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Docket ID OMB–OMB–2013–0007

Via electronic delivery to www.regulations.gov

Honorable Howard Shelanski
Administrator
Office of Information and Regulatory Affairs

Dear Administrator Shelanski:

Thank you for providing an opportunity to comment[1] on the Interagency Working Group's 2013 Technical Support Document (TSD)[2] on the social cost of carbon. The individuals listed above

[1] Office of Management and Budget, *Notice of availability and request for comment*, 78 FR 70586, November 26, 2013, https://webapps.dol.gov/FederalRegister/PdfDisplay.aspx?DocId=27209; Office of Management and Budget, *Notice of extension of public comment period*, 79 FR 4359, January 27, 2014, http://environblog.jenner.com/files/comment-period-1.pdf.

[2] Interagency Working Group on the Social Cost of Carbon, *Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866*, May 2013 (hereafter TSD 2013), http://www.whitehouse.gov/sites/default/files/omb/inforeg/social_cost_of_carbon_for_ria_2013_update.pdf

respectfully present our views in this joint letter. Please direct inquiries about ideas and information discussed herein to Marlo Lewis, Senior Fellow, Competitive Enterprise Institute, 1899 L Street NW, Washington, DC 20036, 202-331-2267, marlo.lewis@cei.org.

I. Summary

The social cost of carbon (SCC) – the damage allegedly imposed on society by an incremental ton of carbon dioxide (CO_2) emissions in a given year – is an unknown quantity. It cannot be discerned in either meteorological or economic data going back a century and more. SCC analysis is too speculative to serve as a basis for regulatory justification. By fiddling with non-validated climate parameters, made-up damage functions, and below-market discount rates, SCC analysts can get almost any result they desire.

Whatever its value as an academic exercise, SCC analysis, when used to influence public policy, is computer-aided sophistry. Its political function is to make renewable energy look like a bargain at any price, and make fossil energy look unaffordable no matter how cheap. OMB should discourage, not patronize, such mischief.

In addition to the generic flaws of SCC analysis, specific defects also render the 2010[3] and 2013 TSDs unfit for use in agency cost-benefit analyses:

1. DICE and PAGE – two of the three integrated assessment models (IAMs) underpinning the TSDs – ignore the immense monetary benefits of carbon dioxide (CO_2) fertilization to global agriculture. Those models are biased, and their use in rulemaking flouts OMB Information Quality Act standards.
2. The Interagency Working Group (IWG) chose not to use a 7% discount rate to calculate the present value of future CO_2 emission reductions, and not to report separate SCC values for the U.S. domestic economy. Those choices inflate the hypothetical value of CO_2 emission reductions and conflict with OMB Circular A-4.
3. The 2013 TSD does not reassess the 2010 TSD's sensitivity assumptions. It does not question the DICE model's revised (lower) estimate of ocean CO_2 uptake. Nor does it question the PAGE model's revised (higher) probability estimate of catastrophic impacts. Recent science indicates that climate sensitivity is lower and catastrophic scenarios less plausible than earlier assessments assumed, and that ocean CO_2 uptake is not decreasing.
4. The 2013 TSD does not question the PAGE model's implausible assumption that adaptation cannot limit climate change damages once warming exceeds 2°C.

Even if SCC analysis were an exact science, it would still be one-sided (partisan) and unsuitable as a basis for regulatory justification unless paired with rigorous assessment of the social *benefits* of carbon energy. Carbon's social benefits likely exceed IAM-estimated SCC values by

[3] Interagency Working Group on the Social Cost of Carbon, *Appendix 15A: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866*, February 2010 (hereafter TSD 2010), http://www1.eere.energy.gov/buildings/appliance_standards/commercial/pdfs/sem_finalrule_appendix15a.pdf.

orders of magnitude. Consequently, tax and regulatory constraints on carbon energy can have significant social costs. The TSDs are oblivious to the potentially serious adverse impacts of climate policy on public health, consumer welfare, economic development, international trade, national security, scientific integrity, and democratic institutions.

Our comment letter concludes with several recommendations for OMB. Among the most important are these:

- OMB should disband the IWG, which inflates the pretense of knowledge and precision already inherent in SCC analysis.
- OMB should return any rule to an agency that relies on SCC estimates for a benefits justification in the rulemaking.

If the IWG is retained, OMB should ensure that future TSDs:

- Acknowledge that carbon's social cost cannot be discerned in meteorological or economic data and "exists" only in the virtual world of computer modeling.
- Acknowledge that SCC estimates rely on climate models that are on the verge of complete statistical failure.
- Use only IAMs that incorporate substantial CO_2 fertilization benefits.
- Use only IAMs that incorporate updated climate sensitivity estimates.
- Include SCC estimates using a 7% discount rate.
- Report domestic as well as global SCC estimates.
- Limit SCC estimates to more plausible timeframes (30, 50, or at most 75 years instead of nearly 300 years).
- Include discussion of the social benefits of carbon energy and the social costs of carbon mitigation.

II. Assumption-Driven Hocus Pocus

The social cost of carbon is a guesstimate of the damage to society from an incremental ton of carbon dioxide-equivalent (CO_2-e) greenhouse gas (GHG) emissions in a given year.

Policymakers, pundits, and activists increasingly invoke SCC estimates to justify the imposition of carbon taxes, fuel economy mandates, Soviet-style production quota for renewable energy, and other interventions to rig the marketplace against fossil fuels.[4] They speak as if carbon's social cost is an objective magnitude like the price of wheat futures at the end of a trading day. In fact, the SCC is an unknown quantity.

[4] Climate Progress, for example, applauds the 2013 TSD's higher SCC estimates, claiming the updated numbers not only support tougher climate regulations, energy-efficiency standards, and clean-energy mandates, but also "make clear that projects like Keystone will emit too much carbon dioxide to allow it to pass a true cost-benefit analysis." See Ryan Koronowsky, "The 'Social Cost of Carbon' Is Almost Double What the Government Previously Thought," June 5, 2013, *Climate Progress*, http://thinkprogress.org/climate/2013/06/05/2103261/the-social-cost-of-carbon-is-almost-double-what-the-government-previously-thought/?mobile=nc.

Try, for example, to discern carbon's social cost in the following information:

- There has been no trend in the strength or frequency of land-falling hurricanes in the world's five main hurricane basins during the past 50-70 years.[5]
- The U.S. is currently enjoying the longest period on record without a major (category 3-5) hurricane landfall.[6]
- There has been no trend in the strength or frequency of tropical cyclones in the main Atlantic hurricane development region during the past 370 years.[7]
- There has been no trend in global accumulated cyclone energy since 1970.[8]
- There has been no trend in U.S. hurricane-related damages since 1900 once economic losses are adjusted ("normalized") for changes in population, wealth, and the consumer price index.[9]
- There has been no trend in global normalized weather-related losses since 1960.[10]
- As a proportion of GDP, normalized global weather-related losses since 1900 have declined by 25%.[11]
- There has been no trend since 1950 in the strength or frequency of tornadoes in the U.S.[12]
- There is no relationship between global warming and U.S. drought as measured by the Palmer Drought Severity Index.[13]
- There has been no trend in U.S. flood magnitudes over the past 85 years.[14]
- As U.S. urban air temperatures have increased, heat-related mortality has declined.[15]

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[5] Jessica Weinkle, Ryan Maue, and Roger Pielke, Jr. 2012. Historical Global Tropical Landfalls. *Journal of Climate*, vol. 25, issue 13, pp. 4729-4735, http://sciencepolicy.colorado.edu/admin/publication_files/2012.04.pdf.

[6] Roger Pielke, Jr., Graphs of the Day: Major US Hurricane Drought Continues, *Roger Pielke, Jr.'s Blog*, 22 November 2013, http://rogerpielkejr.blogspot.com/2013/11/graphs-of-day-major-us-hurricane.html.

[7] Michael Chenoweth and Dmitry Divine. 2012. Tropical cyclones in the Lesser Antilles: descriptive statistics and historical variability in cyclone energy, 1638–2009. *Climatic Change*, vol. 113, issue 3, pp. 583-598, http://econpapers.repec.org/article/sprclimat/v_3a113_3ay_3a2012_3ai_3a3_3ap_3a583-598.htm.

[8] Ryan Maue, Policlimate: Global Tropical Cyclone Activity Update, http://policlimate.com/tropical/http://policlimate.com/tropical/

[9] Laurens M. Bauer. 2011. Have disaster losses increased due to anthropogenic climate change? *Bulletin of the American Meteorological Society*, http://www.ivm.vu.nl/en/Images/bouwer2011_BAMS_tcm53-210701.pdf.

[10] Aon Benfield, *Reinsurance Market Outlook: Reinsurance Capacity Growth Continues to Outpace Demand*, July 2013, http://thoughtleadership.aonbenfield.com/Documents/20130103_reinsurance_market_outlook_external.pdf

[11] Statement of Dr. Roger Pielke, Jr. to the Committee on Environment and Public Works of the United States Senate, Hearing on Climate Change: It's Happening Now, July 18, 2013, p. 3, http://www.epw.senate.gov/public/index.cfm?FuseAction=Files.View&FileStore_id=a6df9665-e8c8-4b0f-a550-07669df48b15.

[12] National Oceanic and Atmospheric Administration (NOAA), National Climate Data Center, U.S. Tornado Climatology, http://www.ncdc.noaa.gov/climate-information/extreme-events/us-tornado-climatology/trends.

[13] Patrick Michaels, "Hansen Is Wrong," *World Climate Report*, August 14, 2012, http://www.worldclimatereport.com/index.php/2012/08/14/hansen-is-wrong/#more-551.

[14] R.M. Hirsch and K.R. Ryberg. 2012. Has the magnitude of floods across the USA changed with global CO_2 levels? *Hydrological Sciences Journal* vol. 57, issue 1, pp. 1-9, http://www.tandfonline.com/doi/abs/10.1080/02626667.2011.621895#.UvFekJ0o4Sk.

- Since the 1920s, global deaths and death rates related to extreme weather declined by 93% and 98%, respectively.[16]
- During the past century of global warming, economic development and disease control have dramatically contracted the geographic range of malaria, and further contraction is expected as African, Latin American, and Asian nations industrialize.[17]
- During 1982-2010, a period of allegedly unprecedented warming, CO_2 fertilization increased green foliage cover by 11% in warm, arid areas on all continents.[18]
- Based on extensive empirical science and FAO market data, climate researcher Craig D. Idso estimates that CO_2 fertilization added $3.2 trillion dollars to global agricultural output during 1961-2011, and will increase output by another $9.8 trillion between now and 2050.[19]
- The greater-than-present warmth of the Holocene Optimum, Roman Warm Period, and Medieval Warm Period contributed to improvements in human health and welfare.[20]
- Historically, rising CO_2 emissions and concentrations are strongly correlated with improvements in per capita income, per capita food production, average lifespan, and public health.[21]

SCC estimates derive from assumptions about inherently speculative issues including: climate sensitivity (how feedback mechanisms, positive or negative, will amplify or damp down the direct warming effect of rising GHG concentrations), climate impacts (how projected warming will affect weather patterns, ice-sheet dynamics, sea-level rise, and eco-system services), economic impacts (how projected changes in global temperature, weather, sea-level rise, and eco-systems will affect heat-related mortality, disease vectors, agriculture, forestry, tourism, and other climate-related activities absent adaptation), and technological change (how adaptive capacities will develop as climate changes to offset potential damages to economic output and public health).

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[15] Robert E. Davis, Paul C. Knappenberger, Patrick J. Michaels, Wendy M. Novicoff. 2003. Changing heat-related mortality in the United States. *Environmental Health Perspectives*, vol. 111, issue 14, pp. 1712-18, http://www.ncbi.nlm.nih.gov/pubmed/14594620.

[16] Indur M. Goklany. 2009. Death and Death Rates Related to Extreme Weather Events: 1900 – 2008. *Journal of American Physicians and Surgeons*, vol. 14, no. 4, pp. 102-109, http://www.jpands.org/vol14no4/goklany.pdf.

[17] Peter W. Gething, David L. Smith, Anand P. Patil, Andrew J. Tatem, Robert W. Snow, and Simon I. Hay. 2010. Climate change and the global malaria recession. *Nature* 465: 342-345, http://www.nature.com/nature/journal/v465/n7296/full/nature09098.html

[18] Randall J. Donohue, Michael L. Roderick, Tim L. McVicar, Graham D. Farquhar. 2013. Impact of CO2 fertilization on maximum foliage cover across the globe's warm, arid environments. *Geophysical Research Letters*, vol. 40, issue 12, pp. 3031-35, http://onlinelibrary.wiley.com/doi/10.1002/grl.50563/abstract.

[19] Craig D. Idso, *The Positive Externalities of Carbon Dioxide: Estimating the Monetary Benefits of Rising Atmospheric CO2 Concentrations on Global Food Production*, Center for the Study of Carbon Dioxide and Global Change, 18 October 2013, http://www.globalwarming.org/wp-content/uploads/2013/10/MonetaryBenefitsofRisingCO2onGlobalFoodProduction.pdf.

[20] Thomas Gale Moore, *Climate of Fear: Why We Shouldn't Worry about Global Warming* (Washington, D.C. Cato Institute, 1998), http://www.stanford.edu/~moore/Climate_of_Fear.pdf.

[21] Indur M. Goklany, *Humanity Unbound: How Fossil Fuels Saved Mankind from Nature and Nature from Humanity*. Cato Institute Policy Analysis No. 715, December 20, 2012, http://www.cato.org/sites/cato.org/files/pubs/pdf/pa715.pdf

Assumptions about those factors and more are fed into computer programs called "Integrated Assessment Models" (IAMs). The IAMs purport to determine the net impact of each incremental ton of CO_2-e emissions on humanity and the biosphere. But each layer of the analysis is fraught with uncertainty and is educated guesswork at best. Uncertainties accumulate through each stage of the analysis.

Finding IAMs "so deeply flawed as to be close to useless as tools for policy analysis," MIT economist Robert Pindyck cautions that "their use suggests a level of knowledge and precision that is simply illusory, and can be highly misleading." By tweaking the assumptions, modelers can get almost any number they want. Pindyck explains:

> The modeler has a great deal of freedom in choosing functional forms, parameter values, and other inputs, and different choices can give wildly different estimates of the SCC and the optimal amount of abatement. You might think that some input choices are more reasonable or defensible than others, but no, "reasonable" is very much in the eye of the beholder. Thus these models can be used to obtain almost any result one desires.[22]

Is that the commentary of a climate skeptic? No. Pindyck believes CO_2 emissions "will eventually result in unwanted climate change." He even favors adoption of a carbon tax.

Two speculative inputs in particular determine IAM outputs, Pindyck notes: *climate sensitivity*, which "translates increases in CO_2e concentration to increases in temperature," and the *damage function*, which "translates higher temperatures into reductions in GDP and consumption."

The range of "likely" climate sensitivity estimates in the UN IPCC's first (1990) climate change assessment report was 1.5°C-4.5°C for a doubling of CO_2 concentrations.[23] After more than two decades of research, the likely range in the IPCC's latest (2013) report is also 1.5°C-4.5°C.[24] Scientists have been unable to narrow the range, much less determine the actual value, Pindyck explains, because "the physical mechanisms that determine climate sensitivity involve crucial feedback loops, and the parameter values that determine the strength (and even the sign) of those feedback loops are largely unknown, and for the foreseeable future may even be unknowable."

