Policy Relevant Climate Issues in Context

Wednesday, April 25, 2013, at 10:00 a.m. in Room 2318 of the Rayburn House Office Building.

The Subcommittee on Environment of the Committee on Science, Space, and Technology

Testimony by Bjorn Lomborg, Copenhagen Consensus Center

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The most important policy-relevant issues facing decision-makers

I will focus mostly on economic impact and policy, but let me briefly start on the science, which I believe Dr. Judith Curry and Dr. William Chameides will address further.

Is global warming happening? Man-made global warming is a reality and will in the long run have overall, negative impact.

It is important to realize that economic models show that the overall impact of a moderate warming (1-2°C) will be beneficial whereas higher temperatures expected towards the end of the century will have a negative net impact. Thus, as indicated in Figure 1, global warming is a *net benefit* now and will likely stay so till about 2070, after which it will turn into a net cost.

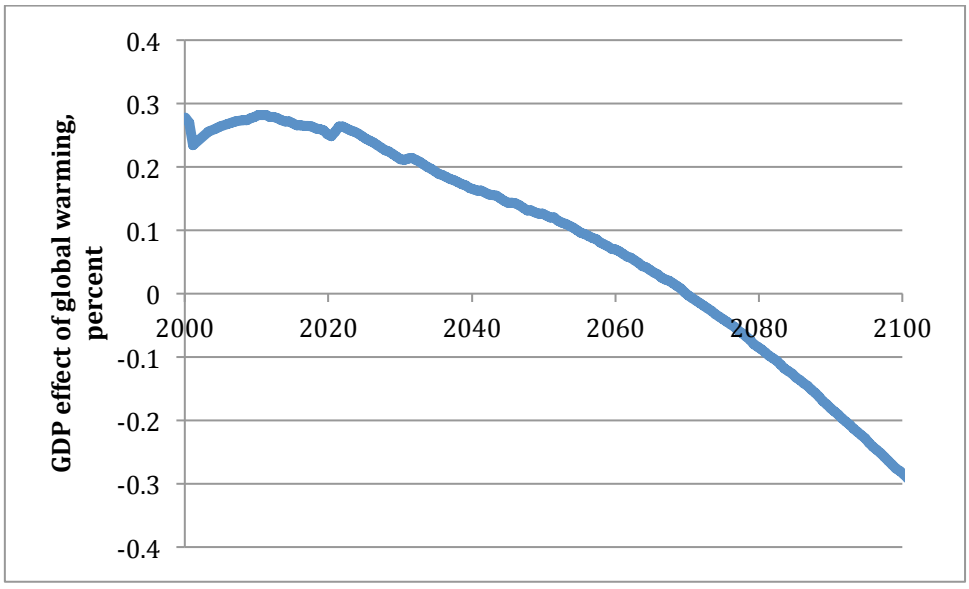

Figure 1 Benefit or cost of global warming.[1]

How important is global warming? To get a sense of the importance of global warming, take a look at the total impact of damage compared to the cumulated consumption using the discount rates from Nordhaus' 2010 DICE model. The total, discounted GDP through the year 2200 (almost the next two centuries) is about $2,212 trillion dollars. The total damage is estimated at about $33 trillion or about 1.5% of the total, global GDP, as indicated in Figure 2. This means that while the global warming impact is *not* zero, it does *not* signify the end of the world, either. It is a problem that needs to be solved.

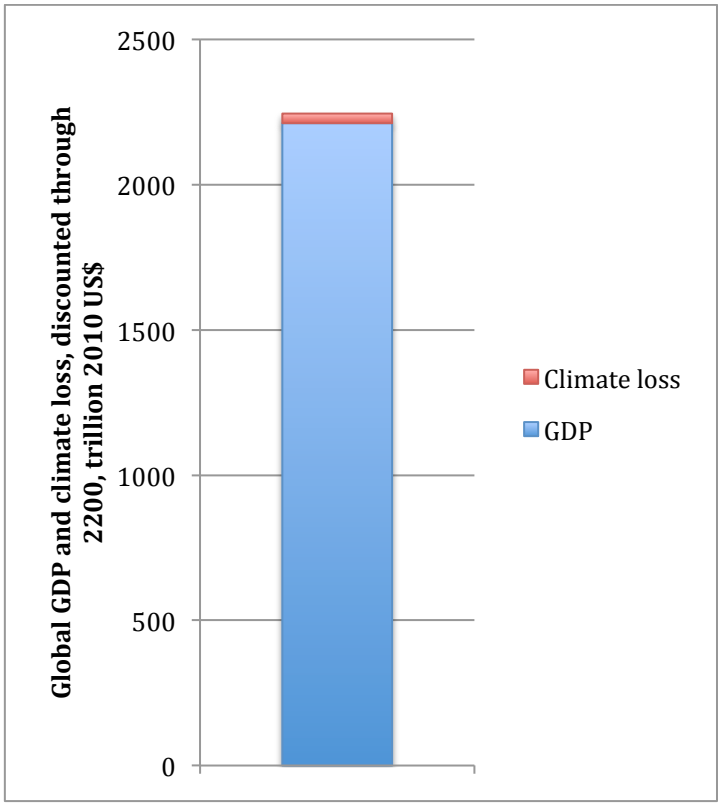

Figure 2 Global, total, discounted GDP through 2200, and climate loss.[2]

How much has the world cut CO2 so far? Very, very little. From Figure 3 it is clear that the world has seen ever increasing CO2 emissions since 1950, and likely will see this continue till 2035. The economic downturn in 2008 led to the reduction in emissions in 2009, but 2010 saw an almost complete rebound. For the Kyoto period of 2008-2012, the global emissions have increased almost 50%. The original reduction suggested by the full Kyoto protocol was 36.6% increase compared to 1990 (the x at 136.6 in 2010). The actual increase came in at 45.4%, and had there been no Kyoto, it would have increased about half a percentage point more at 45.9%. The emissions are likely to continue, here from IEA's 2012 business as usual scenario.

