the potential impact of the Kyoto Protocol on American citizens, American businesses, the U.S. economy, and the U.S. energy system. Many citizens, elected officials from federal, state, and local governments, and experts, some of whom we will hear from today, believe that this treaty, which the Clinton-Gore Administration negotiated in December 1997, could potentially have very serious consequences for Americans. They also believe that these consequences need to be fully analyzed and understood prior to any Senate consideration of the Protocol.

More than six weeks ago, in preparation for this hearing, we requested documents and information from 22 Executive Branch departments and agencies that would justify the President's $6.3 billion budget request. Our first letter was sent to the White House Office of Management and Budget (OMB) on March 2, 1998.

As material justifying the President's Budget request, the documents and information should have been readily available to respond to my inquiries. Nevertheless, almost two months later, as of five o'clock last night we had no response from OMB and responses from only five departments and agencies. Charts 1 and 2 show all the agencies to which we sent our requests and the responses received. Note all the empty boxes. In addition, the White House Counsel has blocked the production of some of the material requested on the ground that domestic budget information implicates the confidentiality of presidential decision making and U.S. foreign policy.

There is also some confusion within the Administration about whether it is requesting funds for climate change initiatives. Although the President's budget request seeks $10 million for the Department of Housing and Urban Development as one of five agencies to receive FY 99 funding, Secretary Cuomo wrote to me denying that the HUD budget request includes any funding for climate change programs. Clearly, the President and HUD have different views about HUD's involvement in climate change.

Frankly, we don't understand the Clinton-Gore Administration's withholding from Congress important information about climate change. How can the Administration expect Congress to favorably consider the President's budget request for $6.3 billion for climate change -- funds that could be devoted instead to saving Social Security, health care, or education?

The inability of the Clinton-Gore Administration to produce any explanation of the need for its huge budget request or any explanation of the impact on the American public is inexcusable. It appears to me that "The Emperor has no clothes."

Even without answers from the Clinton-Gore Administration, the witnesses today will address fundamental flaws in the Kyoto Protocol. Essentially, implementing the Kyoto Protocol would

seriously harm millions of Americans because it: (1) establishes unrealistic targets and timetables for U.S. emissions reductions; (2) gives a free ride to 128 of the 167 nations in the world, while allowing those same nations to determine policies affecting the U.S.; and (3) will result in no net environmental benefit.

Unrealistic target and timetable. By obligating the U.S. to reduce greenhouse gas emissions under this treaty by 7 percent below 1990 levels during the period from 2008 to 2012, President Clinton and Vice President Gore committed the U.S. to assuming the greatest burden of any country in the world. This target would require significant reductions in energy use within a relatively short time frame.

As we will hear today, taking such early actions to dramatically reduce emissions would require substantial investments by both consumers and businesses to improve energy efficiency and to substitute low-carbon energy sources for higher carbon energy sources. Unfortunately, it is highly unlikely that we could reduce our emissions by some 30 percent by the Kyoto deadline without significantly raising the cost of energy for American citizens and businesses.

Moreover, meeting this near-term Kyoto target by accelerating the rate of improvement in energy efficiency would be extremely costly. Because energy-using equipment and facilities have a long life, a great deal of equipment would have to be replaced prematurely.

Finally, these investments would significantly divert our limited resources away from savings and investments for the welfare and care of our children and future generations. No wonder the Administration has repeatedly stated in hearings before Congress that we must begin to take steps now, even prior to Senate ratification, so that we will not have to make the kind of drastic reductions that would otherwise be required.

The Kyoto Protocol is Patently Unfair. This treaty is also patently unfair because it exempts 77 percent of the countries from any obligations. Exempting these countries will cause Americans to see their jobs and livelihoods exported to take advantage of cheap labor, lower capital expenses and production costs, and lower environmental, health, and safety standards. Moreover, whatever relief may exist in the form of the complex emissions trading systems to be established under the Protocol, will be left to the U.N. bureaucracy, dominated by countries not subject to Protocol restrictions, to administer.

Economic Pain Without Environmental Gain. While the scientific evidence on global warming is very inconclusive, one thing is certain: the Kyoto Protocol will not result in any environmental gains. The former Chairman of the Intergovernmental Panel on Climate Change, Bert Bolin, already has noted that emissions reductions only by developed nations "would not be detectable on projected temperature increases" -- regardless of the commitments by the U.S. and other developed nations.

Moreover, by exempting such huge emissions producers as China, India, South Korea, Brazil, and Mexico, this treaty effectively prevents any net reduction of greenhouse gases in the atmosphere because the flight of industry from the United States to these countries would cause even greater emissions of greenhouse gases there, offsetting reductions achieved by the United

States and other developed countries.

What Does This All Mean for Americans? The Kyoto Protocol could become the most costly and far-reaching scheme of regulatory control this country has ever known. This treaty could result in energy rationing on a scale not seen since the stagflation and gas lines of the Carter presidency.

Gasoline prices could go up 70 cents per gallon. Commuting costs would be overwhelming for those who cannot afford to live close to work. Also, there will be no more family reunions or holiday vacations for many Americans — if Vice President Gore has his way.

Massive layoffs could result — according to the AFL-CIO as many as 1.5 million jobs may be lost by 2010. The days of full employment would be no more.

We could lose as much as $3.3 trillion in GDP between 2001 and 2020. Losses of this magnitude would make the malaise of the Carter years seem like the good old days.

Prices for consumer goods could rise more than 50 percent, driving down real wages by about $2,600 per household by 2010.

Let me give you one example of the devastation that this treaty could cause in my district in Indiana. Three years ago, foreign competition and high regulatory costs drove a thousand jobs making manual transmissions from the Borg Warner plant in Muncie to Mexico. Now, if Bill Clinton and Al Gore have their way, the remaining 1200 jobs at the plant, making transfer cases for sport utility vehicles, could be driven out because higher energy costs will make it too costly to manufacture them in the United States and because the high price of gasoline could destroy consumer demand for these vehicles.

In short, the treaty would be a massive Tax on the American Dream levied by President Clinton and Vice President Gore.

In this hearing, we will tell the American people about the real costs of Kyoto — the factories that will be closed, the jobs that will be lost, the small towns that will be boarded up, the pay cuts, the hidden tax on everything from food to family vacations, and, in short, the knife in the back of the American Worker. Despite serious doubts about the science, one thing is certain: the economic and social effects will be catastrophic. If Vice President Gore and the radical environmentalists get their way and Kyoto is implemented, Clinton-Gore will be the first Administration since Jimmy Carter's to usher in a shrinking American economy.

Implementing the Kyoto Protocol: Severe Economic Consequences

Testimony of Mary H. Novak
Senior Vice President, WEFA, Inc.
Before the House of Representatives' Committee on Government Reform and Oversight

The Administration agreed to the Kyoto Protocol, an international treaty that would legally bind the US to drastic reductions in carbon emissions.

Implementing the Kyoto Protocol would mean sharply higher prices for energy and electricity.

- **gasoline prices would rise 65 cents,**
- **industrial gas and electricity prices would double**

Higher energy costs would not only reduce US living standards, but would give developing countries a competitive advantage over the US and other developed economies.

The economic consequences would be felt across the nation. All states would suffer output and job losses.

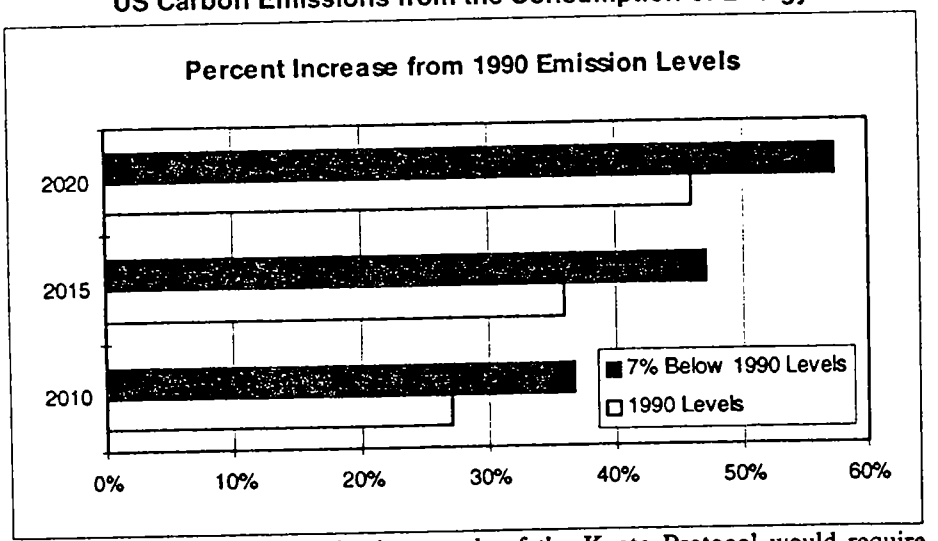
Family incomes would be reduced. The average loss in income, $2700 per family, would take a devastating toll on middle and lower income families.

The U.S. would lose more than 2.4 million jobs.

In December 1997, the Administration agreed to the Kyoto Protocol, an international treaty that would legally bind developed countries to reduce their greenhouse gas emissions. By the terms of the Protocol, the US would have to limit greenhouse gas emissions to 93% of 1990 emission levels in little more than a decade.

Meeting the goal of the Kyoto Protocol would be a daunting task. Today, carbon emissions from the energy sector (85% of total GHG emissions) exceed the goal. By late next decade, WEFA projects that carbon emissions would exceed the goal by 37%.

US Carbon Emissions from the Consumption of Energy



To achieve the emission reductions goals of the Kyoto Protocol would require sharply higher prices for energy and electricity. The Kyoto Protocol does not require developing nations to participate in reducing GHG emissions. Therefore, higher energy costs in the U.S. would not only reduce U.S. living standards, but would give developing countries--such as Mexico, China, India, Korea, Brazil and others--a competitive advantage over the U.S. and other developed economies.

WEFA estimates that a carbon fee of $265 per metric ton would be required by late next decade to reduce emissions 7% below 1990 levels, resulting in:

- **Total output in the U.S. (GDP) would fall 3.2% below baseline projections. This annual loss, $300 billion (1992$), exceeds total expenditures on primary and secondary education.**
- **The U.S. would lose more than 2.4 million jobs.**

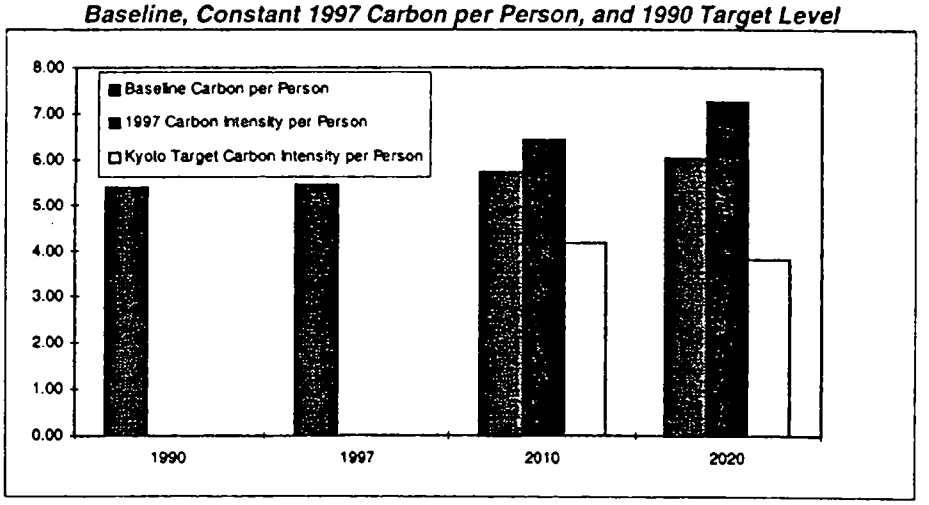
Reducing Carbon Emissions 7% Below 1990 Levels: Uncertain Benefits and High Costs

Amidst calls to sign and ratify the Kyoto Protocol, political leaders have been challenged to develop a prudent hedging strategy in the face of climate-related uncertainties. WEFA, the Energy Information Administration, other independent firms and academics have examined the costs of reducing 2010 emissions of carbon dioxide (CO2) in the United States to 1990 levels. All have estimated a high economic cost, because, without carbon limits, the economy, population and energy use are expected to grow steadily.

The target emission levels agreed to in the Kyoto Protocol are even more daunting. On a per capita basis, the Kyoto target emission level requires a 37% reduction from WEFA's baseline estimate, which includes substantial improvement in energy efficiency.

Assuming that today's carbon intensity per capita were to remain constant, carbon emissions would be 53% above the Kyoto target in 2010.

US per Capita Carbon Emissions from the Energy Sector
Baseline, Constant 1997 Carbon per Person, and 1990 Target Level



To assess the economic consequences of implementing the Kyoto Protocol, WEFA is currently updating a prior study of the much less ambitious goal of the U.S. reducing carbon emissions from the energy sector to the 1990 level.

While the Kyoto Protocol includes provisions that have been touted by its proponents as a means for alleviating the cost of complying with the Protocol's goals, these measures have not been tested and have been heavily discounted in WEFA's analysis. These provisions, which are discussed in more detail later, are currently only conceptual or have very uncertain implications for meeting the target. Measures not included in WEFA's analysis are international emission trading, sinks, the inclusion of an additional three gases, and mechanisms for promoting technology transfer.

This analysis provides a critical component in the nation's evaluation of the Kyoto Protocol: an assessment of the economic consequences the US would face signing this agreement.

Achieving the Kyoto Protocol's Emission Reductions Would Require Extraordinary Energy Price Increases

Achieving a dramatic reduction in carbon emissions would require substantial investments by both consumers and businesses. These investments would require the diversion of funds from education, health care and new productive equipment.

The baseline increase in carbon emissions is a result of continued economic and demographic growth as well as the retirement of nuclear plants. Achieving a dramatic reduction in carbon emissions would require substantial investments by both consumers and businesses to improve energy efficiency and to substitute low-carbon energy sources for higher carbon energy sources. Because energy-using equipment and facilities have a long life, a great deal of equipment would be replaced long before it would have been without carbon permit fees. These investments would require the diversion of funds from savings and/or investments, which would have provided other benefits such as education, health care, or new productive equipment, etc.

To reduce carbon emissions from the energy sector to 93% of 1990 levels by late next decade would require a carbon permit fee of $265 per metric ton (1996$). The permit fee would need to rise continuously over the longer-term, as the goal expressed on a per person basis would be tightening steadily. By 2020, WEFA estimates a cost of $360 per metric ton.

Energy Price Impact
of Limiting Carbon Emissions at 93% of 1990 Levels by 2008-2012
(Percent Difference from Baseline)

	2010	2015	2020
Carbon Permit Fee ($96/metric ton)	**$265**	**$310**	**$360**
Consumer Impacts			
Home Heating Oil	73.2	83.7	95.4
Natural Gas	65.7	78.3	94.3
Electricity	55.7	65.7	72.9
Motor Gasoline	47.5	53.6	60.2
Difference, Cents Per Gallon (96$)	59.1	68.1	78.2
Business Impacts			
Commercial Establishments			
Distillate Fuel Oil	98.3	112.0	127.3
Natural Gas	76.3	89.9	107.5
Electricity	60.2	71.3	79.4
Industrial Facilities			
Residual Fuel Oil	184.5	210.9	240.1
Natural Gas	118.6	135.5	156.4
Electricity	87.7	98.3	105.1
Trucking and Rail			
Diesel	56.2	64.4	73.6
Difference, Cents Per Gallon (96$)	68.3	78.8	90.7

Consumers would see price increases in excess of 55% for electricity and 70% for home heating oil by 2010.

Commercial establishments, including hospitals and schools, as well as industrial facilities, would see electricity price increases of 60% by 2010.

Truckers and railroads would see their fuel costs rise by nearly 70 cents per gallon by 2010.

The Kyoto Protocol: Severe Economic Consequences

Energy is a crucial resource, which affects all sectors of the U.S. economy.

Energy is a crucial resource, which affects all sectors of the U.S. economy. Expenditures on energy consumption account for approximately 7.5% of Gross Domestic Product (GDP). Individuals use energy for transportation, for basic needs such as home heating, air conditioning, cooking, lighting, as well as for other uses such as telephones, computers, televisions etc. In the commercial and government sectors, energy is used in schools, hospitals, state and federal government offices, business offices, retail establishments, and for mass transportation. In the industrial sector, energy is used to produce metals, chemicals, glass, and oil products.

Requiring that consumers and businesses pay for a permit to consume energy effectively causes energy prices to increase. These price increases would cause a major revaluation of resources (lowering the producer price of coal and petroleum, raising the producer price of natural gas) and act as a prolonged series of mini-shocks to the U.S. economy. As with the oil price shocks in the 1970s and early 1980s, inflation increases, economic activity is reduced, and unemployment rises. After 2010, the impact on inflation moderates, ultimately returning to baseline levels before 2020.

Underlying the loss of income, employment and output are major changes in lifestyles and severely impacted industries and regions.

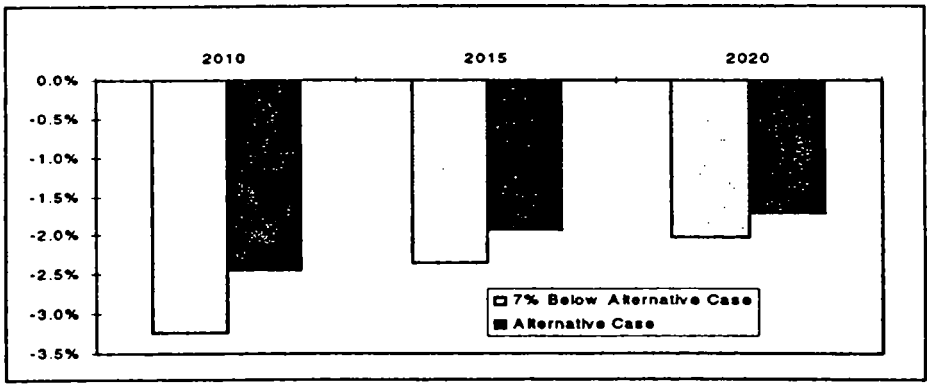
The impacts of these shocks are both pervasive and uneven. At a broad level, their impact can be measured by comparing the lost value of the economy's output and income as measured by GDP. Underlying the loss of income, employment and output are major changes in lifestyles.