As for the damage function component of SCC analysis, it is conjecture and yarn-spinning. According to Pindyck:

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[22] Robert S. Pindyck, *Climate Change Policy: What Do the Models Tell Us?* Working Paper 19244, National Bureau of Economic Research, July 2013, http://www.globalwarming.org/wp-content/uploads/2013/10/Pindyk-Climate-Change-Policy-What-Do-the-Models-Tell-Us.pdf.

[23] Intergovernmental Panel on Climate Change, *First Assessment Report*, Working Group I, Policymakers Summary, p. XXV, http://www.ipcc.ch/ipccreports/far/wg_I/ipcc_far_wg_I_full_report.pdf.

[24] Intergovernmental Panel on Climate Change, *Fifth Assessment Report*, Working Group I, Chapter 12, p. 1111, http://www.climatechange2013.org/images/report/WG1AR5_Chapter12_FINAL.pdf.

> When assessing climate sensitivity, we at least have scientific results [e.g. temperature data] to rely on, and can argue coherently about the probability distribution that is most consistent with those results. When it comes to the damage function, however, we know almost nothing, so developers of IAMs can do little more than make up functional forms and corresponding parameter values. And that is pretty much what they have done.

IAM damage functions are not "based on any economic (or other) theory," Pindyck adds. Rather, "They are just *arbitrary functions*, made up to describe how GDP goes down when T [temperature] goes up."

Damage functions are speculative not only because it is far from clear how a given increment of warming will affect weather patterns and other climatic variables, but also because no one knows how human adaptive capabilities will develop over time. Technology is what enables humans to adapt to whatever climatic conditions they happen to live in, so SCC analysts must forecast technological change decades and even hundreds of years into the future. Good luck with that!

An easy way for modelers to get big SCC estimates is to assume adaptation is impossible above a certain temperature threshold. The PAGE (Policy Analysis of the Greenhouse Effect) model assumes that beyond 2°C of warming, "no adaptation is . . . available to mitigate the impacts of climate change."[25] How realistic is that?

Modern civilization flourishes in climates as different as those of Phoenix, Arizona, Alberta, Canada, and Singapore. The very emission scenarios that produce high-end warming forecasts assume large increases in global GDP between now and 2100.[26] Wealth supports the development and diffusion of new technologies. Adaptive capabilities increase with wealth and technology.

The assumption that 2°C of warming impose an absolute limit on mankind's ability to mitigate climate change impacts is implausible and definitely looks "made up."

III. Accounting Tricks

A. Omitted 7% Discount Rate

The easiest way to get big, scary-sounding SCC estimates is to pick low discount rates to calculate the present value of projected future damages from CO_2 emissions.

OMB Circular A-4 instructs agencies to use discount rates of both 7% (the "average before-tax rate of return to private capital" in the U.S. economy) and 3% (the average rate of return on

[25] TSD 2013, p. 11.

[26] Indur M. Goklany. 2007. Is a Richer-but-Warmer World Better than Cooler-but-Poorer Worlds? *Energy & Environment*, Vol. 18, No. 7&8, 1023-1048, http://goklany.org/library/Richer-but-warmer%20RV.pdf.

long-term government bonds) when estimating the costs and benefits of regulation.[27] But both the 2010 and 2013 TSDs use discount rates of 2.5%, 3%, and 5%. The discrepancy may look like small potatoes, but through the miracle of compounding, small differences in the annual discount rate add up to big bottom-line differences.

For example, in the administration's 2013 assessment, the SCC for 2010 is $11 per ton at a 5% discount rate but $52 per ton at a 2.5% discount rate. "In other words," notes Institute for Energy Research economist Robert Murphy, "cutting the discount rate in half caused the reported SCC to more than quadruple."[28]

IAMs implicitly project regulatory benefits from carbon mitigation policies through the year 2300 and beyond. Accordingly, the 2010 TSD quotes OMB Circular A-4's statement that "If your rule will have important intergenerational benefits or costs you might consider a further sensitivity analysis using a lower but positive discount rate in addition to calculating net benefits using discount rates of 3 and 7 percent."[29] But this statement only justifies using discount rates lower than 3% as part of a "further sensitivity analysis." It does not justify not using a 7% discount rate.

Heritage Foundation analysts Kevin Dayaratna and David Kreutzer ran two of the three IAMs underpinning the TSDs using a 7% discount rate. They found that SCC values generated by the DICE (Dynamic Integrated Climate Economy) model "shift substantially" – that is, are much lower – when reasonable alternative inputs, such as a 7% discount rate, are substituted for just a few of the assumptions made by the modeler.[30] Specifically:

- Using a 7% discount rate reduces the DICE model's 2020 SCC estimate by more than 80%.
- Using the climate sensitivity range indicated by recent studies reduces the 2020 SCC estimate by 40%.
- If, in addition to those substitutions, projections of future damages are limited to an almost plausible time span (through 2150 rather than all the way to 2300), the 2020 SCC estimate "falls by nearly 90%, from $37.79 to $4.03."

Dayaratna and Kreutzer conclude that the DICE model is "loaded" and unfit to guide policy decisions.

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[27] Office of Management and Budget, Circular A-4, September 17, 2003, p. 34, http://www.whitehouse.gov/sites/default/files/omb/assets/omb/circulars/a004/a-4.pdf.

[28] Written Statement of Robert P. Murphy, Senate Committee on Environment and Public Works, Hearing on Climate Change: It's Happening Now, July 18, 2013, http://www.epw.senate.gov/public/index.cfm?FuseAction=Files.View&FileStore_id=d74255e9-6a8a-473f-82a3-ff19921798ef.

[29] TSD 2010, pp. 18-19.

[30] Kevin Dayaratna and David Kreutzer, *Loaded DICE: An EPA Model Not Ready for the Big Game*, Heritage Foundation Backgrounder #2860, November 21, 2013, http://www.heritage.org/research/reports/2013/11/loaded-dice-an-epa-model-not-ready-for-the-big-game.

When the two analysts ran the FUND (Climate Framework for Negotiation and Distribution) model with a 7% discount rate, they found that SCC values are slightly negative in 2010, 2020, and 2030 (in other words, the net impact of an incremental ton of CO_2 is somewhat beneficial). Even in 2050, the SCC is an inconsequential $0.63 per ton.[31]

FUND Model SCC Using Four Discount Rates Including 7%

Year	Discount Rate: 2.5%	Discount Rate: 3%	Discount Rate: 5%	Discount Rate: 7%
2010	$29.69	$16.98	$1.87	-$0.53
2020	$32.90	$19.33	$2.54	-$0.37
2030	$36.16	$21.78	$3.31	-$0.13
2040	$39.53	$24.36	$4.21	$0.19
2050	$42.98	$27.06	$5.25	$0.63

We can't help noticing that OMB is a member of the Inter Agency Working Group on the Social Cost of Carbon. OMB fails to follow its own guidance on discounting in cost-benefit analysis.

B. Omitted Domestic SCC Values

The IWG further skews its presentation by reporting only global SCC estimates. The 2010 TSD acknowledges that, "Under current OMB guidance contained in Circular A-4, analysis of economically significant proposed and final regulations from the domestic perspective is required, while analysis from the international perspective is optional."[32] Yet the TSDs report only the optional global SCC estimates, not the required domestic estimates. Again, OMB fails to follow its own guidance.

The IWG justifies this deviation from Circular A-4 on the grounds that the "climate change problem" is "highly unusual" in two ways. First, a ton of CO_2 emitted in the U.S. causes the same damage globally as a ton emitted outside our borders. Second, "Even if the United States were to reduce its greenhouse gas emissions to zero, that step would be far from enough to avoid substantial climate change. Other countries would also need to take action to reduce emissions if significant changes in the global climate are to be avoided."[33] Although those factors make it reasonable to report global SCC values *along with* domestic values, they do not justify withholding domestic SCC estimates from the public.

There appears to be a pattern here. Omission of SCC estimates using a 7% discount rate inflates the hypothetical benefit of carbon mitigation policies in general. Omission of domestic SCC estimates further inflates the hypothetical benefit to the American people.

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[31] Kevin Dayaratna and David Kreutzer, Comment Letter on OMB–OMB–2013–0007, Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866, January 27, 2014.
[32] TSD 2010, p. 11.
[33] TSD 2013, pp. 13-14.

The global SCC incorporates damage estimates for developing countries, many of which still depend on subsistence agriculture, and all of which lack first-world adaptive capabilities. According to the administration's 2010 SCC report, "a range of values from 7% to 23% should be used to adjust the global SCC to calculate domestic effects."[34] This means that for a global SCC of $33 per ton in 2010 (the "central value" in the 2013 TSD), the corresponding U.S. domestic impact is only $2-$8 per ton.

Not publishing the lower domestic SCC estimates can make uneconomic carbon regulations appear to pass a cost-benefit test. IER's Murphy explains:

> Suppose the EPA issues a new regulation that causes private industry to restrict carbon emissions, and that the compliance costs (in terms of forfeited economic output in the U.S. because of the new regulation) work out to $25/ton. Using the recent headline SCC estimate of $33/ton, this regulation would apparently pass a cost/benefit test, because the $25 cost to American industry for every ton of restricted emissions would be counterbalanced by $33 in avoided future climate change damage. However, Americans would still on net be hurt by the regulation, as they would only receive $2 to $8 of the stipulated benefits (i.e. avoiding the domestic social cost of carbon on each ton no longer emitted), while suffering the full $25 in compliance costs.[35]

Actually, all domestic-only carbon regulations fail a cost-benefit test. Using the UN IPCC's mid-range warming scenario, Cato Institute scientist Chip Knappenberger calculates that the total U.S. contribution to global warming will be less than 0.02°C by 2100.[36] An aggressive regulatory program might cut that contribution in half. But a 0.01°C reduction in warming would have no discernible impact on sea-level rise, weather patterns, or any other climate variable potentially affecting public health and welfare. In contrast, as discussed below, climate regulations could significantly increase household and business energy costs, reducing GDP growth and per capita income.

Regulations that are all economic pain for no environmental gain are worse than useless. If future damages occur anyway, resources spent now on climate change mitigation will be wasted and won't be available to support adaptation, damage repair, or private wealth creation. Unless China, India, and other major developing country emitters also curb their emissions, the benefits of U.S. emission cuts are too small to justify the costs, even if one assumes that IAMs get the science and economics of climate change exactly right.

IV. Computer-Aided Sophistry

A. Bargain at any Price

[34] TSD 2010, p. 12.
[35] Murphy, Ibid.
[36] Chip Knappenberger, "Carbon Tax: Climatically Useless," MasterResource.Org, December 3, 2012, http://www.masterresource.org/2012/12/carbon-tax-climatically-useless/.

A recent study by economists Laurie Johnson, Starla Yeh, and Chris Hope, *The Social Cost of Carbon: Implications for Modernizing Our Electricity System*,[37] has the unintentional virtue of exposing the political and economic risks of SCC analysis.

Johnson, Yeh, and Hope (JYH) compute carbon's social cost using discount rates even lower than the low-end of the IWG's range. The 2013 TSD, using 5%, 3%, and 2.5% discount rates, produced year-2010 SCC estimates of $11, $33, and $52 per ton. JYH, using discount rates of 2%, 1.5%, and 1%, produces SCC estimates of $62, $122, and $266 per ton. JYH's lowest SCC value is higher than the IWG's highest SCC value.

Those big numbers leverage a lot of mischief if adopted by federal agencies, which is a distinct possibility. Johnson and Yeh are analysts with the Natural Resources Defense Council, a key ally of the administration's climate policies, and Chris Hope is the creator of the PAGE model, one of the three IAMs underpinning the IWG's SCC estimates.

JYH translate their SCC estimates into cents-per-kilowatt estimates, and then "compare the total social cost (generation plus environmental costs) of building new generation from traditional fossil fuels versus cleaner technologies." They also "examine the cost of replacing existing coal generation with cleaner options, ranging from conventional natural gas to solar photovoltaic." Their results are exactly what climate campaigners want to hear:

1. In a full accounting that incorporates environmental damages, renewable energies are always more "efficient" than new coal generation, and usually more efficient than new gas generation.
2. If the SCC is $266/ton or even $122/ton, switching from coal to solar or installing carbon capture and sequestration (CCS) is more "efficient" than maintaining an existing coal power plant.

In the authors' words:

> We find that for most SCC values, it is more economically efficient (from a social cost–benefit perspective) for the new generation to come from any of these cleaner sources rather than conventional coal, and in several instances, the cleanest sources are preferable to conventional natural gas. For existing generation, for five of the six SCC estimates we examined, replacing the average existing coal plant with conventional natural gas, natural gas with carbon capture and storage, or wind increases economic efficiency. At the two highest SCCs, solar photovoltaic and coal with carbon capture and storage are also more efficient than maintaining a typical coal plant.

An obvious objection is that the average cost of generating electric power from today's existing coal fleet is 3.0 cents/kWh, as JYH acknowledge. To all relevant economic actors – power

[37] Laurie T. Johnson, Starla Yeh, Chris Hope. 2013. The social cost of carbon: implications for modernizing our electricity system. *Journal of Environmental Science Studies*, DOI 10.1007/s13412-013-0149-5, http://www.globalwarming.org/wp-content/uploads/2013/10/Johnson-J-Environ-Stud-Sci-2013.pdf.

producers, consumers, and shareholders – that is pretty darn efficient. At 3.0 cents/kWh, society is getting a whole lot of bang for very little electricity buck.

But, argue JYH, a $266/ton SCC makes the "real" cost of electric power from existing coal plants ten times greater:

> Specifically, at $266/ton CO_2, the average coal plant costs 34.5 cents/kWh (more than ten times its direct generation costs) versus 15.1 and 13.3 cents/kWh, respectively, for new coal with CCS and solar. At $122/ton CO_2, the average coal plant costs 18.7 cents/kWh versus 13.8 and 13.3 cents/kWh, respectively.

The method to their madness is obvious. Having selected very low discount rates to produce very high SCC estimates, JYH compare their "real" (computer-modeled) price of coal- or gas-fired electricity with the actual market price of wind- or solar-generated electricity. They then deduce that wind and solar are cheaper than new gas, and that replacing existing coal power plants with renewable energy will make the U.S. economy more "efficient." Stunning!

Any serious attempt to repower America with wind turbines and solar panels would drive up electric rates, especially in states where coal is a major power source.[38] The premature retirement of the existing U.S. coal fleet, which supplies 40% of U.S. electric power,[39] could destroy billions of dollars in shareholder value. Regulating or taxing natural gas generation based on SCC estimates of $122-266/ton would trigger capital flight from the gas industry.

