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Hearing On “21st Century Economy: Protecting the Financial System from Risks Associated with Climate Change”

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Climate “Risk” and the Distortion of U.S. Financial Markets

Efforts by the Federal Reserve and Financial Institutions to Predict Climate Phenomena and Their Impacts Would Be Politicized and Futile

Benjamin Zycher

Resident Scholar, American Enterprise Institute

Thank you, Chairman Brown and Ranking Member Toomey, for this opportunity to offer my views on the topic of the financial system and anthropogenic climate change, one now receiving substantial attention from policymakers and many interested observers. The Statement below makes a number of observations that I hope will prove of interest to this Committee. I begin with a summary of my arguments, and then proceed to discuss them in more detail in the ensuing sections:

- I. Climate Uncertainties and Choices Among Crucial Assumptions.
- II. The Evidence on Climate Phenomena and the Effects of Climate Policies in the EPA Climate Model.
- III. Observations on the Materiality of Climate “Risks.”
- IV. Additional Observations and Conclusions.

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Summary

- Neither the Federal Reserve or any other bank regulator, nor banks or other financial institutions, are in a position to evaluate climate phenomena, whether ongoing or prospective, with respect to which the scientific uncertainties are vastly greater than commonly asserted.
- The range of alternative assumptions about central parameters is too great to yield clear implications for the climate “risks” attendant upon the allocation of financial capital among economic sectors.
- Those central parameters include the choices among climate models, the assumed sensitivity of the climate system to increases in the atmospheric concentration of greenhouse gases (GHG), the assumed future increase in that GHG concentration through, say, 2100, and the analytic assumptions underlying calculations of the effects of aerosol emissions on cloud formation, about which surprisingly little is known. That short list is far from exhaustive.
- If the Federal Reserve and the financial institutions opt to use the same (or similar) sets of assumptions about central parameters, a very real danger would arise of more-or-less homogeneous predictions inconsistent with historical, ongoing, and prospective climate phenomena. If the Federal Reserve and the financial institutions opt to use sets of assumptions that differ in important dimensions, the ensuing predictions about future climate phenomena (“risks”) would vary substantially, yielding very large uncertainties in terms of policy implications.
- It is reasonable to hypothesize that financial institutions will have powerful incentives to undertake climate analysis driven not by the actual evidence and the peer-reviewed literature on climate phenomena. Instead, they will be driven to undertake such analysis, whether in response to regulatory directives or to political pressures, under assumptions and methodologies insulating them from adverse regulatory actions and litigation threats.
- It is reasonable to hypothesize also that the aggregate benefits (that is, positive “risks”) of increasing GHG concentrations, as reported by the National Oceanic and Atmospheric Administration and in the peer-reviewed literature, will be excluded from such analytic efforts.
- It is reasonable to hypothesize further that such analyses will exclude the risks of climate policies, prominent among which are the large and adverse implications of artificial increases in energy costs. Such policy risks are likely to be greater when implemented by bureaucracies insulated from democratic accountability.
- Anthropogenic climate change is “real” in that increasing atmospheric concentrations of GHG have yielded effects that are detectable. But they are much smaller than commonly asserted; and there is no evidence in support of the ubiquitous assertions of

a climate “crisis,” whether ongoing or looming, and no evidence in support of the even more extreme “existential threat” argument. Moreover, the available analysis suggests that the financial risks of anthropogenic climate change in the aggregate are much smaller than many assert.

- The mainstream climate models have a poor track record in terms of predicting the actual temperature trend of recent decades, having consistently overstated that trend by a factor of over two.
- Application of the Environmental Protection Agency climate model suggests strongly that climate policies, whether implemented by the U.S. government alone or as an international cooperative policy, would have temperature effects by 2100 that would be virtually undetectable or very small. Such policies cannot satisfy any plausible benefit/cost test.
- Because the perceived “climate “risks” confronting the financial sector are dependent upon crucial choices among alternative assumptions, the evaluation of such “risks” would be largely arbitrary given that the “correct” assumptions are very far from obvious. This means that a requirement, whether formal or informal, that climate “risks” be incorporated into the business decisions of financial institutions would weaken the materiality standard for disclosures by those institutions. “Materiality” always has meant the disclosure of information directly relevant to the financial performance of the bank or other institution. When “risk” analysis becomes an arbitrary function of choices among assumptions complex, opaque, and far from obvious, the traditional materiality standard inexorably will be diluted and rendered far less useful for the investment and financial markets, an outcome diametrically at odds with the ostensible objectives of those advocating the evaluation of climate “risks.” Moreover, the “risks” of anthropogenic climate change are far from the only such mass-geography “risks.” A bias toward focusing only on climate “risks” would distort the allocation of capital.
- Because the uncertainties attendant upon the future effects of increasing atmospheric concentrations of GHG are so great, a top-down policy approach for the evaluation of any attendant “risks” is itself very risky. A wiser approach would entail allowing market forces to make such “risk” determinations in a bottom-up fashion, thus avoiding an obvious politicization of the allocation of capital.
- Proposals that the Federal Reserve enforce a mandate that financial institutions evaluate climate “risks” represent a blatant effort to distort the allocation of capital away from economic sectors disfavored by certain political interest groups pursuing ideological agendas. This would represent the return of Operation Choke Point, a past attempt to politicize access to credit, one deeply corrosive of our legal and constitutional institutions.
- Protection of those institutions is consistent only with formal policymaking by the Congress through enactment of legislation, rather than with powerful pressures, whether formal or informal, exerted by the Federal Reserve or other regulatory agencies. This