The Loss in GDP is Large

The lost GDP, just in the year 2010, exceeds 300 billion 1992 dollars, approximately equal to total public and private expenditures on elementary and secondary education.

Under the Kyoto Protocol's carbon reduction regime, real GDP would be 3.2% below the baseline 2010 estimate, and 2.0% below the 2020 estimate. These reductions amount to a huge economic impact. The lost GDP, just in the year 2010, is equal to 300 billion 1992 dollars, approximately equal to total public and private expenditures on elementary and secondary education.

Gross Domestic Product
Percent Difference from Baseline



Job Losses: 2.4 million

Some workers would lose their jobs through a weaker economic environment. All workers would face a slowing in their real wage growth as more workers compete for fewer jobs.

Implementing the Kyoto Protocol would have a devastating impact on workers. Some workers lose their jobs through a weaker economic environment while other workers lose relatively high paying manufacturing jobs and find only lower wage service jobs. All workers face a slowing in their real wage growth as more workers compete for fewer jobs. Hence, though the government compensates workers — through a refund of the fees collected to consume carbon-based energy resources — for their increased energy expenditures, total real disposable income falls due to reduced employment.

Loss in GDP per Household is Significant

In the year 2010, the loss in GDP would cost each household $2,728 (in 1996$).

On a per household basis, the cost of signing the Kyoto Protocol results in an average real GDP loss in 2010 of $2,728 per household. While all consumers would feel the impact, lower income families would feel the impact of lost income and sharply higher prices for basic necessities.

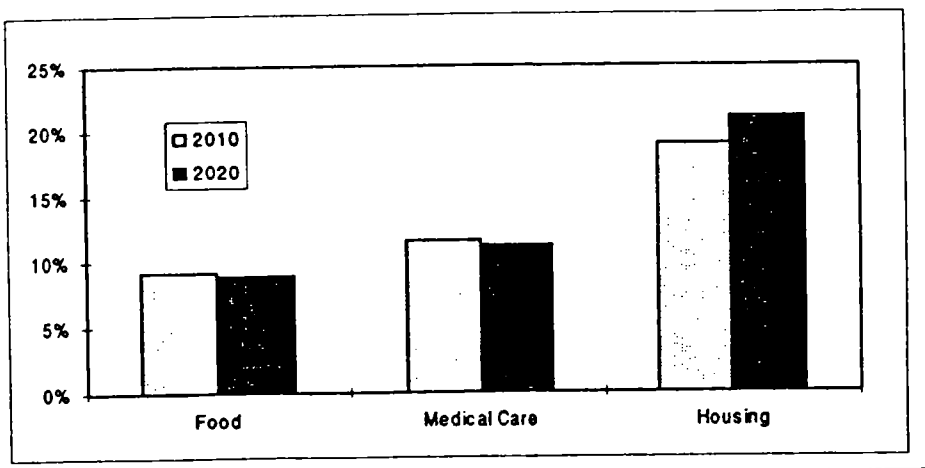
Real GDP Loss per Household (1996$)

2010	$2,728
2015	$2,083
2020	$1,876

Commodities such as food, medical care, and housing would all be at least 9% more expensive by 2020.

Throughout the forecast period, food, medical care, and housing continue to become more expensive under the carbon stabilization case. By 2020, food is nearly 9% more expensive, medical care is roughly 11% higher, and housing is nearly 21% higher than the base case.

Inflation in the Prices of Food, Medical Care, and Housing: Percent Difference 7% Carbon Limitation Case and Base Case



Loss of Global Competitiveness Leads to Output and Job Losses

The most severely impacted industries would be energy producing industries, industries that produce energy-intensive products, and industries that depend on export sales or face strong import competition.

As the imposition of carbon limits is not borne equally by all countries — the developed economies face comparable energy price increases, but the developing countries do not — U.S. exports are relatively more expensive on the world market.

The most severely impacted industries would be energy producing industries, industries that produce energy-intensive products, and industries that depend on export sales or face strong import competition. Because the imposition of the carbon target and permit system is not borne equally by all countries (the developed economies of the OECD face comparable energy price increases, but the developing countries do not) U.S. exports are relatively more expensive on the world market. As a consequence, exports are lowered dramatically, while imports are increased substantially. Real net exports — the difference between total exports and total imports of goods and services — are significantly lower after the imposition of the policy to limit carbon emissions. This effect would be particularly problematic for:

- the chemicals and paper industries, which are both energy-intensive and already subject to stiff price competition from new producers in developing countries,
- the textile and apparel industries, which have difficulty competing on price due to higher U.S. labor rates, and
- the computer and electronic products industries, particularly from imports. (It is also worth noting that the trade deficit in this area, an emerging issue even in the baseline economic assessment, would escalate dramatically under the carbon emission stabilization case.)

Reducing the Impact of the Kyoto Protocol: Price Incentives Needed to Bring Technology to Market

Implementing the Protocol would require significant reductions in energy use.

The Kyoto Protocol calls for early actions to reduce greenhouse gas emissions. Implementing the Protocol would require significant reductions in energy use. Energy plays an important role in creating and sustaining economic prosperity. Breaking the link between energy and economic performance would result in severe economic consequences.

The Administration has argued that the economic cost estimates from WEFA, the Energy Information Administration, and other independent firms and academics are overstated. Relying on several technology assessments, the Administration concludes that substantial technological progress is available with little or no price incentives.

WEFA, through its on-going assessments of energy technology and analysis of the aggregate performance of the economy in improving energy use, comes to a different conclusion. Substantial improvements in energy-efficiency particularly in newly restructured electric power markets are included in WEFA's baseline. Further efficiency gains would be increasingly expensive. The extraordinary efficiency gains required to achieve the Kyoto target would only occur in response to extraordinary price incentives.

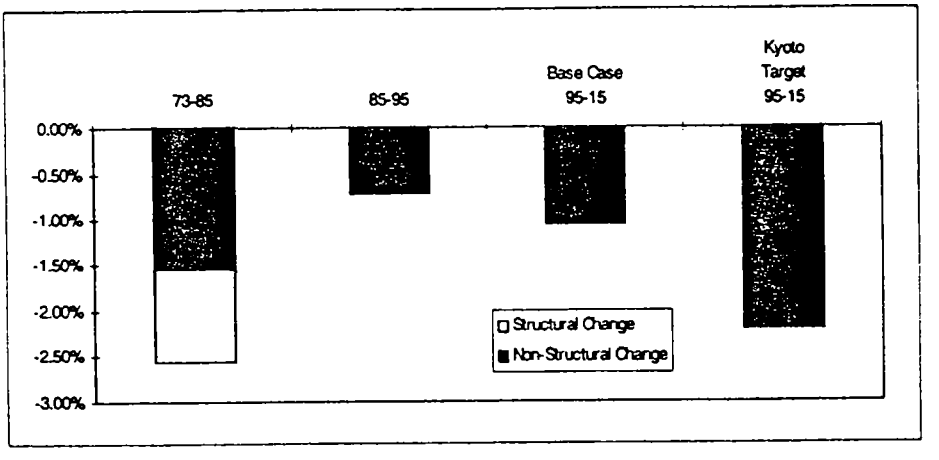
The carbon permit fees must be high in order to provide the economic incentive for dramatic improvements over a base case, which already includes many changes in it to lower carbon emissions.

The carbon fee has to bring about a large reduction in the demand for energy services, major improvements in energy efficiency, as well as improve the opportunity for substitution of low carbon and non-carbon emitting fuels. The required change in energy efficiency to meet the goal is unprecedented. As shown in the graph below, energy use per dollar of real GDP would need to improve at a rate in excess of 2.0% per year. Historically, the only period that experienced a similar rate of energy improvement was the late 1970s and early 1980s – and nearly half of that improvement is attributable to structural changes in the economy (the loss of energy intensive well-paying manufacturing jobs overseas.) Without price incentives, the goal would not be reached.

Historically, the only period that experienced a rate of energy improvement similar to the one needed to meet the Kyoto target was the late 1970s and early 1980s.

Nearly half of that improvement is attributable to structural changes in the economy (the loss of energy intensive well-paying manufacturing jobs overseas.)

Compound Annual Growth Rates in the Energy to GDP Ratio (Quadrillion BTU/Billion 1992$)



The Prospects for Emissions Trading, Sinks, Other Gases to Reduce the Economic Consequences: Untested Mechanisms Without International Support

While the Kyoto Protocol includes several provisions the Administration proposed in an effort to alleviate some of the devastating impact on the economy of meeting the negotiated target and timetable, these provisions are currently only conceptual or have very uncertain implications for meeting the target. The following provisions of the Kyoto Protocol have not been included in this analysis due to these uncertainties in their structure or implementation:

- the sequestration of carbon through forest management policies,
- emission trading between Annex 1 countries,
- and the inclusion of several other greenhouse gases.

The following provisions of the Kyoto Protocol have not been included in this analysis due to uncertainties in their structure or implementation:

- **sinks**
- **international emission trading**
- **other gases**

Sinks

While the Protocol identifies sinks as a mechanism to adjust the target limit on greenhouse gases, these are limited to forestry initiatives subject to restrictions that have not been fully specified. There are several issues that need clarification before the opportunity for using sinks to achieve the target emission reduction can be assessed, including:

- There is limited lead-time for growing trees and substantial uncertainty regarding the administration of crediting net additions to the stock of trees.
- Population in the U.S., for example, is expected to increase by about 50 million people between 1990 and 2010, implying direct human induced land-use changes for roads and housing etc. These factors would tend to reduce sequestration of carbon. Unless other programs exist to offset any such reduced sequestration, then greater reductions in anthropogenic emissions of the six greenhouse gases would be required for a nation to meet its overall emissions limitation target.
- The rules for this category of emissions have yet to be written, and their potential significance will depend critically on those rules.

International Trading of Carbon Emission Permits

Given the diverse and strongly held views about trading that were expressed in the negotiations leading to the protocol and that prevented the inclusion of trading rules in the protocol, it is unclear if and when an effective inter-country carbon emission trading program would be implemented.

The WEFA analyses do not include international trading of carbon emission permits. International trading of carbon emission permits could potentially reduce the cost of achieving carbon emission targets. In *concept* the Kyoto protocol allows inter-country trading of carbon emission permits. Details such as the principles, rules, verification, reporting and accountability are not addressed. Until these details are addressed it is not possible for trading to take place. Given the diverse and strongly held views about trading that were expressed in the negotiations leading to the protocol and that prevented the inclusion of trading rules in the protocol, it is unclear if and when an effective inter-country carbon emission trading program would be implemented. Further, the benefits that would actually be realized from such a program could be limited because trading would be limited to Annex B Parties only.

Working out these details to allow trading to actually take place will require overcoming difficult political, administrative and technical hurdles. To illustrate the difficulties of implementing such a system, the following briefly describes some of the details that need to be addressed.

- *Initial Allocation of Permits*: A carbon permit system would probably be implemented by issuing permits to the first seller of a product. Each country would have to determine who will get these permits and how. Permits could be issued by a lottery, auctioned off, or allocated based upon historic emissions. These permits will have substantial value and it is likely that the allocation of these permits will cause substantial political conflict within each country.
- *Verification*: Monitoring and inspection systems will have to be set up to assure that carbon emissions do not exceed the level allowed by the carbon permits owned. *Each owner* of a carbon permit would have to have a record keeping system with checks and balances that could be audited, to assure compliance with the permit system. Both physical audits of the business facilities and accounting systems would be required. If the owner of carbon permits were the government, the government would have to be audited. Controls would have be implemented to assure carbon-based products are not imported from a non-

participating country and sold on the black market. Given the potential magnitude of the carbon permit fees there will strong incentives to circumvent these fees.

- *Control of Permits:* Controls would have to be implemented to assure that countries do not issue more permits than allowed.
- *Record Keeping:* A central record system will have to be kept to track ownership of carbon permits. This system will have to assure seller is a legitimate owner of a carbon permit and track transactions as ownership changes.
- *Transactions costs*: While accomplishing the goals above, the administrative system must assure the cost of trading carbon emissions is low enough allow the possibility of substantial benefits from trading.

As proposed in the Kyoto Protocol, emissions trading is limited to Annex B Parties only. This will greatly reduce its cost effectiveness.

If these hurdles can be overcome it still is unknown how large the benefits from international trading of emission permits will be. As proposed in the Kyoto Protocol, emissions trading is limited to Annex B Parties only. This will greatly reduce its cost effectiveness. Developing countries have resisted committing themselves to binding limits on their emissions. Yet developing countries have the least cost opportunities for reducing carbon emissions. If these countries do not participate in the plan, many businesses will move rather than pay for carbon permits. Also, the results of previous *intra*-country permit trading systems are unclear. The cost of SO_2 acid rain, emissions permits dropped substantially under a trading system. However, a very large part of the decline in these permits was a result of lower railroad rates, a result of de-regulation, which allowed low-sulfur Western coal to be transported to power plants at a low cost.

Other Gases

The cost of reducing these gases may exceed the cost of reducing carbon through the energy sector.

If so, even greater reductions in emissions from the energy sector may be required.

Finally, the impact of other gases was not included in this analysis. The impact of the other gases on achieving the Kyoto goals is highly uncertain. While several analyses, notably the US Government's 1997 Interagency Task Forces analysis, have presumed that reductions in the other gases could exceed their individual target of 7% below the 1990 level (1995 for three of the gases), no independent study as shown the opportunity for reductions nor the cost of reduction. In fact, the cost of reducing these gases may exceed the cost of reducing carbon through the energy sector. If so, even greater reductions in emissions from the energy sector may be required.

The Kyoto Protocol Is Not the Only Option

The Kyoto Protocol is not the only option. Given the uncertainty of the scientific evidence the global warming is occurring, the prudent strategy may be to continue or expand support for energy-efficient technologies.

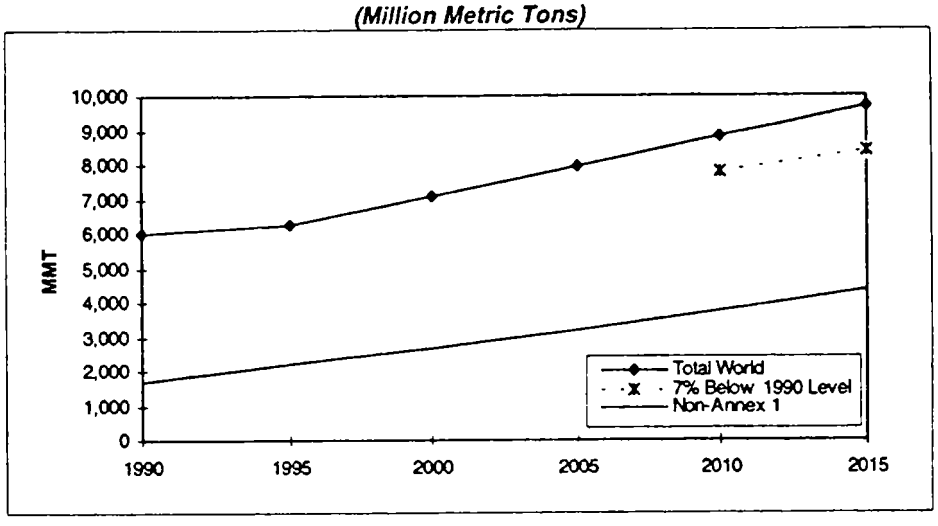
The Kyoto Protocol is not the only option. The economic consequences must be balanced against the scientific evidence suggesting *catastrophic* global warming. Although it may not be possible to rule out potential climate change over the very long-run, it may be the prudent strategy to continue on the "low-regrets" path of encouraging investment in new energy-efficient technologies, continuing to support research and development of non-carbon based technologies and supporting voluntary efforts to reduce GHG emissions.

Further support for investing in a technologically based solution is evident from the chart below. It is the developing countries that are the principal contributors to annual global emission increases. Driven by their expanding economies and their rising populations, the less developed economies of the world will emit more emissions than the industrialized economies by 2015.

The principal contributors to GHG emission growth are the emerging economies.

Reducing carbon emissions from Annex 1 countries by 5% would not substantially impact global emissions.

Global Carbon Emissions from Energy Use
(Million Metric Tons)



Source: U.S. DOE/EIA "International Energy Outlook 1997" Reference Case

The emerging economies of the world will not meaningfully participate in a greenhouse gas emission reduction or limitation program *until* there is a technological alternative that provides an equal or better opportunity for economic growth than is offered by fossil fuels today.

The reduction in carbon emissions that would result from the developed economies fully meeting their targets under the Kyoto Protocol would not significantly affect the annual global emissions. The emerging economies of the world will not meaningfully participate in a greenhouse gas emission reduction or limitation program *until* there is a technological alternative that provides an equal or better opportunity for economic growth than is offered by fossil fuels today.

WEFA

A PRIMARK Company

WEFA is a full-service economic and information consulting firm providing a broad range of services to over 1200 clients in 45 countries. We forecast over 90 economies in-depth, maintain over 2 million time-series including data on 200 countries, provide the leading software, AREMOS®, to business economists, and consult on a wide variety of business and government issues. For complete information on our capabilities, please call any of our economists, account vice presidents, or 610-490-2685.

http://www.wefa.com

- **Forecasting**
  - Macro forecasting for over 90 countries
  - U.S. and Canada regional
  - Industry
- **Industry-specific services in key sectors:**
  - Agriculture, automotive, consumer, energy, financial services, international market analysis and sub-regional analysis in advanced economies, materials and mining, metals, real estate and construction, transportation and utilities
- **Data**
  - Economic, financial and demographic data for 200 countries
- **Software**
  - AREMOS
  - Custom applications
- **Consulting**
  - Custom projects
  - Econometric models
- **Conferences, Seminars, Training**

WEFA OFFICES WORLDWIDE

UNITED STATES

WEFA, Inc.