Plus, if SCC estimates demand corrective taxes for coal and gas, why not for oil, too? Such measures could snuff out the entire shale revolution – arguably the most important source of new jobs, investment, tax revenue, and U.S. competitive advantage of the past 20 years.[40]

Even if those "transitional" costs could somehow be avoided, wind and solar energy are simply too costly, intermittent, and unreliable – in a word, too *inefficient* – to power a modern economy. In 2012, wind and solar technologies provided 3.46% and 0.11% of U.S. electric

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[38] Coal provides the majority of electric power in 21 states, is the largest source of electric power in 25 states, and provides 10% or more of electric power in 39 states. Nicolas Loris, Kevin Dayaratma, and David Kreutzer, *EPA Power Plant Regulations: A Backdoor Energy Tax*, Heritage Foundation Backgrounder #2863, December 5, 2013, http://www.heritage.org/research/reports/2013/12/epa-power-plant-regulations-a-backdoor-energy-tax#_ftnref18.

[39] EIA, "Coal regains some electric generation market share from natural gas," May 23, 2013, http://www.eia.gov/todayinenergy/detail.cfm?id=11391.

[40] IHS, *America's New Energy Future: The Unconventional Oil and Gas Revolution and the Economy – Volume 3: A Manufacturing Renaissance*, September 2013, http://press.ihs.com/press-release/economics/us-unconventional-oil-and-gas-revolution-increase-disposable-income-more-270.

generation, respectively.[41] Wind and solar would not make even those meager contributions but for mandatory production quota in 29 states[42] and other policy privileges.[43]

Swapping out existing coal with solar and installing wind turbines instead of new gas would compel America to spend more for a costlier, smaller, less reliable electricity supply. How could that possibly improve the *efficiency* of the U.S. economy?

Circular A-4 admonishes agencies that "you cannot conduct a good regulatory analysis according to a formula."[44] SCC analysis is a license to regulate by formula. Grant the premise that carbon has a social cost, and presto, climate activists conclude that taxing and regulating away affordable energy will make the economy more "efficient."

JYH try to finesse renewable electricity's well-known deficiencies: "An ideal comparison of costs would be one that adjusted for the intermittency of renewable sources, which is not captured in a levelized cost comparison. Adjusting for this factor is beyond the scope of this analysis, so the estimates here should be viewed as a first approximation."

In other words, JYH place "beyond the scope" of their analysis the very thing that: (1) makes kilowatts from wind and solar power less valuable than kilowatts from coal, gas, or nuclear energy; (2) renders wind and solar energy unfit to provide base load electricity (power you can depend on 24/7); and (3) disqualifies wind as a source of peaking power on summer days when the heat is intense precisely because the wind isn't blowing.

In a study of three interconnection regions that account for more than half of U.S. installed wind capacity, economist Jonathan Lesser found that during 2009-2012, over 84% of the installed wind generation failed to produce electricity when demand was greatest. During peak hours on high demand days, only 1.8% to 7.6% of wind infrastructure generated power in the Midwest (ISO) region, only 6.0% to 15.9% of installed wind generated power in the Texas (ERCOT) region, and only 8.2% to 14.6% of installed wind produced power in the East Coast (PJM) region.[45]

An electric power station that fails to produce during a heat wave is like metro service that's available except during rush hour. Neither is of much value. As Lesser put it, forcing taxpayers and ratepayers to subsidize wind "is like asking someone to pay for a taxi that does not show up

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[41] EIA, "Frequently Asked Questions: What is U.S. electricity generation by energy source?" http://www.eia.gov/tools/faqs/faq.cfm?id=427&t=3

[42] EIA, "Most states have Renewable Portfolio Standards," February 3, 2012, http://www.eia.gov/todayinenergy/detail.cfm?id=4850.

[43] For an overview of federal tax credits, grants, and subsidized loans to renewable energy companies, see Congressional Budget Office, *Federal Financial Support for the Development and Production of Fuels and Energy Technologies*, Issue Brief March 2012, http://www.cbo.gov/sites/default/files/cbofiles/attachments/03-06-FuelsandEnergy_Brief.pdf#page=3.

[44] OMB Circular A-4, p. 3.

[45] Jonathan A. Lesser, *Wind Intermittency and the Production Tax Credit: A High Cost Subsidy for Low Value Power*, October 2012, http://www.continentalecon.com/publications/cebp/Lesser_PTC_Report_Final_October-2012.pdf.

when it's raining." But armed with their SCC estimates, JYH can claim the no-show taxi is a bargain at any price!

SCC analysis fosters the dangerous illusion that politically-mandated energy is more efficient than market-driven energy. OMB should discourage, not patronize, such mischief.

B. Unaffordable No Matter How Cheap

SCC analysis not only makes renewable energy look like a bargain at any price, it also makes fossil energy, especially coal-based power, look unaffordable no matter how cheap.

The administration's SCC estimates for the year 2020 range from \$12/ton CO_2 at the low end to \$129/ton CO_2 at the high end.

What this means, according to utility industry analyst Bob Kapplemann, is that the administration implicitly attributes over \$210 million a year in social costs to a mid-sized (600 Megawatt) pulverized coal power plant and over \$74 million a year to a natural gas combined cycle power plant. Given those damage estimates, "even radical reductions" in existing coal-fired generation can look economically justified.[46]

For example, assume the administration's central SCC estimate of \$43/ton CO_2 in 2020, and new coal generation becomes more expensive than wind and solar power. Assume the administration's high SCC estimate of \$129/ton CO_2, and new gas becomes more expensive than renewable energy.

By fiddling with discount rates, climate sensitivity estimates, or damage functions, modelers can raise SCC estimates to the point where the numbers seemingly justify premature retirement of existing coal-fired and even gas-fired generation before commercially-viable replacements exist.

The social cost of carbon has become a menace to society.

V. Excluding Positive Externalities

Societies will adapt more easily to climate change if CO_2 emissions have benefits ("positive externalities") as well as costs. Carbon dioxide is the basic compound from which plants construct their tissues, and literally thousands of laboratory and field experiments demonstrate

[46] Robert Kappelmann, "The Social Cost of Carbon (SCC): A Game Changer for U.S. Energy and Environmental Regulation," November 18, 2013.

that crops raised in CO_2-enriched environments grow faster and larger, utilize water more efficiently, and are more resistant to drought, pests, pollution, and other stresses.[47]

As noted above, Craig Idso, using extensive empirical data on crop yield response to CO_2 fertilization and Food and Agriculture Organization data on crop production and prices, estimates that the ongoing rise in the air's CO_2 content boosted agricultural output by $3.2 trillion during 1961-2011, and that rising CO_2 concentrations will boost output by another $9.8 trillion between now and 2050.

Of the three IAMs underpinning the TSDs, the DICE and PAGE models *have little-to-no CO2 fertilization benefit*. That omission alone is reason enough to reject those models as SCC calculators. As Idso comments:

> The very real positive externality of inadvertent atmospheric CO_2 enrichment must be considered in all studies examining the SCC; and its observationally-deduced effects must be given premier weighting over the speculative negative externalities presumed to occur in computer model projections of global warming. Until that time, little if any weight should be placed on current SCC calculations.[48]

OMB's Information Quality Guidelines[49] lead to the same conclusion. Information "quality" is an encompassing term comprising *objectivity*, *utility*, and *integrity*. "Objectivity" is a measure of whether agency-disseminated information is "accurate, reliable, and unbiased." By excluding the immense positive externality of CO_2 fertilization, the DICE and PAGE models are biased, inaccurate, and unreliable. Therefore, under OMB guidelines, agencies should not use those models to estimate regulatory costs and benefits.

VI. Dubious Science

As noted in Section II above, significant harm from CO_2-induced global warming is not evident in meteorological and economic data going back decades and more. However, most of the alleged harm in SCC analyses is projected to occur between now and 2300 or even later. To guesstimate future CO_2-related damages, SCC analysts must make assumptions about climate sensitivity, the carbon cycle, and the probability of catastrophic events, among other speculative issues.

The 2013 TSD does not reassess the 2010 TSD's sensitivity assumptions. It does not question the DICE model's revised (lower) estimate of ocean CO_2 uptake. Nor does it question the PAGE model's revised (higher) probability estimate of catastrophic impacts. Recent science indicates

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[47] Craig D. Idso and Sherwood B. Idso, *The Many Benefits of Atmospheric CO_2 Enrichment*, Center for the Study of Carbon Dioxide and Global Change, 2 February 2011, http://www.co2science.org/education/book/2011/55BenefitsofCO2Pamphlet.pdf.

[48] Idso, *The Positive Externalities of Carbon Dioxide.*

[49] OMB, Information Quality Guidelines, October 1, 2002, http://www.whitehouse.gov/omb/info_quality_iqg_oct2002/.

that climate sensitivity is lower, ocean CO_2 uptake is greater, and catastrophic scenarios are less plausible than earlier assessments assumed.

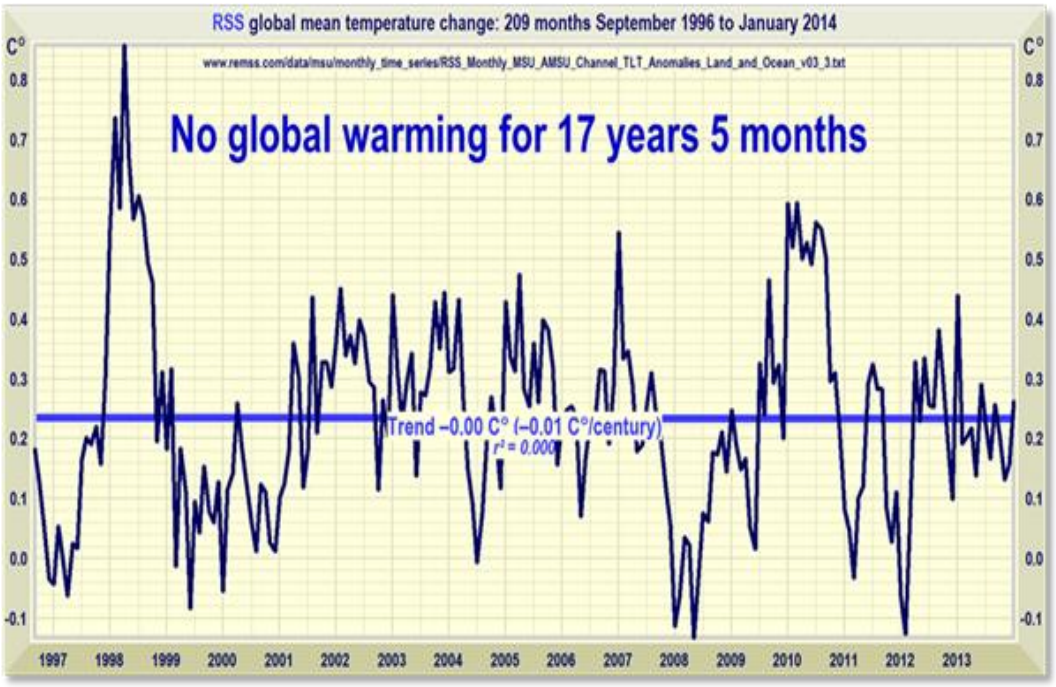
A. Sensitivity

The 2010 TSD states that the "most authoritative statement" about climate sensitivity is the Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate (IPCC), which concluded that "the global mean equilibrium warming for doubling CO_2, or 'equilibrium climate sensitivity', is likely to lie in the range 2°C to 4.5°C, with a most likely value of about 3°C."[50] The 2013 TSD does not "revisit" the 2010 TSD sensitivity assumptions.[51] The 2013 TSD thus ignores climate data and research produced after publication of AR4 in 2007. It is not based on the best available science.

One important issue not considered in AR4 is the warming "pause," now in its 17th year. Global CO_2 emissions during 1997-2013 increased faster than predicted, yet there was virtually no warming in the tropical mid-troposphere, the atmospheric layer where models project the strongest positive warming feedback.[52]

The graph below shows mid-troposphere temperatures from December 1996 through January 2014 in the Remote Sensing System (RSS) satellite record.[53]

[50] TSD 2010, pp. 13-14.
[51] TSD 2013, pp. 2, 4.
[52] John Christy, "Why should we care about the tropical temperature?" The (missing) tropical hotspot, Climate Dialogue: Exploring different views on climate change, July 16, 2013, http://www.climatedialogue.org/the-missing-tropical-hot-spot/.
[53] Christopher Monkton of Brenchley, "Satellites show no global warming for 17 years 5 months," WattsUpWithThat.Com, February 6, 2014, http://wattsupwiththat.com/2014/02/06/satellites-show-no-global-warming-for-17-years-5-months/.



The pause intensifies a long-term divergence between model projections and observed temperatures, a serious problem for mainstream ("consensus") climatology.

Hamburg University Prof. Hans von Storch and colleagues examined the accuracy of the CMIP3 and CMIP5 model ensembles used, respectively, to inform the IPCC's 2007 (AR4) and 2013 (AR5) assessment reports.[54] They find that "for the 15-year trend interval corresponding to the latest observation period 1998-2012, only 2% of the 62 CMIP5 and less than 1% of the 189 CMIP3 trend computations are as low as or lower than the observed trend." In short, even state-of-the-art climate models are on the verge of complete statistical failure.

Among the factors that may account for the models' poor performance, Storch and colleagues state that "an overestimation of the model sensitivity to elevated greenhouse gas concentrations cannot be ruled out."

A study published last year in *Nature Climate Change* finds that climate models overestimated warming over the past 20 years.[55] The three authors are IPCC bigwigs. Francis Zwiers is Vice Chair of Working Group I (physical science) of AR5; John Fyfe was a lead author for AR4; and Nathan Gillett is a lead author for AR5's Chapter 10 on climate change detection and attribution.

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[54] Hans von Storch Armineh Barkhordarian, Klaus Hasselmann, Eduardo Zorita. 2013. Can climate models explain the recent stagnation in global warming? http://www.academia.edu/4210419/Can_climate_models_explain_the_recent_stagnation_in_global_warming

[55] John C. Fyfe, Nathan P. Gillett and Francis W. Zwiers. 2013. Overestimated global warming over the past 20 years. *Nature Climate Change* 3: 767-768, http://www.see.ed.ac.uk/~shs/Climate%20change/Climate%20model%20results/over%20estimate.pdf

The authors find that during the 20-year period from 1993 through 2012, the warming trend computed from 117 climate model simulations (0.3°C/decade) was more than twice the observed trend (0.14°C/decade); and during the 15-year period from 1998 through 2012, the simulated trend (0.21°C/decade) was more than four times the observed trend (0.05°C/decade). They note that "such an inconsistency is only expected to occur by chance once in 500 years."