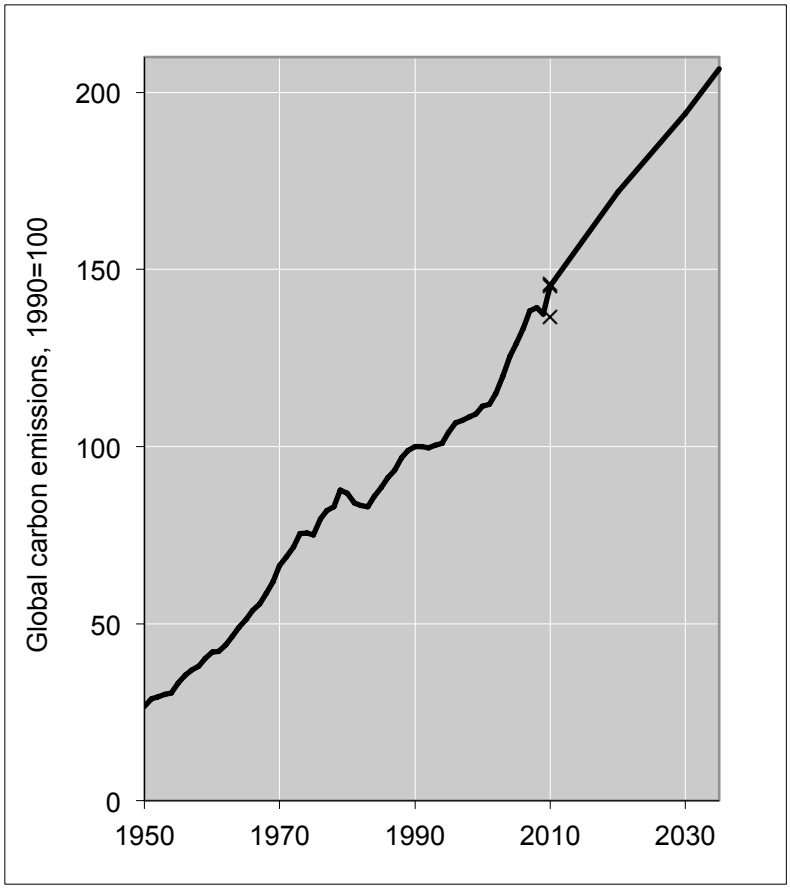

Figure 3 Global CO2 emissions 1950-2010, with estimates for 2020 and 2035 from IEA. Xs indicate original Kyoto reduction promise and actual reduction (of 0.5 percentage point).[3]

We will have lots of renewables by 2035? No. IEA. The world will even in two decades run predominantly on fossil fuels. In 2010 81.2% of all energy comes from fossil fuels. Even with IEA's most optimistic green energy production scenario, 78.5% will still be produced with fossil fuels in 2035. See Figure 4.

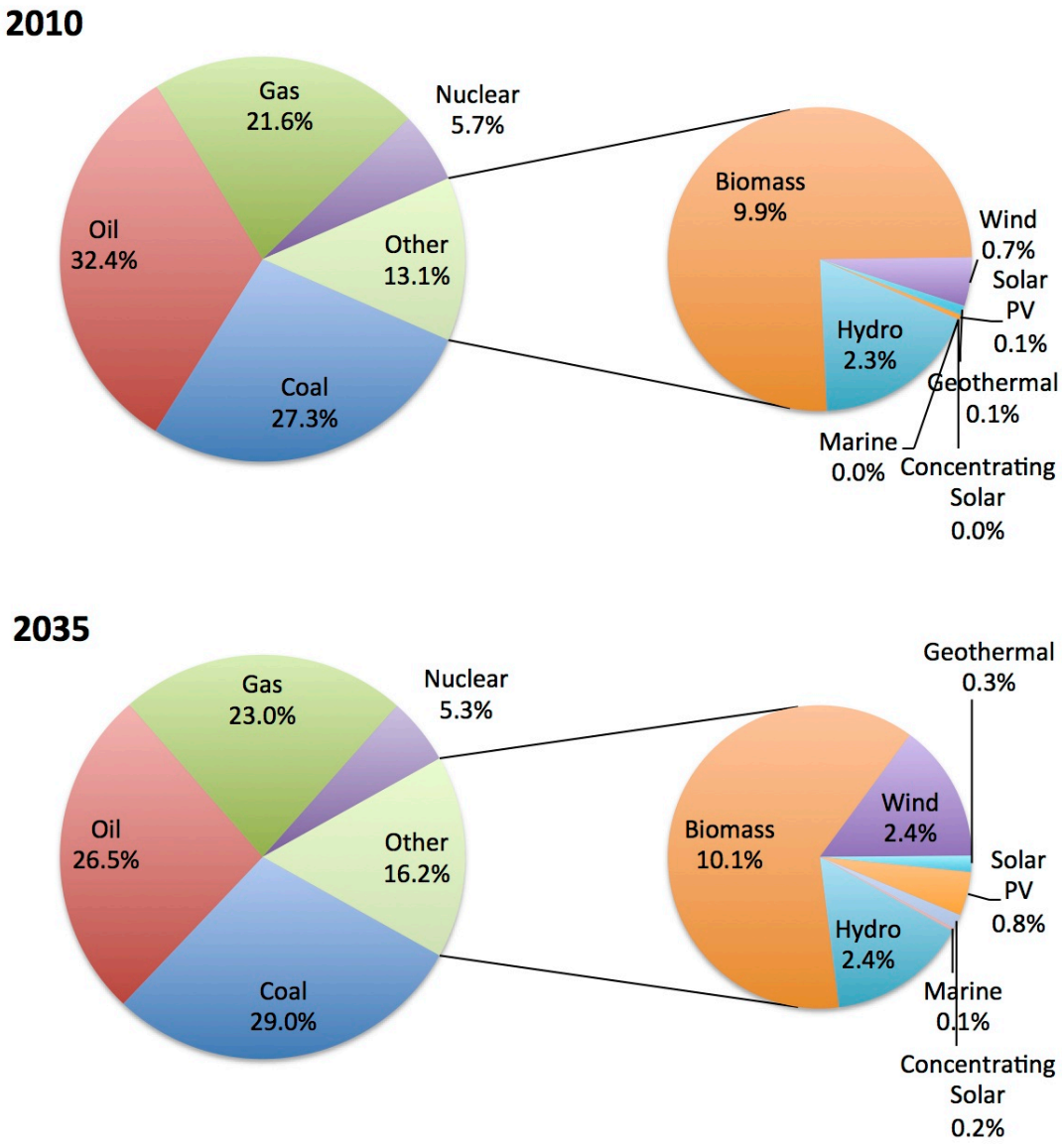

Figure 4 Relative contributions of energy sources, 2010 and 2035, assuming the most green energy production scenario, but keeping the business-as-usual total energy production.[4]

Economic growth and CO2 growth is strongly correlated. In Figure 5 we see how there is a very strong correlation between economic growth and CO2 growth. This underscores the fact that nations don't burn fossil fuel to annoy the environmentalists but because they support economic growth.