Headquarters
800 Baldwin Tower
Eddystone, PA 19022
(610) 490-4000
FAX: (610) 490-2770
Hotline: (610) 490-2700

Atlanta
500 Northpark Town Center
1100 Abernathy Road
Suite 625
Atlanta, GA 30328
(770) 551-8230
FAX: (770) 551-8105

Boston
25 Burlington Mall Road
Burlington, MA 01803
(781) 221-5843
FAX: (781) 221-4809

Chicago
150 South Wacker Drive
Suite 360
Chicago, IL 60606
(312) 236-6747
FAX: (312) 236-5420

Los Angeles
6033 W. Century Boulevard
Suite 710
Los Angeles, CA 90045
(310) 670-7393
FAX: (310) 670-4509

New York
111 Broadway
8th Floor
New York, NY 10006-1091
(212) 406-2095
FAX: (212) 406-2922

Washington, DC
1110 Vermont Avenue, NW
Suite 1100
Washington, DC 20005
(202) 775-0610
FAX: (202) 833-3673

INTERNATIONAL

Brussels
WEFA (Benelux), S.A.
Place Guy d'Arezzo 17
1180 Brussels
Belgium
(32-2) 345-0284
FAX: (32-2) 345-5487

Frankfurt
WEFA GmbH
Reuterweg 47
D-60323 Frankfurt am Main
Germany
(49-69) 719174-0
FAX: (49-69) 719174-28

London
WEFA, Ltd.
Mappin House, Third Floor
4 Winsley Street
London W1N 7AR, U.K.
(44-1-71) 631-0757
FAX: (44-1-71) 631-0754

Mexico City
CIEMEX-WEFA, Inc.
Calle del Puente No. 222
Esquina Periferico Sur
Colonia Ejidos de Huipilco
14380 Mexico, D.F.
Mexico
(52-5) 723-2181
FAX: (52-5) 671-8035

Milan
B.I.G. SPA
Via Manzoni, 31
20121 Milan, Italy
(39-2) 2900-4333
FAX: (39-2) 2900-3811

Paris
WEFA SA
25, rue de Ponthieu
75008 Paris, France
(33-1) 5389-1910
FAX: (33-1) 4563-7672

Pretoria
WEFA Southern Africa
(Pty) Ltd.
East Entrance, Ground Floor
83 Lois Avenue
Lynnwood Glen, 0081
Pretoria, South Africa
(27-12) 348-6861
FAX: (27-12) 348-8151

CANADA

Ottawa
WEFA Canada Inc.
350 Sparks Street
Suite 510
Ottawa, Ontario
Canada K1R 7S8
(613) 233-0235
FAX: (613) 233-0240

Toronto
WEFA Canada Inc.
777 Bay Street, Suite 1910
P.O. Box 143
Toronto, Ontario
Canada M5G 2C8
(416) 599-5700
FAX: (416) 599-5197

Noah:
781-221-0340

Statement of
Margo Thorning, Senior Vice President and Chief Economist
American Council for Capital Formation
Before the House Subcommittee on National Economic Growth,
Natural Resources, and Regulatory Affairs
of the
House Committee on Government Reform and Oversight
April 23, 1998

Introduction

My name is Margo Thorning. I am Senior Vice President and Chief Economist of the American Council for Capital Formation (ACCF).

The ACCF represents a broad cross-section of the American business community, including the manufacturing and financial sectors, Fortune 500 companies and smaller firms, investors, and associations from all sectors of the economy. Our distinguished board of directors includes cabinet members of prior Republican and Democratic administrations, former members of Congress, prominent business leaders, and public finance and environmental policy experts.

The ACCF is now celebrating its twenty-fifth year of leadership in advocating tax, regulatory, and environmental policies to increase U.S. economic growth and environmental quality.

We commend Chairman McIntosh and the Subcommittee on National Economic Growth, Natural Resources, and Regulatory Affairs for their focus on the critical issue of the effect of climate change policy on U.S. economic growth.

My testimony begins first with a review of several analyses sponsored by the ACCF Center for Policy Research, the public policy research affiliate of the American Council for Capital Formation. These analyses illustrate the economic and environmental impact of near-term limitations on the growth in U.S. carbon emissions. Next, the testimony will describe the likely parallel between the energy shocks of the 1970s and 1980s with the energy cutbacks required of the United States by the Kyoto agreement. Third, I discuss the environmental impact of carbon dioxide (CO_2) stabilization by developed countries alone. Finally, strategies for a cost-effective, long-term approach to stabilization of CO_2 concentrations are presented.

Macroeconomic Effects of CO_2 Emission Limits

The Kyoto Protocol to the United Nations Framework Convention on Climate Change, which the United States negotiated in December, 1997, calls for industrial economies such as the United States, Canada, Europe, and Japan to reduce their collective emissions of six greenhouse gases by an average of 5.2 percent from 1990 levels by

2008–2012. The U.S. target is a 7 percent reduction from 1990 levels. Many experts believe that the Kyoto agreement has potentially serious consequences for all Americans, and that these consequences have not been fully analyzed and understood.

Research conducted over the past decade for the ACCF Center for Policy Research by top climate change scholars such as Professor Gary W. Yohe of Wesleyan University, Dr. Lawrence M. Horwitz of Primark Decision Economics, WEFA, Inc. Senior Vice President Mary H. Novak, Professor Richard Schmalensee of the Massachusetts Institute of Technology, Professor Alan S. Manne of Stanford University, Dr. Richard Richels of the Electric Power Research Institute, and Dr. W. David Montgomery of Charles River Associates concludes that the cost of stabilizing CO_2 emissions in the near term would impose a heavy burden on U.S. households and industry.

■ Impact on Economic Growth

These macroeconomic studies estimate the economic impact of stabilizing CO_2 emissions at 1990 levels (this was the Administration's original, pre-Kyoto, emission reduction target). Thus, the results shown below are lower-bound, conservative estimates of the Kyoto agreement's impact since, as mentioned above, the agreement calls for the United States to reduce its emissions 7 percent below 1990 levels (or about 30 percent more than was modeled in studies sponsored by the ACCF Center for Policy Research).

For example, Dr. Horwitz's study shows that reducing emissions to 1990 levels by 2010 or 2015 would require a carbon tax in the range of $200 or more per tonne of carbon emitted. Dr. Horwitz argues that this tax would reduce U.S. GDP growth by more than 4.0 percent annually or over $350 billion per year. As emissions were reduced, economic growth would slow due to lost output as prices rise for carbon-using goods—goods that must be produced using less carbon and/or more expensive processes. Output would also fall because of slower net capital accumulation, reflecting the premature obsolescence of capital equipment due to sharp energy price increases. A study presented last year by WEFA's Ms. Novak concludes that stabilization would require a carbon tax of $200 per ton and would send a prolonged series of shocks through the economy, causing major changes in production patterns and resulting in significant economic losses. For example, GDP would fall by 2.4 percent by 2010. Professor Yohe concludes that emission stabilization would require a tax of as much as $260 per ton and that U.S. GDP growth would slow by 1 percent annually.

■ Impact on Income, Wages and Employment

The analyses by Dr. Horwitz, Professor Yohe, and Ms. Novak conclude that stabilization of CO_2 emissions at 1990 levels would reduce real wage growth and raise unemployment. Dr. Horwitz predicts that household disposable income would fall by 1.2 percent, and wages would also drop. Ms. Novak concludes that the average U.S. household would have $2,061 (in 1996 dollars) less income by 2010. Professor Yohe's analysis shows that stabilization would cause real wages would fall by 5 to 10 percent per year.

■ Impact on Household Consumption and Lifestyles

Stabilizing emissions at 1990 levels requires raising energy prices sharply in order to reduce demand. Energy price increases result in higher prices for the goods and services purchased by consumers (see Figure 1). Ms. Novak's "stabilization" analysis shows that by 2010, food and medicine would be 8 to 10 percent more expensive, gasoline would be about 35 percent more costly, and consumers would pay about 50 percent more for electricity. In response to sharply higher energy prices, U.S. consumers would be forced to make major changes in their lifestyles, including lowering their thermostats in winter, driving less, and reducing their use of air conditioning in summer. Studies by Drs. Yohe and Horwitz show that as a result of higher prices and lower income, household consumption of goods and services such as electricity, gasoline, natural gas, autos, and housing are curtailed. For example, electricity use drops by an average of 30 percent, natural gas by 17 percent, and auto purchases by 8 percent (see Figure 2).

■ Impact on Income Distribution

Policies to curb emissions not only reduce employment and income growth and curtail household consumption, they also worsen the distribution of income in the United States, according to the analyses of both Professor Yohe and Ms. Novak. For example, based on a standard measure of the degree of income inequality among a country's population called the GINI coefficient, Professor Yohe's analysis shows that carbon taxes, even when recycled through personal income tax reductions, cause relatively large losses in the poorest quintile (lowest one-fifth of the population). These losses, added to modest losses in the middle quintiles, underwrite gains for the richest fifth of the population (see Figure 3).

The Energy Crisis of the 1970s and the Impact of the Kyoto Agreement

Policies designed to stabilize CO_2 emissions at 1990 levels by 2010 are likely to cause consumers to feel as though they are living through the oil price shocks of the early 1970s and 1980s all over again. Professor Yohe compares the impact of CO_2 stabilization at 1990 levels on income inequality with actual experience during those time periods. Figure 4 compares changes in income inequality in the recent past, as measured by the GINI coefficients, with those predicted if the United States imposes carbon taxes to stabilize emissions. The black bars in Figure 4 represent: (1) 1968–73, the period prior to the oil shocks of the 1970s; (2) 1973–78, the period of the most dramatic increase in oil prices; and (3) 1978–83, the subsequent period of sharply rising oil prices and dramatic recession.

The tallest black bar, showing the GINI coefficient increasing by 3.5 percent, reflects the growth of income inequality in the United States from 1978 through 1983. The distributional effects of the 1980s recession were noticed by nearly everyone and documented in the professional and popular press. Poverty rates climbed. Unemployment hit highs that had not been seen since the Great Depression. For example, in 1983 the unem-

ployment rate reached 9.6 percent. Plants and factories closed and people moved in search of jobs and/or improved public assistance.

It is equally significant that the second largest distributional effect depicted in Figure 4 (an increase in the GINI coefficient of 2.5 percent) reflects the cost of a carbon tax designed to achieve stabilization in emissions—an income tax recycling scheme that could have a distributional effect about 70 percent as large as the effect of the 1980s recession. Put another way, contrasting the more "normal experience" of 1968 through 1978 with the effects of a carbon tax, it is easy to see that other policies designed to stem even the long-term trend toward less equitable distributions of income might have to work more than twice as hard just to hold the line if they were forced to work in a overall policy environment that included either substantial taxes or required the use of tradable permits to stabilize carbon emissions.

Level of Effort Required to Meet the Kyoto Targets

Another way of measuring the effort or sacrifice required to meet the Kyoto emission targets is presented in a new study by Ms. Rayola Dougher and Dr. Russell Jones of the American Petroleum Institute. The Dougher and Jones study takes neither the traditional macroeconomic, general equilibrium modeling approach nor the engineering technology approach. Instead, it takes a simpler but more intuitive approach using the Kaya Identity, which is described below. This approach, using 35 years of history plus government projections of growth in GDP and energy use through 2010, provides a yardstick to evaluate how much behavior must be altered from current and expected patterns in order to meet the Kyoto targets and how this altered behavior compares to past experience, especially the effort to limit energy during the energy crisis years of 1974–1986.

As Dougher and Jones note, the Kaya Identity analysis provides a useful tool for characterizing past changes in key factors impacting carbon emissions. It also allows a comparison with the types of changes required to meet future emission targets. Under the Kaya Identity formulation, carbon emissions depend upon the carbon content of energy used in the economy, the energy intensity of economic activity, per capita GDP, and population. In equation form the Kaya Identity is:

$$C = C/E * E/GDP * GDP/Population * Population$$

where C equals carbon emissions and E equals energy use. For small to moderate changes in the Kaya Identity components between any two given years, the sum of the percent changes in each of the components closely approximates the change in carbon emissions between those two years.

It should be noted that the Kaya Identity, by itself, says little about the nature of policies that would be required to reach the Kyoto targets. The Kaya Identity also does not evaluate the cost to the economy of changes in what and how products are made and consumed. Instead, it illustrates the trade-offs between the key factors affecting carbon emissions. Comparing past and forecast changes in these key factors provides a framework for

measuring the level of effort that would be required to achieve the carbon emission reduction targets set in Kyoto.

Table 1 shows the average annual percentage changes in carbon emissions and the key factors affecting these emissions in the United States, Japan, and the European Union over different time periods. Reading from left to right, the percentage changes in carbon

Table 1 Key Factors Affecting Carbon Emissions
Average annual percentage changes

Country/Region	1 Carbon Emissions	2 Carbon/ Energy	3 Energy/ GDP	4 GDP/ Population	5 Population
THE EARLY YEARS, 1961–1973					
United States	4.0	-0.2	0.3	2.7	1.2
European Union	5.0	-0.9	1.1	4.0	0.7
Japan	10.4	-0.6	1.3	8.4	1.2
THE ENERGY CRISIS YEARS, 1974–1986					
United States	0.0	-0.2	-2.1	1.3	1.0
European Union	-0.4	-1.1	-1.4	1.8	0.3
Japan	-0.1	-1.1	-2.3	2.5	0.9
RECENT HISTORY, 1987–1995					
United States	1.4	-0.4	-0.4	1.3	1.0
European Union	0.2	-0.8	-1.1	1.8	0.4
Japan	3.0	-0.6	0.6	2.6	0.4
BUSINESS-AS-USUAL FORECASTS, 2001–2010					
United States	1.3	0.1	-0.9	1.3	0.8
European Union	0.5	-0.2	-1.5	2.1	0.1
Japan	0.2	-1.1	-1.3	2.4	0.2

Source: Rayola Dougher and Russell Jones, "OECD Country Carbon Emissions: A Kaya Identity Perspective on Historic Emissions and Proposed Emission Reduction Targets and Timetables," *Proceedings of the 21st IAEE Annual International Conference*, forthcoming.

emissions shown in the first column very closely approximate the sum of the percentage changes in each of the key factors shown in the remaining columns.

As Table 1 shows, the only time industrialized countries experienced stable or declining carbon emissions was during the energy crisis years of 1974–1986. Comparing the oil crisis years with the earlier years shows reductions in the per capita GDP (Table 1, Column 4) to be the single most important factor contributing to the decline in carbon emissions between the two periods. In the United States and Europe, growth in the GDP per capita was cut in half, and in Japan it was two-thirds less than it had been.

The second most important contributing factor to the declines in carbon emissions during the oil crisis years, as Dougher and Jones note, was the change in the amount of energy used per dollar of GDP (Table 1, Column 3). In Japan, the Energy/GDP ratio changed from a 1.3 percent per year average increase during the early years of 1960–1973 to a 2.3 percent per year decline during 1974–1986. Similarly, in Europe the ratio changed from a 1.1 percent per year increase to a 1.4 percent per year decline. For the United States, the ratio changed from a 0.3 percent per year increase to a 2.1 percent per year decline.

■ Kyoto Target: Maximum Historic Effort Case

As Dougher and Jones observe, one of the difficulties in evaluating public policy is reflected in the dictum: you never do only one thing. A strength of the Kaya Identity approach is that it can be used to evaluate what emissions would be under specific assumptions about the various Kaya Identity components. In Table 2 the Kaya Identity is used to answer the question of what emissions would be in 2010 if the maximum past efforts at limiting carbon emissions in each Kaya Identity component were somehow to reoccur simultaneously for the next decade.

The authors conclude that the United States falls far short of the Kyoto target even under the maximum historic effort scenario, which yields an emissions reduction of 1.1 percent per year compared to a 2.3 percent per year reduction required to reach the Kyoto target (see Table 2). The EU just meets the Kyoto target under this scenario, although cutting the growth in GDP per capita in half, as in the United States, was a requirement for this achievement. Japan's emissions fall more rapidly than required to meet the Kyoto target under the maximum historic scenario. However, as with the EU, without a 50 percent reduction in the rate of growth in per capita GDP, Japan also would miss the Kyoto target.

The Kaya Identity analysis casts serious doubt on the claim that the Kyoto target is realistic. In the past, achieving the assumed maximum historic efforts required rapidly rising energy prices, an expanding nuclear power sector, deregulation of the energy sector, significant advances in technology, and a host of government efficiency programs. Even if the maximum historic effort were repeated, the United States would not achieve the Kyoto target (see Figure 5). And the EU and Japan only achieve the target if the rate of growth in per capita GDP is cut in half. This indicates that the effort required to reach the Kyoto targets would be quite large.

Table 2 Maximum Historic Effort Case for 2001–2010
Average annual percentage changes

Case	1 Carbon Emissions	2 Carbon/ Energy	3 Energy/ GDP	4 GDP/ Population	5 Population
UNITED STATES					
BAU Projection	1.3	0.1	-0.9	1.3	0.8
Max. Effort Case	-1.1	-0.4	-2.1	0.6	0.8
Kyoto Target	-2.3				
EUROPEAN UNION					
BAU Projection	0.5	-0.2	-1.5	2.1	0.1
Max. Effort Case	-1.4	-1.1	-1.4	1.1	0.1
Kyoto Target	-1.3				
JAPAN					
BAU Projection	0.2	-1.1	-1.3	2.4	0.2
Max. Effort Case	-2.0	-1.1	-2.3	1.2	0.2
Kyoto Target	-1.4				

Note: Table 2 summarizes the results of this maximum historic effort what-if scenario. The first line in each section repeats the "business-as-usual" (BAU) projections while the second line gives the what-if assumptions as well as the resulting annual change in carbon emissions. The short third line gives the annual change in carbon emissions required to reach the Kyoto target.

Source: Rayola Dougher and Russell Jones, "OECD Country Carbon Emissions: A Kaya Identity Perspective on Historic Emissions and Proposed Emission Reduction Targets and Timetables," *Proceedings of the 21st IAEE Annual International Conference*, forthcoming.

Environmental Impact of Emission Limits

Economic analysis tells only half the story about policies aimed at reducing near-term U.S. greenhouse gas emissions. Scholars such as Professors Manne and Schmalensee and Dr. Jae Edmonds and his colleagues James Dooley and Marshall Wise of Pacific Northwest National Laboratory (PNNL) all warn that there will be almost no environmental benefits if the United States and other industrialized countries were to stabilize CO_2 emissions by 2010 or 2015, because most of the new emissions would come from China, India, the former Soviet Union, Latin America, and other emerging economies. In fact, developing nations, which are not required to cut CO_2 emissions under the Kyoto agreement, already

produce about 50 percent of all emissions—and by 2050 are expected to produce 75 percent of all greenhouse gases, according to Dr. Montgomery (see Figure 6).