institutional protection would preserve the traditional roles of the private sector and of the government, respectively, as part of the larger permanent objectives of maximizing the productivity of resource use under free market competition, and preserving the political accountability of the policymaking process under the institutions of democratic decisionmaking as constrained by the constitution.

I. Climate Uncertainties and Choices Among Crucial Assumptions

Notwithstanding ubiquitous assertions that climate science is “settled,” that a crisis is upon us or looming large, and that government policies must address the “existential threat” posed by anthropogenic climate change, in reality the uncertainties attendant upon the prospective effects of increasing atmospheric concentrations of greenhouse gases (GHG) are very substantial. Moreover, no evidence supports the “crisis” narrative, as discussed below. These realities are illustrated by the ranges of various estimates published by the Intergovernmental Panel on Climate Change (IPCC) in its most recent Assessment Report, by the wide range of temperature paths projected by the mainstream climate models, and by the scientific literature more generally.¹

The evaluation of climate “risks” to the financial system would require choices among the available climate models, choices among alternative assumptions about the path of future atmospheric concentrations of GHG, choices among assumptions about the effect of increasing GHG concentrations upon the climate system, that is, the “sensitivity” of the climate system, and deeply problematic assumptions about the effects of aerosol emissions on cloud formation, about which little is known.²

Let us note that the mainstream climate models have found it very difficult to predict the historical and current climate record; as an example, the models have been unable to explain the warming observed from 1910-1945.³ That period of warming cannot have been the result of increased atmospheric concentrations of GHG, in that such concentrations had increased only from about 278 ppm in 1750 to about 295 ppm by 1910.⁴ Another example: Every climate model predicts that increasing atmospheric concentrations of GHG should result in an enhanced heating effect in the mid- and upper troposphere over the tropics. The satellites have been unable to find

¹ See, e.g., Figure 2.5 in the IPCC Fifth Assessment Report (2013), on alternative paths for future temperature changes, at <https://www.ipcc.ch/report/ar5/syr/synthesis-report/>. On the wide range of temperature projections yielded by the mainstream climate models, see Figure 2 in the testimony of John R. Christy before the U.S. House Committee on Science, Space, and Technology, March 29, 2017, at https://science.house.gov/imo/media/doc/Christy%20Testimony_1.pdf?1. On the general state of scientific uncertainty in the context of climate phenomena, see e.g., Judith Curry, “Uncertainty About the Climate Uncertainty Monster,” *Climate Etc.*, May 19, 2017, at <https://judithcurry.com/2017/05/19/uncertainty-about-the-climate-uncertainty-monster/>.

² See, e.g., Judith Curry, “The Cloud-Climate Conundrum,” *Climate Etc.*, June 2, 2016, at <https://judithcurry.com/2016/06/02/the-cloud-climate-conundrum/>.

³ See the HadCRUT5 reconstructions of temperature anomalies at <https://crudata.uea.ac.uk/cru/data/temperature/>. Interestingly enough, the Russian climate models from the Institute for Numerical Mathematics (models INM-CM4 and INM-CM4.8) do the best job of predicting the past and the present. See <http://www.gisaclimate.org/node/2220> and https://www.researchgate.net/publication/329748540_Simulation_of_the_modern_climate_using_the_INM-CM48_climate_model.

⁴ See the NOAA reconstruction of carbon dioxide emissions and concentrations for 1750-2019 at https://www.climate.gov/sites/default/files/CO2_emissions_vs_concentrations_1751-2019_lrg.gif.

that effect.⁵ In the latest iteration of the suite of climate models, to be applied in the next IPCC Assessment report, the average predicted tropospheric temperature increase for 1979-2019 is 0.40 degrees C per decade. The actual record as measured by the satellites: 0.17 degrees C per decade.⁶ The climate models on average have overstated the temperature record by a factor of more than two.

Consider only the effect of varying assumptions about the future path of atmospheric GHG concentrations. IPCC in the latest (2013) Assessment Report uses four such alternative paths: Representative Concentrations Pathways 2.6, 4.5, 6, and 8.5.⁷ The following table illustrates the range of temperature effects (“anomalies”) by 2100 under the four RCPs.

