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The Myth of Vanishing CO_2 Emissions

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Demands to reduce carbon dioxide (CO_2) emissions and other greenhouse gases are intensifying. Many environmental groups, foreign governments, state governors, the Congress, and presidential candidates assert that the only way to avoid a climate catastrophe is to prevent emissions from reaching levels that constitute dangerous interference with the climate system. To achieve that end, the goal of reducing greenhouse gas emissions 60% or more by mid-century from some recent level, such as 2005 is promoted. Is such a goal achievable? At what cost?

The answers to those questions are overwhelmed by the appeal to the dire consequences of supposedly failing to act, but they are significant to any calculation of the feasibility of a public policy for addressing climate change and the mix of energy sources. Advocates claim that such reductions are achievable with existing and almost commercial technology and without imposing serious economic harm on economies. Such fanciful claims divert attention from the true crux of the issue, which is how can the world reconcile its growing energy needs and reduce the extreme poverty of 1.6 billion people with demands to reduce CO_2 emissions.

A Baseline: How Much Do We Emit Today?

In 2005, 28.2 billion metric tons of carbon dioxide were emitted globally. As the world's largest economy, the United States predictably emitted the most carbon dioxide, just below 6 gigatons that year. China, Russia, Japan, and India are the world's other large emitters of CO_2.

Global CO_2 emissions are projected to rise to 43 gigatons by 2030, according to a projection from the U.S. Energy Information Administration released in the spring of 2007. U.S. emissions rise to 7.9 gigatons under these projections, accounting for 18% of the world's CO_2 emissions. Chinese emissions jump to 11.2 gigatons in 2030; China is the world's largest emitter, producing one-quarter of the world's CO_2 emissions.

Carbon Emissions & GDP for Top-15 World Economies

Rank	Country	2007 GDP *(millions of USD)*	2005 Carbon Intensity *(Metric Ton of CO_2 per thousand USD)*	2005 CO_2 Emissions *(Million Metric Tons)*
1	United States	13,843,825	0.54	5,956.98
2	Japan	4,383,762	0.25	1,230.36
3	Germany	3,322,147	0.43	844.17
4	China	3,250,827	2.84	5,322.69
5	United Kingdom	2,772,570	0.35	577.17
6	France	2,560,255	0.29	415.27
7	Italy	2,104,666	0.41	466.64
8	Spain	1,438,959	0.57	387.11
9	Canada	1,432,140	0.77	631.26
10	Brazil	1,313,590	0.54	360.57
11	Russia	1,289,582	4.85	1,696.00
12	India	1,098,945	1.78	1,165.72
13	South Korea	957,053	0.78	499.63
14	Australia	908,826	0.90	406.64
15	Mexico	893,365	0.90	398.25

GDP from International Monetary Fund, World Economic Outlook Database, April 2008: Nominal GDP list of countries. Data for the year 2007.

GHG data from EIA Total Energy-Related Carbon Emissions (CO2 in Million Metric Tons) and Energy-Related Carbon Intensity (Metric Tons of Carbon Dioxide per Thousand 2000 U.S. Dollars) Tables (http://www.eia.doe.gov/environment.html)