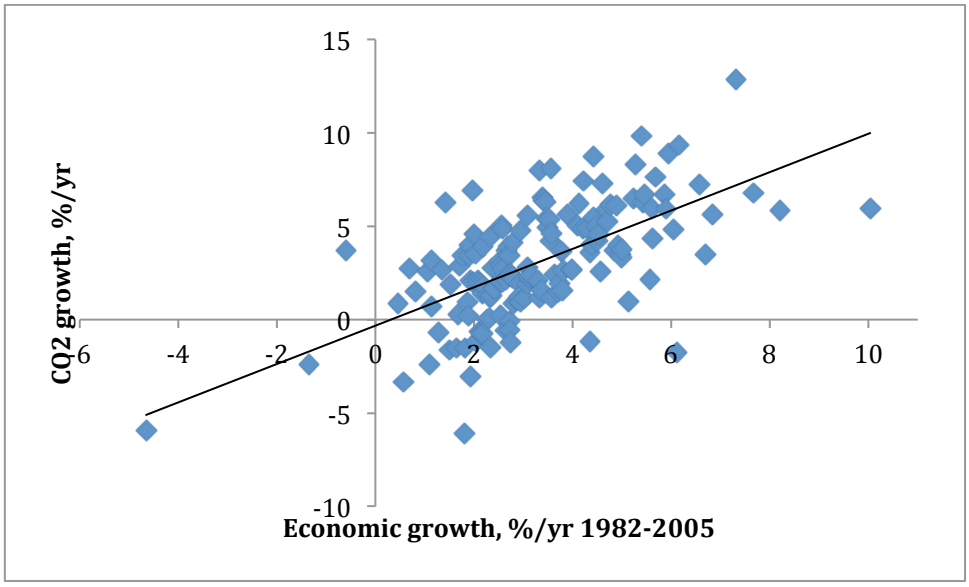

Figure 5 Economic growth per year 1982-2005, compared with CO2 growth per year for the same period. Best fit line added.[5]

What are the uncertainties and certainties of global warming?

There are a large number of uncertainties in global warming science. Dr. Judith Curry and Dr. William Chameides will undoubtedly address these further. However, I think it is perhaps more important to realize that there are a small number of very clear, near-certainties when addressing global warming.

No matter what carbon cuts we make in the next couple of decades, it only makes a difference towards the end of the century. Many people argue that global warming is so urgent that we need to cut carbon emissions *now*. However, the problem is that almost no matter what we do now, it will only have a measurable impact in the second half of this century, as is evident in Figure 6. This matters because many of the cuts that have been proposed are hard to sustain. Thus, what matters is not necessarily to cut a lot now, but to make sure we can cut a lot in the long run.