Cost-Effective CO_2 Stabilization Policies and U.S. Economic Growth

A number of economic and environmental analyses provide guidance on how best to balance environmental and economic considerations when formulating climate mitigation policy. Voluntary measures clearly reduce the growth in greenhouse gas emissions, as the U.S. Second National Communication to the Framework Convention on Climate Change noted last year. Moreover, reducing global CO_2 emissions should be a gradual, three-stage process, according to PNNL's Edmonds, Dooley, and Wise. During the next twenty-five years (Stage I), the United States should commit resources to carbon capture and sequestration as well as the development and spread of new energy technologies such as hydrogen transformation from natural gas, advanced liquefied hydrogen fuel cells, biomass, solar photovoltaic, and nanotechnology (the design and building of structures atom-by-atom). Although such technologies are now in their early stages, their development could revolutionize energy production while sharply reducing the cost of stabilizing atmospheric concentrations of greenhouse gases. Stage II, from 2020–2050, would see the enforcement of an emissions cap; Stage III could see the gradual phaseout of all free-venting of carbon into the atmosphere if the science indicates the need for such a policy.

Conclusions

The consensus of these noted scholars is clear. Given the need to increase U.S. economic growth to address challenges such as a growing population, the retirement of the baby boom generation, and a persistent trade deficit, policymakers should weigh carefully the likely negative economic impact of precipitous near-term reductions in U.S. CO_2 emissions and energy use. Adopting a thoughtfully timed climate change policy—based on science and improved climate models—would both enhance U.S. and global economic growth and lead to long-term stabilization of carbon concentrations in the atmosphere. ❖

Sources

Dougher, Rayola and Russell Jones. Forthcoming. "OECD Country Carbon Emissions: A Kaya Identity Perspective on Historic Emissions and Proposed Emission Reduction Targets and Timetables." *Proceedings of the 21st IAEE Annual International Conference.*

Edmonds, Jae, James Dooley, and Marshall Wise. June 1997. Atmospheric Stabilization and the Role of Energy Technology. In *Climate Change Policy, Risk Prioritization, and U.S. Economic Growth*, 73–94. Washington, D.C.: American Council for Capital Formation Center for Policy Research.

Horwitz, Lawrence M. February 1996. The Impact of Carbon Taxes on Consumer Living Standards. In *An Economic Perspective on Climate Change Policies*, 119–157. Washington, D.C.: American Council for Capital Formation Center for Policy Research.

Montgomery, W. David. February 1996. Developing a Framework for Short- and Long-Run Decisions on Climate Change Policies. In *An Economic Perspective on Climate Change Policies*, 15–43. Washington, D.C.: American Council for Capital Formation Center for Policy Research.

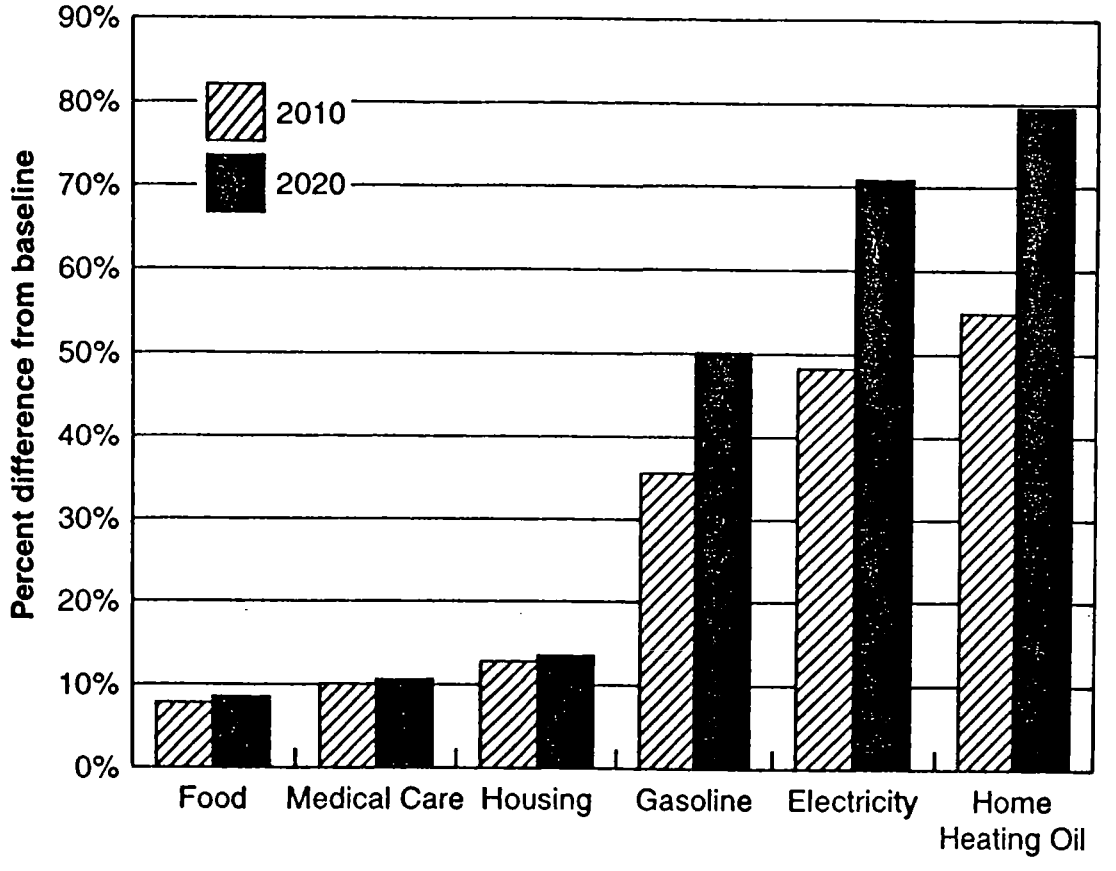
Novak, Mary H. April 1998. Global Climate Change, Environmental Quality, and U.S. Living Standards: The Impact on Consumers. In *The Impact of Climate Change Policy on Consumers: Can Tradable Permits Reduce the Cost?*, 3–18. Washington, D.C.: American Council for Capital Formation Center for Policy Research.

Schmalensee, Richard. April 1998. Tradable Emissions Rights and Joint Implementation for Greenhouse Gas Abatement: A Look Under the Hood. In *The Impact of Climate Change Policy on Consumers: Can Tradable Permits Reduce the Cost?*, 39–55. Washington, D.C.: American Council for Capital Formation Center for Policy Research.

Yohe, Gary W. June 1997. Climate Change Policies, the Distribution of Income, and U.S. Living Standards. In *Climate Change Policy, Risk Prioritization, and U.S. Economic Growth*, 13–54. Washington, D.C.: American Council for Capital Formation Center for Policy Research.

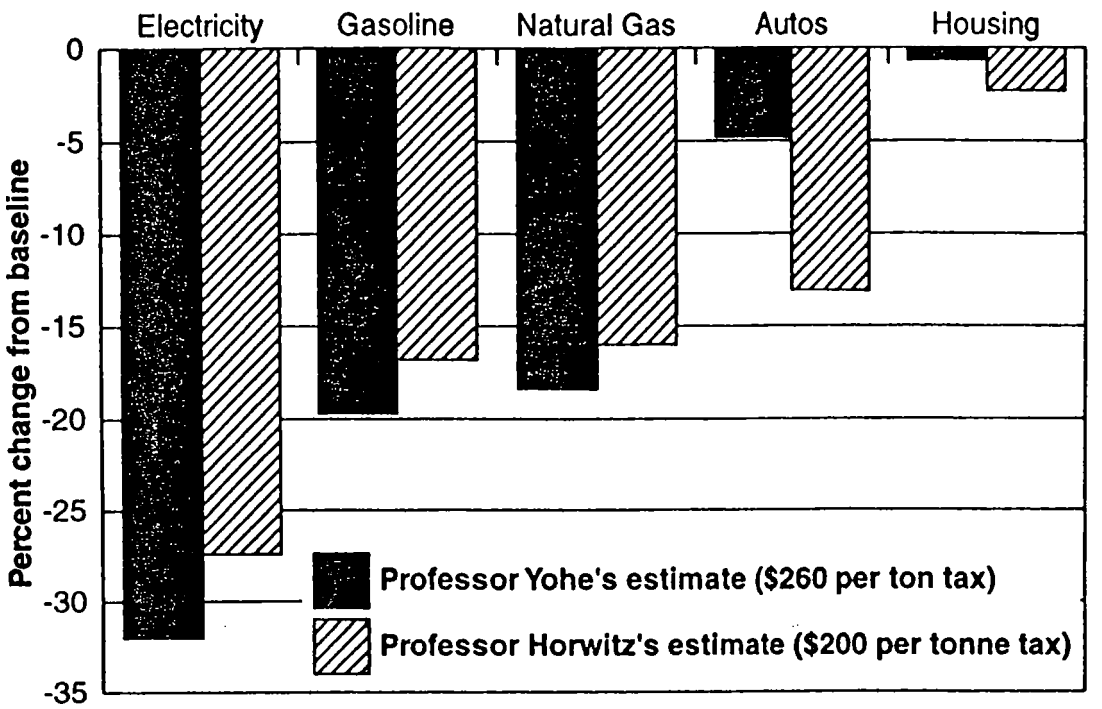
The American Council for Capital Formation and ACCF Center for Policy Research have not received any Federal grants or contracts in fiscal year 1998.

Figure 1 Impact on Prices Paid by Households of Stabilizing Carbon Dioxide Emissions at 1990 Levels
Percent difference from base case



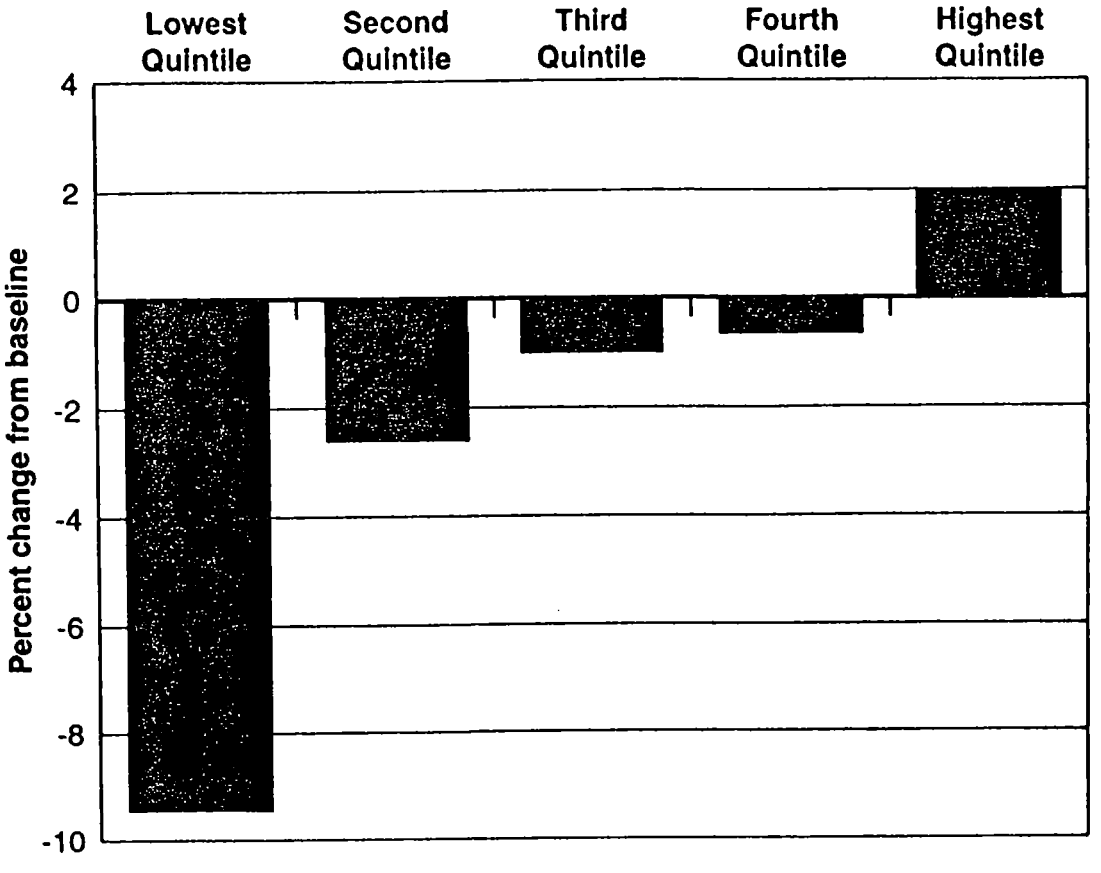
Source: "Global Climate Change, Environmental Quality, and U.S. Living Standards: The Impact on Consumers" by Mary H. Novak, in *The Impact of Climate Change Policy on Consumers: Can Tradable Permits Reduce the Cost?* (Washington, D.C.: American Council for Capital Formation Center for Policy Research, April 1998), pp. 3–18.

Figure 2 Alternative Estimates of the Negative Impacts by 2010 on U.S. Household Consumption Due to Stabilizing Carbon Dioxide Emissions at 1990 Levels



Source: "The Impact of Carbon Taxes on Consumer Living Standards" by Lawrence M. Horwitz, in *An Economic Perspective on Climate Change Policies* (Washington, D.C.: American Council for Capital Formation Center for Policy Research, February 1996), pp. 119–157; and "Climate Change Policies, the Distribution of Income, and U.S. Living Standards" by Gary W. Yohe, in *Climate Change Policy, Risk Prioritization, and U.S. Economic Growth* (Washington, D.C.: American Council for Capital Formation Center for Policy Research, June 1997), pp. 13–54. Compiled by the American Council for Capital Formation, April 1998.

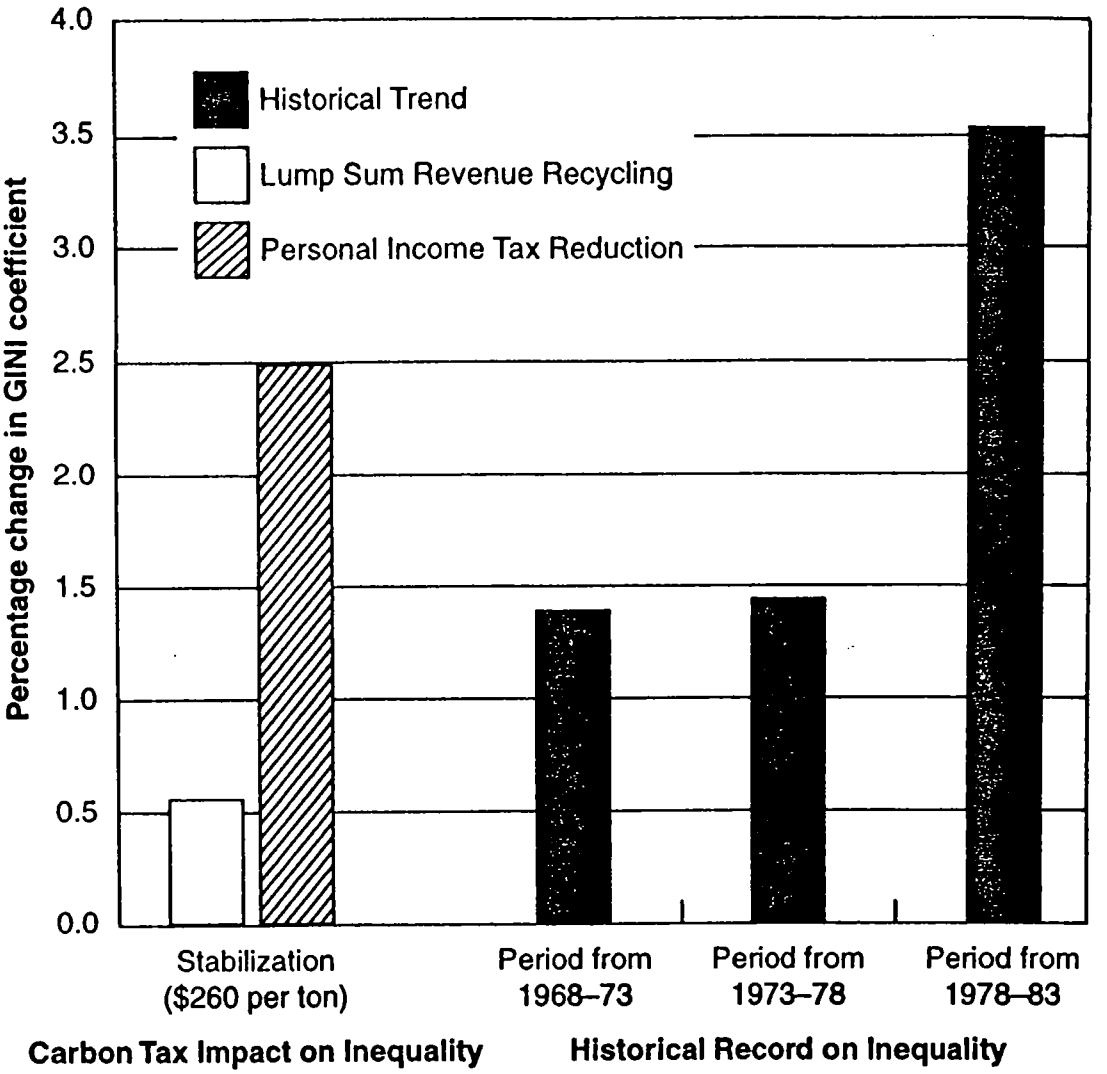
Figure 3 The Impact of Stabilizing CO_2 Emissions at 1990 Levels by 2010 on U.S. Households by Quintile



Note: A $260 per ton tax or tradable permit price of that amount would be needed to stabilize emissions at 1990 levels by 2010 if emission reductions begin in 1997 or 1998. The analysis assumes the tax is rebated through reductions in the personal income tax.

Source: "Climate Change Policies, the Distribution of Income, and U.S. Living Standards" by Gary W. Yohe, in *Climate Change Policy, Risk Prioritization, and U.S. Economic Growth* (Washington, D.C.: American Council for Capital Formation Center for Policy Research, June 1997), pp. 13–54.