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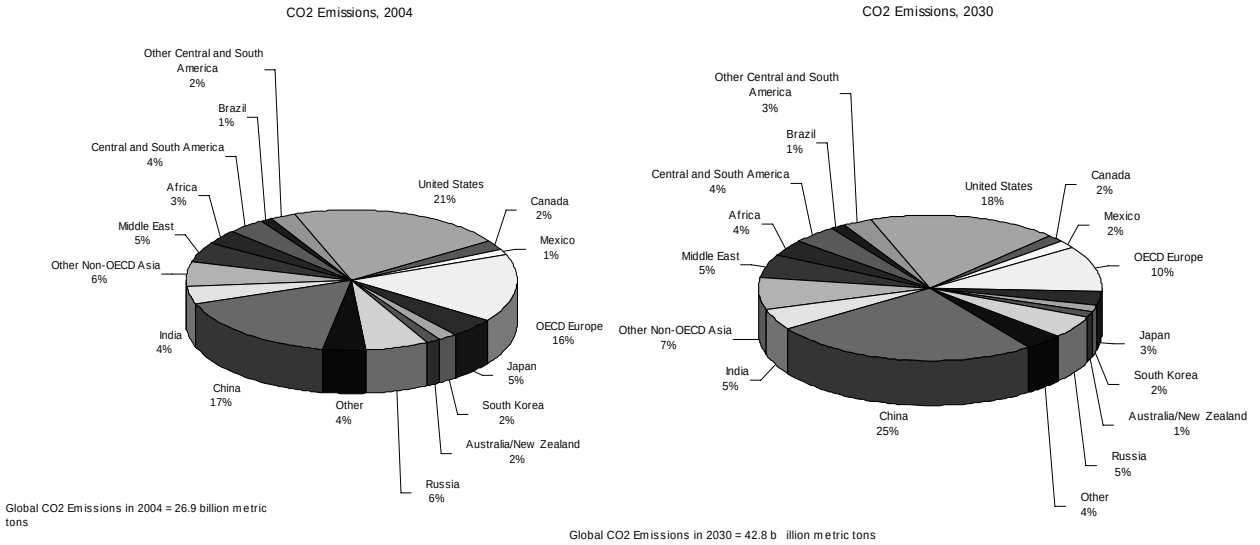
Share of Global CO_2 Emissions, 2004 v. 2030



Source: EIA, International Energy Outlook, 2007: Table A10.

These forecasts are sensitive to assumptions about economic growth rates and energy prices. In its most recent forecast for the United States, the EIA substantially revised these numbers downward, reflecting more pessimistic views of U.S. economic performance in the decades to come. The 2008 *Annual Energy Outlook* lowers the projection of economic growth through 2030, resulting in a decline of projected U.S. CO_2 emissions of nearly a gigaton. The more conservative numbers are used for the remainder of this analysis.

The other variable to consider when evaluating claims about CO_2 reductions is atmospheric concentration. More specifically, the Intergovernmental Panel on Climate Change (IPCC) estimated that 2005 levels of CO_2 were 379 parts per million (ppm). As defined by those who believe that a human-caused climate crisis is pending, dangerous human interference will occur as atmospheric concentrations of CO_2 exceeding 450-550 ppm or double the pre-industrial level. Projections of when the world will cross this threshold vary as do opinions about whether this is the right threshold. Like the EIA's forecasts, these projections are

What is a Gigaton?

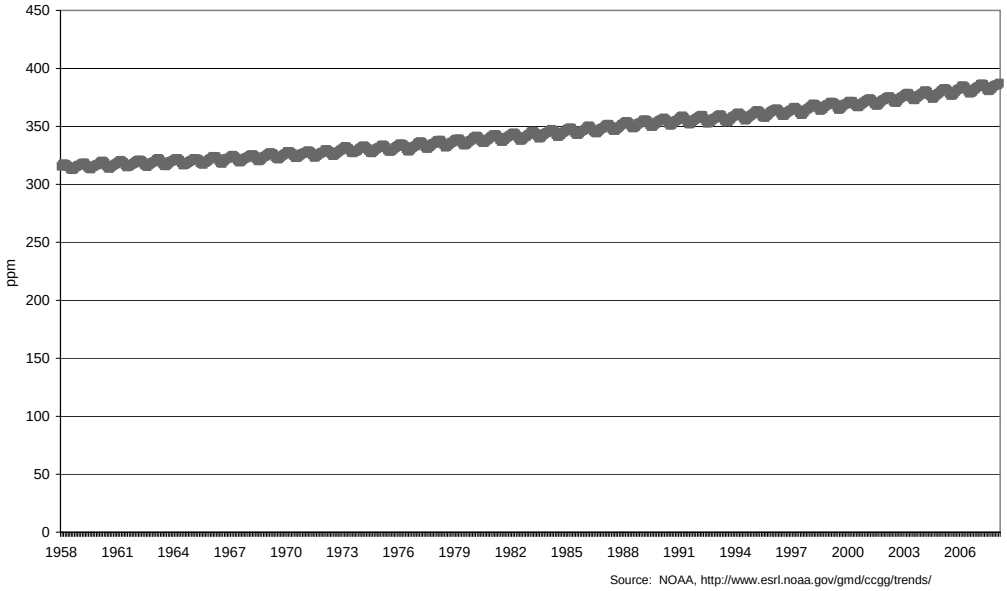
One metric ton of CO_2 equals 509.4 cubic meters; 1 gigaton is 1 billion metric tons, so the volume of 1 gigaton of CO_2 is 509,400,000,000 cubic meters (509.4 billion m^3).