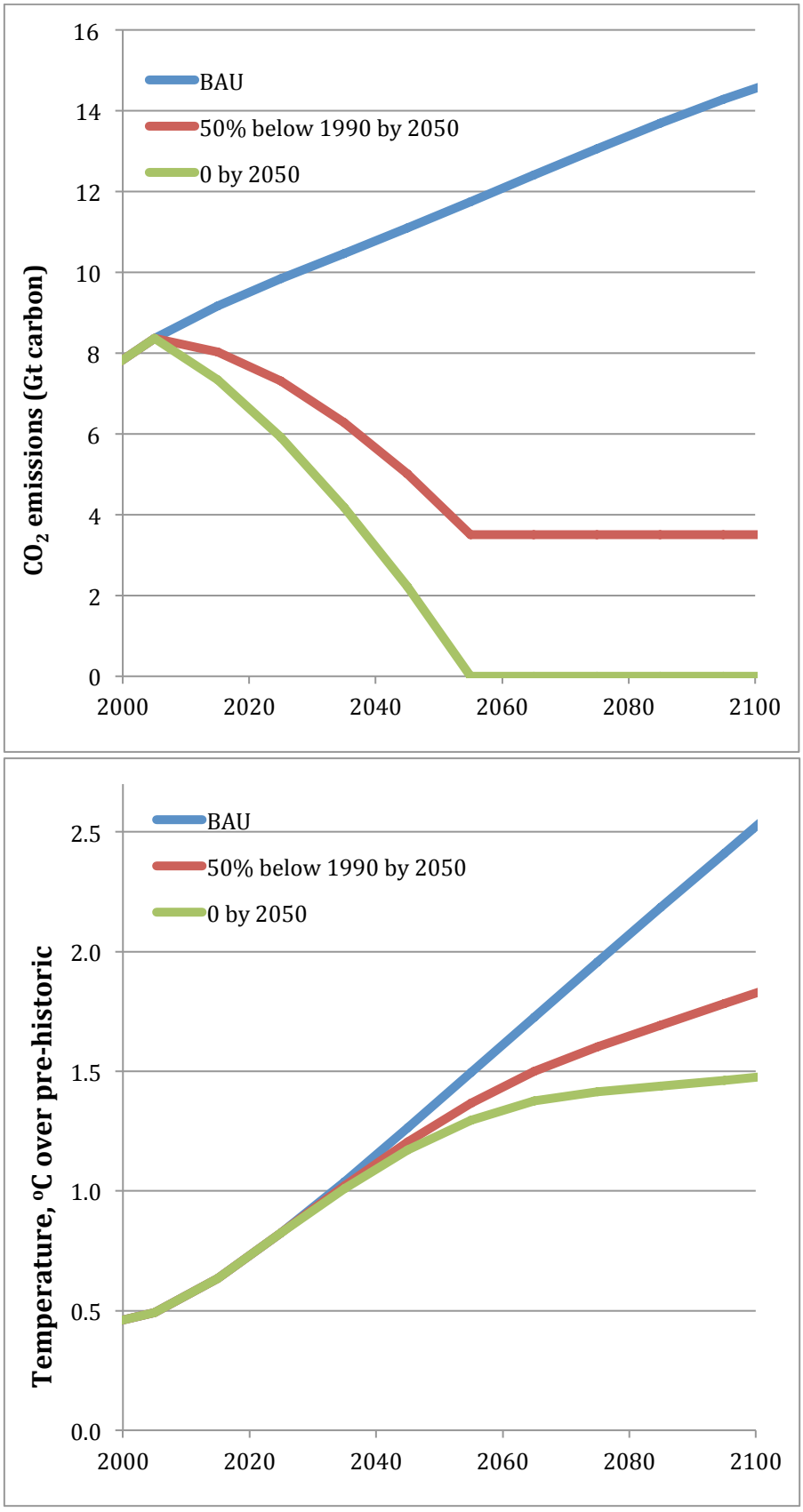

Figure 6 Reduction in CO2 emissions and its consequent reduction in temperature. [6]

What matters in the 21st century is the emissions from the developing world, not the developed world. Whereas the rich world emitted almost all

CO2 in the 20th century, it is now only responsible for 43%, as is evident in Figure 7. Towards the end of the century, that fraction could be down to 23%. Thus, while first world countries can still make climate policies, it will not matter much unless China, India, the rest of Asia, Latin America, Africa and the Middle East is in on it.

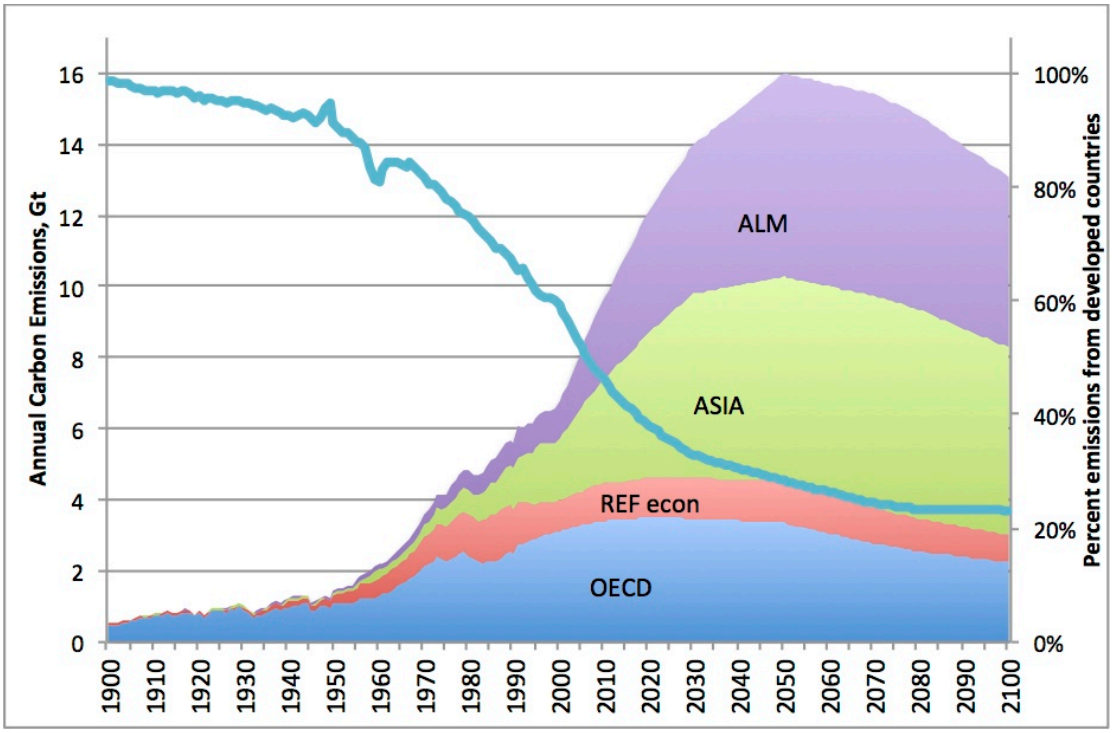

Figure 7 CO2 emissions from fossil fuels and proportion from developed countries, 1900-2100, data and SRES scenario A1B. Regions are OECD, REF economies (Russia, East and Central Europe), ASIA and ALM (Africa, Latin America and Middle East).[7]

Much of the hyped carbon reductions from the West have simply been exported to China. Take the Great Britain's carbon emissions 1990-2010, in Figure 8. Here Great Britain can comfortably claim that it has reduced emissions some 14% over the past 20 years. At the same time, however, imports from other places (typically China) have increased, and when counting both the implicit content of CO2 in these imports (and deducting implicit CO2 emissions in exports), Great Britain has actually *increased* its CO2 emissions over the past 20 years by 18%.

The same holds true for the entire developed world 1990-2008. In Figure 9 we see how the US has increased its territorial (domestic) CO2 emissions, but Europe has reduced its emissions, as has the Former Soviet Union (rest of Annex B). The reductions in the FSU are mainly from the collapse in 1991. But the much vaulted EU reduction is exactly the same as the increased CO2 emissions import from China. Overall, the EU emissions have increased, not as the national accounts seem to indicate, decreased.

This matters because when nations claim to be able to cut CO2, it often simply means that they have exported the CO2 emissions to somewhere else, leaving them feeling better, but obviously with no real environmental benefit.