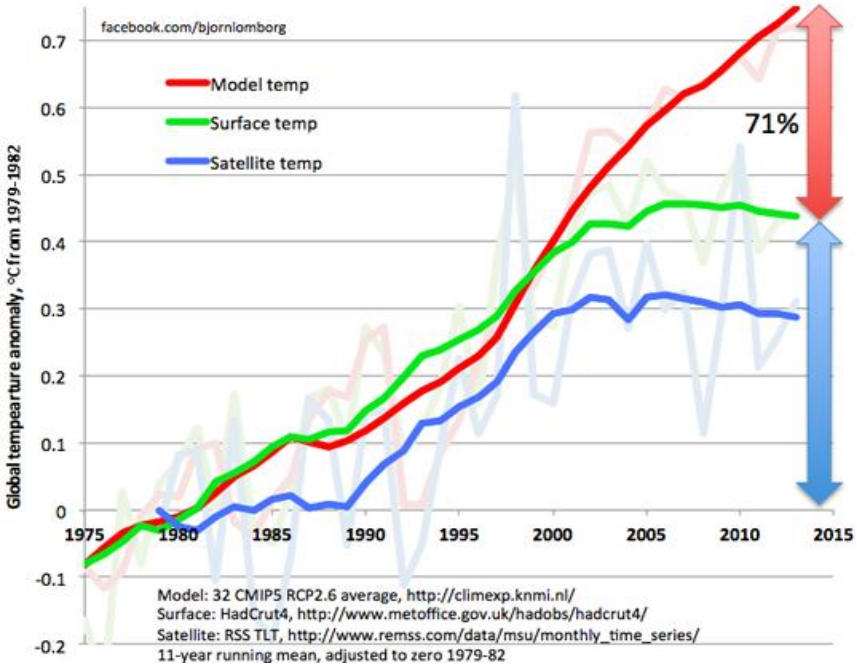
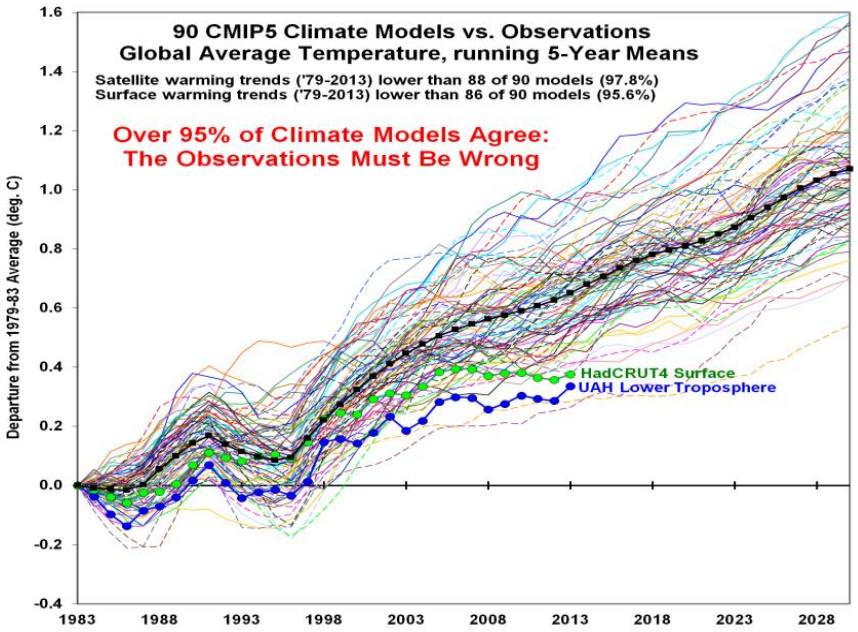


Figure source: Bjorn Lomborg[56]

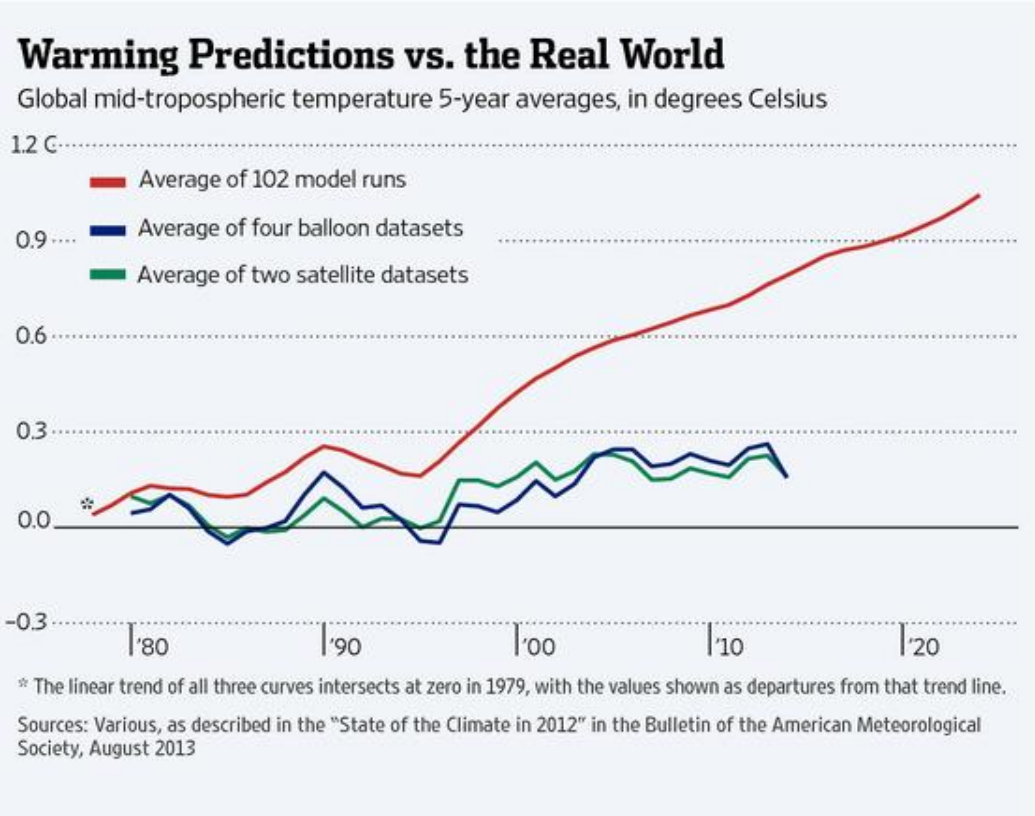
Model overestimation of observed warming goes all the way back to the beginning of the satellite record in late 1978. Roy Spencer of the University of Alabama in Huntsville (UAH) reports that more than 95% of 90 CMIP5 models overshoot observed warming during the past 34 years whether measured by the UAH satellite dataset or the UK Met Office Hadley Center surface dataset.[57]

[56] Bjorn Lomborg, "Global Warming without Fear," Project Syndicate, September 13, 2013, http://www.project-syndicate.org/commentary/realism-in-the-latest-ipcc-climate-report-by-bj-rn-lomborg.

[57] Roy W. Spencer, "95% of Climate Models Agree: The Observations Must Be Wrong," February 7, 2014, http://www.drroyspencer.com/2014/02/95-of-climate-models-agree-the-observations-must-be-wrong/.



Spencer's colleagues Richard McKnider and John Christy compare the average of 102 CMIP5 model runs with four independent datasets of tropical mid-troposphere temperatures since 1979.



As they note, "the disparity between the predicted temperature increases and real-world evidence has only grown in the past 20 years."[58]

In fact, the multi-model mean trend has been overestimating observed warming since 1950.[59]

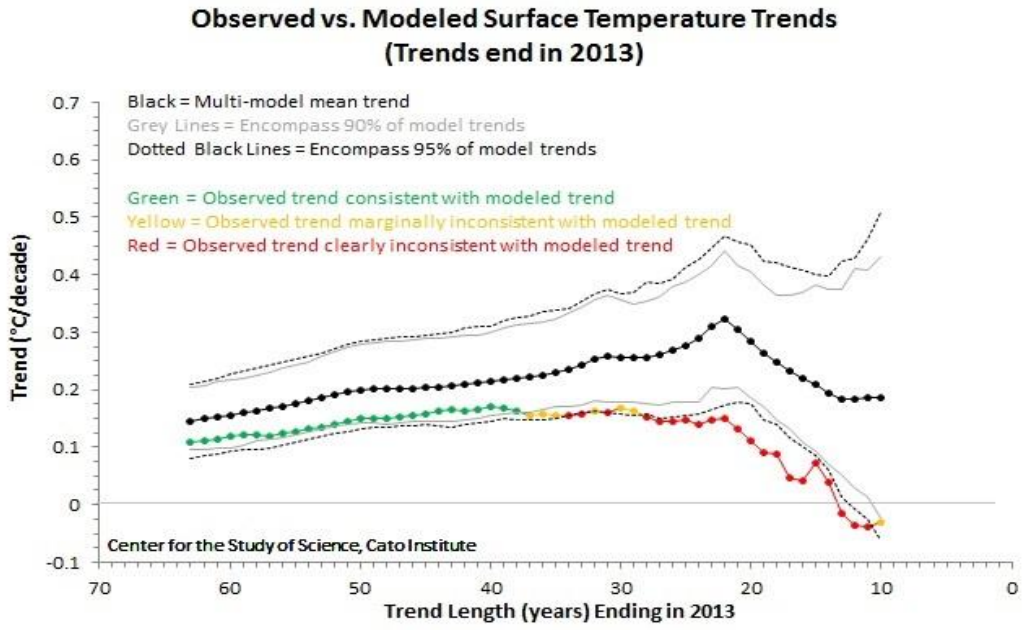


Figure 2. Same as Figure 1, except the end year for the trend calculations is 2013.

Model failure could be due to other factors besides overestimated climate sensitivity. Other possible causes include unknown external forcing mechanisms and underestimated internal climate variability. Nonetheless, the pause and the mismatch between models and observations are part of the impetus for several studies published since 2011 indicating that AR4 sensitivity estimates are too hot.

Cato Institute scientists Patrick Michaels and Chip Knappenberger maintain a growing list of such studies.[60] As of January 2014, the list included 18 studies estimating lower sensitivity than both the best estimate of IPCC AR4 and the average sensitivity of the models used in AR5. The AR4 best estimate of 3°C is 50% higher than the mean of the recent estimates (2°C); the AR5 model average of 3.4°C is 70% higher.

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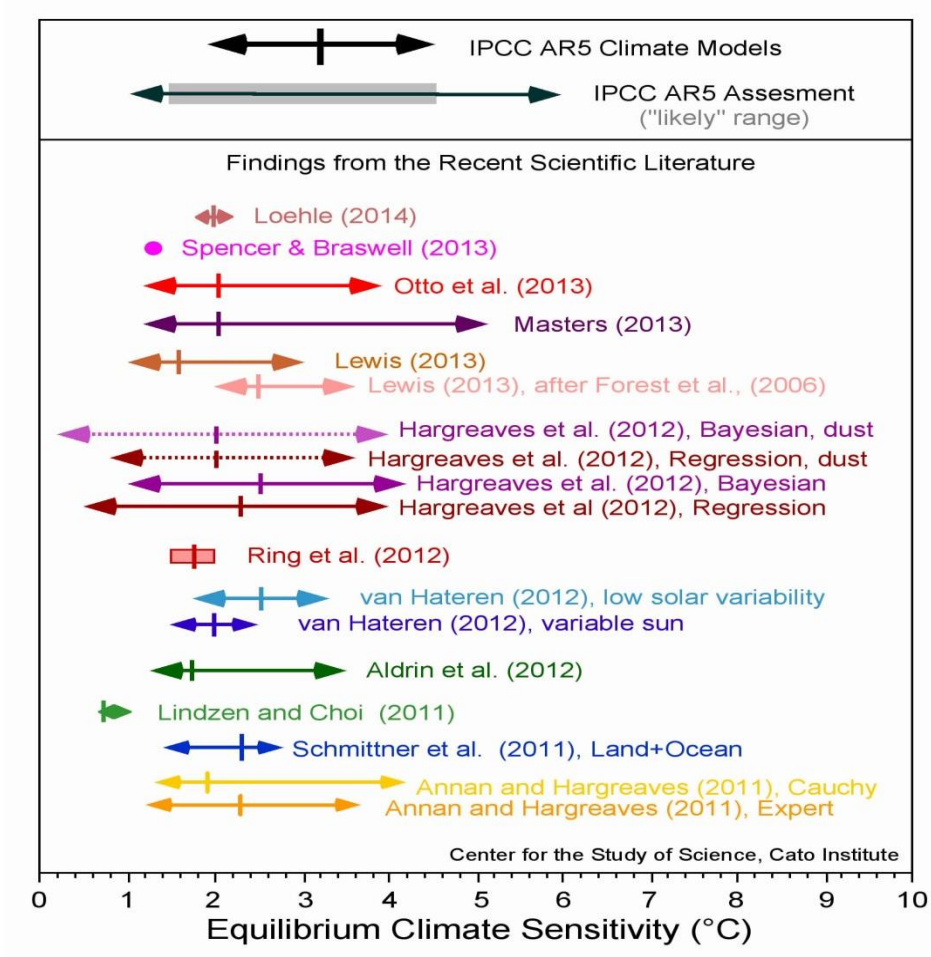
[58] Richard McKnider and John Christy, "Why Kerry Is Flat Wrong on Climate Change: It was the scientific skeptics who bucked the 'consensus' and said the Earth was round," *Wall Street Journal*, February 19, 2014, http://online.wsj.com/news/articles/SB10001424052702303945704579391611041331266?mod=WSJ_Opinion_LEADTo.

[59] Paul C. Knappenberger and Patrick Michaels, "Observations Now Inconsistent with Climate Model Predictions for 25 (going on 35) Years," November 5, 2013, http://www.cato.org/blog/current-wisdom-observations-now-inconsistent-climate-model-predictions-25-going-35-years.

[60] Patrick Michaels and Paul C. Knappenberger, "Still Another Low Climate Sensitivity Estimate," April 25, 2013, http://www.cato.org/blog/still-another-low-climate-sensitivity-estimate-0



All else equal, lower sensitivity means smaller climate impacts, hence less potential damage from CO_2 emissions and lower SCC estimates. Yet the 2013 TSD's central SCC estimate for 2010 ($33/ton) is 54% higher than the 2010 TSD's corresponding estimate ($21.4/ton), and the central estimates for 2020, 2030, 2040, and 2050 are roughly 60% higher.[61]

The IWG makes no effort to reconcile the higher SCC estimates with post-AR4 research on the warming pause, model failure, or climate sensitivity. The 2013 TSD simply sweeps those issues under the rug.

One reason given for 2013 TSD's higher SCC values is a revision in the FUND model, such that global temperatures are projected to increase faster for any level of sensitivity assumed. "The overall effect of this change is likely to increase estimates of the SCC as higher temperatures are reached during the timeframe analyzed and as the same damages experienced in the previous version of the model are now experienced earlier and therefore discounted less," the IWG explains.[62] That makes little sense. Warming is occurring more slowly than predicted, not faster

[61] TSD 2010, p. 29; TSD 2013, p. 13.
[62] TSD 2013, p. 9.

than predicted. There is no empirical evidence that warming will accelerate faster than "consensus" science previously assumed.

It is hard to shake the suspicion that SCC values increased by 50%-60% in only three years because otherwise the 2013 TSD would not conform to the political narrative that climate change is "worse than we thought."

Be that as it may, the IWG owes the public an explanation of why we should put any stock in SCC estimates derived from climate models that perform so poorly in replicating climate reality.