The volume of the Houston Astrodome = 1,132,673.86 cubic meters. 1 gigaton = 509.4 billion cubic meters of CO_2. The Houston Astrodome has a volume of 1,132,674 cubic meters, so 449,732 Astrodomes would contain one gigaton.

The Hindenberg contained 6 million cubic feet of hydrogen (169,901.08 cubic meters) so 2,998,216.6 (about 3 million) Hindenbergs would contain one gigaton of CO_2.

The Goodyear *Spirit of America* has a volume of 202,700 cubic feet (5,739.82 cubic meters), so 88,748,736.8 (about 89 million) Goodyear blimps would contain one gigaton of CO_2.

CO_2 Trends at Mauna Loa Observatory
(Mauna Loa CO_2 monthly mean data)



Source: NOAA, http://www.esrl.noaa.gov/gmd/ccgg/trends/

sensitive to assumptions about world economic growth and the mix of energy consumed.

How Much is an 80% Reduction?

Without addressing the scientific basis for the assertions that lead to demands to reduce emissions by 60-80%, it is important to understand what such a reduction would involve and its implications for economic growth and standards of living.

Members of Congress, notably Senators Boxer, Warner and Lieberman, have proposed legislation that would mandate that the U.S. be 19% below the 2005 level of carbon dioxide emissions for selected sectors of the economy by 2020 and 71% by 2050. U.S. CO_2 levels were 5.9 gigatons in 2005.

The Boxer-Warner-Lieberman bill is not the only call for reductions on this scale. Democratic and Republican presidential candidates

Proposal	Level of Reduction	Allowed Emissions for Covered Facilities (gigatons)	Reductions Required (gigatons)
Barak Obama	80% reduction from 1990 levels by 2050	n/a	3.9
Hillary Clinton	80% reduction from 1990 levels by 2050	n/a	3.9
John McCain	15% reduction from 2005 levels by 2020	5.0	0.8
John McCain	66% reduction from 2005 levels by 2050	3.6	3.5
Boxer-Lieberman-Warner Climate Security Act	19% reduction from 2005 levels by 2020	4.3	0.9
Boxer-Lieberman-Warner Climate Security Act	71% reduction from 2005 levels by 2050	3.0	3.4

Notes:
McCain and the two Senate bills both apply emission reductions from "covered facilities". Based on information available, those facilities account for 90% (McCain) and 82% (Senate bills) of total U.S. emissions in 2005.

Sources:
http://lieberman.senate.gov/documents/lwcsaonepage.pdf
http://epw.senate.gov/public/index.cfm?FuseAction=Files.View&FileStore_id=441a4c27-8df5-4008-8931-7e07e8914a51
http://www.hillaryclinton.com/issues/energy/
http://www.barackobama.com/issues/energy/
http://www.johnmccain.com/Informing/Issues/da151a1c-733a-4dc1-9cd3-f9ca5caba1de.htm

Emission data from EIA, AEO 2008

have called for similar reductions. Barak Obama's campaign website states support for the 80% reduction goal by 2050, as does Hillary Clinton's. They both call for 80% reductions below the 1990 level of CO_2 emissions. U.S. emissions in 1990 were 5 gigatons. An 80% reduction is nearly 4 gigatons by 2050. John McCain is a long-time co-sponsor of the cap-and-trade approach advanced in the Boxer-Lieberman-Warner bill. His campaign website creates a structure similar to the Boxer-Lieberman-Warner approach, with goals of a 15% reduction from 2005 levels for designated covered facilities by 2020 and a 66% reduction from the same facilities by 2050.