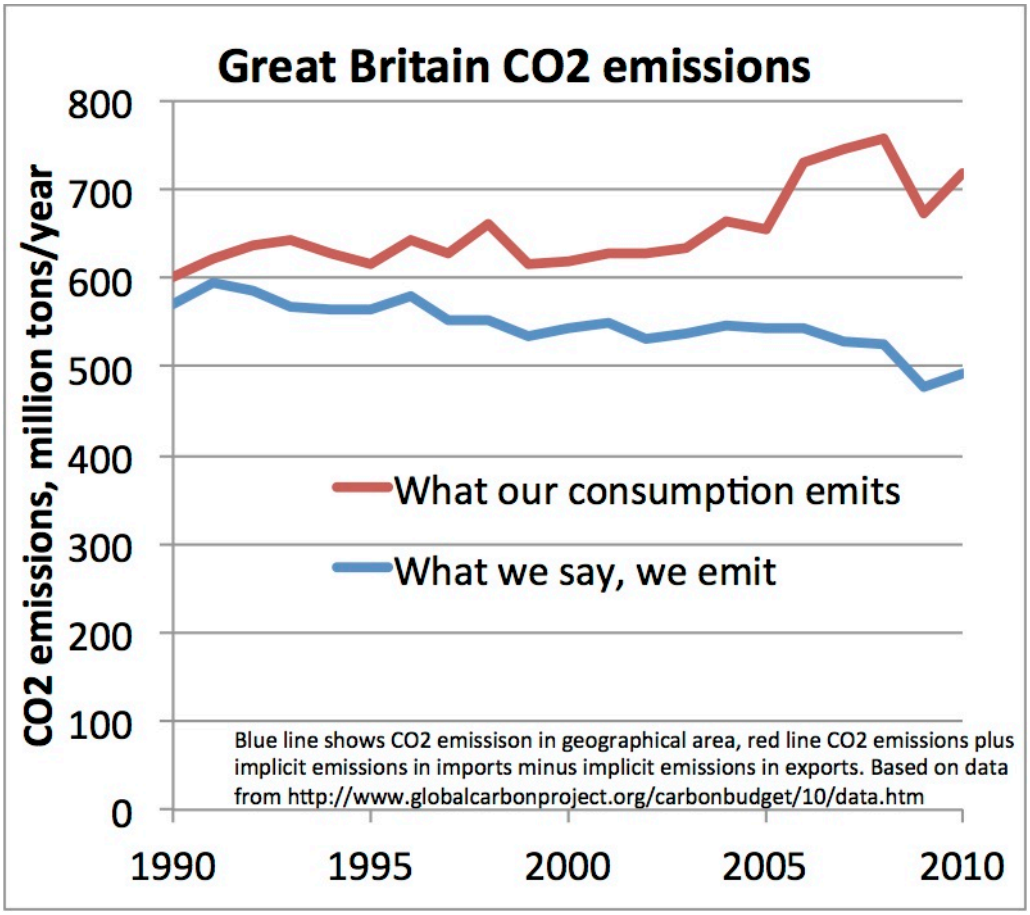

Figure 8 CO2 emissions for Great Britain. Blue line shows the national emissions, the red line shows the emissions including CO2 content in GB import minus CO2 content in GB exports[8]

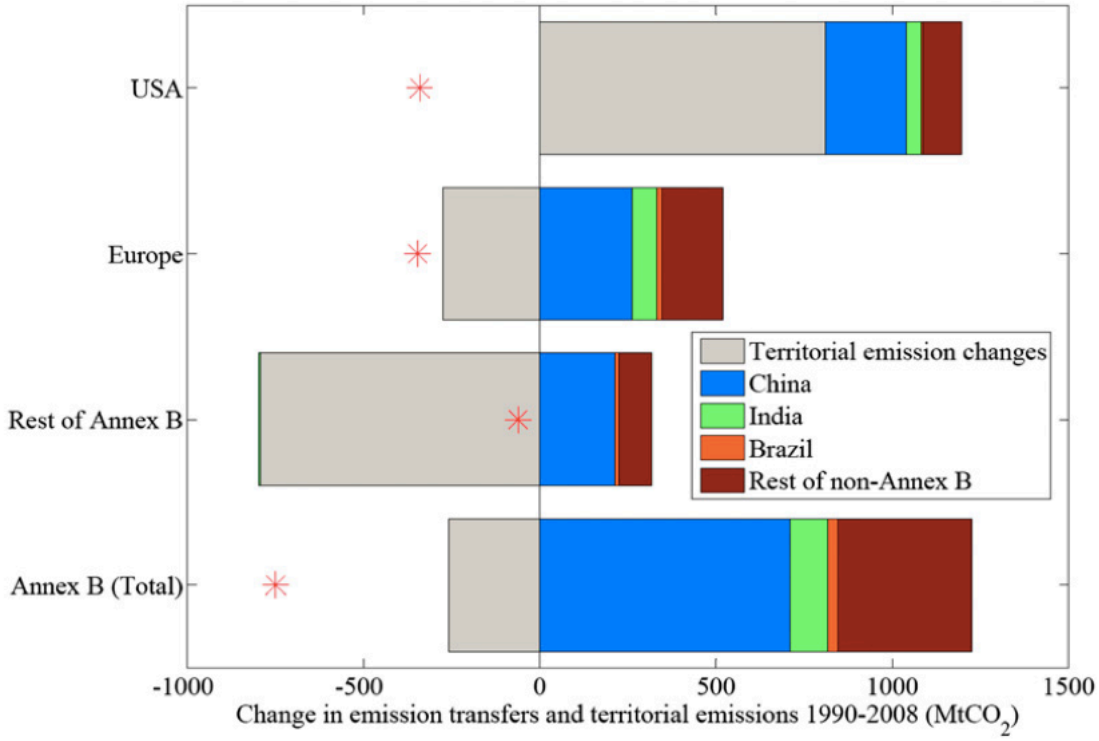

Figure 9 Change in CO2 emissions for developed countries (Annex B) from national (territorial) changes and from imports from China, India and Brazil, 1990-2008.[9]

Failed policies to tackle global warming

Ultimately, the central question of global warming is what to do about it.

The first realization needs to be that the current, old-fashioned approach to tackling global warming has failed, as is evident in Figure 3. The current approach, which has been attempted for almost 20 years since the 1992 Earth Summit in Rio, is to agree on large carbon cuts in the immediate future. Only one real agreement, the Kyoto Protocol, has resulted from 20 years of attempts, with the 2009 Copenhagen meeting turning into a spectacular failure.