B. Ocean CO_2 Uptake

SCC values are also higher in the 2013 TSD because the oceans are a weaker carbon sink in the latest (2010) DICE model than in the previous (2007) DICE model. A given emissions path thus leads to higher atmospheric concentrations. "All else equal, these changes will generally increase the level of warming and therefore the SCC estimates in DICE2010 relative to those from DICE2007."[63]

Although models typically project a gradual decrease in the capacity of oceans and other terrestrial sinks to store anthropogenic carbon, the percentage of CO_2 emissions retained by the atmosphere – a quantity known as the airborne fraction – has held fairly constant so far. Comparing emissions data with atmospheric concentrations going back to 1850, Knorr (2009) reports that "despite the predictions of coupled climate-carbon cycle models, no trend in the airborne fraction can be found." He concludes that the oceans and terrestrial sinks are "keeping up" with the rise in anthropogenic emissions.[64]

Ballantyne et al. (2012) confirms those results.[65] The lead from the authors' Web site summarizes:

> Although numerous studies suggest the so-called C sinks on land and in the ocean may be becoming limited, we see no evidence of this based on global measurements of atmospheric CO_2 and estimates of CO_2 emissions. In fact, the Earth continues to lend us a hand by taking up twice as much atmospheric CO_2 as 50 years ago.[66]

OMB should be skeptical of SCC-inflating IAM-parameter adjustments that conflict with empirical research.

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[63] TSD 2013, p. 6.

[64] Center for the Study of Carbon Dioxide and Global Change, "The Airborne Fraction of Anthropogenic CO_2 Emissions," review of W. Knorr. 2009. Is the airborne fraction of anthropogenic CO2 emissions increasing? *Geophysical Research Letters* 36: 10.1029/2009GL040613, http://co2science.org/articles/V12/N48/B1.php.

[65] AP Ballantyne, CB Alden CB, JB Mille, PP Tans PP, and JMC White JWC. 2012. Increase in observed net carbon dioxide uptake by land and oceans. *Nature* 488: 70-72, http://www.nature.com/nature/journal/v488/n7409/full/nature11299.html.

[66] Global Carbon Project, Increased in observed net carbon dioxide uptake by land and oceans during the past 50 years, August 2012, http://www.globalcarbonproject.org/news/CarbonSinkIncreases.html.

C. Catastrophic Climate Change

The higher SCC values in the 2013 TSD partly derive from revisions in the PAGE model's "sub-function" computing the probability and economic damage of catastrophic events.[67] Doomsday is not only more likely in PAGE2009 than in PAGE2002, it is also more costly!

> The threshold [temperature] value for a possible discontinuity [in PAGE2009] is lower than in PAGE2002, while the rate at which the probability of a discontinuity increases with the temperature anomaly and the damages that result from a discontinuity are both higher than in PAGE2002.[68]

There are three main climate catastrophe scenarios: ocean circulation shutdown triggering a new ice age, ice sheet disintegration raising sea levels 10-20 feet during our lifetimes or those of our children and grandchildren, and runaway warming from melting frozen subsea methane crystals and Arctic peat-bog carbon deposits. Recent science indicates those scenarios are less plausible than earlier assessments assumed.

The once-fashionable scare of a warming-induced ice age[69] due to ocean circulation collapse was always more fiction than science,[70] and is seldom mentioned today as a reason to control GHG emissions. Since publication of the 2010 TSD, Zhang et al. (2011) found that the "anticipated slowdown" in the Atlantic Meridional Overturning Circulation (AMOC) "has not occurred yet, even though global temperatures have been significantly higher since the 1970s."[71]

Climate literature of the mid-2000s[72] warned that melting permafrost could release vast deposits of frozen methane from the sea floor and huge stores of CO_2 from peat bogs, which would cause more warming, which would release more methane and CO_2, in a climate-destabilizing feedback loop.

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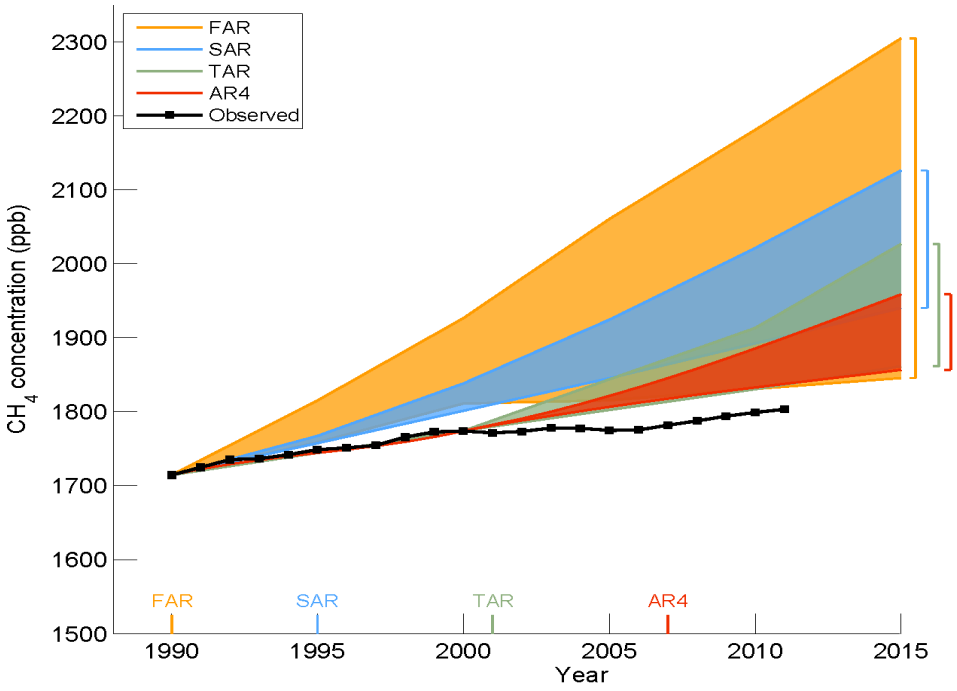
[67] TSD 2010, p. 8.
[68] TSD 2013, p. 11.
[69] Peter Schwartz and Doug Randall, *An Abrupt Climate Change Scenario and Its Implications for United States National Security: Imagining the Unthinkable*, October 2003, http://www.gbn.com/articles/pdfs/Abrupt%20Climate%20Change%20February%202004.pdf; Al Gore, *An Inconvenient Truth* (Emmaus, Pennsylvania: Rodale Press, 2006), p. 149.
[70] Richard Seager, *The Gulf Stream, European Climate and Abrupt Climate Change, Past and Future*, http://www.ldeo.columbia.edu/res/div/ocp/gs/pubs/Seager_NYAS_GulfStream.pdf.
[71] Zhang, D., Msadek, R., McPhaden, M.J. and Delworth, T. 2011. Multidecadal variability of the North Brazil Current and its connection to the Atlantic meridional overturning circulation. *Journal of Geophysical Research* 116**:** 10.1029/2010JC006812, http://onlinelibrary.wiley.com/doi/10.1029/2010JC006812/abstract . See also "Ocean Circulation Slowdown: False Alarm," *World Climate Report*, August 22, 2007, http://www.worldclimatereport.com/index.php/2007/08/22/ocean-circulation-slowdown-false-alarm/.
[72] Al Gore, *An Inconvenient Truth: The Planetary Emergency of Global Warming and What We Can Do about It* (Emmaus, Pa: Rodale, 2006); Fred Pearce, *With Speed and Violence: Why Scientists Fear Tipping Points in Climate Change* (Boston: Beacon Press, 2007); Joseph Romm, *Hell and High Water: Global Warming – the Solution and the Politics – and What We Should Do* (New York: William Morrow, 2007).

Schultz (2011) found that even under the most extreme climatic scenario tested, permafrost thaw in the Siberian shelf will not exceed 10 meters in depth by 2100 or 50 meters by the turn of the next millennium, whereas the bulk of methane stores are trapped roughly 200 meters below the sea floor.[73]

Kessler et al. (2011) found that microbes digested the methane released during the 2010 BP Deepwater Horizon oil spill, indicating that any warming-induced "large-scale releases of methane from hydrate in the deep ocean are likely to be met by a similarly rapid methanotrophic response."[74]

Gao et al. (2013) found that methane from melting permafrost presents a "low risk" of "warming feedback." The researchers estimate that "the additional warming, across the range of climate policy and uncertainties in the climate-system response, would be no greater than 0.1°C by 2100." They conclude that methane feedback from permafrost degradation will be "relatively small whether or not humans choose to constrain global emissions."[75]

As with global temperatures, so with methane concentrations, the actual trend is better – not worse – than "consensus" scientists predicted.



[73] Colin Schultz, Siberian shelf methane emissions not tied to modern warming. 2011. *EOS* 92:48, 469, http://onlinelibrary.wiley.com/doi/10.1029/2011EO490014/abstract

[74] John D. Kessler, David L. Valentine, Molly C. Redmond, Mengran Du, Eric W. Chan, Stephanie D. Mendes, Erik W. Quiroz, Christie J. Villanueva, Stephani S. Shusta, Lindsay M. Werra, Shari A. Yvon-Lewis, Thomas C. Weber. 2011. *Science* 331: 312-315, http://www.sciencemag.org/content/331/6015/312.abstract

[75] Xiang Gao, C Adam Schlosser, Andrei Sokolov, Katey Walter Anthony, Qianlai Zhuang and David Kicklighter. 2013. Permafrost degradation and methane: low risk of biogeochemical climate-warming feedback. *Environ. Res. Lett.* 8 (2013) 035014, http://iopscience.iop.org/1748-9326/8/3/035014/pdf/1748-9326_8_3_035014.pdf.

The chart above is from the leaked second order AR5 draft. It shows that methane concentrations are increasing more slowly than previously projected.[76] Indeed, the IPCC has had to lower its methane concentration prediction three times since 1990, yet even the lower bound of its most recent (2007) prediction overshoots observations.

Charman et al. (2012), a team of 36 researchers, examined "carbon accumulation" in Northern latitude peat lands over the past millennium. "Opposite to expectations," the scientists found that in warm periods, peat lands become more bio-productive, leading to net increases in "long-term carbon accumulation." Thus, the researchers opine, "the carbon sequestration rate could increase over many areas of northern peat lands" as the world warms.[77]

Loisel and Yu (2013) examined 15 peat cores collected from south-central Alaska. They found that "the observed apparent carbon accumulate rates over the past 100 years were almost ten times greater than those over the past 4000 years." They conclude: "these results are contrary to the widespread notion that higher temperature will increase peat decay and associated carbon dioxide release from peat lands to the atmosphere, contributing to the positive carbon cycle-climate feedback to global warming."[78]

As for ice sheet disintegration, King et al. (2012) found that the rate of Antarctic ice loss is not accelerating and translates to less than one inch of sea-level rise per century.[79] Faezeh et al. (2013) found that Greenland's four main outlet glaciers are projected to contribute 0.7 to 1.1 inches to sea-level rise by 2200 under a mid-range warming scenario (2.8°C by 2100) and 1.1 to 1.9 inches under a high-end warming scenario (4.5°C by 2100).[80] The contribution of the great ice sheets to 21st century sea-level rise is more likely to be measured in inches than in feet or meters.

The North Greenland Eemian Drilling (NEEM) project led by Dorthe Dahl-Jensen of the University of Copenhagen should finally put an end to claims[81] that half the Greenland ice sheet could melt or break off and slide into the sea. The 14-nation research team drilled and analyzed a 2,540-meter-long ice core from Northwestern Greenland. They found that although

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[76] IPCC WGI *Fifth Assessment Report, Second Order Draft*, Chapter 1, p. 1-42, http://climatefailfiles.files.wordpress.com/2012/12/ch1-introduction_wg1ar5_sod_ch01_all_final.pdf.

[77] Charman et al. 2012. Carbon-related changes in peatland carbon accumulation during the last millennium. *Biogeosciences Discussions* 9, 14327–14364, 2012 http://www.biogeosciences-discuss.net/9/14327/2012/bgd-9-14327-2012-print.pdf

[78] J. Loisel and Z. Yu. 2013. Recent acceleration of carbon accumulation in a boreal peatland, south central Alaska. *Journal of Geophysical Research,* 118: 41-53, reviewed by the Center for the Study of Carbon Dioxide and Global Change, http://www.co2science.org/articles/V16/N40/C2.php.

[79] Matt A. King, Rory J. Bingham, Phil Moore, Pippa L. Whitehouse, Michael J. Bentley & Glenn A. Milne. 2012. Lower satellite-gravimetry estimates of Antarctic sea-level contribution. *Nature* 491: 586-589, http://www.nature.com/nature/journal/v491/n7425/full/nature11621.html

[80] Faezeh M. Nick, Andreas Vieli, Morten Langer Andersen, Ian Joughin, Antony Payne, Tamsin L. Edwards, Frank Pattyn. 2013. Future sea-level rise from Greenland's main outlet glaciers in a warming climate. *Nature* 497: 235-238, http://www.nature.com/nature/journal/v497/n7448/full/nature12068.html.

[81] Popularized by Al Gore in *An Inconvenient Truth*, p. 196.

Greenland temperatures exceeded present-day temperatures by as much as 8°C for six millennia during the Eemian interglacial, the ice sheet retained nine-tenths of its height and three-quarters of its mass.[82]

The studies cited above are consistent with AR5, which states that, in the 21st century, Atlantic Ocean circulation collapse is "very unlikely," ice sheet collapse is "exceptionally unlikely," and catastrophic release of methane from melting permafrost is "very unlikely."[83]

Forecasts of ecological catastrophe have a dismal record. The headline-grabbing predictions of Paul Ehrlich ("In the 1970s and 1980s hundreds of millions of people will starve to death in spite of any crash programs embarked upon now"[84]), the Club of Rome ("The most probable result will be a sudden and uncontrollable decline in both population and industrial capacity"[85]), and the Carter Administration ("between half a million and two million species – 15 to 20 percent of all species on earth – could be extinguished by 2000"[86]) – all proved to be duds.[87]

Fine-tuning the probability and cost of disasters in future centuries is a fool's errand and just plain silly if used to estimate the monetary benefits of regulations having no measurable impact on global temperatures.

VII. Ignoring the Other Side of the Ledger

A. Social Benefits of Carbon

Carbon taxes and other policies based on SCC estimates assume that all the benefits of carbon energy are captured in motor fuel prices and monthly utility bills, hence that the only relevant

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[82] Quirin Schiermeier, "Greenland defied ancient warming: But Antarctic glaciers may be more vulnerable than thought," *Nature,* 23 January 2013, http://www.nature.com/news/greenland-defied-ancient-warming-1.12265. Note: The subtitle is editorial spin. The researchers did not drill or analyze ice cores from Antarctica.

[83] Intergovernmental Panel on Climate Change, *Fifth Assessment Report*, Working Group I, Chapter 12, Table 12.4, p. 1115, http://www.climatechange2013.org/images/report/WG1AR5_Chapter12_FINAL.pdf.

[84] Paul Ehrlich, *The Population Bomb* (Rivercity, Massachusetts: Rivercity Press, 1968), p. xi, http://faculty.washington.edu/jhannah/geog270aut07/readings/population/Ehrlich%20-%20Population%20Bomb%20Ch1.pdf.

[85] Club of Rome, *The Limits to Growth* (Washington, D.C.: Potomac Associates, 1972), p. 23, http://www.donellameadows.org/wp-content/userfiles/Limits-to-Growth-digital-scan-version.pdf. In fairness, the authors predict doomsday only if current trends (exponential growth in population, pollution, etc.) continue. However, the clear implication of *Limits* is that unsustainable trends would continue absent coordinated planning by the world's governments.