Central Parameters of IPCC AR5 RCP Scenarios

Year 2100	-----Representative Concentration Pathway-----			
	2.6	4.5	6	8.5
GHG concentration (ppm)	490	650	850	1370
Average increase 2018-2100 (ppm)	1.1	3.0	5.5	11.9
Temperature anomaly 2100 (°C)	1.5	2.4	3.0	4.9

Source: G.P. Wayne, “The Beginner’s Guide to Representative Concentration Pathways,” *Skeptical Science*, August 2013.

Note: RCP 2.6 (sometimes denoted RCP3PD) predicts radiative forcing of 3 Wm² before 2100, declining to 2.6 Wm² by 2100. “PD” stands for “peak and decline.”

Neither the Federal Reserve or any other bank regulator, nor banks or other financial institutions, are in a position to evaluate the strengths and weaknesses of alternative RCP assumptions, or of the other crucial parameters underlying climate projections in the context of GHG emissions.⁸ The IPCC in the 2013 Assessment Report provides a range of estimates for the

⁵ The tropics for the most part are water, and emissions of additional GHG would warm the earth slightly, resulting in an increase in ocean evaporation. In the climate models, as the water vapor rises into the mid troposphere, it condenses, releasing heat. This seems straightforward, but efforts to demonstrate this phenomenon with satellite measurements have proven very difficult. See Ross McKittrick and John R. Christy, “Pervasive Warming Bias in CMIP6 Tropospheric Layers,” *Earth and Space Science*, Vol. 7, Issue 9 (September 2020), at <https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2020EA001281>; and Ross McKittrick, “New Confirmation That Climate Models Overstate Atmospheric Warming,” *Climate Etc.*, August 25, 2020, at <https://judithcurry.com/2020/08/25/new-confirmation-that-climate-models-overstate-atmospheric-warming/>.

⁶ See the Coupled Model Intercomparison Project, Phase 6, at <https://pcmdi.llnl.gov/CMIP6/>. See also, e.g., the recent presentation by Professor John R. Christy at <https://www.youtube.com/watch?v=D2Cd4MLUoN0>.

⁷ The figures (2.6, etc.) are not temperature effects; they are theoretical calculations of “radiative forcings” in watts per square meter. For an introduction, see G.P. Wayne, “The Beginner’s Guide to Representative Concentration Pathways,” *Skeptical Science*, August 2013, at https://skepticalscience.com/docs/RCP_Guide.pdf.

⁸ Note that RCP8.5 is a popular assumption among those advocating strong climate policies, but it is a scenario essentially impossible. Under RCP8.5, atmospheric concentrations of GHG rise at almost 12 parts per million (ppm)

equilibrium sensitivity of the climate system, from 1.5 degrees to 4.5 degrees, with a mean of 3 degrees.⁹ Many of the more extreme or “alarmist” assertions of the effects of anthropogenic climate change assume RCP8.5 and a climate sensitivity of 4.5 degrees (or even higher). The numerous estimates reported in the peer-reviewed literature do not support that assumption, instead supporting an assumption of 2 degrees or even less; the range estimated from the actual data is 1.5 to 2.3 degrees C.¹⁰

Again: Neither the Federal Reserve or any other bank regulator, nor banks or other financial institutions, are in a position to sort through such enormous complexities; government agencies and international bodies wholly dedicated to doing so find the task daunting. Instead, the Federal Reserve and financial institutions will be driven to adopt assumptions (or to retain consultants who will do so) minimizing the degree to which their analyses might subject them to political attacks, adverse regulatory actions, and litigation. This is very different from an objective effort to evaluate climate phenomena and a reasonable range of prospective effects of increasing GHG concentrations, that is, climate “risks.”

Instead, for example, they will have powerful incentives to use the Environmental Protection Agency climate model, used by most federal agencies to evaluate climate trends and the effects of climate policies; since that is the U.S. government model, it would be difficult to attack a financial institution for choosing it.¹¹ For the earlier suite of climate models (CMIP-5), the EPA model provided predictions close to the average of those models under a given set of underlying assumptions, equilibrium climate sensitivity in particular. For the new suite (CMIP-6), the EPA model provides predictions cooler than the average of those models, not because the EPA model now is providing predictions more consistent with the historical evidence, but because the CMIP-6 models have incorporated a range of climate sensitivity assumptions and estimates higher on average than those in the CMIP-5 iteration. That range of climate sensitivity values in CMIP-6 also is wider than that in CMIP-5, meaning that the uncertainty of the climate models is increasing.¹²

Again, the Federal Reserve and the financial institutions will have powerful incentives to choose among assumptions on future emissions and atmospheric concentrations, climate sensitivity, and other crucial parameters so as to insulate themselves from political attack, adverse regulatory actions, and litigation. They thus will be led toward analytic homogeneity, yielding a

through 2100 as an annual average; the average for 1985-2019 was about 1.9 ppm, and the single largest increase was about 3 ppm in 2016. See the data reported by NOAA at <https://www.esrl.noaa.gov/gmd/ccgg/trends/global.html>. See Kevin Murphy, “Reassessing the RCPs,” *Climate Etc.*, January 28, 2019, at <https://judithcurry.com/2019/01/28/reassessing-the-rcps/>; and Judith Curry, “Is RCP8.5 An Impossible Scenario?”, *Climate Etc.*, November 24, 2018, at <https://judithcurry.com/2018/11/24/is-rcp8-5-an-impossible-scenario/>.