The **Kyoto approach is not working** for three reasons. **First**, cutting CO_2 is **costly**. We burn fossil fuels because they power almost everything we like about modern civilization. Cutting emissions in the absence of affordable, effective fossil fuel replacements means costlier power and lower growth rates. The only current, comprehensive global warming policy, the EU 20-20-20, will cost about $250bn/year.[10]

Second, the approach **won't solve the problem**. Even if everyone had implemented Kyoto, temperatures would have dropped by the end of the century by a miniscule 0.004°C (0.007°F). The EU policy will, across the century, cost about $20 trillion, yet will reduce temperatures by just 0.05°C (0.1°F).[11]

Third, **green energy is not ready** to take over from fossil fuels.[12] It is generally much costlier, its deployment does not in general create new jobs (because its higher, subsidized costs destroy jobs in the rest of the economy)[13], and because it typically produces electricity, which is not generated with oil, it doesn't reduce oil dependence[14]. Today, wind supplies 0.7% of global energy and solar about

0.1%, and even with very optimistic assumptions from the International Energy Agency, wind will supply only 2.4% in 2035 and solar 0.8%, as shown in Figure 4.[15]

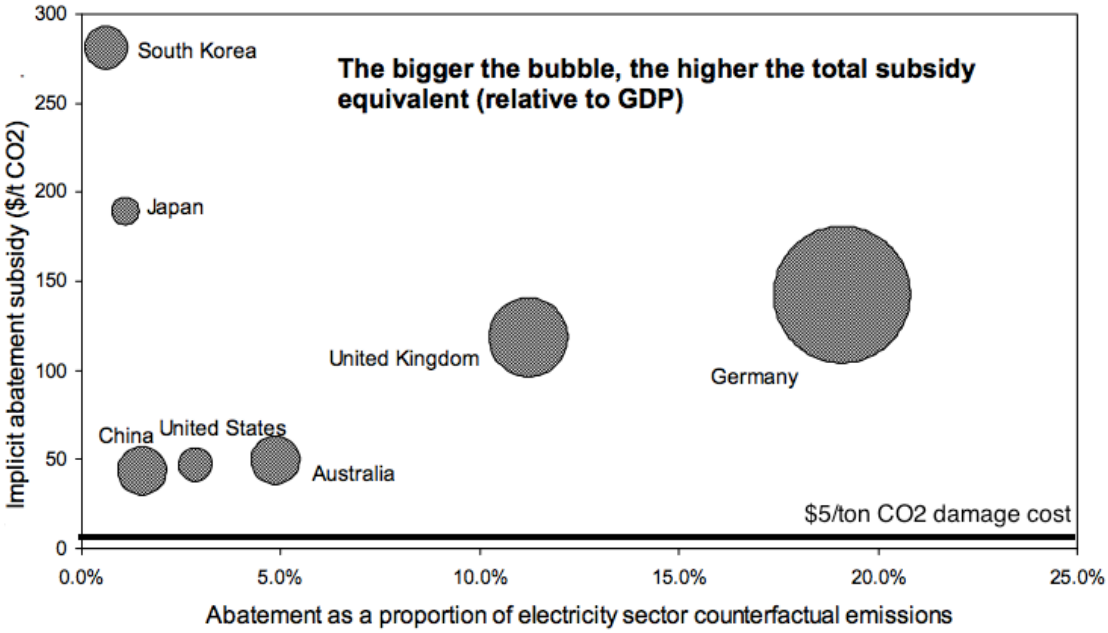

Figure 10 Abatement and implicit CO2 reduction cost for electricity, various nations. $5/ton CO2 damage insert for referece. In AUS$, which is almost equivalent to US$.[16]

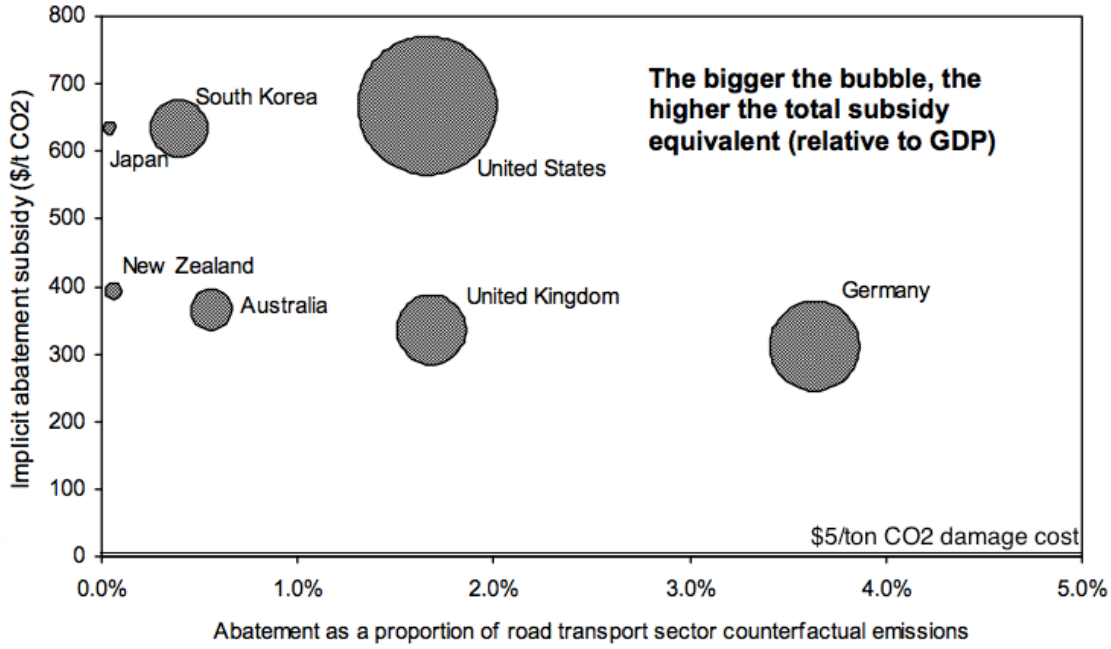

Figure 11 Abatement and implicit CO2 reduction cost for biofuels, various nations. $5/ton CO2 damage insert for referece. In AUS$, which is almost equivalent to US$.[17]

Because there is no good, cheap green energy, the almost universal political choices have been expensive policies that do very little. In Figure 10 we see how all major nations have managed to enact policies for electricity that cost a lot, yet do very little (Germany is leading the pack and still only reducing emissions from the power sector of 19% or 7% of the economy).