[86] Gerald O. Barney (study director), *The Global 2000 Report to the President: Entering the Twenty First Century* (1980), p. 37, http://www.geraldbarney.com/Global_2000_Report/G2000-Eng-7Locks/G2000_Vol_One_7Locks.pdf.

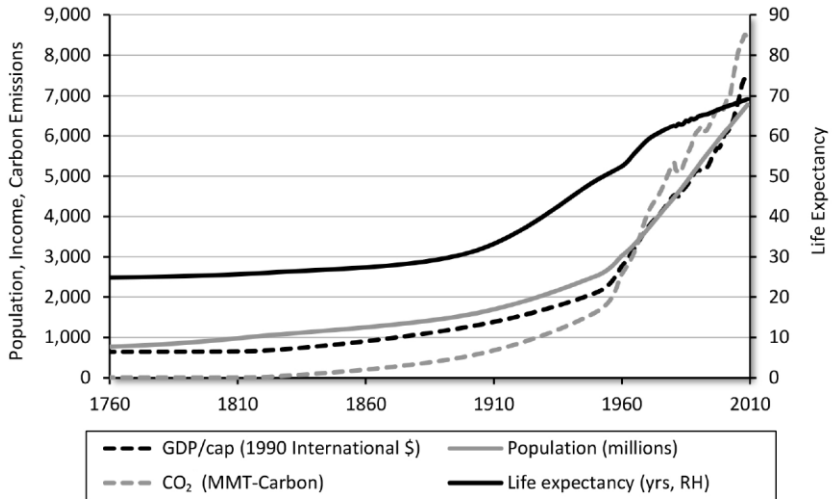
[87] Ronald Bailey, "The Progress Explosion: Permanently Escaping the Malthusian Trap," in Bailey, Ronald, ed. *Earth Report 2000: Revisiting the True State of the Planet*, Competitive Enterprise Institute (New York: McGraw-Hill, 2000); Bjorn Lomborg, *The Skeptical Environmentalist: Measuring the Real State of the Worl*d (Cambridge: Cambridge University Press, 2001); Indur M. Goklany, *The Improving State of the World: Why We're Living Longer, Healthier, More Comfortable Lives* (Washington, D.C.: Cato Institute, 2007); Matt Ridley, *The Rational Optimist: How Prosperity Evolves* (UK: Harper Collins, 2010).

externalities associated with fossil fuels are negative. That narrow perspective ignores fundamental facts of life.

Carbon energy supports all the technological advances that sustain and improve a world of seven billion people who on average live longer, healthier, and with greater access to information than the privileged elites of former ages. Fossil fuels have been and remain the chief energy source of what Cato Institute scholar Indur Goklany calls a "cycle of progress" in which economic growth, technological change, human capital formation, and freer trade co-evolve and mutually reinforce each other.[88] Progressive civilization is the very context of modern life. It is the most valuable of all public goods. Without carbon energy, humankind would be dramatically smaller, poorer, and sicker.

The fundamental contribution of carbon energy to social progress is reflected in the strong correlation between CO_2 emissions, per capita GDP, and population.

Global Progress, 1760–2009 (as indicated by trends in world population, GDP per capita, life expectancy, and carbon dioxide (CO_2) emissions from fossil fuels)



A survey by the National Academy of Engineers identifies 20 engineering achievements that made the greatest improvements in the quality of human life during the 20th century:[89]

1. Electrification - the vast networks of electricity that power the developed world.
2. Automobile - revolutionary manufacturing practices made the automobile the world's major mode of transportation by making cars more reliable and affordable to the masses.
3. Airplane - flying made the world accessible, spurring globalization on a grand scale.
4. Safe and Abundant Water - preventing the spread of disease, increasing life expectancy.

[88] Indur Goklany, *Humanity Unbound: How Fossil Fuels Saved Humanity from Nature and Nature from Humanity*, Policy Analysis No. 715, Cato Institute, December 20, 2012, http://www.cato.org/sites/cato.org/files/pubs/pdf/pa715.pdf

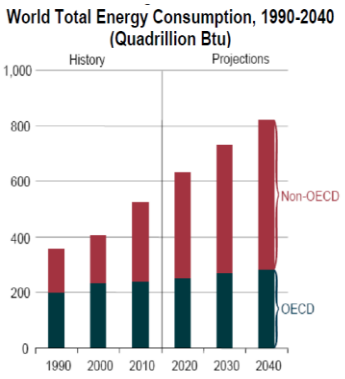
[89] Top 20 engineering achievements of the 20th century, http://composite.about.com/od/inthenews/l/blnae1.htm.

5. Electronics - vacuum tubes and, later, transistors that underlie nearly all modern life.
6. Radio and Television - dramatically changed the way the world received information and entertainment.
7. Agricultural Mechanization - leading to a vastly larger, safer, less costly food supply.
8. Computers - the heart of the numerous operations and systems that impact our lives.
9. Telephone - changing the way the world communicates personally and in business.
10. Air Conditioning and Refrigeration - beyond convenience, it extends the shelf life of food and medicines, protects electronics, and plays an important role in health care delivery.
11. Interstate Highways - 44,000 miles of U.S. highway allowing goods distribution and personal access.
12. Space Exploration - going to outer space vastly expanded humanity's horizons and introduced 60,000 new products on Earth.
13. Internet - a global communications and information system of unparalleled access.
14. Imaging Technologies - revolutionized medical diagnostics.
15. Household Appliances - eliminated strenuous, laborious tasks, especially for women.
16. Health Technologies - mass production of antibiotics and artificial implants led to vast health improvements.
17. Petroleum and Gas Technologies - the fuels that energized the 20th century.
18. Laser and Fiber Optics - applications are wide and varied, including almost simultaneous worldwide communications, non-invasive surgery, and point-of-sale scanners.
19. Nuclear Technologies - from splitting the atom, we gained a new source of electric power.
20. High Performance Materials - higher quality, lighter, stronger, and more adaptable.

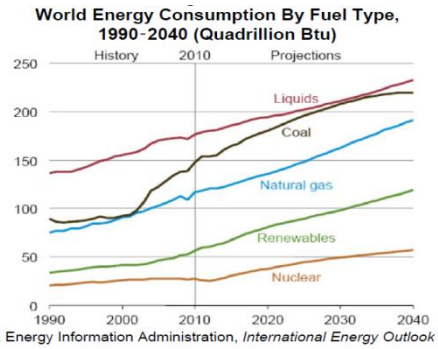
None of those technologies would have been highly developed or deployed at scale without access to plentiful, reliable, affordable energy, most of which came from fossil fuels.

The notion that fossil fuels are outmoded and can be phased out without hardship or peril flies in the face of well-established economic trends. Global energy consumption is projected to increase substantially between now and 2040, and most of the additional energy is projected to come from fossil fuels.[90]

[90] Roger Bezdek, *The Social Costs of Carbon? No, the Social Benefits of Carbon*. Prepared for the American Coalition for Clean Coal Energy, January 2014, pp. 34-35, http://www.americaspower.org/sites/default/files/Social_Cost_of_Carbon.pdf.



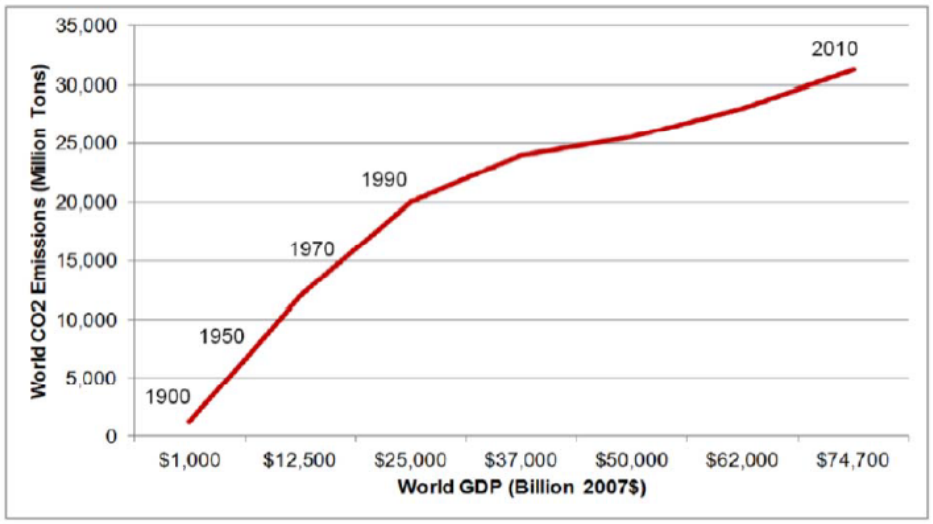
Source: U.S. Energy Information Administration, *International Energy Outlook 2013*



U.S. Energy Information Administration, *International Energy Outlook 2013*

In a recent report, economist Roger Bezdek, using EIA data, estimates that in 2010 carbon energy supported about $2,400 in global GDP for every ton of CO_2 emitted.[91] That indirect economic benefit of CO_2 emissions is in addition to the significant direct monetary benefits of CO_2 fertilization, discussed above.

Relationship Between World GDP and CO_2 Emissions



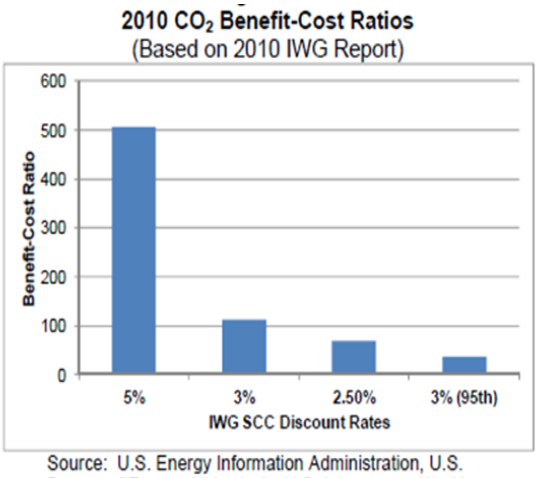
Source: U.S. Energy Information Administration, International Energy Agency, U.S. Bureau of Economic Analysis, and Management Information Services, Inc.

Bezdek compares the economic benefits of the carbon energy represented by one ton of CO_2 emissions in 2010 with SCC values for the same year as estimated in the 2010 and 2013 TSDs. The comparison produces a very different bottom line than the IWG's one-sided presentation. CO_2-related benefits exceed costs by literally orders of magnitude:

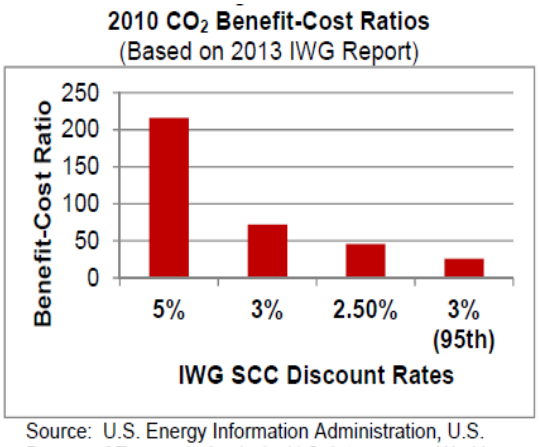
- Based on the 2013 IWG report, the benefit-cost (B-C) ratios for the three discount rates (2.5%, 3%, and 5%) range between about 50-to-1 and 250-to-1.

[91] Bezdek, Ibid., pp. 127-128.

- Based on the 2010 IWG report, the B-C ratios for the three discount rates range between about 70-to-1 and 500-to-1.
- Even using the extreme 3.0% 95th percentile estimates, the B-C ratios range between about 30-to-1 and 40-to-1.



Source: U.S. Energy Information Administration, U.S. Bureau of Economic Analysis, U.S. Interagency Working Group, and Management Information Services, Inc.



Source: U.S. Energy Information Administration, U.S. Bureau of Economic Analysis, U.S. Interagency Working Group, and Management Information Services, Inc.

Although impressive, Bezdek's B-C ratios considerably understate the total social benefit of carbon energy, because greater wealth improves health and saves lives. The social benefit of a meal that saves a life, for example, far exceeds the cost of the food or the net income to the farmer.

As Goklany explains, by improving the productivity and efficiency of food production, distribution, and storage, fossil fuels rescued mankind from the age-old Malthusean trap of over-population and famine.[92]

Every critical input of modern agriculture depends to some extent on fossil fuels:

> Fossil fuels provide both the raw materials and the energy for the manufacture of fertilizers and pesticides; farm machinery is generally run on diesel or another fossil fuel; and irrigation, where it is employed, often requires large amounts of energy to operate pumps to move water.

Fossil fuel-supported agricultural technologies continually improve, with the result that "In 2007, the global food and agriculture system delivered, on average, two and a half times as much food per acre of cropland as in 1961."

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[92] Indur M. Goklany, *Humanity Unbound: How Fossil Fuels Saved Humanity from Nature and Nature from Humanity*, Cato Institute Policy Analysis No. 715, December 20, 2012, http://www.cato.org/sites/cato.org/files/pubs/pdf/pa715.pdf.

Fossil fuels also provide energy for refrigeration and raw material for plastic packaging — technologies critical to limiting food spoilage and waste. Finally, fossil fuels are essential for transporting food from farms to population centers and from surplus to deficit regions.

The social benefits of fossil fuel-dependent agriculture are incalculably large. A more abundant, affordable, and secure food supply makes human life more abundant. A better-fed population is healthier, longer-lived, and more productive. More productive farms allow more people to develop skills and pursue vocations unrelated to farm work. Compared to those obvious but often unappreciated social benefits, the hypothetical social costs of carbon are vanishingly small.

In addition to advancing human health and welfare, the explosion in agricultural productivity also helps conserve habitat and biodiversity.

Goklany estimates that to maintain the current level of food production without fossil fuels, "at least another 2.3 billion hectares of habitat would have to be converted to cropland" – an area equivalent to the territories of the United States, Canada, and India combined.[93] He concludes:

> Not only have these fossil fuel–dependent technologies ensured that humanity's progress and well-being are no longer hostage to nature's whims, but they saved nature herself from being devastated by the demands of a rapidly expanding and increasingly voracious human population.

What are the monetized benefits of the eco-system services and biodiversity preserved through fossil fuel-supported advances in food production, distribution, and storage? We don't know. However, we would not be surprised if those benefits alone exceed TSD estimates of carbon's social cost.

B. Social Costs of Carbon Mitigation

People use a portion of their income to enhance their health, safety, and well-being. For both societies and individuals, wealthier is healthier, richer is safer. By raising business and household energy costs, carbon taxes or regulations can reduce consumption, growth, and employment.[94] Poverty and unemployment increase risks of sickness and death.[95] Hence there are potential social costs not only of carbon but also of carbon mitigation.

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[93] As Goklany points out, the actual amount of habitat saved is likely much larger. The 2.3 billion hectares estimate unrealistically assumes that all additional land converted in a world without carbon energy would be as naturally productive as that currently under cultivation.

[94] David W. Kreutzer and Nicolas Loris, "Carbon Tax Would Raise Unemployment, Not Swap Revenue," Issue Brief #3891, Heritage Foundation, January 8, 2013, http://www.heritage.org/research/reports/2013/01/carbon-tax-would-raise-unemployment-not-revenue.