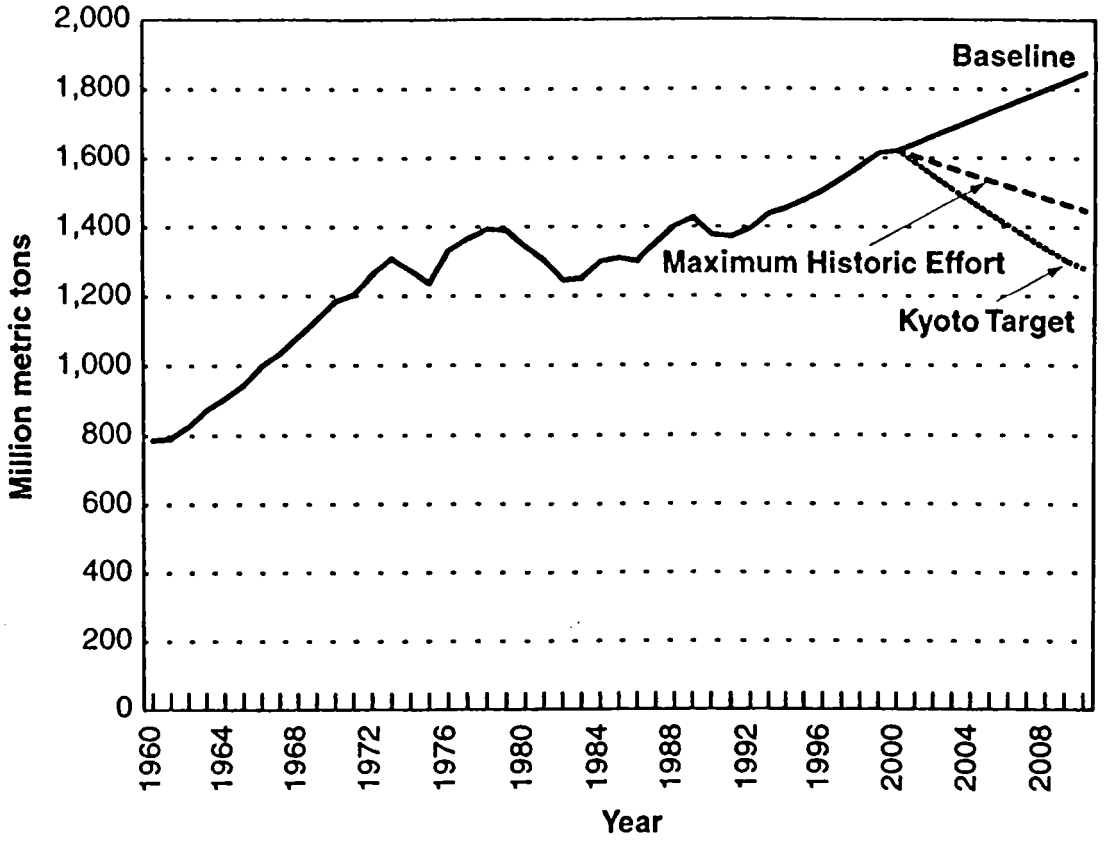
Figure 4 The Impact of Stabilizing CO_2 Emissions at 1990 Levels by 2010 on Income Inequality In the United States



Note: The bars show changes in GINI coefficients. The higher the bar, the greater the increase in the inequality in the distribution of income. For example, the high unemployment rates and recession in the late 1970s and early 1980s caused those in the lowest quartiles to receive a smaller share of income; thus, the GINI coefficient rose (see black bar). The bars showing the changes in GINI coefficients using either lump sum revenue recycling or personal income tax reductions are based on various econometric models from the 12th Energy Modeling Forum.

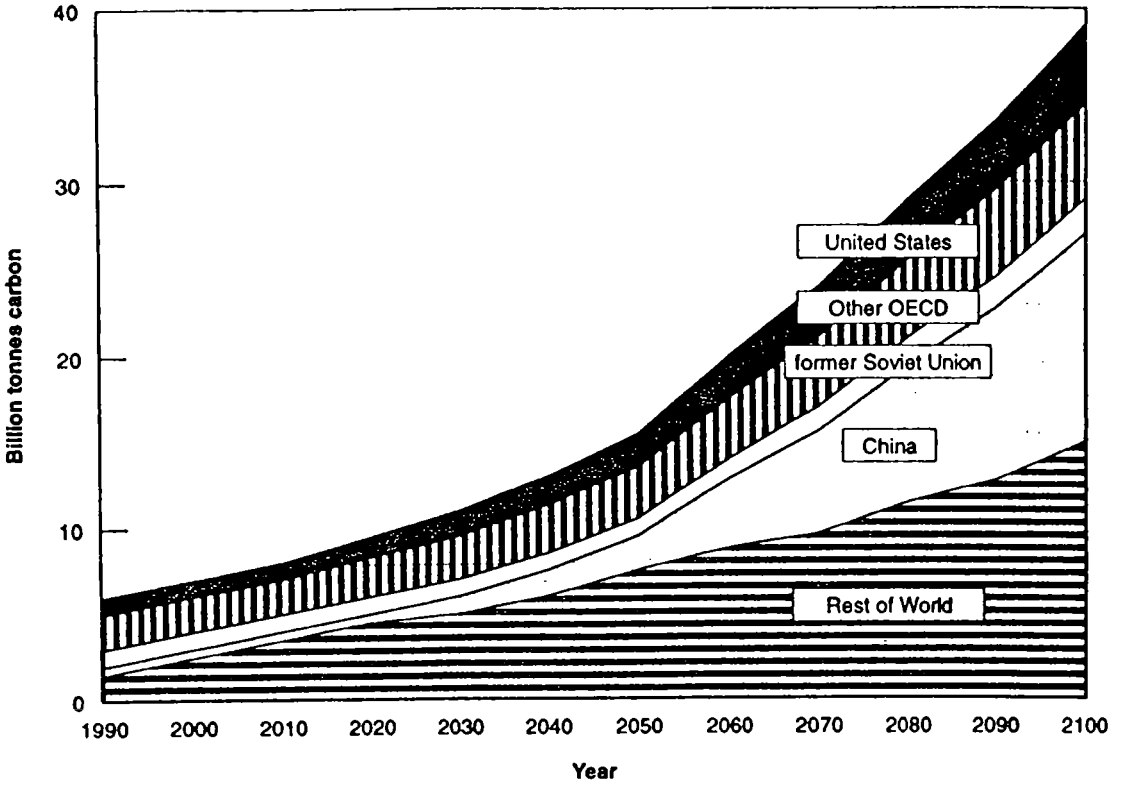
Source: "Climate Change Policies, the Distribution of Income, and U.S. Living Standards" by Gary W. Yohe, in *Climate Change Policy, Risk Prioritization, and U.S. Economic Growth* (Washington, D.C.: American Council for Capital Formation Center for Policy Research, June 1997), pp. 13–54.

Figure 5 U.S. Carbon Emissions: Projected Baseline, Maximum Historic Effort, and the Kyoto Target



Source: Rayola Dougher and Russell Jones, "OECD Country Carbon Emissions: A Kaya Identity Perspective on Historic Emissions and Proposed Emission Reduction Targets and Timetables," *Proceedings of the 21st IAEE Annual International Conference*, forthcoming.

Figure 6 Relative Carbon Contributions of Different Regions to Global Carbon Emissions



Source: Adapted from A.S. Manne and R.G. Richels, *Buying Greenhouse Gas Insurance: The Economic Costs of CO_2 Emission Limits* (Cambridge, Mass.: MIT Press, 1992), p. 91, by W. David Montgomery, "Developing a Framework for Short- and Long-Run Decisions on Climate Change Policies," in *An Economic Perspective on Climate Change Policies* (Washington, D.C.: American Council for Capital Formation Center for Policy Research, February 1996) pp. 15–43.

The Kyoto Protocol and its Economic and Employment Impacts
Testimony of Dr. Joyce Brinner
Principal, Standard & Poor's *DRI*
Before the House Subcommittee on National Economic Growth, Natural Resources, and Regulatory Affairs
April 23, 1998

In Kyoto, Japan, the Parties to the UN Framework Convention on Climate Change agreed to a Protocol that imposes greenhouse gas emissions targets and timetables for industrialized nations. The Protocol requires all Annex I (developed) countries to limit their emissions of six greenhouse gases to 92-110% of 1990 (or 1995) levels on average over the 2008-12 period; U. S. emissions are limited to 93% of 1990 levels. The emission ceilings are to be controlled through a system of country-allocated permits which can be traded among the Annex I countries. In addition, countries may receive credit toward their targets through project-based emission reductions in developed countries ("joint implementation"), and through certified project-based emission reductions in developing countries ("Clean Development Mechanism"). Certified emissions reductions achieved starting in the year 2000 in developing countries can count toward compliance in the first budget period. And finally, the Protocol allows activities that absorb carbon, or "sinks," to be used as offsets against emission targets.

My comments will focus on U.S. policies to reduce CO_2 emissions under the Kyoto Protocol because of the dominance of CO_2 as a greenhouse gas. The Kyoto Protocol implies that the United States will have to reduce its CO_2 emissions by nearly 500 million tonnes, or 30% below base-case (business-as-usual) levels in the 2008-12 period (Exhibit 1). The required reductions in the U.S. equal the combined required reductions in Western Europe, Japan and Canada. In contrast, emissions in the Former Soviet Union and Eastern Europe under business-as-usual conditions are projected to average 160 million tonnes below target levels in the 2008-12 period.

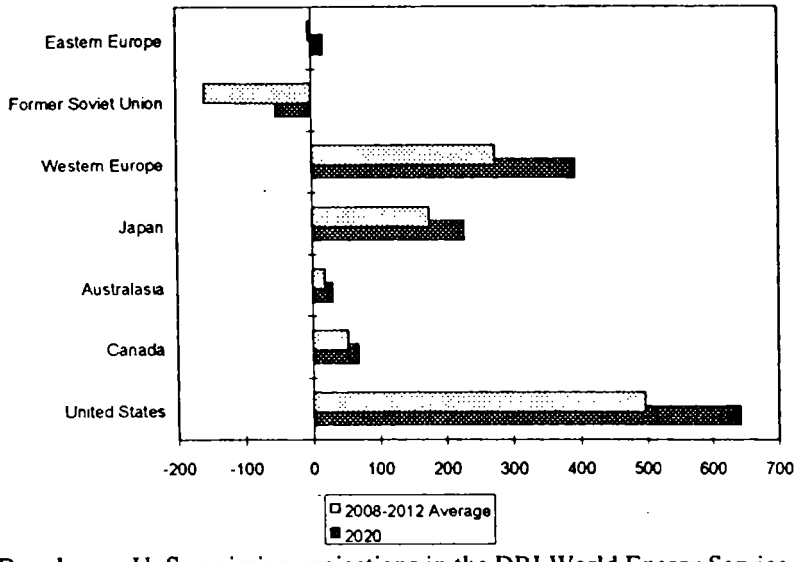
The United States can achieve emission reductions at home by shifting our mix of fuels, curtailing our energy usage, making further reductions in other greenhouse gases with higher global warming potentials, and expanding sinks. Or we can achieve the reductions abroad by purchasing emission credits from other Annex I countries and by investing in emission-reducing or sequestering projects in other industrialized and developing countries.

Before we ratify the Kyoto Protocol, economists need to answer three questions in sequence:

- How much do we need to cut our domestic fossil fuel combustion relative to business-as-usual levels?
- What carbon permit price or end-use energy prices will achieve that reduction within what time-frame?
- What will be the impact of the price increases on U.S. growth and employment?

We cannot assume the most optimistic case for question 1, and then proceed to answering questions 2 and 3. Scientists will then need to quantify the benefits of the carbon reductions, and policymakers will need to weigh the benefits against the costs.

Exhibit 1
Required Reductions in CO2 Emissions
(Million tonnes of carbon)



Based upon U. S. emission projections in the DRI World Energy Service, U.S. Outlook, Fall, 1997, and international projections in DOE/EIA International Energy Outlook, 1997.

How Much Do We Cut Domestic Fossil Fuel Use?

Options abroad may be more costly than at home. U.S. emissions per unit of GDP are 33% higher than the average for Europe and Japan and our emissions per capita are the highest in the world (Exhibit 2). High energy taxes in Europe and Japan have yielded higher conservation than in the United States. Therefore, U.S. marginal costs of abatement are, arguably, significantly lower. Marginal abatement costs may also be lower than in Canada, where lower coal usage, faster population growth, and a bigger geography make further reductions more difficult. This means that other nations may be willing to pay more than the U.S. for available credits and investments abroad.

My colleague in Europe explains that the European Union opposed trading because it believes in the "polluter pays principal," and views trading as a rich country's way to continue to pollute. The Clinton Administration interpreted the European Union's stand to mean that they would not be competing for the Russian permits. Can we really expect the European Union to only trade internally at marginal costs estimated around $400 per tonne while the U.S. purchases credits at $14-23 per tonne? I do not think that is a reasonable assumption. We should investigate the amount of European-backed projects

already in Eastern Europe and the Former Soviet Union, to determine the hold Europe may already have on emission credits from these areas..

Consequently, I expect Europe to be aggressive with Joint Implementation projects, if not trading. Japan will be trading and investing in sinks, and other countries may even be looking to the U.S. to purchase credits. It should also be noted that Europe's philosophy on trading may also lead to limits on the amount of reductions any one country can achieve outside its borders.

Exhibit 2
Carbon Intensities by Region and Country, 1995

	Emissions/GDP (tonnes per thousand US $)	**Emissions per Capita** (tonnes per capita)
North America	0.20	4.4
US	0.20	5.4
Canada	0.22	4.8
Mexico	0.17	1.1
Western Europe	0.15	2.3
Industrialized Asia	0.16	3.2
Japan	0.15	2.9
Total Industrialized	0.17	3.3
Former Soviet Union	0.78	3.3
Eastern Europe	0.42	2.7
Developing World	0.23	0.7
Total World	0.21	1.4

Calculated from carbon emissions reported in the DOE/EIA International Energy Outlook, 1997, and real GDP in purchasing power parity calculated by the DRI World Markets Service.

Because of the uncertainty surrounding potential emission reductions from overseas, DRI is currently analyzing three cases with varying degrees of emission purchases from abroad. Case 1 assumes limited international escape valves, on the order of 70 million tonnes, and a 40 million tonne offset from reductions in other gases and sinks. In this case, we would need to meet 78% of our required emission reduction through reductions in domestic fossil fuel use. That is, emissions associated with domestic fossil fuel combustion would have to be reduced 20% below the level of emissions that would otherwise occur a little more than a decade from now. Part of the emission objective could be achieved by substitution among fuels, such that the energy reduction target is on the order of 15%.

Cases 2 and 3 assume that 58% and 30% of the required reductions, respectively, would have to come through reductions in emissions from domestic fossil fuel combustion. This

implies that emissions would have to be reduced 17% and 8% below base-case levels, respectively. (See Exhibit 10 for a comparison across the Cases.)

What Permit Price Will Achieve the Reduction?

All American parties agree that the reduction in carbon emissions should be achieved by using market mechanisms. That is, price signals to consumers and producers. Unfortunately, demand for energy is greatly determined by the cars, buildings, manufacturing equipment, and electrical generating capacity in place at any point in time. Consequently, very large price increases would be required to motivate quantity usage responses until this "hardware" is replaced (Exhibit 4).

Exhibit 4
Physical Lifetimes of Energy-using Equipment
(Service lives, years)

Private Nonresidential Equipment	
Steam Engines and Turbines	32
Electric Transmission, Distribution, and Industrial Apparatus	33
Ships and Boats	27
Railroad Equipment	28
Other Private Nonresidential Equipment	7-16
Private Nonresidential Structures	
Mobile Offices	16
Mining and Petroleum Structures	12-20
Other private nonresidential structures	31-54
Residential Structures	
New	65-80
Replacements and alterations	20-40
Residential Equipment	
Furnaces*	20
Heat Pumps*	15
Other	11
Automobiles*	8

Source: Survey of Current Business, Bureau of Economic Analysis, May 1997.
* DRI estimates.

DRI research, in line with the consensus of energy economists, points to only a 3% quantity reduction for each 10% price increase within a decade. Therefore, a 15% energy reduction would only come forth in response to a 50% price increase for 10 years. Given 25 years, and the turnover of autos, buildings and equipment, the quantity response to any given price response rises an additional 60%. All this means that the Administration has

established an ambitious target: a very large emission target to be achieved in a relatively short period of time.

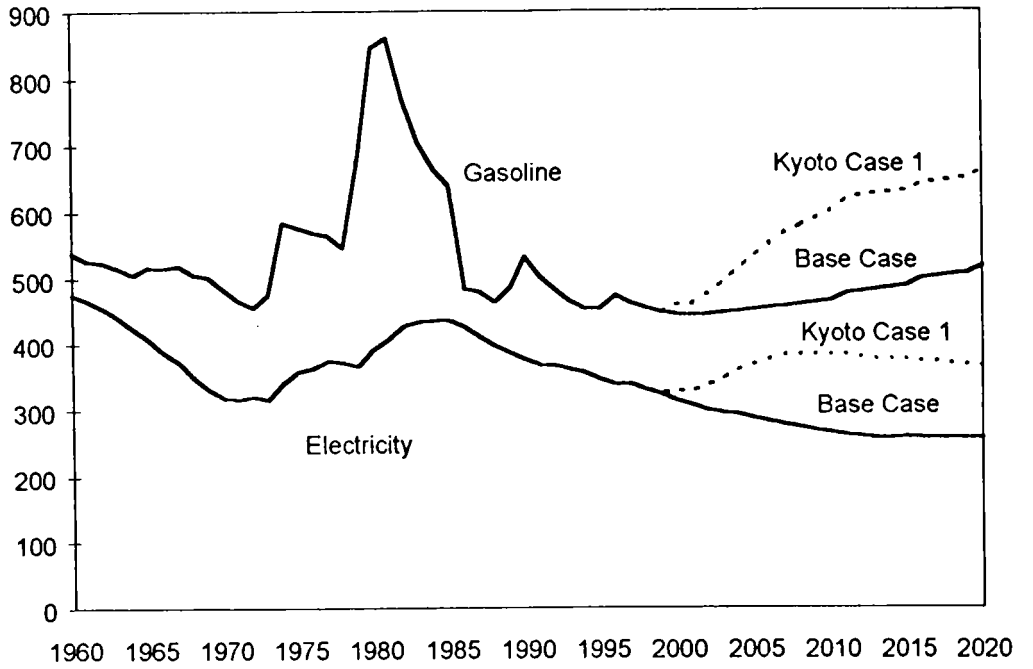
The price system can be used with either direct taxes on usage, subsidies to encourage non-usage, or restricted emission permits. Permits are an implicit tax. If you need to buy one, this is readily apparent. If you are given one and you sell it to another citizen or company, you are in the position of a "tax collector" of the implicit energy or emission tax. Everyone recognizes that permits are merely a tax that are not recorded as a tax, and whose revenues are collected by whomever the permit is given to.