⁹ The equilibrium sensitivity of the climate system is the temperature increase that would result from a doubling of atmospheric concentrations of GHG, after the climate system were to “finalize” all attendant adjustments.

¹⁰ See Patrick J. Michaels and Paul C. Knappenberger, *Lukewarming: The New Climate Science That Changes Everything*, Washington D.C.: Cato Institute, 2016; and the recent presentation by Professor John R. Christy at <https://www.youtube.com/watch?v=D2Cd4MLUoN0>.

¹¹ This is the Model for the Assessment of Greenhouse Gas Induced Climate Change (MAGICC), at www.magic.org.

¹² Private communication with Professor John R. Christy, March 14, 2021. See CMIP-5 at <https://pcmdi.llnl.gov/mips/cmip5/>; and CMIP-6 at <https://pcmdi.llnl.gov/CMIP6/>.

very real danger of an artificial “consensus” among financial institutions regardless of the actual evidence, and perhaps largely inconsistent with it. Any such consensus would be an artifact of the political pressures to which the financial institutions would be subjected; it would have nothing to do with “science.”

If, implausibly, the Federal Reserve and the financial institutions were to opt to use models and/or sets of assumptions that differ in important dimensions, the ensuing predictions about future climate phenomena (“risks”) would vary substantially or hugely, yielding very large uncertainties in terms of policy implications. What would the Federal Reserve do under that condition, how would financial institutions respond, and---again---what would such decisions have to do with “science”?

Those political pressures will weigh against consideration of the benefits of increasing atmospheric concentrations of GHG, as reported by the National Oceanic and Atmospheric Administration (NOAA), and in the peer-reviewed literature. Examples are planetary greening, increased agricultural productivity, increased water use efficiency by plants, and reduced mortality from cold.¹³ Nor will such analysis include the possible adverse impacts of government climate policies, which as a core imperative must have the effect of increasing energy costs artificially, notwithstanding common assertions that alternative energy sources are competitive in terms of costs.¹⁴ More narrowly, government policies that lead financial institutions to incorporate climate “risks” into their decisions on lending and other parameters are likely to yield important distortions in capital markets, one of which is a weighting of climate “risks” above those posed by other important natural phenomena.

II. The Evidence on Climate Phenomena and the Effects of Climate Policies in the EPA Climate Model

The available body of evidence does not support the ubiquitous assertions that a climate “crisis” is upon us or looming large. This means in the context of this hearing that the asserted climate “risks” threatening the U.S. financial system are far less obvious than often assumed.

That anthropogenic climate change is “real”---that increasing GHG concentrations are having detectable effects---is incontrovertible, but that does not tell us the magnitude of the observable impacts, which must be measured empirically. Temperatures are rising, but as the Little Ice Age ended no later than 1850, it is not easy to separate natural from anthropogenic effects on temperatures and other climate phenomena.¹⁵ The latest research in the peer-reviewed literature

¹³ On the carbon dioxide “greening” effect see NOAA at <https://www.nasa.gov/feature/goddard/2016/carbon-dioxide-fertilization-greening-earth>. On the agricultural productivity effects, see, e.g., Goudriaan and Unsworth at <https://access.onlinelibrary.wiley.com/doi/abs/10.2134/soilwaterpub53.c8>. On water use efficiency by plants, see, e.g., <http://www.co2science.org/subject/w/summaries/wateruse.php>. On the beneficial impacts of moderate warming on mortality, see [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(14\)62114-0/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(14)62114-0/fulltext).

¹⁴ See Benjamin Zycher, *The Green New Deal: Economics and Policy Analytics*, American Enterprise Institute, 2019, at <http://www.aei.org/wp-content/uploads/2019/04/RPT-The-Green-New-Deal-5.5x8.5-FINAL.pdf?x91208>.