[95] David J. Roelfs, Eran Shor, Karina W. Davidson, Joseph E. Schwartz. 2011. Losing life and livelihood: A systematic review and meta-analysis of unemployment and all-cause mortality. *Social Science & Medicine* 72: 840-854, http://www.mcgill.ca/sociology/sites/mcgill.ca.sociology/files/2011_--_social_science__medicine_0.pdf

1. Adverse Consumer Impacts

Bezdek provides several tables and charts illustrating the health risks of policies that raise energy costs.

Energy costs already consume large portions of after-tax income for millions of U.S. households.

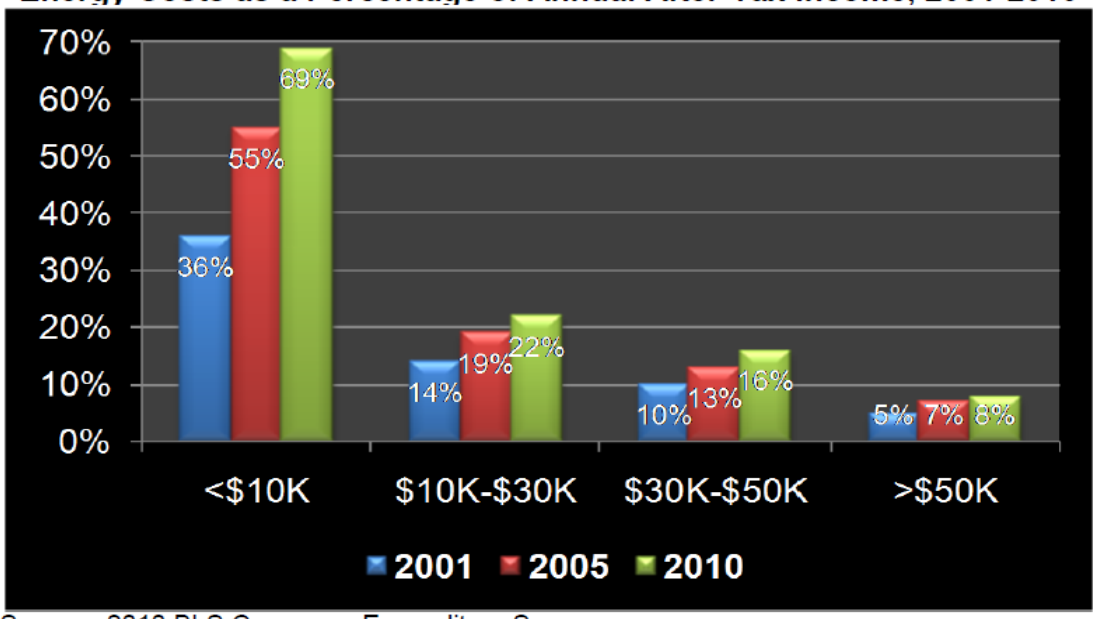
Estimated U.S. Household Energy Expenditures as a Percentage of Income, 2010

Pre-tax income	<$10K	$10K-$30K	$30K-$50K	>$50K	Average
Percent of Households	7.1%	23.1%	19.4%	50.3%	
Residential Energy	$1,559	$1,729	$1,997	$2,501	$2,157
Transportation Fuel	$1,837	$2,280	$3,221	$4,316	$3,456
Total Energy	$3,395	$4,009	$5,218	$6,817	$5,613
Average After-Tax Income	$4,903	$18,138	$33,436	$84,337	$53,904
Energy Percent% of After-Tax Income	69.3%	22.1%	15.6%	8.1%	10.4%

Sources: U.S. Bureau of the Census, *Current Population Survey*; U.S. DOE, *Residential Energy Consumption Survey*; U.S. DOE/EIA, *Annual Energy Review* and *Short-Term Energy Outlook*; U.S. DOE/EIA, *Household Vehicle Energy Use: Latest and Trends*; U.S. Congressional Budget Office, *Effective Federal Tax Rates Under Current Law, 2001-2014* and *Effective Federal Tax Rates, 1979-2006.*

Even without carbon taxes, cap-and-trade, or a national "clean energy standard," household energy burdens (energy expenditures as a percentage of after-tax income) have increased over the past decade, especially for the poorest households.

Energy Costs as a Percentage of Annual After-Tax Income, 2001-2010



Source: 2010 BLS Consumer Expenditure Survey.

On average, U.S. households earning less than $50,000 a year spend more on energy than on food, medicine, clothing, insurance, or healthcare.

Average Annual Household Expenditures, 2009

Pre-tax annual income (average)	$50,000 or Less	% of Total Expenditures
After-tax income (average)	$36,218	--
Clothing	$1,340	3.7%
Energy – residential & transportation	$5,396	14.9%
Healthcare	$2,861	7.9%
Food	$5,287	14.6%
Housing (ex. utilities)	$10,395	28.7%
Transportation (ex. fuel)	$5,179	14.3%
Entertainment	$1,920	5.3%
Insurance and pensions	$1,956	5.4%
Education and reading	$507	1.4%
Tobacco and alcohol	$761	2.1%
All other	$616	1.7%
Total expenditures	$36,218	100%

Source: U.S. Bureau of Labor Statistics, *Consumer Expenditure Survey 2009*, October 2010.

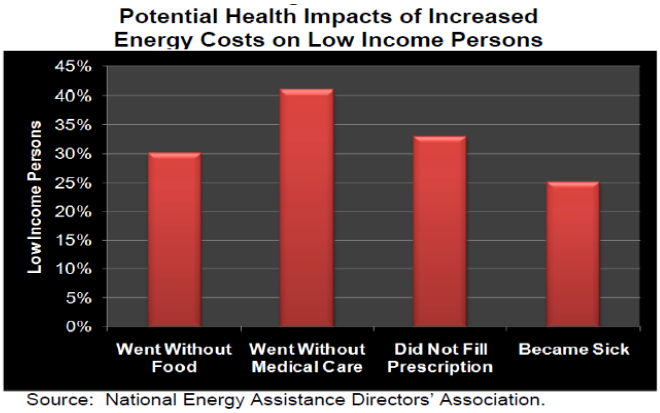
Unsurprisingly, energy costs already impose real sacrifices on low-income households. Impacts include reduced expenditures for food, medicine, and education, reduced savings, and late credit card payments.

Actions Taken by U.S. Households as a Result of High Energy Prices

Actions taken	All respondents	≤150% of poverty	151%-250% of poverty
Reduced purchases of food	43%	70%	51%
Reduced purchases of medicine	18%	31%	23%
Changed plans for education or children's education	11%	19%	18%
Behind on credit card bills	11%	18%	15%
Reduced amount of money put into savings	55%	58%	58%

Source: 2008 Energy Costs Survey (NEADA).

The chart below shows how current energy costs adversely affect the health of low-income households.



Source: National Energy Assistance Directors' Association.

Carbon taxes, cap-and-trade, or national "clean energy" mandates would make energy more costly. Potential social costs, according to Bezdek, include:

- Adverse impacts on GDP, income, and employment, which can increase illness and mortality rates.
- Inadequate heating or cooling of homes during cold winters or summer heat waves.
- Substitution of risky alternatives for central heating when households can't pay their utility bills.
- Financial stress contributing to poor credit ratings, missed mortgage payments, evictions, and household instability.

2. Adverse GDP Impacts

The 2013 TSD defines the social cost of carbon as "an estimate of the monetized damages associated with an incremental increase in carbon emissions in a given year."[96] FUND model author Richard Tol and colleague David Anthoff offer an alternative definition: "It is the carbon tax that would be imposed by a benevolent social planner."[97] The tax supposedly would make the overall economy more efficient by forcing producers and consumers to pay for the external costs of carbon energy.

As indicated earlier, such thinking overlooks the foundational importance of energy to all other economic activity. In this respect, energy is very much like food. Direct spending on food represents only a small fraction of the economy, but without food there would be no economy! Food also has external costs not reflected in the prices we pay at the supermarket – obesity, heart disease, Type 2 diabetes, Medicare payments, agricultural runoff, ground water depletion, and more. But "internalizing the externalities" via corrective "caps" (rationing) or taxes would increase food prices and cut food production. The social cost could far exceed the direct losses to farmers and related industries. Even small increases in global food prices can push millions of people below the poverty line and damage human health.

Much the same holds for carbon energy: Without it, there would be no modern civilization. In particular, there would be far less food production, as discussed above. Thus, carbon taxes can have social costs exceeding the direct economic losses to energy producers and related industries.

Note also that benevolent social planners will almost certainly not be in charge. Given the speculative character of SCC estimates, Washington's limitless appetite for "revenue enhancements," and the "worse than we thought" alarmism of SCC advocates, carbon taxes emerging from the sausage factory may be more punitive and damaging than those set by a Philosopher King.

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[96] TSD 2013, p. 2.

[97] David Anthoff and Richard S. J. Toll. 2013. The uncertainty about the social cost of carbon: A decomposition analysis using FUND, *Climatic Change*, 117: 515-530, http://ideas.repec.org/p/esr/wpaper/wp404.html.

The social costs of carbon mitigation partly explain why China, India, and other developing countries reject binding emission limitations in climate treaty negotiations.

Between 2005 and 2012, China's GDP nearly doubled (from $5.38 trillion to $10.73 trillion)[98] while CO_2 emissions increased by 66%.[99] GDP grew more rapidly than emissions due to improvements in energy efficiency. Nonetheless, emissions increased dramatically because China's development is overwhelmingly fossil-fueled.[100]

Those numbers make crystal clear that China could not accept even a "soft" Kyoto target (such as 25% above 2005 levels by 2008-2012) without sacrificing trillions of dollars in cumulative GDP. A substantial fraction of the 680 million people[101] who escaped from poverty would have remained trapped in it. The social cost would be staggering.

Yet U.S. and European negotiators keep pushing China, India, Brazil, Argentina, and South Africa to join the club of the carbon constrained. First World negotiators offer developing countries "adaptation assistance" in return for emission limitation commitments.[102] Government-to-government aid is fraught with social costs of its own, such as financing the centralization of economic decisions and corruption in high places that made the recipient countries poor in the first place.[103]

The greater risk, though, is that some combination of threats and bribes will actually induce developing countries to limit their energy consumption and, thus, their growth. As UCLA economist Deepak Lal cautions:

> The greatest threat to the alleviation of the structural poverty of the Third World is the continuing campaign by western governments, egged on by some climate scientists and green groups, to curb greenhouse gas emissions, primarily the CO_2 from burning fossil

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[98] Energy Information Administration, World gross domestic product (GDP) by region expressed in purchasing power parity, *International Energy Outlook 2013*, reference case, http://www.eia.gov/oiaf/aeo/tablebrowser/#release=IEO2013&subject=0-IEO2013&table=3-IEO2013&region=0-0&cases=Reference-d041117.

[99] Energy Information Administration, World carbon dioxide emissions by region, I*nternational Energy Outlook 2013*, reference case, http://www.eia.gov/oiaf/aeo/tablebrowser/#release=IEO2013&subject=0-IEO2013&table=10-IEO2013&region=0-0&cases=Reference-d041117.

[100] Despite significant investment in nuclear, hydro, and renewables, 91% of China's primary energy in 2011 came from fossil fuels. U.S. Energy Information Administration, China, February 4, 2014, http://www.eia.gov/countries/analysisbriefs/China/china.pdf.

[101] "Poverty: Not always with us," *Economist*, June 1, 2013, http://www.economist.com/news/briefing/21578643-world-has-astonishing-chance-take-billion-people-out-extreme-poverty-2030-not.

[102] Gerard Wynn and Peter Harrison, "U.S. backs $100 bln climate fund, world leaders meet," Reuters, December 17, 2009, http://www.reuters.com/article/2009/12/17/us-climate-copenhagen-idUSGEE5BB07F20091217.

[103] Dexter Samida, *A Hand Out Instead of a Hand Up: Where Foreign Aid Fails*, Policy Public Sources No. 30, 1999, The Fraser Institute,

> fuels. To put a limit on the use of fossil fuels without adequate economically-viable alternatives is to condemn the Third World to perpetual structural poverty.[104]

For the U.S., the chief risk is that carbon taxes will be used as a political weapon to suppress North America's development into an "energy colossus."[105] As mentioned above, unconventional oil and gas production is the most promising source of GDP growth, new investment, job creation, tax revenue, and competitive advantage of the past 20 years. Adoption of carbon taxes would expose this sector to significant new levels of political risk. The GDP fallout could far exceed the direct economic burden of the tax itself.

3. National Security Risks

Circular A-4 instructs agencies to provide qualitative descriptions of regulatory costs and benefits that are non-quantifiable or difficult to monetize.[106] Although non-quantifiable, policy disaster risk contributes to the social cost of carbon mitigation. Potential risks include adverse impacts on world hunger, economic development, international trade, and nuclear proliferation – and, thus, on international stability and peace.

Indeed, one climate policy has already exacerbated world hunger, instability, and conflict – the very ills we are supposed to fear from global warming. The Renewable Fuel Standard (RFS), a policy ostensibly designed to reduce the carbon footprint of U.S. transportation, puts upward pressure on grain prices. Grain price spikes sparked violent protests in both 2008 and 2011.[107]

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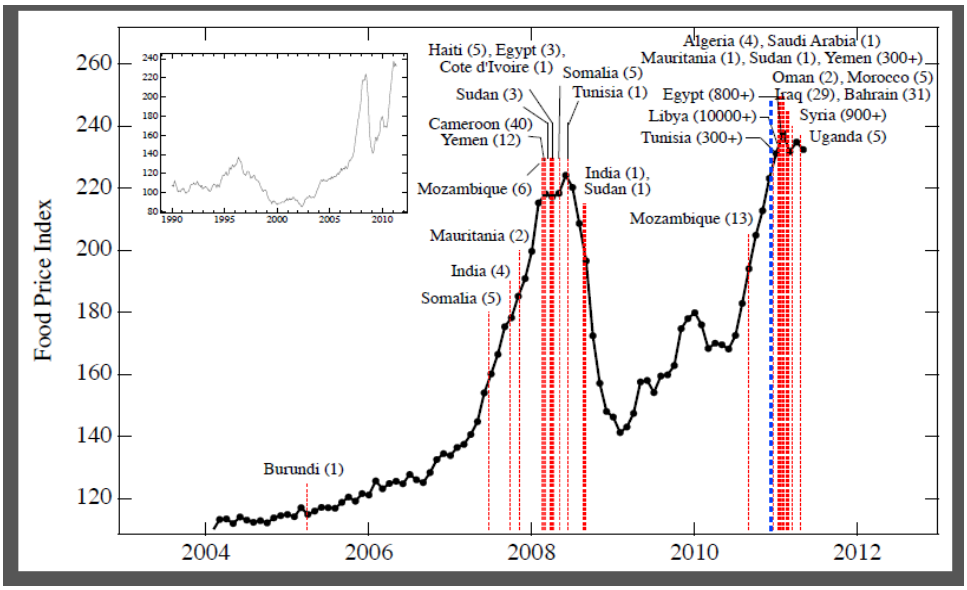
[104] Deepak Lal, *Poverty and Progress: Realities and Myths about Global Poverty* (Washington, D.C.: Cato Institute, 2013).