The Administration hopes to ease the price shock on the U.S. economy by finding cheaper international "supplies" of emission reductions. Indeed, the Administration hopes American firms can secure 85% of our national needs overseas at an incremental price, roughly 1/10 the cost of equivalent reductions at home. To the extent this is true, the price shock to the American economy would be reduced. But a large revenue stream would be diverted overseas.

If the shifting overseas cannot occur, then a large price shock would have to be fed into the American macroeconomy--and digested with some difficulty. The potential indigestion problems would be akin to those of the oil shocks of the mid-1970s and early-1980s. A major favorable difference, however, is that the extra resource revenues or values created by implicit or explicit energy taxes would be kept in the hands of American consumers, businesses, and government.

DRI estimates that a permit price of $180 per tonne of carbon, phased in over the 2001-10 period, would be required to achieve the required reduction in energy demand and emissions, with limited permit purchases from abroad (Case 1). The resulting run-up in energy prices over this period would be approximately one-half that experienced in the mid-1970s and early-1980s (Exhibit 5). The price run-up is assumed to be introduced at a more gradual rate and known in advance, giving the economy more time to prepare for the changes. High consumer discount rates, however, are likely to minimize the benefits of the advance notice in the residential sector. In Cases 2 and 3, where assumed offsets from other gases, sinks, and abroad are more generous, the permit prices rise to $110 per tonne and $40 per tonne, respectively.

Exhibit 5
Consumer Energy Expenditures Per Capita at 1997 Consumption Levels
(1997 dollars)



During the decade following the first oil price shock, energy demand per unit of real GDP declined at a rate of 2.5% per year in response to higher real energy prices and trend efficiency improvements (Exhibits 6 and 7). In DRI's base-case forecast, energy demand per unit of real GDP is projected to decline 1.0 % annually between 2000 and 2012, due to trend efficiency improvements; stable to falling energy prices provide no incentive for price-induced conservation gains. The improvement in the energy-to-real GDP ratio in the base-case is consistent with that assumed in the Administration's analysis.

With a $180 permit price, phased-in over the 2001-12 period, energy per unit of real GDP would decline 2.5% per year. This conservation response to the permit program is comparable to that observed during the 12 years following the first OPEC price shock, even through the price shock is one-half, because of the strong trend efficiency assumptions already incorporated into the base-case. Advance notice of future price increases also gives a moderately faster demand response than in the OPEC era.

Exhibit 6
Cumulative Reduction in Energy Demand Relative to Real GDP
(Percent difference from 1971 levels)

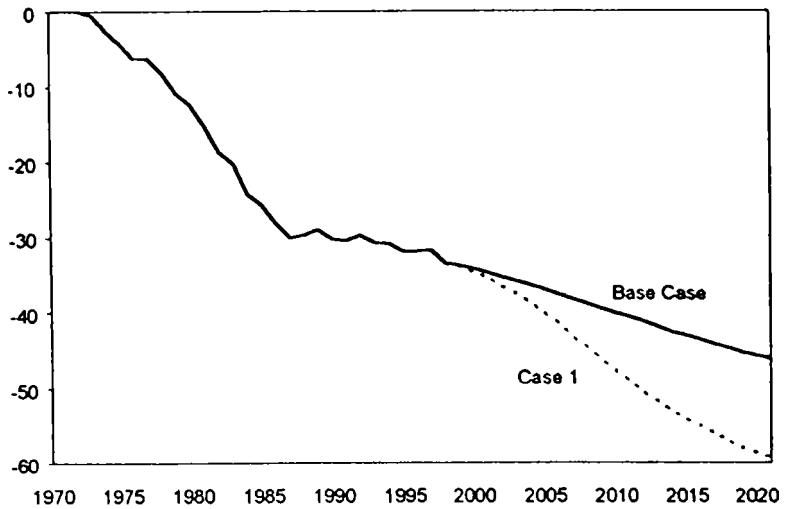
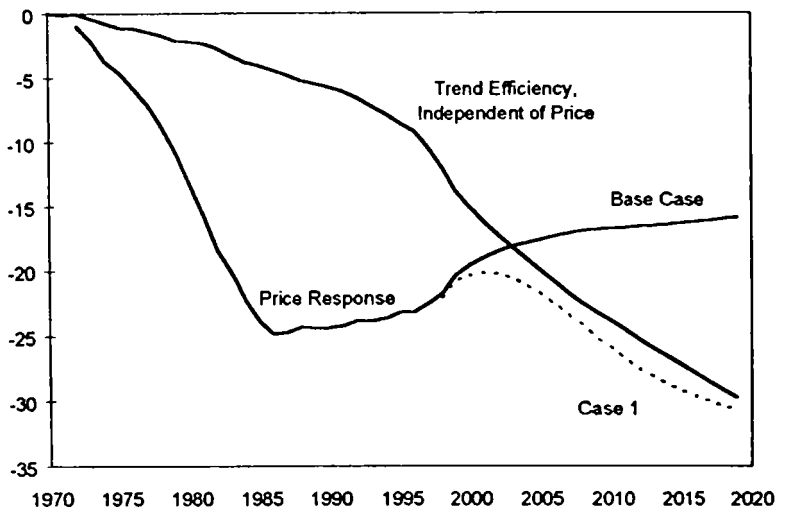


Exhibit 7
Cumulative Reduction in Energy Demand Relative to Real GDP
in Response to Price Changes and Trend Efficiency
(Percent difference from 1971 levels)



What Will Be the Impact on U.S. Growth and Employment?

Employment and output losses would be expected over the next decade because: energy-using equipment and vehicles would be made prematurely obsolete; consumers would be

rattled by rapid increases in living costs; and the Federal Reserve would most likely need to target more slack in the economy to deflate non-energy prices and thus stabilize the overall price environment. The analysis assumes that emission permits would be given to businesses, recognizing their key role as central managers of most of the economy's emissions. While this would imply lower consumer real incomes and higher business profits in the medium term, this strategy would also accelerate investment and thus support better long-term productivity growth--and probably greater energy efficiency.

The lower the energy price rise and the more gradually it is phased in, the less would be the negative impact on economic growth and jobs. With a $180 permit price phased-in over the 2000-10 period, real GDP would fall a maximum 2.0% below base-case levels in 2008, and average 1.6% lower during 2008-12. With a $110 and a $40 permit price, real GDP would average 1.1% and 0.6% below base-case levels during 2008-12.

Consumption and residential fixed investment would be the hardest-hit components of real GDP because of the direct loss of real disposable income. Business fixed investment would initially be depressed by lower consumer spending levels, but would ultimately be boosted by the increased revenue accruing to the business sector and lower real long-term interest rates. This investment boost is key to restoring the economy's supply potential in the longer-term. With a relatively fixed labor force, lower energy usage, and an existing capital base made inefficient by the higher energy prices, increased investment is the only means by which the economy's supply potential can be restored.

The average annual job loss from base-case levels during 2008-12 would be 1.6 million jobs (1.1% in Case 1), 1.1 millions jobs (0.7%) in Case 2, and 500,000 jobs (0.4%) in Case 3 . The percentage loss in employment is less than that in output because of a decline in labor productivity.

- Coal mining states such as Wyoming, West Virginia, and Kentucky would suffer the largest employment losses--three times the national average.

- Texas and Louisiana, large oil and natural gas producing states, would experience employment losses of nearly twice the national average.

- States with above-average concentrations in energy-intensive manufacturing industries, such as petroleum, paper, cement, and primary metals, would also be hit harder. Alabama, Tennessee, South Carolina, Louisiana, Delaware, and Pennsylvania are included in this group.

States with production concentrated in investment goods would generally fair better than states with production in consumer goods, because the capital stock would need to be expanded and reconfigured. The role of developing countries in the Protocol is still undefined. The impact on states producing goods traded goods could potentially be severe if developing countries would be allowed to use low-cost, high-polluting technologies and sell their products at a lower cost in the United States.

Exhibit 8
States with Above Average Employment Impacts
(Average percent difference from base-case, 2008-12)

Wyoming	-3.5
West Virginia	-3.2
Kentucky	-2.6
Alabama	-2.4
Tennessee	-2.2
South Carolina	-2.1
Louisiana	-2.0
Virginia	-1.8
Mississippi	-1.7
Texas	-1.7
North Carolina	-1.7
Maryland	-1.6
Georgia	-1.5
Nevada	-1.5
Delaware	-1.5
Alaska	-1.3
Pennsylvania	-1.2

Exhibit 9
Mining Employment Impact, 2008-12

	Mining Employment (percent difference from base)	Energy Mining (share of total employment)	Coal Mining (share of total employment)
U.S.	-16.5	0.3	0.1
Virginia	-38.4	0.2	0.2
Kentucky	-37.9	1.2	1.1
West Virginia	-37.9	3.2	2.9
Alabama	-29.1	0.4	0.3
Wyoming	-28.7	4.3	2.3
Montana	-25.2	0.6	0.3
North Dakota	-16.8	1.1	0.4
New Mexico	-16.1	1.2	0.3
Colorado	-13.6	0.4	0.1
Texas	-10.2	1.6	0.1
Oklahoma	-8.4	2.0	0.0
Louisiana	-7.0	2.4	0.0
Alaska	-4.7	2.9	0.0

Exhibit 10
Summary Impacts of Alternative Emission Reduction Cases

	Case I Limited Options from Abroad	Case II Medium Options from Abroad	Case III Generous Options from Abroad
Emissions (million tonnes)			
Required Reduction	500	500	500
Offsets from Other Gases & Sinks	-40	-60	-80
Offsets from Abroad	-70	-150	-270
Required Reduction in Emissions from Domestic Fossil Fuel Combustion	390	290	150
Percent of Required Reduction	78%	58%	30%
Permit Price (1997 dollars)	$180	$110	$40
Wholesale Energy Prices (percent difference from base)	77%	49%	18%
Consumer Energy Prices (percent difference from base)	36%	24%	9%
2008-12 Average GDP Impact (percent difference from base)	-1.6%	-1.1%	-0.6%
2008-12 Employment Impact (percent difference from base)	-1.1%	-0.7%	-0.4%
2008-12 Employment Impact (average annual difference from base, millions)	-1.6	-1.1	-0.5

CLIMATE CHANGE AND PUBLIC HEALTH: CONSEQUENCES AND COSTS

Testimony
for
The Congress of the United States
House of Representatives
Committee on Government Reform and Oversight

Subcommittee on National Economic Growth, Natural Resources,
and
Regulatory Affairs

April 23, 1998

Paul R. Epstein, M.D., M.P. H.
Associate Director
Center for Health and the Global Environment
Harvard Medical School
Oliver Wendell Holmes Society
Room 263
260 Longwood Avenue
Boston, MASS 02115

Phone: 617-432-0493
Fax: 617-432-2595
E-mail: PEPSTEIN@warren.med.harvard.edu

"Epidemics are like sign-posts from which the statesman of stature can read that a disturbance has occurred in the development of his nation …."

--Dr. Rudolf Virchow, 1848

CLIMATE CHANGE
AND
PUBLIC HEALTH:
CONSEQUENCES AND COSTS

INTRODUCTION

The United Nations' World Health Organization reports that thirty diseases new to medicine have emerged in the past two decades; and in the last five years, the incidence of malaria has quadrupled. There are multiple determinants of health and well-being, but climate circumscribes the range of insect-borne diseases, while weather affects the timing and intensity of outbreaks. Warm, wet conditions increase the populations and biting rates of insects, and the maturation of parasites and viruses within them. Thus, as the world warms and weather patterns grow more unstable, we may expect a change in the prevalence and distribution of several prominent infectious diseases.

Are we seeing changes in disease distribution attributable to climate change?

Insects and insect-borne diseases (including malaria and dengue fever) are today being reported at high elevations in Africa, Asia, and Latin America, and highland malaria is becoming a problem for urban centers like Nairobi, Kenya. Highland malaria occurred earlier in this century during warm years. But it is the *resurgence* of insect-borne disease at high elevations in the 1990s and *reappearance* of this disease among previously unexposed populations that is of concern. Moreover, the change in range of *conditions conducive to transmission* is occurring in tandem with three other observed changes in the mountains, namely: 1)the accelerating retreat of summit glaciers throughout the tropics, 2)the migration of plants to higher altitudes on alpine peaks in Europe, New Zealand, Alaska and the U.S. Sierra Nevada, and -- the underlying change being -- 3)the upward shift in the level at which freezing occurs in the mountains (30°S to 30°N latitudes) some 500 feet since 1970, equivalent to about 2°F warming. Since the 1970s snow cover in the Northern Hemisphere has decreased 10%. Mountain regions are sentinel areas for monitoring long-term climate change and biological responses.

Small outbreaks of malaria have occurred in temperate latitudes in this decade. In the 1990s outbreaks of *locally-transmitted* (as opposed to imported or "airport" cases of) malaria have occurred within the continental U.S.: In Michigan, Texas, Florida, Georgia, California, New Jersey and Queens, NY, during hot, wet summers. In the 1980s, only California reported local transmission of malaria in the continental U.S. As mentioned, malaria occurred within the U.S. earlier this century, and these reports lack the supporting documented changes occurring at high

elevations in plants, glaciers and the upward shift in the freezing isotherm. But these reports are consistent with projections that warmer, wetter *conditions conducive* to greater transmission potential can be expected at higher latitudes.

What might account for these changes?

A warmer atmosphere holds more moisture (6% more for every 1°C). Increasing cloudiness keeps days cooler but keeps the nighttime warmer.

Since 1950 winters and nighttime temperatures have warmed at twice the rate of overall warming. To be precise, minimum daily temperatures over land areas have risen at a rate of 1.86°C per 100 years while maximum daytime temperatures have risen at 0.88°C per 100 years. The disproportionate rise in nighttime and winter temperatures accompanying climate change favors insect overwintering and activity.

Ocean warming and greater evaporation is principally (85%) responsible for the increase in atmospheric water content, and deep ocean warming has been reported from the Indian, Pacific and Atlantic Oceans. The ocean may turn out to be the long-term repository for this century's warming.

What about weather extremes?

While changes in disease distribution are occurring at high elevations, altered weather patterns and more extreme events may be the chief characteristic of climate change on the earth's surface; and weather extremes also contribute to disease outbreaks. Floods foster fungal growth and provide new breeding sites for mosquitoes; while droughts concentrate microorganisms, and encourage aphids, whiteflies and locusts -- and when interrupted by sudden rains -- spur explosions of rodent populations.

More cloudiness means heavier precipitation events when it cools enough to induce condensation.

Records from the National Climatic Data Center -- this nation's main repository for meteorological data -- indicate that extreme weather events have increased in the continental United States and in many other nations. Droughts have become longer and bursts of precipitation more intense (>2 inches over 24 hours). Warmer temperatures lower atmospheric pressure and pull in stronger winds and more extreme weather. This year's storms and last year major urban floods left damaging deposits and significant clean-up bills in their wake.

A pattern of greater weather variability has begun and

continued with the El Niño of 1997/98. Since 1976, such anomalies in Pacific Ocean temperatures and in weather extreme events have become more frequent, more intense and have persisted longer than at any time in the records kept since 1877.

Prolonged anomalous conditions of the sort that applied in 1990-1995 can also have biological consequences. In New Orleans, for example, five years without frost was associated with an explosion of mosquitoes, termites, and cockroaches. Termites persisted inside trees into the cold winter of 1995-1996, and now threaten to destroy stands of New Orleans' fabled "mighty oaks."

The story of the hantavirus illustrates a similar synergy in the case of microbial agents. A prolonged drought in the U.S. southwest in the early 1990s reduced the populations of animals such as owls, coyotes, and snakes that prey on rodents.

When the drought yielded to intense rains in 1993, the grasshoppers and pinon nuts on which rodents feed became more abundant. The result, when combined with the drop in predators, was a ten-fold increase in rats and mice by June, 1993. An outcome was the emergence of a "new" disease -- called Hantavirus Pulmonary Syndrome -- stemming from a virus, transmitted through rodent droppings, that was perhaps already present, but dormant; and was now transmitted through rodent saliva, urine and droppings.

Lyme Disease is a growing problem in many U.S. states. The life-cycle of this disease is complex, involving deer, deer mice, the "masting" of oak trees (producing acorns) and ticks. But warm, wet conditions favor tick reproduction and may accelerate transmission.

Persistent spells of extremely hot, humid weather (heatwaves0 can threaten the health of people living in temperate latitudes. During the summer of 1995, excess deaths in Chicago and other large cities around the world were directly associated with heat waves. (Social isolation was also a factor.) Farm animals are adversely affected when there is no let up of high temperatures at night temperatures remains, according to meteorologists, the key factor in Chicago was the increased nighttime heat and humidity.

While some will argue that warming may decrease winter deaths, unstable weather patterns and brief, intermittent cold snaps could have also have a negative impact on respiratory illness.

This year's events helps us understand the force of unstable climatic conditions.

In the U.S. Southwest rodent populations increased dramatically beginning in January, due to wet, warm conditions and increased vegetation. The increased threat of hantavirus

transmission this spring and summer warrants increased vigilance and surveillance.

Last summer favorable conditions in Florida precipitated several outbreaks. In Orlando, St. Louis Encephalitis threatened local residents and tourists to Disneyworld. Three agricultural pests emerged: Medfly, bringing pesticide-spraying to Dade county; citrus canker sore; and a tomato leaf virus carried by whiteflies.

Coastal waters and health.

Warming and heavy rains that increase the flow of nutrients into coastal waters also contribute to the proliferation of coastal algal blooms, "red and brown tides." Harmful algal blooms (HABs) are increasing in extent, duration, and intensity -- and are involving new species like *Pfeisteria* -- around the world. With sufficient nutrients, *Pfeisteria* appears in warmer waters; thus we must increase our vigilance for this disease this spring and summer. Some scientists consider the worldwide increase in coastal algal blooms to be one of the first biological signs of global change.