For the cap-and-trade proposals, the definition of the facilities covered is critical to judging the extent of the likely emission reductions. The Environmental Protection Agency (EPA) estimated that the Lieberman-Warner bill would cover 82% of U.S. emissions. The McCain website suggests facilities accounting for 90% of U.S. emissions would be affected. These percentages are subject to change as the specific definition of a covered facility changes. As such, the analysis below is illustrative of the general effect these proposals are likely to have on U.S. emissions.

Rising emissions associated with the natural growth of the economy and expanding population will cause U.S. (and global) emissions to continue rising. The Energy Information Administration projects that in 2020, CO_2 emissions will be about 6.3 gigatons and, given EIA's assumptions, they could be about 7.9 gigatons in 2050.

Compared against this baseline of rising emissions, the Boxer-Warner-Lieberman bill will require the nation to achieve almost a gigaton reduction in the next 12 years and a 3.4 gigaton reduction in 32 years.

Affecting the 2020 target is rising population and expected economic growth. In 2020, the U.S. will have a population of about 325 million compared with 296 million in 2005 and current projections foresee an economy just under $16 trillion (which is about 50% larger than 2005's GDP).

Meeting Unrealistic Goals with Unrealistic Policies

Picking a greenhouse reduction target four decades in the future may give the appearance of thoughtful long-range planning, but in reality it is meaningless. Population levels, economic growth rates, energy technologies, energy intensity levels and the energy mix that will exist in 2050 are unknowable. These factors also affect global emission levels so any U.S. action that is not consistent with global action, especially in developing countries, would be imprudent.

While discussions about 2050 are not productive, that is not the case with 2020, which is the near-term bench mark in most proposed climate legislation. A gigaton reduction is the equivalent of:

- Doubling the miles per gallon of 273 million cars (from 20 to 40 mpg); or
- Building 273 "zero-emission" 500 MW coal-fired power plants; or
- Building 136 new nuclear power plants of 1 gigawatt each; or
- Installing 14-times the wind capacity presently available or 1 million 1 megawatt wind turbines; or
- Installing 273-times the current solar capacity; or
- Replacing petroleum fuels with biofuels equivalent to the harvest from an area two times the size of the United Kingdom (or 480,000 sq km); or
- Convert a barren area the size of Germany and France into new forest (over 900,000 sq. km.).

Meeting Boxer-Warner-Lieberman would require doing one of these or some combination thereof in the United States in less than 12 years, plus perhaps more to zero out whatever growth in emissions might accompany a larger than expected population and economy and a higher standard of living. The magnitude of the challenge and the enormity of the cost it will

impose of the American public are simply staggering and not being seriously considered in the current political debate.

Absent the widespread employment of low- and no-carbon technologies, which currently do not exist, there is simply no way to accommodate almost 30 million more people and add $5 trillion in economic growth without CO_2 emissions growing, although new technologies can slow the rate of growth.

The Energy Information Administration estimates that fossil energy—coal, oil, and gas—will remain our dominant sources of energy for decades to come. So, where will the gigaton reduction in CO_2 emissions come from while the population and economy are growing?

A future president and future Congresses could demand any one of the aforementioned actions. Last December, the *Energy Independence and Security Act of 2007* increased fleet-wide gas mileage to 35 mpg by 2020. New legislation could increase the standard another 5 mpg. Average fuel economy in 2004 was 24.6 mpg. There were 240 million cars and trucks in use in the U.S. in 2005 and cars average at least 10 years of active use. Consequently, the government also would need to consider ways to accelerate the normal turnover rate of the auto fleet, which is more than 15 years of use per vehicle, in order to capture the expected environmental benefit in the time desired.

Proponents of cap and trade legislation assume that pricing carbon will spur innovation. In fact, it is far more likely that technology will be frozen, not stimulated. Firms facing the 2020 target are more likely to invest in today's technology, locking it in place for decades, and then vigorously lobbying the government to relax future emission targets.