[105] Mark Mills, "Unleashing the North American Energy Colossus: Hydrocarbons Can Fuel Growth and Prosperity," Power & Growth Initiative Report No. 1, July 2012, Manhattan Institute, http://www.manhattan-institute.org/html/pgi_01.htm; "The Case for Exports: America's Hydrocarbon Industry Can Revive the Economy and Eliminate the Trade Deficit," Power & Growth Initiative No. 3, May 2013, http://www.manhattan-institute.org/html/pgi_03.htm#.UwOVq50o674.

[106] OMB, Circular A-4, p. 12, http://www.whitehouse.gov/sites/default/files/omb/inforeg/regpol/circular-a-4_regulatory-impact-analysis-a-primer.pdf.

[107] Marco Lagi, Karla Z. Bertrand and Yaneer Bar-Yam, *The Food Crisis and Political Instability in North Africa and the Middle East*, New England Complex Systems Institute, September 28, 2011, http://necsi.edu/research/social/food_crises.pdf.



Red dashed vertical lines correspond to beginning dates of "food riots" in 2008 and protests associated with major Mideast unrest in 2011. Reported death tolls are in parenthesis. The black line shows the FAO food price index from 2004 to 2011.

Bjorn Lomborg identifies a major potential policy disaster. More than a billion of the world's people have no access to electricity. The poorest of the poor heat their homes and cook their food with wood, dung, crop waste, and coal burned in open fires and leaky stoves. About 3.5 million of them die prematurely each year from indoor pollution.[108] If developing countries deny themselves the benefits of carbon energy before genuinely cheaper alternatives are available, they will thwart their peoples' aspirations for a better life. That could increase risks of instability and conflict.

A related issue is how developing-country emission limitations would be enforced. The likeliest option is trade sanctions – carbon tariffs in retaliation for "carbon dumping." Former French President Nicholas Sarkozy,[109] the current French government,[110] the European Union High Court,[111] former DOE Secretary Stephen Chu,[112] ten U.S. senators,[113] sponsors of the Waxman-

[108] Bjorn Lomborg, "The Poor Need Cheap Fossil Fuels," *New York Times*, December 3, 2013, http://www.nytimes.com/2013/12/04/opinion/the-poor-need-cheap-fossil-fuels.html?_r=0.
[109] EurActiv.Com, "Sarkozy renews pressure for CO2 border tax," 14 September 2009, http://www.euractiv.com/climate-change/sarkozy-renews-pressure-co2-bord-news-222460.
[110] Frédéric Simon, "France plans to revive EU carbon tariff," EurActiv.Com, May 18, 2012, http://www.theguardian.com/environment/2012/may/18/france-eu-carbon-tariff.
[111] Fran Smith, "A 'Trade War for Christmas' – EU High Court Rules on Airline Emissions," December 21, 2011, http://www.openmarket.org/2011/12/21/a-%e2%80%9ctrade-war-for-christmas%e2%80%9d-%e2%80%93-eu-high-court-rules-on-airline-emissions/.
[112] Nicolas Loris, "Cap-and-Trade Equals Reduced Trade," The Foundry, May 11, 2009, http://blog.heritage.org/2009/05/11/cap-and-trade-equals-reduced-trade-part-6-in-a-10-part-series/.

Markey cap-and-trade bill,[114] nationally-syndicated columnists,[115] U.S. Steel, American Electric Power, and AFL-CIO[116] have all advocated carbon tariffs at one time or another. China has threatened retaliation, warning that carbon tariffs could start a trade war.[117]

Trade wars seldom end in shooting wars but an era of trade conflict with China, India, and other emerging industrial nations would not be in the U.S. national interest. More broadly, the save-the-planet agenda threatens to usher in a new era of protectionism. The EU already has a policy (the Single Payment Scheme) to "level the playing field" with farm imports from developing countries that do not adhere to EU environmental standards.[118] Carbon tariffs could become a pretext for shutting developing country imports out of First World markets. The European Environment Agency, for example, frets that the carbon footprint of imported Chilean grapes is 842 times bigger than that of grapes obtained locally.[119]

Proliferation risk should also be considered. Pakistan is in talks with China to purchase 3 large nuclear power plants for $13 billion, "a blow to international efforts to restrict trade in nuclear technology."[120] India, which is not a party to the Nuclear Non-Proliferation Treaty, expects to have 14,000 MW of nuclear power on line by 2020, and aims to supply 25% of its electricity from nuclear power by 2050.[121] Fukushima set back nuclear power in Japan and Germany, but not in Pakistan and India.

Nuclear power could become more attractive to developing countries if climate policies restrict access to coal- and gas-generation. India, for example, would need an estimated 250 nuclear

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[113] Keith Johnson, "Cap and Trade: Ten Democratic Senators Call for Carbon Tariffs," *Wall Street Journal*, August 6, 2009, http://blogs.wsj.com/environmentalcapital/2009/08/06/cap-and-trade-ten-democratic-senators-call-for-carbon-tariffs/.

[114] Carolyn Fisher and Alan K. Fox, *Comparing Polices to Combat Carbon Leakage: Carbon Border Adjustments versus Rebates*, Discussion Paper, Resources for the Future, March 2011, http://www.rff.org/rff/documents/rff-dp-09-02-rev.pdf.

[115] Paul Krugman, "Climate, trade, Obama," *New York Times*, June 29, 2009, http://krugman.blogs.nytimes.com/2009/06/29/climate-trade-obama/.

[116] Mark Drajem and Catherine Dodge, "Obama Climate Plan May Spur Trade Row Over Company Protections," Bloomberg, February 20, 2009, http://www.bloomberg.com/apps/news?pid=newsarchive&sid=aHscSU9C.1F8&refer=c

[117] "China: carbon tariff could trigger trade war," *People's Daily, July* 3, 2009, http://english.peopledaily.com.cn/90001/90778/90857/90861/6693060.html [link no longer active].

[118] "Exploring links between EU agricultural policy and world poverty," Trinity College Dublin, http://www.tcd.ie/iiis/policycoherence/eu-agricultural-policy/protection-measures.php.

[119] European Environment Agency, *Beyond transport policy: exploring and managing the external drivers of transport demand*, Technical report No. 12/2008, p. 27, http://www.eea.europa.eu/publications/technical_report_2008_12.

[120] Saeed Shah, "Pakistan in Talks to Acquire 3 Nuclear Plants from China," *Wall Street Journal*, January 20, 2014, http://online.wsj.com/news/articles/SB10001424052702304757004579332460821261146.

[121] World Nuclear Association, "Nuclear Power in India," January 28, 2014, http://www.world-nuclear.org/info/Country-Profiles/Countries-G-N/India/.

reactors to meet projected electric demand growth through 2030 without incremental new coal power.[122]

We are not opposed to nuclear power or trade in nuclear technology. Nonetheless, the conflict over Iran's nuclear program shows how difficult it is resolve security concerns when a rogue state acquires fissile material. Proliferation risk is real and could ramp up quickly in a carbon-constrained world.

4. Other significant non-monetized costs

Use of SCC analysis in regulatory justification would set a dangerous precedent. Agencies could ultimately be forced to allow the "social cost" of other perceived dangers (e.g., the social cost of firearms, the social cost of alcohol, the social cost of driving automobiles, the social cost of fast food, etc.) to be factored into a wide variety of regulatory decisions.

The supposed avoidance of these types of "social" costs, when overlaid on the more traditional costs and benefits of specific regulatory actions, would make cost/benefit assessment an arbitrary exercise, with literally every form of government regulation (whether or not it could or would actually achieve its objective) being totally justified on a cost/benefit basis because of the massive social benefits it would purportedly deliver.

SCC analysis ignores the opportunity costs of climate policy. Among the "valuable activities the world has foregone," notes author Rupert Darwall, are "the innovations and productivity from Silicon Valley venture capital dollars diverted into green tech investments." A related opportunity cost is the diversion of entrepreneurial talent from wealth-creation to rent-seeking: "Because alternative energy projects depend on government support, entrepreneurs and energy utility executives are turned into government lobbyists maximizing their take from global warming policies."[123]

"Perhaps the biggest casualty is science," Darwall opines. Climate models produce long-term forecasts that cannot be validated in our lifetimes. Inevitably, "consensus" and "expert judgment" displace reproducibility as tests of scientific validity. Government grants and appointments reward researchers whose findings support the consensus. Researchers face continual pressure or temptation to cross the line between policy relevance and policy advocacy. Groupthink becomes the norm.[124]

A related casualty is the democratic process. The Obama administration's M.O. is to "enact" climate policies through regulations Congress has not approved and would reject if introduced

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[122] Dr. Frank Clemente, "Why India Is Turning to Coal," *Energy Facts Weekly*, March 4, 2010, http://www.energy-facts.org/LinkClick.aspx?fileticket=8QuyFCt5lJQ%3d&tabid=100.

[123] Rupert Darwall, *The Age of Global Warming: A History* (London: Quartet Books, 2013), p. 340.

[124] Patrick Michaels, ed., *Climate Coup: Global Warming's Invasion of Our Government and Our Lives* (Washington, D.C.: Cato Institute, 2011).

as legislation and put to a vote. Such policies include the 54 mpg fuel-economy standard,[125] application of best available control technology standards to major stationary GHG emitters,[126] and a "carbon pollution rule" that effectively bans construction of new commercial coal generation. Administration officials and their allies invoke the "consensus of scientists" to explain why they "can't wait"[127] for the people's representatives to act.

In his farewell address, President Dwight D. Eisenhower warned not only of a military-industrial complex, but also of the capture of public policy by a "scientific-technological elite."

Observing that a "steadily increasing share" of scientific research "is conducted for, by, or at the direction of, the Federal government," Eisenhower stated that the "prospect of domination of the nation's scholars by Federal employment, project allocations, and the power of money is ever present and is gravely to be regarded." While holding scientific research and discovery in respect, "we must also be alert to the equal and opposite danger that public policy could itself become the captive of a scientific-technological elite."[128]

Science is a mode of inquiry, not a font of practical wisdom, and still less a set of moral imperatives. But in the Age of Global Warming, government-funded science becomes a political bludgeon for discrediting opponents and dictating policy. Anyone who doubts the narrative of a planet in peril or who opposes centralized eco-energy planning is instantly dismissed as a "shoddy scientist," "ideological extremist," or member of the "Flat Earth Society."[129] Not just actual scientific expertise but mere conformity to a government-approved scientific "consensus" becomes a claim to rule. The spread of this elitist mentality is not healthy in a democracy.

The pseudo-science of SCC estimation gives regulators, NGOs, and other politically-unaccountable experts a new rhetorical tool for claiming special knowledge about climate risks and solutions, and for lording it over the public and their representatives. We think Eisenhower would be appalled.

Some good may come of it, though. The skeptic movement is partly a reaction to the scientism of those who have hyped "consensus" into a claim to rule. With SCC analysis, the anti-carbon

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[125] Marlo Lewis. 2011. EPA Regulation of Fuel Economy: Congressional Intent or Climate Coup? *Engage*, Volume 12, Issue 3, http://www.fed-soc.org/publications/detail/epa-regulation-of-fuel-economy-congressional-intent-or-climate-coup.

[126] Marlo Lewis, "Supreme Court Global Warming Case: What Legislative History Reveals about Congressional Intent," December 19, 2013, Masterresource.Org, http://www.masterresource.org/2013/12/supreme-court-global-warming-case-what-legislative-history-reveals-about-congressional-intent/.

[127] EPA, "We Can't Wait: Obama Administration Proposes Historic Fuel Economy Standards To Reduce Dependence on Oil, Save Consumers Money at the Pump," November 16, 2011, http://yosemite.epa.gov/opa/admpress.nsf/bd4379a92ceceeac8525735900400c27/c153bac1a0f4febc8525794a0061da1f!OpenDocument.

[128] President Dwight D. Eisenhower, Farewell Address, 1961, http://www.ourdocuments.gov/doc.php?flash=true&doc=90&page=transcript.

[129] John Kerry, Secretary of State, Remarks, Jakarta, Indonesia, February 16, 2014, http://www.state.gov/secretary/remarks/2014/02/221704.htm#.UwEe-hfRKHU.twitter.

faction's pretense of knowledge and precision ceases to be artful and becomes blatant. Skeptics are bound to have a field day debunking SCC analysis. In fact, they already are.

VIII. Recommendations

OMB should:

- Return any rule to an agency that relies on SCC analysis for a benefits justification in the rulemaking. By picking and choosing among non-validated climate parameters, made-up damage functions, and below-market interest rates, SCC analysts can get almost any result they desire. SCC estimates are too subjective to inform regulatory decisions.
- Disband the IWG. Climate models that increasingly diverge from observations and made-up damage functions are too unreliable to estimate carbon's potential social costs. Building an inter-agency "consensus" around specific SCC estimates inflates the pretense of knowledge inherent in SCC analysis, misleading policymakers and the public alike. The IWG exercise also fosters groupthink hostility to fossil fuels, which, like it or not, remain the chief energy source of human progress.

If the IWG is not disbanded, OMB should ensure that future TSDs:

- Use only non-biased IAMs that include substantial CO_2 fertilization benefits, as required by OMB Information Quality Act guidelines.
- Report separate domestic SCC values, as required by OMB Circular A-4.
- Include SCC estimates using a 7% discount rate, as required by Circular A-4.
- Limit SCC estimates to more plausible timeframes (30, 50, or at most 75 years). Estimating CO_2-related regulatory benefits over 30 years is difficult and doubtful, even as an academic exercise. Projecting regulatory benefits out to 2300 as a basis for policy decisions is ludicrous.
- Acknowledge that the SCC cannot be inferred from meteorological and economic data and exists only in the virtual, assumption-dependent world of computer modeling.
- Acknowledge that the climate models underpinning the 2010 and 2013 SCC estimates are on the verge of complete statistical failure in replicating observed temperatures over the past 17 years.
- Use only IAMs that have been updated in light of post-AR4 science. IAMs should incorporate: (1) the lower mean climate sensitivity estimate of recent studies; (2) the increased implausibility of ocean circulation shutdown, catastrophic sea-level rise, and runaway climate change; and (3) whatever revisions are needed in carbon cycle parameters to reflect greater-than-predicted CO_2 ocean uptake.

Finally, we recommend that future TSDs address the social costs of carbon mitigation. Absent a rigorous assessment of carbon policy risk, the TSDs will remain biased (one-sided) documents regardless of the quality of the science and economics they incorporate. Appropriate topics for discussion include:

1. The public health and welfare risks of policies that raise business and energy costs.
2. The economic, fiscal, and energy security risks of policies that endanger the shale revolution.
3. The economic development risks of policies that limit poor countries' access to affordable energy.
4. The risks to international peace and stability of impeding developing country economic growth through carbon caps or taxes and carbon-tariff protectionism.
5. The proliferation risks of policies that increase developing country demand for fissile materials and nuclear technology.
6. The risks to scientific integrity when government is both chief funder of climate research and chief beneficiary of "consensus" science supporting a bigger role for government in economic decisions.
7. The risk to the democratic process when governments promote "consensus" climatology to justify bypassing legislatures and marginalizing opponents as "anti-science."