Warm years may result in a confluence of adverse events. Sea mammals are historically affected in warm and cold years. This year there have been enormous strandings and mortalities, for example in: Cape Cod, Mass., New Jersey, Florida, California, Peru, Venezuela and New Zealand. Some are from malnutrition, others from viral pneumonia, others from toxic algal blooms (HABs).

Worldwide there has been an increase in coral bleaching from warming (sea surface temperatures surpassing 29°C), and coral diseases, attributable to pollution and perhaps warming that increases microbial growth. This year the Great Barrier Reef off Australia bleached for the first time in recent history, as did those off the Galapagos Islands off the Americas. Bleaching and diseases of coral are of particular concern, for -- in addition to the potential impacts of these changes on the tourist industry -- coral reefs are the habitat and nurseries for much of marine life.

Two other hot spots around the world.

The massive blaze and haze covering Southeast Asia and swaths of the Amazon -- from deforestation and forest burning, combined with prolonged droughts -- leading to acute and chronic respiratory disease and losses in agriculture, wildlife, transport, trade and tourism.

West Africa has suffered from intense rains and flooding, leading to upsurges of cholera, malaria and mosquito-borne (and a particularly virulent, hemorrhagic form of) Rift Valley Fever -- affecting humans, livestock and the economies of several nations. Additionally, European nations have banned fish imports from East

Africa due to cholera.

COSTS OF EXTREME EVENTS AND EPIDEMICS

The recent rise in severe wind and flood-related events worldwide has had extraordinary consequences for property insurers. Prior to 1989, no single-event insured loss in the U.S. had ever exceeded a billion dollars. Since then annual insured losses have risen dramatically -- from $1.6 billion annually in the 1980s to $12 billion annually in the 1990s (only partially explained by increased "exposure"). Federal relief bills, chiefly from flooding, amounted to $13 billion from 1992-97, compared to $3.3 billion for the preceding five years. It is significant that we are having difficulty insuring our future.

The economic impacts of disease in humans, livestock, and food crops can also be severe and far-reaching. While the 1991 cholera epidemic cost Peru over $1 billion in seafood export and tourist income, airline and hotel industries lost from $2 to $5 billion from the 1994 Indian plague. Cruise boats, quite understandably, have begun to avoid islands racked by dengue fever. This trend could threaten a $12 billion-a-year tourist industry in the Caribbean that employs more than half a million people. In 1997, California floods left fungi and root rot that threatened that state's $22 billion citrus industry.

In 1997, the *Pfeisteria* outbreak along the U.S East Coast cost millions of dollars in investigation, monitoring, seafood, tourism and recreation industries. Persistent brown tides since the late 1980s in Long Island's Peconic have suffocated the seagrass and crippled the scallop industry. Recurrent contamination near Appalachicola, Florida have caused recurrent recalls of nationally-distributed oysters. Most recently, the fishing industry in Hong Kong lost $31 million due to an extensive "red tide' and fish kill.

Worldwide, 40 to 50 percent of all crops are lost to pests, pathogens and weeds, costing some $250 billion. The range of plant pests and pathogens are also affected by temperature, and may be encouraged by extreme weather events. The numbers of whitefly, for example, swell during a drought; and whiteflies are injecting at least eighteen types of geminiviruses into tomato, squash, and bean plants throughout Latin America, depleting the primary source of protein for many who live there. Recently a necrosis virus that attacks rice(carried by soil-based fungi) has appeared in Colombia, and spread of a disease of this staple food source could have enormous impacts on world food supplies. There is evidence that carbon dioxide "fertilization" can render plants more sumptuous for insect, thus enhance herbivory.

CONCLUSIONS

Climate change and weather instability can affect human

health through storms and trauma, heatwaves and cold snaps, impacts on food and clean water, and through the spread of infectious disease.

The global resurgence of infectious disease in the last quarter of the twentieth century -- a backward step that few would have anticipated twenty years ago -- is a consequence of compounding changes in social, local environmental and global conditions. Greater health surveillance and response capability are the first, essential, steps. But viewed as a symptom, the resurgence of infectious disease may be a signal that we are vastly underestimating the true costs of "business-as-usual."

The resurgence of malaria, dengue fever, and cholera -- and the emergence of relatively new diseases like hantavirus pulmonary syndrome and Lyme Disease -- affects not only the health of individuals, but impacts national economies through health care costs, investigations and monitoring, food production practices, and impacts on fisheries, international trade and tourism.

The world has not experienced this degree of infectious disease resurgence since the 1830s, when conditions in northern urban centers -- so graphically described by Charles Dickens -- help explain the triple epidemics of those times: TB, smallpox and cholera. Environmental and sanitary reform addressed the underlying conditions, and those diseases receded.

Human activities are altering atmospheric chemistry and changing the earth's heat budget. Together, physical and chemical changes have begun to affect biological systems, and we as citizens and policy makers must be increasingly concerned with the biological consequences and economic costs associated with climate change. The waste products of fossil fuel combustion have direct consequences for human and ecological health through air pollution and acid precipitation; now the aggregate of emissions appears to be destabilizing the earth's climate system, and changing the conditions under which opportunistic pests and pathogens can thrive.

Even as out powers of climate prediction increase, there is growing uncertainty about how the climate system, particularly the oceans, will behave with changes in the distribution of heat. But a warmer world with more unstable weather patterns may be expected to encourage the spread of pests of humans, marine life and agricultural crops, thus there are enormous implications for our food as well as our biological security.

Finally, we will have to make investments in our common future. And we can expect excellent returns. Furthermore, the economic growth generated by expanding jobs to put new technologies into the market place will contribute greatly to the long-term health of populations. Indeed, we may be vastly underestimating the economic, investment and employment

opportunities to society as a whole, as we launch upon a transition in which we use finite resources efficiently and generate energy cleanly.

"The nation behaves well if it treats the natural resources as assets which it must turn over to the next generation increased and not impaired in value. Conservation means development as much as it does protection."

-- Theodore Roosevelt

NATURAL RESOURCES DEFENSE COUNCIL

Statement of

Daniel A. Lashof, Ph.D.
Senior Scientist
Natural Resources Defense Council

Before the

House of Representatives
Committee on Government Reform and Oversight
Subcommittee on National Economic Growth, Natural Resources, and Regulatory Affairs

April 23, 1998

Thank you Mr. Chairman for allowing me to address the problem of global warming and some of the issues regarding the Kyoto Protocol. My name is Daniel Lashof, and I am a senior scientist with the Natural Resources Defense Council (NRDC). NRDC is a nationwide, non-profit organization with over 350,000 members, dedicated to protecting human health and the environment. Given the seriousness and magnitude of global climate change, and the need to promptly begin reducing greenhouse pollution, NRDC and the national environmental community have made this issue our highest priority this year.

My testimony focuses on the following four points:

1. **The Kyoto Protocol is a vital first step toward preventing dangerous changes in global climate.**

2. **US leadership is essential.**

3. **Achieving meaningful participation by developing countries.**

4. **The US can achieve the global warming pollution reductions called for in the Kyoto agreement without harming the economy.**

1200 New York Ave., N.W.
Suite 400
Washington, DC 20005
202 289-6868
Fax 202 289-1060

71 Stevenson Street
Suite 1825
San Francisco, CA 94105
415 777-0220
Fax 415 495-5996

6310 San Vicente Boulevard
Suite 250
Los Angeles, CA 90048
213 934-6900
Fax 213 934-1210

40 West 20th Street
New York, NY 10011
212 727-2700
Fax 212 727-1773

www.nrdc.org

1. **The Kyoto Protocol is a vital first step toward preventing dangerous changes in global climate.**

As a party to the United Nations Framework Convention on Climate Change, signed by President Bush and ratified by the Senate in 1992, the United States is committed to the objective of preventing dangerous anthropogenic interference with the climate system. Achieving this objective requires substantial and progressive reductions in greenhouse gas pollution, beginning immediately. The Kyoto Protocol is a vital first step, designed to put the United States and the world on a path to protecting the planet from dangerous climate change.

It is an indisputable fact that atmospheric concentrations of greenhouse gases are climbing and that this rising trend can be attributed to human activities. The most detailed scientific assessment of an environmental problem ever conducted—the Second Assessment Report of the Intergovernmental Panel on Climate Change--concluded that global warming is already upon us, and that, unless emissions of greenhouse gases are reduced significantly, future impacts on human health and the environment will be severe, and are likely to include:

- **More frequent and intense heat waves.** As average temperatures rise over the coming century, the frequency of severe heat waves will increase dramatically, which is expected to result in an increase in heat-related deaths. The heat wave that killed over 400 people in Chicago in 1995 is an example of the kind of event that is expected to occur with increasing regularity.

- **Increased spread of infectious diseases.** Infectious diseases that are carried by insects and other pests are highly sensitive to environmental conditions. Higher temperatures will increase the range of malaria-carrying mosquitoes and make the mosquitoes more infectious. Global warming could cause as many as one-million additional deaths from malaria each year during the middle of the next century. Other sensitive diseases include hantavirus and dengue fever, which has already broken out in Texas.

- **Flooding along our coasts and river basins.** Warmer temperatures cause sea levels to rise and allow the atmosphere to hold more moisture. Warmer sea surface temperatures are expected to make hurricanes more severe. In addition to battered coasts, inland areas can be affected by earlier and more rapid snow melt and more intense storms, leading to greater rates of flooding, such as the ones witnessed last year in North Dakota and Minnesota.

- **Extreme droughts and more severe storms in our heartland.** More of our rainfall is now coming in intense downpours rather than steady drizzles. This coupled with higher rates of evaporation in a warmer world is expected to intensify droughts and storm damage in America's breadbasket.

The climate system is complex, and there are remaining uncertainties, particularly about the details of climate change at the regional and local level. Nonetheless, it is abundantly clear that we are facing a real and serious threat. Uncertainty is after all a double-edged sword. We cannot rule out the possibility that climate change will be less severe than the scenario outlined above, but it is just as likely that things will turn out to be worse than the mainstream forecast. The Defense Department would never base its response to military threats on the views of a handful of doubters or on the hope that the world will turn out to be benign. We should apply the same precautionary principle to global warming policy.

The Kyoto protocol is indeed a very modest response to the threat posed by global warming. Much deeper and more rapid reductions in greenhouse pollution could easily be justified, as NRDC and many other environmental organizations have advocated. This in no way implies that the environmental benefits of the Kyoto Protocol are insignificant. The benefits of the Protocol itself will be cumulative over a period of more than a century. More importantly, the Protocol must be seen as the first of many steps that will be needed to protect the planet, as observed by Professor Bert Bolin, who chaired the Intergovernmental Panel on Climate Change until recently:

> "Because of the long residence time of CO_2 in the atmosphere, even a modest reduction in the rate of increase of atmospheric CO_2 would be of long-term significance. It would still be an important first step and be increasingly beneficial during future decades, even if a reduction would be far from what is required to reach the goal of stabilizing the concentration of CO_2 in the atmosphere.
>
> The inertia of the climate system was not appreciated fully by the delegates in Kyoto. It therefore seems likely that another international effort will be required well before 2010 to consider whether further measures are warranted."
>
> *Science*, 16 January 1998, Vol. 279, p. 330-331.

2. US leadership is essential.

The history of the 20th Century will focus on the role of the United States in leading the West's successful prosecution of the Cold War. The probability of global climate change threatening the security of the United States in the 21st Century is in fact higher than the probability ever was that the Soviet Union was planning an invasion of Western Europe or the United States. We are rapidly approaching a world with 10 billion people all aspiring to the standard of living we enjoy here. The fact is that this goal is simply unattainable based on the 19th century technologies that currently dominate our energy supply system. The ecological catastrophe and economic frustration that would result from an attempt to follow this path represent a clear and present danger to the security of the United States. US leadership is essential to avert this catastrophe.

The US has both the capability and responsibility to take the lead in combating climate change. Currently, the US contributes more than 20 percent to the world's emissions of the most important greenhouse gas, carbon dioxide (CO_2), although we have only four percent of the world's population. Since 1950, the 36 most industrialized countries of the world—those categorized as Annex I nations under the Framework Convention on Climate Change—have been responsible for approximately three-fourths of the greenhouse gases added to our

atmosphere. On a per capita basis, the disparity between Annex I nations and developing nations is even more stark. US per capita CO_2 emissions are eight times greater than those in China and 20 times those in India.

3. Achieving meaningful participation by developing countries.
Developing countries are Parties to the Framework Convention on Climate Change and are expected to be Parties to the Kyoto Protocol. They have a range of obligations, including adopting national programs to mitigate climate change. Claims that developing countries are exempt from the treaty are simply false. The convention establishes "common but differentiated responsibilities" among Parties and calls for those who contributed most to the problem to "take the lead in combating climate change." The quickest way to ensure that developing countries take on appropriate additional responsibilities is for industrialized countries to begin implementing the commitments they made in Rio and Kyoto to achieve real reductions in global warming pollution.

I fear that some who have argued that the US should not take any action against global warming unless developing countries simultaneously commit to similar action are not motivated by a desire to improve the climate treaty, but by a desire simply to kill it. For example, the Global Climate Coalition, an industry association that has forcefully advanced this position, has said that the Kyoto agreement should be rejected quickly, which would make it impossible to secure additional developing country commitments. This would have the effect of delaying action by all Parties even further, and thus would delay any action on a problem that threatens the health and well-being of all Americans.

Claims that simultaneous additional commitments from developing countries are needed to protect US jobs are similarly dubious. More than two-thirds of US emissions come from sectors of the economy that are inherently domestic in nature. In the manufacturing sector, many factors are far more important that environmental requirements or energy costs in determining the competitiveness of US firms. US wages are (fortunately) far higher than world averages, yet US firms remain competitive by having higher labor productivity. Similarly, higher "eco-efficiency" keeps US firms competitive despite stricter environmental standards than in most other countries. For the small handful of products for which energy costs represent a significant fraction of their value, targeted policies are the best approach to ensure that US firms and workers are not disadvantaged by any domestic emission reduction policies. For example, importers of energy intensive products, such as steel or paper, could be required to obtain emission permits on the same basis as would have been required had the product been manufactured domestically. Alternatively, emission abatement costs could be rebated to domestic manufacturers of such products based on their US payroll or on some other basis that does not diminish their incentive to reduce emissions.

The question therefore is not, nor has it ever been, if developing nations should participate in solving the global warming problem. Rather, the questions is how to secure the meaningful participation that the President has called for. First the industrialized countries must provide the leadership they pledged at the Rio Earth Summit, but have so far failed to deliver. Actions speak

louder than words. If the United States and other industrialized countries begin to make meaningful changes in our own energy systems, developing countries will be strongly motivated to not become a dumping ground for obsolete technologies. Once the industrialized countries have taken the first step, we can and should insist that developing countries follow by agreeing to appropriate limits on their emissions. This is the only way to avoid the train wreck that would ensue if the engineers of two trains careening toward each other both said that they were going to continue full steam ahead until they saw the other train slowing down. It is in the national interest of the US to provide the leadership needed to slow the train down.

4. The US can achieve the global warming pollution reductions called for in the Kyoto agreement without harming the economy.

Over 2000 economists issued a statement last year, which says in part, "Economic studies have found that there are many potential policies to reduce greenhouse gas emissions for which the total benefits outweigh the total costs." Nonetheless, contradictory claims about the costs and benefits of reducing greenhouse gas emissions are currently rampant. The World Resources Institute report by Rapetto and Austin puts these different claims in a useful perspective by analyzing the differences in assumptions that are most responsible for the different results. Particularly striking, however, is that every analysis of the costs and benefits of reducing US greenhouse gas emissions that has looked explicitly and realistically at technology has reached the same conclusion: We can reduce US emissions substantially without economic harm and with the potential for economic benefits due to the introduction of more efficient technology.

Indeed, an innovation-led strategy for achieving the target adopted in Kyoto can be expected to produce a net increase in US jobs by improving energy productivity, reducing expenditures on oil imports, and expanding sectors of the economy that result in the most employment per dollar of expenditure. A study conducted by NRDC, along with four other environmental and energy organizations, called *Energy Innovations*, shows that the US can reduce its CO_2 emissions 10 percent below 1990 levels by the year 2010, while boosting economic performance. The *Energy Innovations* study found that by following an innovation path, the economy would support 800,000 additional jobs by 2010 compared to business-as-usual growth in the economy, and consumers would save $530 per household per year. Similar results were obtained by using results from the Department of Energy's "Five Labs" study as an input to macroeconomic models, such as Markal Macro and Argonne National Laboratory's Amiga model. These results are reviewed in a forthcoming paper by Laitner et al., to be published shortly in the Journal *Energy Policy*.

It is important to keep these results (and competing claims of economic losses) in perspective. In an economy that creates 250,000 new jobs per month, the job gains forecast *by Energy Innovations* amount to a little less than one-half of one percent of baseline employment forecast for 2010. Also, it is important to recognize that there will be some shift in future employment prospects. Job gains in motor vehicle manufacturing, agriculture, construction, and services will be partially offset by lower employment in the energy sector, and US policy should ensure that a

just transition is provided for displaced individuals. We should not, however, allow US policy to be dictated by any narrow set of interests at the expense of the public interest.

Note that these results are based on achieving emission reductions entirely through domestic action in the energy sector. The US can and should plan to achieve a substantial majority of the emission reductions called for in the Kyoto Protocol through such domestic action. Nonetheless, the additional flexibility built into the Kyoto Protocol ensures that marginal emission control costs will remain low, even if some approaches are not as successful as we expect.

Putting the models aside, what does history and common sense and tell us? History tells us that every time we have faced an environmental challenge--from getting the lead out of gasoline, to protecting the ozone layer, to controlling acid rain—there have been those in industry that have said that it won't work and it will wreck the economy. They have never been right. In fact, once the decision was made, each time industry rose to the challenge and American ingenuity found ways to address these problems cheaper and faster than had been anticipated. To take one example, industry predicted that controlling acid rain would cost as much as $1500 per ton of sulfur removed. Sulfur allowances are now trading at about $100 per ton—less than one-tenth the prior estimate.

Is there some reason why history won't repeat itself in the case of global warming? Physics and common sense say no. Indeed, a recent New York Times editorial by Swiss businessman Stephan Schmidheiny takes US businesses to task for their "new American can't-do spirit." (Reprinted in *Energy Futures*, which is attached to my testimony for the record.) Power plants and automobiles are the two largest sources of greenhouse gas emissions in the US and they are both incredibly inefficient. Power plants waste two-thirds of the energy they consume and automobiles waste almost nine-tenths. That means that US power plants alone waste more energy than is consumed in India plus all of Africa. We must be able to do better and we can. Trigen Energy Corporation is marketing systems that achieve 90% overall efficiency by capturing this waste heat and putting it to useful work heating and cooling buildings. The Partnership for a New Generation of Vehicles has identified technologies capable of tripling the fuel efficiency of automobiles. These are just two examples of the kinds of technology innovations that will be unleashed once the United States makes a serious commitment to reducing global warming pollution.