¹⁵ On the surface (land/ocean) temperature record, see UK Met Office, Hadley Centre/University of East Anglia Climatic Research Unit, “Tim Osborn: HadCRUT4 Global Temperature Graphs,” <https://crudata.uea.ac.uk/~timo/diag/tempdiag.htm>. On the Little Ice Age, see Michael E. Mann, “Little Ice Age,” in *Encyclopedia of Global Environmental Change, Volume 1: The Earth System: Physical and Chemical Dimensions*

suggests that mankind is responsible for about half a degree of the global temperature increase of about 1.5-1.7 degrees C of global warming observed since 1850.¹⁶

The “crisis” assertions are unsupported by the evidence reported in the peer-reviewed, official, or scientific literature. There is little trend in the number of “hot” days for 1895–2017; 11 of the 12 years with the highest number of such days occurred before 1960.¹⁷ NOAA has maintained since 2005 the U.S. Climate Reference Network, comprising 114 meticulously maintained temperature stations spaced more or less uniformly across the lower 48 states, 21 stations in Alaska, and two stations in Hawaii.¹⁸ They are placed to avoid heat island effects and other such distortions as much as possible; the reported data show no trend over the available 2005–20 reporting period.¹⁹ A reconstruction of global temperatures over the past one million years, using data from ice sheet formations, shows that there is nothing unusual about the current warm period.²⁰

Global mean sea level has been increasing at about 3.3 mm per year since satellite measurements began in 1992. The tidal-gauge data before then show annual increases of about 1.9 mm per year, but that comparison does not show an acceleration because the two datasets are not comparable. The tidal gauges do not measure sea levels per se; they measure the difference

of *Global Environmental Change*, ed. Michael C. MacCracken, John S. Perry and Ted Munn (Chichester, England: John Wiley & Sons, 2002), http://www.meteo.psu.edu/holocene/public_html/shared/articles/littleiceage.pdf.

¹⁶ See, for example, Ross McKittrick and John Christy, “A Test of the Tropical 200- to 300 hPa Warming Rate in Climate Models”; Nicholas Lewis and Judith Curry, “The Impact of Recent Forcing and Ocean Heat Uptake Data on Estimates of Climate Sensitivity,” *Journal of Climate* 31 (August 2018): 6051–71, <https://journals.ametsoc.org/doi/pdf/10.1175/JCLI-D-17-0667.1>; and John R. Christy and Richard McNider, “Satellite Bulk Tropospheric Temperatures as a Metric for Climate Sensitivity,” *Asia-Pacific Journal of Atmospheric Sciences* 53 (2017): 511–18, <https://link.springer.com/article/10.1007/s13143-017-0070-z>. For a chart summarizing the recent empirical estimates of equilibrium climate sensitivity as reported in the peer-reviewed literature, see Patrick J. Michaels and Paul C. Knappenberger, “The Collection of Evidence for a Low Climate Sensitivity Continues to Grow,” Cato Institute, September 25, 2014, <https://www.cato.org/blog/collection-evidence-low-climate-sensitivity-continues-grow>.

¹⁷ For the reconstruction of the NASA data, see John R. Christy, “Average per Station (1114 USHCN Stations) 1895–2017: Number of Days Daily Maximum Temperature Above 100°F and 105°F,” [drroyspencer.com, http://www.drroyspencer.com/wp-content/uploads/US-extreme-high-temperatures-1895-2017.jpg](http://www.drroyspencer.com/wp-content/uploads/US-extreme-high-temperatures-1895-2017.jpg).

¹⁸ For the Climate Reference Network program description, see National Centers for Environmental Information, “U.S. Climate Reference Network,” <https://www.ncdc.noaa.gov/crn/>.

¹⁹ For a visualization of a prototypical station, see Willis Eschenbach, “NOAA’s USCRN Revisited—No Significant Warming in the USA in 12 Years,” *Watts Up with That?*, November 8, 2017, <https://wattsupwiththat.com/2017/11/08/the-uscrn-revisited/>. For the monthly data and charts reported by the National Oceanic and Atmospheric Administration (NOAA), see National Oceanic and Atmospheric Administration, “National Temperature Index,” https://www.ncdc.noaa.gov/temp-and-precip/national-temperature-index/time-series?datasets%5B%5D=uscrn¶meter=anom-tavg&time_scale=p12&begyear=2005&endyear=2020&month=8.

²⁰ See R. Bintanja and R. S. W. van de Wal, “North American Ice-Sheet Dynamics and the Onset of 100,000-Year Glacial Cycles,” *Nature* 454, no. 7206 (August 14, 2008): 869–72, https://www.researchgate.net/publication/23171740_Bintanja_R_van_de_Wal_R_S_W_North_American_ice-sheet_dynamics_and_the_onset_of_100000-year_glacial_cycles_Nature_454_869-872. NOAA published the underlying data at R. Bintanja and R. S. W. van de Wal, “Global 3Ma Temperature, Sea Level, and Ice Volume Reconstructions,” National Oceanic and Atmospheric Administration, August 14, 2008, <https://www.ncdc.noaa.gov/paleo-search/study/11933>. For a chart showing the temperature record over one million years, see Institute for Energy Research, “Temperature Fluctuations over the Past Million Years,” <https://www.instituteforenergyresearch.org/wp-content/uploads/2020/03/temperature-fluctuations.png>.