The reality is that the technologies needed for reductions on the scale demanded do not exist. When and if they do come into existence, it will take decades to put them in place because the nation's capital stock turns over slowly.

Nuclear power is one alternative to coal-generated electricity, but it is currently more expensive and faces continued political opposition. Ironically, some cap and trade proponents also oppose more nuclear power. Natural gas, which is also a substitute, is rising in price because of political decisions preventing increased domestic production. Forcing utilities to shift to natural gas will drive its price higher, impacting home owners and driving investments in industries like chemicals overseas. There also is no abundant and affordable substitute for gasoline and diesel fuels in the near term. In spite of the new CAFE standards, population growth and the fleet mix that will exist between now and then mean that emissions from personal transportation will be higher, not lower. Even if the technology to meet the recent biofuel mandate existed, which it will not anytime soon, there are new questions about how much these fuels reduce emissions, if they do. Plug-in electric and hybrid vehicles have potential to significantly alter transportation emission trends if the requisite technical advances allow their widespread introduction to the market. For these products to have an impact on the 2020 reduction goal, however, they will have to replace tens of millions of vehicles presently on the road.

Vehicles are currently produced that get 40 miles per gallon or better. But, with the exception of hybrids, the public doesn't want to buy them in large quantities. Last year, hybrid vehicles accounted for 2% of the U.S. car fleet. A recent estimate from JD Power suggests hybrid ownership will triple by 2015, which means they will represent just 7% of U.S. cars. The bottom line of all these figures is that we know what kinds of technology can be put in place before the 2020 milestone and they are not sufficient to meet the target. The implications of legislative failure should be obvious—higher prices and avoidance schemes.

The Boxer-Warner-Lieberman legislation is a fossil energy rationing system that will impose economic costs that are far from trivial. Analyses of various cap and trade proposals put the annual economic cost somewhere between $160 billion and $250 billion in 2015 and $800 billion to over $1 trillion by mid-century. Yale University's, Professor William Nordhaus, one of the nation's leading experts on climate change economics, has labeled cap and trade

proposals highly inefficient. He has said they are "inefficient because they impose excessively large emission reductions in the short run.... they imply carbon taxes rising to around $300 per ton in the next two decades, and to the $600-$800 per ton range by mid-century."

A $300 per ton carbon tax is the equivalent of adding 75¢ to the price of a gallon of gasoline.

The burdens of this legislation will fall heaviest on users of electricity, which accounts for almost 40% of current emissions, and drivers, because gasoline accounts for another 20%. The cost of goods and food will be higher as well because commercial transportation of goods produces about 13% of emissions. Some estimate that residential electricity costs could rise by 28% and gasoline and diesel fuels by 20%. Since this is the result of government action, it is a disguised tax and one likely to hurt the poorer elements of our society the most.

The spike in gasoline prices in recent months, a 72¢ increase in the past year, brought about noticeable changes in consumer behavior. Consumers responded to the new environment without intervention of government and have done so by reducing their purchases of the fuel and by shifting their vehicle choices. The highly publicized decline in sales for sport-utility vehicles and rising demand for hybrids illustrates the power of shifting consumer choice.

The rise in prices, however, is accompanied by significant outrage from our political leaders, leading some to consider a "gas tax holiday" and other ways to lessen the burden on the public. Yet, controls on carbon emissions will produce an outcome similar to what we are presently experiencing. Proponents of controlling carbon want the results without bearing the costs.

The bottom line is that a growing population and growing economy are not compatible with lower emissions, given the state of today's technology and the technologies that could be in the market in the next decade. Proponents of cap and trade legislation should be held accountable for reconciling their assertions with economic, energy and technology realities.

It is hard to understand why thoughtful senators would support a legislative approach that is so obviously flawed. The only explanation is a willingness to embrace an illusion because the facts are not politically expedient. A number of people claimed in 1997 that the Kyoto Protocol would fail, and it has. Cap and trade schemes also will fail and we challenge advocates to show us why they won't have the same fate as Kyoto. Assertions and well meaning intentions are not a substitute for cold, hard facts.