The cost per ton of CO2 avoided is universally far above the most likely $5/ton CO2 damage, with China at the cheapest at 8 times the damage of at about $40, and South Korea at a phenomenal $280/ton CO2, 56 times higher than the damage cost. Germany pays each year about 0.3% of its GDP in electricity subsidies.

On biofuels, the excess cost is even more pronounced, and yet the emission reductions even smaller, as can be seen in Figure 11. Germany is paying 62 times too much or $310/ton CO2, reducing just 0.6% of its total emissions at a cost of $1.7bn. The US is paying a phenomenal 133 times too much, at $666/ton CO2, costing $17.5bn/year and reducing just 0.5% of its total emissions.

Yet, the cost is not just in economic terms. There is also increasing dissatisfaction with high energy costs in countries like the UK and Germany. In Germany the cost of electricity has risen 61% in real terms since 2000, as is evident in Figure 12. A fourth of all consumer energy costs are now direct subsidies to renewables. In Rumania, the government just fell because of discontent with high energy costs.

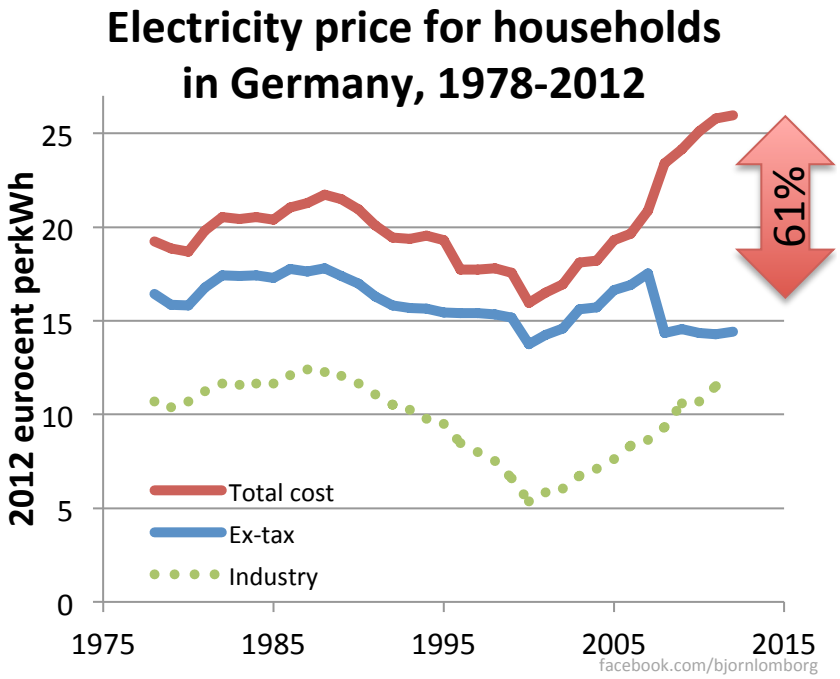

Figure 12 Electricity price for households in Germany, 1978-2012.[18]

Another proposed solution is a **carbon tax** (or an equivalent cap-and-trade). The argument is typically based on the assumption that it would be a significant step toward solving global warming. This is incorrect. If the tax were set high enough to significantly curtail emissions, it would also curb economic growth because of renewable much higher costs. This would be economically inefficient and probably politically impossible to introduce because of the (economic) damage it would cause.

If the tax were set at the economically efficient level, it would not dramatically reduce emissions. Economists agree that a negative externality like CO2 should be taxed at the level of its damage (which is about $5/ton[19] or ¢4/gallon or about €0.01/liter gas), but at this level a tax would make **very little difference** to emissions. If the entire world taxed all emissions at this level, global reductions would only be less than 10 percent.[20] If just one country or region adopted the tax, the effect would be unnoticeable.

A better policy approach to tackling global warming

It is important to realize that the old-fashioned policies have failed. Current green technologies just won't make it[21]. The only way to move towards a long-term reduction in emissions is if green energy becomes much cheaper. If green energy was cheaper than fossil fuels, everyone would switch.

This requires breakthroughs in the current green technologies, which means focusing much more on innovating smarter, cheaper, more effective green energy.

Of course, pursuing an approach of R&D holds no guarantees—we might spend dramatic amounts on R&D and still come up empty in 40 years — but it has much higher likelihood of succeeding than our twenty-year futile attempts to cut carbon so far.

This was the recommendation of the Copenhagen Consensus on Climate, where a panel of economists including three Nobel laureates found that **the best long-term strategy** is to dramatically increase investment in green R&D.[22] They suggested to 10-fold increase the current investment of $10bn to $100bn/year globally. This would be 0.2% of global GDP, and would entail a commitment of about $40bn from the US.

This approach would be significantly cheaper than the current policies (like the EU 20-20) and 500 times more effective. It is also much more likely to be acceptable to the developing countries.

The **metaphor** here is the **computer** in the 1950s. We did not obtain better computers by mass-producing them to get cheaper vacuum tubes. We did not provide heavy subsidies so that every Westerner could have one in their home in 1960. Nor did we tax alternatives like typewriters. The breakthroughs were achieved by a dramatic ramping up of R&D, leading to multiple innovations, which enabled companies like IBM and Apple to eventually produce computers that consumers wanted to buy.

This is what the US has done with fracking. The US has spent about $10bn in subsidies over the past three decades to get fracking innovation, which has opened up large new resources of previously inaccessible shale gas. Despite some legitimate concerns about safety, it is hard to overstate the overwhelming benefits. Fracking has caused gas prices to drop dramatically and changed the US electricity generation from 50% coal and 20% gas to now 30% coal and 35% gas.

This means that the US has reduced its annual CO2 emissions by 400-500Mt. This is about twice the *total* reduction over the past twenty years of the Kyoto Protocol from the rest of the world, including the European Union.

Estimates suggest that the cost of achieving a further 330 Mt CO_2 reduction in the EU would be $250 billion per year using carbon taxes.[23] Yet, the fracking bonanza in the US not only delivers much more than that reduction for free, it also creates long-term, social benefits through lower energy costs.[24] The total benefit to US consumers in terms of lower gas prices is about $100bn.