between sea levels and “fixed” points on land that in reality might not be fixed due to seismic activity, tectonic shifts, land settlement, etc. Accordingly, the data are unclear as to whether there is occurring an acceleration in sea level rise; it is reasonable to hypothesize that there has been such an acceleration simply because temperatures are rising, as noted above, and such increases should result in more melting ice and the thermal expansion of water. But because rising temperatures are the result of both natural and anthropogenic causes, we do not know the relative contributions of those causes to any such acceleration.²¹

The Northern and Southern Hemisphere sea ice changes tell different stories; the arctic sea ice has been declining, while the Antarctic sea ice has been stable or growing.²² U.S. tornado activity shows either no trend or a downward trend since 1954.²³ Tropical storms, hurricanes, and accumulated cyclone energy show little trend since satellite measurements began in the early 1970s.²⁴ The number of U.S. wildfires shows no trend since 1985, and global acreage burned has declined over past decades.²⁵ The Palmer Drought Severity index shows no trend since 1895.²⁶ U.S. flooding over the past century is uncorrelated with increasing GHG concentrations.²⁷ The

²¹ As a crude approximation, the data suggest that about two-thirds of such sea level increases are due to ice melt, and one-third to thermal expansion of water. See Judith Curry, “Sea Level and Climate Change,” Climate Forecast Applications Network, November 25, 2018, <https://curryja.files.wordpress.com/2018/11/special-report-sea-level-rise3.pdf>. Curry cites research from Xianyao Chen and colleagues, the central finding of which is that “global mean sea level rise increased from 2.2 ± 0.3 mm/year in 1993 to 3.3 ± 0.3 mm/year in 2014.” See Xianyao Chen et al., “The Increasing Rate of Global Mean Sea-Level Rise During 1993–2014,” *Nature Climate Change* 7 (June 26, 2017): 492–95, <https://www.nature.com/articles/nclimate3325>. Whether the trend from a 21-year period can yield important inferences is a topic not to be addressed here. For a different empirical conclusion from the tidal gauge record, see J. R. Houston and R. G. Green, “Sea-Level Acceleration Based on U.S. Tide Gauges and Extensions of Previous Global-Gauge Analyses,” *Journal of Coastal Research* 27, no. 3 (May 2011): 409–17, <https://meridian.allenpress.com/jcr/article-abstract/27/3/409/28456/Sea-Level-Acceleration-Based-on-U-S-Tide-Gauges?redirectedFrom=fulltext>. For an example of temporary rapid sea-level rise in the 18th century, see W. R. Gehrels et al., “A Preindustrial Sea-Level Rise Hotspot Along the Atlantic Coast of North America,” *Geophysical Research Letters* 47 (2020), <https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2019GL085814>. For further reported evidence of an acceleration, see Hans-Otto Pörtner et al., *Special Report on the Ocean and Cryosphere in a Changing Climate*, Intergovernmental Panel on Climate Change, 2019, <https://www.ipcc.ch/srocc/>.

²² See Patrick J. Michaels, “Spinning Global Sea Ice,” Cato Institute, February 12, 2015, <https://www.cato.org/blog/spinning-global-sea-ice>. It appears to be the case that the Antarctic eastern ice sheet---about two-thirds of the continent---is growing, while the western ice sheet (and the peninsula) may be shrinking. No agreed explanation for this phenomenon is reported in the literature.

²³ For the historical data reported by the NOAA, see National Ocean and Atmospheric Administration, “Historical Records and Trends,” <https://www.ncdc.noaa.gov/climate-information/extreme-events/us-tornado-climatology/trends>.

²⁴ For data on global tropical cyclone activity, see Ryan N. Maue, “Global Tropical Cyclone Activity, updated March 16, 2021, at <http://climatlas.com/tropical/>.

²⁵ For the reported U.S. wildfire data, see National Interagency Fire Center, “Total Wildland Fires and Acres (1926–2019),” https://www.nifc.gov/fireInfo/fireInfo_stats_totalFires.html. On the decline in global area burned over past decades, see Stefan H. Doerr and Cristina Santin, “Global Trends in Wildfire and Its Impacts: Perceptions Versus Realities in a Changing World,” *Philosophical Transactions of the Royal Society of London, Series B, Biological Sciences* 371, no. 1696 (2016), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4874420/pdf/rstb20150345.pdf>.

²⁶ See US Environmental Protection Agency, “Climate Change Indicators: Drought,” <https://www.epa.gov/climate-indicators/climate-change-indicators-drought>; and US Department of Commerce, National Climatic Data Center, “Divisional Data Select,” <https://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp>.