The Administration's Climate Technology Initiative is a well-designed proposal to begin putting the US on the innovation path. It would bring support for innovation in energy efficiency, renewable energy, and other clean energy technologies to a total of $1.3 billion dollars in FY99—consistent with the recommendations of the President's Council of Advisors on Science and Technology and still less than one-half of one percent of US expenditures on energy last year. These technologies enjoy overwhelmingly public support as the top priority for energy funding. This initiative also includes well-targeted tax reductions tied to the environmental performance of automobiles, homes, and energy using equipment.

The Climate Technology Initiative will not only help the United States to cost-effectively meet its international obligations under the Rio Climate Treaty, it will deliver immediate clean air benefits and confer a competitive advantage to innovative US firms.

Conclusion

Global warming poses a serious threat to the planet that our children and grandchildren will inherit. US leadership is essential to crafting an effective global solution. Leading the international effort to combat global warming will not harm the US economy. Indeed, implementing the Kyoto protocol is a vital national interest of the United States.

STATEMENT BY
SENATOR CHUCK HAGEL
BEFORE THE
SUBCOMMITTEE ON NATIONAL ECONOMIC GROWTH,
NATURAL RESOURCES, AND REGULATORY AFFAIRS
HOUSE COMMITTEE ON GOVERNMENT REFORM

HEARING ON THE KYOTO PROTOCOL

APRIL 23, 1998

Mr. Chairman and members of the committee, thank you for the opportunity to appear before your subcommittee. My colleagues in the Senate and I are very enthusiastic about the leadership role our colleagues in the House have taken on the global climate change issue.

As Chairman of the Foreign Relations Subcommittee with jurisdiction over the Kyoto Protocol, I know that oversight work is difficult work ... it is unglamourous work. But it is essential work. So I am grateful to you for holding this hearing.

In the case of the Kyoto Protocol it is particularly important that oversight hearings be held because the treaty would have a severe impact on the everyday lives of Americans ... people we all represent. As the Administration continues to withhold the Global Climate Treaty from Senate consideration, your leadership, Mr. Chairman, becomes even more important. Committees in the House and Senate must work together to carefully investigate whether this Administration is working to begin implementing parts of a treaty that has not even been submitted ... and will not be submitted to the Senate for ratification.

In February, Undersecretary of State Stuart Eizenstat -- who was the lead U.S. negotiator in Kyoto -- testified before the Senate Foreign Relations Committee. I pressed Secretary Eizenstat about any attempts to implement this treaty prior to Senate ratification. He replied:

> "We have no intention through the back door or anything else, without Senate confirmation, of trying to impose or take any steps to impose what would be binding restrictions on our companies, on our industry, on our business, on our agriculture, on our commerce, or on our country until and unless the Senate of the United States says so."

That certainly sounds clear. It sounds definitive. But I fear that there are others in the Administration who do not share Secretary Eizenstat's clearly stated position. It took over two months for the Administration to answer 39 questions for the record that I asked to be answered within two weeks. Those answers just arrived yesterday. As expected, they did not fully answer most of the questions asked. The Administration only supplied answers this month to the Senate Energy Committee for a hearing they held last October.

The Administration's interest in "implementation without ratification" is not mere speculation. Last October, the President stated that the United States, "must not wait" for the treaty before taking action. By all indications, the Administration is following these instructions.

- The Administration submitted a Budget proposal this year to dramatically increase spending on climate change initiatives. The Administration has asked for $6.3 billion over 5 years. In yesterday's *Financial Times*, Joe Romm of the Department of Energy was quoted as admitting that $6.3 billion initiative is intended to help meet emissions reductions mandated in the Kyoto Protocol.

- A leaked EPA memorandum called for creation of a domestic "cap and trade" system to regulate carbon dioxide emissions even before the Kyoto Protocol was submitted to the Senate. This memorandum argued that the Environmental Protection Agency (EPA) has authority under the Clean Air act to directly regulate carbon dioxide emissions. The memo also called for even clearer regulatory authority through the Administration's electricity deregulation proposal. I am convinced that the Administration did not attempt to include climate change programs in its electricity deregulation proposal only because they were caught by the first leak.

- EPA has initiated regulatory outreach programs with states and localities, to encourage them to take action on their own.

- Virtually every Department and Agency now has a climate change office and initiative ... which begins to implement the Kyoto Treaty. Even the Department of Agriculture has taken up this issue. On March 5, Deputy Secretary Rominger testified before the Senate Agriculture Committee that: "the USDA must escalate its level of activity in the area of global climate change. The Global Change Program Office will be responsible for coordinating the wide range of climate change activities across the Department, supporting the activities of the executive branch and working with the agriculture and rural communities to help them address the challenges of climate change ***and realize the opportunities that Kyoto will present.***" I wrote to USDA and asked exactly what they are doing to "realize the opportunities that Kyoto will present," based on the fact that the Kyoto Protocol has not been ratified -- in fact, has not even been signed or submitted to the Senate.

Mr. Chairman, you know how serious this issue is. The Kyoto Protocol violates the explicit criteria set last July when the Senate passed 95-0 the Byrd-Hagel resolution. The Senate is on record opposing any treaty that does not include the 134 developing countries or seriously harms the U.S. economy. This treaty fails on both accounts.

First it fails to include any of the 134 developing countries -- countries like China, Mexico, and Korea. This means more than unequal treatment for the U.S. economy and lost jobs for Americans. It also ensures that the treaty would fail to meet its own objective to limit greenhouse gas emissions. Early in the next century, 60% of all manmade greenhouse gas will

come from developing countries. By 2015, China will become the largest greenhouse gas emitter in the world.

Second, the Kyoto Protocol would inflict devastating harm on the U.S. economy while leaving untouched many of our toughest global competitors, such as China, Korea, Mexico, Singapore and India. Mary Novak, senior vice president of Wharton Econometrics Forecasting Associates (WEFA) (who is one of your panelists today) stated recently before the Senate Agriculture Committee that the Administration's economic "analysis" of the Kyoto agreement is terribly flawed. WEFA has predicted that the U.S. total cost of meeting obligations under the treaty would be $250 billion. This would be a loss of 3.2% of our gross national product. She stated that the treaty would eliminate about 2.5 million jobs. The annual expense per family would exceed $2,700.

And for what? Just yesterday the U.S. Energy Information Administration admitted that under the Kyoto Protocol global carbon emissions would jump 32 percent by 2010. This assumes that the United States and every other industrial nation met the draconian cuts in energy use called for in this U.N. Global Climate Treaty. Why should the U.S. Congress support a treaty that would accomplish nothing while devastating the U.S. economy? Even if one accepts the most extreme scientific claims of impending doom -- which I do not -- this treaty would be meaningless, as many of us have been saying, without the developing world.

And the science *is* still uncertain -- at best it is contradictory. Three days ago, 15,000 scientists released a petition urging rejection of the Kyoto Protocol. Nearly all of these 15,000 scientists have technical training suitable for evaluating climate research data. They stated, "there is no convincing scientific evidence that human release of carbon dioxide, methane, or other greenhouse gases is causing or will cause catastrophic heating of the Earth's atmosphere and disruption of the Earth's climate."

And just two weeks ago two respected weather scientists spoke at the National Hurricane Conference in Norfolk, Virginia. They were sharply critical of the global warming holocaust theory so popular in the Administration. William Gray, well-known for his work in hurricane prediction, stated "the changes in climate that the world is experiencing are natural." Neil Frank, former director of the National Hurricane Center, stated that "climate change has nothing to do with carbon dioxide." He also criticized the Administration's climate computer models, saying "the atmosphere is too complex, and computers are too slow" to make long term climate forecasts. He added that he has not seen any data that should force the U.S. into quick decisions on carbon dioxide emissions.

After failure of the Administration's "BTU tax" in 1993, I can understand their possible interest in "backdoor" implementation of the Kyoto Protocol. But such an approach is dishonest. Thank you, Mr. Chairman and your House colleagues, for your efforts to ensure an open and honest debate on this issue, and for your leadership in protecting the hardworking Americans whose interests were abandoned by the Administration in Kyoto, Japan.

Thank you.

ozone action

April 23, 1998

Testimony Before the Subcommittee on National Economic Growth, Natural Resources and Regulatory Affairs. Chairman David McIntosh.

Submitted by John Passacantando, Executive Director, Ozone Action

Greetings, Mr. Chairman, and members of this committee. I am grateful for the opportunity to share with you some thoughts on the international agreement forged in Kyoto, Japan last December on climate change. The question I have been invited to answer, "Is the climate agreement good for the United States," is a most appropriate one.

First and foremost we must consider the overwhelming consensus that has emerged regarding the threat of global warming. The Intergovernmental Panel on Climate Change (IPCC), comprised of more than 2,000 experts from around the world from government agencies, academia and industry have determined that "the balance of evidence suggests a discernible human influence on global climate." Thousands of scientists, including hundreds of Nobel Laureates, and members of the National Academy of Sciences, have lent their names to statements urging the U.S. to lead the world in averting climate change. In the peer-reviewed science journals, new research emerges weekly showing ever stronger evidence of human-induced climate change and the wide range of negative impacts to our environment and the health of our children.

I will not belabor the list of negative impacts. I will merely say that if you accept the science, as I do, you must acknowledge that we are facing an awesome problem. As a race, we are creating a global problem by our excessive burning of fossil fuels that experts tell us will throw a wrench into our blessedly stable climate for centuries, if not millennia. Impacts include the spread of infectious diseases, a rising sea level, disrupted agriculture and increasingly severe weather. More immediate are the direct, but externalized, costs from the burning of fossil fuels. Expressed in terms of present day dollars, these direct costs of burning fossil fuels may comprise 2 to 5% of our Gross Domestic Product.

More disconcerting than the threat of global warming is the response U.S. leaders have had to this threat because is completely out of character to the American spirit. America is a land of optimism, of endless possibility. We have the smartest engineers in the world. In times of adversity, Americans have always responded nobly with leadership and ingenuity.

When the astronauts of Apollo 13 thought they might not survive, NASA's smartest rolled up their shirtsleeves and found a way to bring them home.

1636 Connecticut Avenue, NW • Washington, DC 20009-1043 • (202)265-6738 • Fax (202)986-6041

As evil rolled throughout the world in the 1940s, U.S. leaders did not sit back and wait for developing nations to join the fight. We accepted the challenge, retooled our economy, and led the Allies to victory, building the foundation for the greatest economy the world has ever seen.

Naysayers keep proselytizing that reducing our greenhouse gas emissions will harm Americans but historical evidence teaches us the opposite. For the last thirty years, America has passed and enforced the best health and environmental laws in the world. Every time the naysayers said we couldn't have cleaner water, cleaner air, refrigeration without ozone depleting chemicals, gasoline without lead, they have been proven wrong. Instead, we have built our economy in harmony with a cleaner environment. We have an economy that is the envy of the world. Nevertheless, the American Petroleum Institute can pay for countless studies that say reducing our consumption of fossil fuels will make us less competitive with Mexico or China, but think about it. If such stories were true, given all our past environmental laws, we'd have people swimming south across the Rio Grande and stowing away on boats TO China.

I've had many interesting jobs in my career, but one of the most illuminating was as the director of marketing for Polyconomics, run by Jude Wanniski, the high priest of supply side economics. Now regardless of what you think about his theories, you must give him and the supply siders credit for one thing. When we had the high inflation and low growth of the 1970s and all the conventional economists resigned themselves to the belief that you had to choose one bad or the other, supply siders said that we could do better. They believed we could have an economic renaissance with strong growth and low inflation. Likewise, we can protect the environment, create jobs *and* improve our quality of life. It is not a zero sum game.

A funny thing happened on the road to the international climate change meeting in Kyoto, Japan this past December. Before the US could even start negotiations, the Byrd-Hagel Resolution on climate change was passed by the Senate 95-0. This resolution stated the US would not be a signatory to any climate agreement unless it "mandates new specific scheduled commitments to limit or reduce greenhouse gas emissions for developing country parties. . ." Interpretations of exactly what the resolution means vary as widely as the political spectrum. It is certain, however, that the Senate set a dangerous new precedent for environmental protection. For the first time, US environmental protection must wait for action from countries like China and Mexico.

The developing world requirement goes against our very American notion of sovereignty. Consider the first global environmental threat that was addressed through an international agreement, ozone depletion. Negotiators for Presidents Reagan and Bush struck a series of agreements, beginning in 1987 that ultimately led to a ban on the production of most ozone depleting chemicals We did not wait for the developing nations. They came on board later and are still laggards. In the meantime, a critical, perhaps planet threatening, amount of ozone depleting chemicals was never produced *and* US companies became leaders in the production of more profitable replacement chemicals. Claims about job loss and damage to our economy have vaporized, as usual.

Right now, the Senate seems to be held hostage to the whims of foreign leaders. Shall US leadership to reduce greenhouse gas emissions wait for President Ernesto Zedillo to clean the air

in Mexico City or Prime Minister Zhiang Zemin to make the Chinese less reliant on dirty coal for energy?

If we do, Americans lose the ability to set the living and environmental standards that have made us the envy of the world. More than 20 million people in the US with chronic respiratory problems live in areas with levels of smog likely to trigger their illnesses. Asthma is the leading serious chronic illness affecting our children, up 188% since 1980. An estimated 40,000 premature deaths occur each year due to particulate soot pollution. Consider also the unnaturally fast rise of the oceans, projected to rise one to three feet during the next 100 years from global warming. Sea level rise accelerates the pace of beach erosion, which threatens the lifeblood of entire coastal communities. New York, California, Massachusetts, Texas, Florida, Maryland, Delaware, Virginia and every other coastal state already spend millions of dollars, supplemented with taxpayer dollars, pumping sand back on shore, just to give us a day at the beach.

With the Senate's resolution, our economy and job base also become major losers. Students graduating from college are not lining up to interview at Exxon and the local coal mine for their dream jobs. The coal and oil companies want us to believe they are the backbone of the economy, when in fact, entrepreneurship and innovation are the real drivers. Government does best when it sets high standards that stimulate innovation. Management expert Michael Porter from Harvard has argued that "managers must start to recognize environmental improvement as an economic and competitive opportunity," rather than a cost. In fact, the countries that pass and enforce the strongest environmental laws develop the industries that lead in the exports of the regulated technologies. We witnessed the tiniest glimpse of such a useful prod to the US auto industry in early January.

Last fall, the auto and oil companies in the US were determined to keep any climate treaty from emerging in Kyoto. One single campaign spent $13 million to convince the American public that US emissions reductions without developing country participation will lead to our competitive and economic downfall. Exxon Chairman Lee Raymond became the poster child of hypocrisy, starting his day arguing against any climate treaty that lacked developing country participation at home, and finishing with a trip to China to threaten the Chinese not to sign on if they wanted foreign investment. The fossil fuel industry's position stands in sharp contrast with the majority of Americans, 74% of whom said they support the global warming treaty according to a December 17, 1997 Harris poll.

A treaty was struck despite these heavy-handed efforts, but it was a weak agreement. Weak, as Abraham Lincoln once said, "as the soup made from the shadow of a crow that had died of starvation." Weak, in that if all nations comply with the commitments made, we will still have severe, human-induced climate change. Nevertheless, the Kyoto Protocol still sent a signal. European carmakers recently proposed voluntarily increasing their emissions standards by 25%. GM's Chairman and CEO John F. Smith overnight became a vocal promoter of Detroit's forthcoming high-mileage vehicles. US automakers are starting to see that the future belongs to the Japanese and the Europeans unless they can recover lost time—time spent lobbying and advertising against change—time they couldn't recover in the 1970s after fuel prices shot up and they only had gas guzzlers to offer the American public.

I believe it was Senator Byrd who commented that the Protocol is a work in progress. I agree, but perhaps for different reasons. It is a minimally acceptable first step that must be strengthened considerably. We must aim higher because there is no going back if we make mistakes. According to best scientific estimates, we actually need to reduce emissions by 50-70 percent as soon as possible. We must not delay. To wait for developing countries is anti-American and counter-productive. We need to create strong enough incentives to make U.S. industry more energy efficient. If, in our weakness, our negotiators continue to push for loopholes in the Protocol, then, ironically, they will disadvantage the U.S. in the technology race of the future.

I believe the issue has been improperly framed as one of competitiveness between the industrialized world and the developing world – a static analysis showing that any emission reduction by the U.S. not mirrored by China, is a competitive advantage for China. Initial intransigence by developing nations is understandable because we have broken all our promises to them on this topic up until now. Nevertheless, they will ultimately choose the best technology, the most efficient paths they can afford. In fact, they have already taken many more steps than we have to maximize their efficiency. When Japan rebuilt after World War II, they built the most advanced steel mills in the world and, for a while, leapfrogged U.S. production facilities. Many developing nations are currently putting up cellular phone towers and skipping the copper wire stage altogether. Before long, the developing nations will be doing the same with energy technology. They will find that it is cheaper to bypass the more wasteful stage of energy use that current industrialized nations are just realizing they need to graduate from. The day is not long in the future when our mothballed coal-fired power plants are symbols of another era, like horses and telegrams are today.

So, if the Kyoto Protocol is constructed with strong enough incentives, if it encourages faster U.S. innovation of energy efficient technology and renewable energy sources, then with one exception, it will be a boon for the U.S. The one exception is the proud guild of coal miners. Approximately 25,000 people in this country are involved in extracting coal from the ground, our most polluting energy source by far. Moving away from this energy source will benefit the health of our country in myriad ways, but the miners, who have kept our lights burning, our heat on and our air conditioners running all these years must be compensated in this new era. They deserve a just transition and full American support to move away from this technology. There is currently $1.5 billion in the Surface Mine Reclamation Fund which, if released faster than it is currently, would be a smart step towards transition.

Now more than ever, we need leadership from our elected officials. It will be hard work, but when has that ever stopped American citizens? Waiting any longer to take action will be a grave mistake, an irreversible decision to accept the adverse consequences of climate disruption.