Table 1 Two policy options with CO2 reductions and costs or benefits.

	CO2 cut/year	Price/year
EU (EU 20-20)	320 Mt	Costs $250bn
US (fracking)	400-500 Mt	Pays $100bn

Summary

How should we tackle global warming?

Don't continue with the old-fashioned, failed policy of the past twenty years. When green energy isn't ready, we're likely to spend vast sums of money on cutting CO2 only marginally.

Instead, we should **focus on investing dramatically more in R&D of green energy**. This will likely bring about green technologies over the next 20-40 years that will be cheaper than fossil fuels, which will mean everyone will adopt them.

In short, **the solution is not to make fossil fuels so expensive that nobody wants them – because that will never work – but to make green energy so cheap that everyone wants them.**

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[1] Figure 4.1 in Gary W. Yohe, Richard S.J. Tol,, Richard G. Richels, Geoffrey J. Blanford 2009: The Challenge of Global Warming, in Lomborg, B 2009: *Global Crises, Global Solutions*, 2nd edition, Cambridge University Press. http://www.copenhagenconsensus.com/Files/Filer/CC08/Papers/0%20Challenge%20Papers/CP_GlobalWarmingCC08vol2.pdf

[2] Calculated from Nordhaus DICE model 2010, http://nordhaus.econ.yale.edu/RICEmodels.htm

[3] http://cdiac.ornl.gov/ftp/ndp030/global.1751_2009.ems, IEA 2012: World Energy Outlook 2012, http://www.worldenergyoutlook.org/, Kyoto impact estimated from Bohringer, C., & Vogt, C. (2003). Economic and environmental impacts of the Kyoto Protocol. *Canadian Journal of Economics–Revue Canadienne d'Economique*, 36(2), 475–94.

[4] From IEA 2012: World Energy Outlook 2012, http://www.worldenergyoutlook.org/, using New Policy Scenario green energy, but total energy production from Current Policies.

[5] Data from Worldbank Global Development Indicators, http://databank.worldbank.org/data/views/variableSelection/selectvariables.aspx?source=world-development-indicators.

[6] Nordhaus DICE model, 2001.

[7] Data from 1900-2008: http://cdiac.ornl.gov/CO2_Emission/timeseries/regional, Spliced with UN SRES data, AIM A1B scenario. http://sedac.ciesin.columbia.edu/ddc/sres/

[8] http://www.globalcarbonproject.org, downloaded Sept 2012 from http://www.globalcarbonproject.org/carbonbudget/10/data.htm.
[9] p4, Peters, GP 2011: " Growth in emission transfers via international trade from 1990 to 2008" doi: 10.1073/pnas.1006388108, PNAS April 25, 2011 201006388
[10] Richard S. J. Tol (2010) *The Costs and Benefits of EU Climate Policy for 2020*, Copenhagen Consensus Center.
[11] Tol (2010).
[12] Isabel Galiana and Christopher Green (2010) *Technology-Led Climate Policy*, in Smart Solutions to Climate Change; Comparing Costs and Benefits, Cambridge University Press.
[13] Gürcan Gülen (2011) *Defining, Measuring and Predicting Green Jobs*, Copenhagen Consensus Center.
[14] Research by climate economist Böhringer even shows that, fully implemented, the EU 20-20-20 plan does not boost energy security. See: Christoph Böhringer and Andreas Keller (2011) *Energy Security: An Impact Assessment of the EU Climate and Energy Package*, Copenhagen Consensus Center.
[15] International Energy Agency (2010) *World Energy Outlook 2000*, IEA/OECD.
[16] Pxxxvii, Australian Government Productivity Commission 2011: Carbon Emission Policies in Key Economies, http://www.pc.gov.au/projects/study/carbon-prices/report
[17] Pxxxix, Australian Government Productivity Commission 2011: Carbon Emission Policies in Key Economies, http://www.pc.gov.au/projects/study/carbon-prices/report
[18] Data from OECD (prices http://bit.ly/10IXX5J, with 2012 estimated from first two quarters from IEA, and adjusted with German Consumer Price Index (MEI), http://bit.ly/UkWaj7)
[19] Richard S. J. Tol (2011). The Social Cost of Carbon, Annu. Rev. Resour. Econ. 2011. 3:419–43, doi: 10.1146/annurev-resource-083110-120028.
[20] Estimate from Lomborg 2007: Cool It, based on Nordhaus economic models.
[21] For a sobering examination of the scale of the technological challenge, see: Isabel Galiana, Christopher Green (2009) *A Technology-led Climate Policy*, in Advice for Policymakers, Copenhagen Consensus Center.
http://fixtheclimate.com/fileadmin/templates/page/scripts/downloadpdf.php?file=/uploads/tx_templavoila/COP15_Policy_Advice.pdf
[22] Other influential research papers arguing for this approach include:
Prins, Gwyn and Galiana, Isabel and Green, Christopher and Grundmann, Reiner and Korhola, Atte and Laird, Frank and Nordhaus, Ted and Pielke Jnr, Roger and Rayner, Steve and Sarewitz, Daniel and Shellenberger, Michael and Stehr, Nico and Tezuko, Hiroyuki (2010) *The Hartwell Paper: a new direction for climate policy after the crash of 2009*. Institute for Science, Innovation & Society, University of Oxford; LSE Mackinder Programme, London School of Economics and Political Science; and also
Steven F. Hayward, Mark Muro, Ted Nordhaus and Michael Shellenberger (2010) *Post-Partisan Power: How a limited and direct approach to energy innovation can deliver clean, cheap energy, economic productivity and national prosperity.* American Enterprise Institute, Brookings Institution, Breakthrough Institute.
[23] The EU needs to reduce 20% below 1990 by 2020, or 334Mt reduction from 2011; the cost is estimated from five models here:
http://copenhagenconsensus.com/Admin/Public/DWSDownload.aspx?File=%2fFiles%2fFiler%2fArticles+2010%2fcccTolPaper.pdf.
[24] http://rff.org/RFF/Documents/RFF-IB-12-05.pdf