²⁷ See R. M. Hirsch and K. R. Ryberg, “Has the Magnitude of Floods Across the USA Changed with Global CO₂ Levels?,” *Hydrological Sciences Journal* 57, no. 1 (2012): 1–9, <https://www.tandfonline.com/doi/full/10.1080/02626667.2011.621895?scroll=top&needAccess=true&>.

available data do not support the ubiquitous assertions about the dire impacts of declining pH levels in the oceans.²⁸ Global food availability and production have increased more or less monotonically over the past two decades on a per capita basis.²⁹ The IPCC itself in the *Fifth Assessment Report* was deeply dubious about the various severe effects often asserted to be looming as impacts of anthropogenic warming.³⁰

If we apply the Environmental Protection Agency climate model, under sensitivity assumptions higher than those reported in the recent peer-reviewed literature, net-zero U.S. GHG emissions effective immediately would yield a reduction in global temperatures of 0.104 degrees C by 2100. That effect would be barely detectable given the standard deviation (about 0.11 degrees C) of the surface temperature record.³¹ The entire Paris agreement: about 0.17 degrees C. Net-zero emissions by the entire Organization for Economic Cooperation and Development: 0.21 degrees C. A 35 percent reduction in global GHG emissions implemented immediately and maintained strictly would reduce global temperatures in 2100 by about half a degree.³² Note that GHG emissions in 2020 fell by about 6.4 percent as a result of the COVID-19 economic downturn.³³ Can anyone believe that even larger GHG reductions are plausible politically? Is there a believable benefit/cost model that would justify such policies?

III. Observations on the Materiality of Climate “Risks.”

It is clear that those in support of the proposition that banks and other financial institutions evaluate the “risks” of anthropogenic climate change to the financial system view such analyses as “material” in terms of disclosures to investors.³⁴ Several problems are attendant upon that premise, in substantial part for the reasons discussed above. Any such projections of climate phenomena and resulting “risks” to the financial system---far into the future---are very far from trivial methodologically. Which climate model(s) should financial institutions use? Which assumptions about future emissions, about the sensitivity of the climate system, about policies to be adopted internationally, about the climate effects of those policies, *ad infinitum*, should financial institutions incorporate into those models? Are those financial institutions---even very large ones---in a position to do such analysis in a credible fashion? If not, whom should they retain

²⁸ See CO₂ Science, “Ocean Acidification Database,” <http://www.co2science.org/data/acidification/results.php>. See also Alan Longhurst, *Doubt and Certainty in Climate Science*, pp. 214–25, <https://curryja.files.wordpress.com/2015/09/longhurst-print.pdf>.

²⁹ See Food and Agriculture Organization of the United Nations, *World Food and Agriculture Statistical Pocketbook 2018*, 2018, Charts 28 and 46, <http://www.fao.org/3/CA1796EN/ca1796en.pdf>. See also Kevin D. Dayaratna, Ross McKittrick, and Patrick J. Michaels, “Climate Sensitivity, Agricultural Productivity and the Social Cost of Carbon in FUND,” *Environmental Economics and Policy Studies* 22 (2020): 433–48.

³⁰ Julie M. Arblaster et al., “Long-Term Climate Change: Projections, Commitments and Irreversibility—Final Draft Underlying Scientific-Technical Assessment,” in *Working Group I Contribution to the IPCC Fifth Assessment Report (AR5), Climate Change 2013: The Physical Science Basis*, September 23–26, 2013, p. 12–78, http://www.climatechange2013.org/images/uploads/WGIAR5_WGI-12Doc2b_FinalDraft_Chapter12.pdf.

³¹ See <https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029/1999JD900835>.

³² Author computations using MAGICC 5.3. The MAGICC model can be found at <http://www.magicc.org/>.

³³ See <https://www.nature.com/articles/d41586-021-00090-3>.

³⁴ See the Federal Reserve Financial Accounting Manual for Federal Reserve Banks at <https://www.federalreserve.gov/aboutthefed/files/BSTfinaccountingmanual.pdf>. The Securities and Exchange Commission final rule for materiality disclosure requirements for banks is at <https://www.federalregister.gov/documents/2020/10/16/2020-20655/update-of-statistical-disclosures-for-bank-and-savings-and-loan-registrants>.

to do that analysis for them, and how should they evaluate the differences among the available alternative providers of such analyses?

The reality is that a “climate risk” disclosure requirement would be deeply speculative, and the level of detail and the scientific sophistication that would be needed to satisfy such a requirement is staggering. Such “disclosures” and supporting analysis and documentation would take up thousands of pages, with references to thousands more, and the premise that this “disclosure” requirement would facilitate improved decision making by investors in the financial sector is difficult to take seriously.

If climate “risks” are deemed material in terms of disclosure requirements, why not others that are uncertain or speculative? Climate “risks” are hardly the only ones potentially relevant to the financial system but difficult to incorporate into business decisions. What about massive volcanic eruptions? Asteroid impacts? Powerful earthquakes? Tsunamis? The potential problem of mass contagion is one with which we are far more familiar now than was the case only a bit more than a year ago. The use of bioweaponry by terrorists, nuclear war, gamma ray storms, and on and on. Is climate “risk” the most important? If that is the hypothesis, what is the basis for it? Why are those others, and many more, not worthy of incorporation into financial decisions? What distortions would result from attention only to climate change and not others?

Because the perceived “climate “risks” confronting the financial sector are dependent upon crucial choices among alternative assumptions, the evaluation of such “risks” would be largely arbitrary given that the “correct” assumptions are very far from obvious. This means that a requirement, whether formal or informal, that climate “risks” be incorporated into the business decisions of financial institutions would weaken the materiality standard for disclosures by those institutions. “Materiality” always has meant the disclosure of information directly relevant to the financial performance of the bank or other institution. When “risk” analysis becomes an arbitrary function of choices among assumptions complex, opaque, and far from obvious, the traditional materiality standard inexorably will be diluted and rendered far less useful for the investment and financial markets, an outcome diametrically at odds with the ostensible objectives of those advocating the evaluation of climate “risks.”

IV. Additional Observations and Conclusions

The available analysis suggests that the financial risks of anthropogenic climate change, at least in the aggregate, are much smaller than many assert. Consider the predictions from the central integrated assessment models, one of which is the Dynamic Integrated Climate and Economy Model, for which William D. Nordhaus won the Nobel Prize in Economics in 2018.³⁵ Under DICE, global gross domestic product (GDP) in 2100 varies by about 3 percent across policy scenarios, including no climate policies at all, a figure that is both very small and almost certainly not statistically significant given the vagaries of economic forecasting and the number of years

³⁵ See William Nordhaus and Paul Sztorc, “DICE 2013R: Introduction and User’s Manual,” Yale University, Department of Economics, October 2013, Figure 4 and Table 1, http://www.econ.yale.edu/~nordhaus/homepage/homepage/documents/DICE_Manual_100413r1.pdf. See also Benjamin Zycher, “The Climate Left Attacks Nobel Laureate William D. Nordhaus,” monograph, American Enterprise Institute, July 2020, at <https://www.aei.org/wp-content/uploads/2020/07/The-Climate-Left-Attacks-Nobel-Laureate-William-D.-Nordhaus.pdf>.

remaining before the end of this century. (I exclude here Nordhaus' "Stern discounting" policy scenario, as it assumes a discount rate effectively equal to zero, a fundamental analytic error.³⁶) Per capita consumption varies only by about 1.3 percent across policy scenarios, also a very small number and almost certain not to be statistically significant.

Proposals that the Federal Reserve enforce a mandate that financial institutions evaluate climate "risks" represent a blatant effort to distort the allocation of capital away from economic sectors disfavored by certain political interest groups pursuing ideological agendas. This would represent the return of Operation Choke Point, an attempt to politicize access to credit, one deeply corrosive of our legal and constitutional institutions. Protection of those institutions is consistent only with formal policymaking by the Congress through enactment of legislation, rather than with pressures, powerful but informal, exerted upon and by the Federal Reserve and other regulatory agencies.

Because the uncertainties attendant upon the future effects of increasing atmospheric concentrations of GHG are so great, a top-down policy approach for the evaluation of any attendant risks is itself very risky. A wiser approach would entail allowing market forces to make such "risk" determinations in a bottom-up fashion, thus avoiding an obvious politicization of the allocation of capital. It is reasonable to hypothesize that the market in its atomistic fashion has decided that it is the sum of decisions by financial institutions and investors that is the more reliable gauge of the highly uncertain business implications of evolving climate phenomena. So as to drive the appropriate responses from businesses, it is not necessary that all investors make such difficult judgments; it is necessary only that marginal investors do so.

Financial institutions are not charities, and they are not government. The campaign for evaluation and disclosure of climate "risks" by the Federal Reserve and financial institutions is a clear effort to use private-sector resources for ideological purposes, in the context of the unwillingness of the Congress to enact such policies explicitly. The proper course in the context of climate phenomena is the preservation of the traditional roles of the private sector and of the government, respectively, as part of the larger permanent objectives of maximizing the productivity of resource use under free market competition, and preserving the political accountability of the policymaking process under the institutions of democratic decisionmaking as constrained by the constitution.

Thank you, Chairman Brown and Ranking Member Toomey, for this opportunity to offer my views on this prominent topic. I will be very pleased to address any questions that you or the other members of this committee may have.

³⁶ See, e.g., David Kreutzer, "Discounting Climate Costs," Heritage Foundation, June 16, 2016, at <https://www.heritage.org/environment/report/discounting-climate-costs>. See Nicholas Stern, *The Economics of Climate Change: The Stern Review* (Cambridge, UK: Cambridge University Press, January 2007), <https://www.cambridge.org/us/academic/subjects/earth-and-environmental-science/climatology-and-climate-change/economics-climate-change-stern-review?format=PB>.