Attachment A

RESPONSE TO KEY RPC CLAIMS

Scientific Consensus on the Fundamentals of Climate Change

There is high confidence regarding critical elements of climate change science. The RPC document misrepresents the state of climate change science. The agreement among the vast majority of climate change experts is that:

> **1) there is a natural greenhouse effect that keeps the world warmer than it otherwise would be;**
> **2) greenhouse gases are increasing in the atmosphere because of human activities and they are trapping increasingly more heat;**
> **3) there is a collective picture of a warming world and humans have likely contributed; and**
> **4) continued increase in greenhouse gases is projected to lead to increases in sea-level rise and global temperatures.**

There also are areas of uncertainty which includes:

> **1) the exact magnitude of future climate change in individual regions; and**
> **2) the implications of climate change for extreme events and climate surprises.**

As noted in IPCC reports—based on assessment of the scientific literature—there is already ample evidence of climate change and its impacts: mountain glaciers are rapidly disappearing (a widespread global phenomena); plants are blooming earlier; birds are laying eggs earlier and are migrating earlier; and butterflies and marine species are moving pole ward in response to warming. None of these facts are mentioned in the RPC selection of IPCC findings.

What "scientific consensus" means and how strong it is on climate change. The notion of a "scientific consensus" on the fundamentals of climate change science does not require perfect agreement on every single aspect of a very complex issue, – which would be clearly unrealistic. There is not a single major issue in the business, security, or medical communities for which such perfect scientific agreement exists, yet the Congress has previously acted preventively on many issues with far less scientific consensus than what exists over climate change.

Within the IPCC, "scientific consensus" means that the working group authors agree that a fair representation of the scientific debate has been achieved. Points of dispute in the science of climate change are usually resolved either by developing appropriate intervals of uncertainty around certain projections or by crafting language that reflects the different

viewpoints of experts within the scientific community and the reasons that the differences exist.[1] The very existence of the large range cited by the IPCC Working Group 1 *Summary for Policy Makers* (SPM) for warming projections to 2100 (2.5-10.4º F) attests to the insistence of such carefully peer reviewed documents to summarize uncertainties and disagreements. This stands in stark distinction to the easy and elliptical pronouncements of climate change skeptics to reporters or at Congressional hearings. They are non-representative of the scientific consensus. A small handful of contrarian counter examples does not constitute a diminution of broad scientific consensus that climate change is a potentially risky prospect.

As Don Kennedy, chief editor of the international scientific journal *Science* has argued, "*Consensus as strong as the one that has developed around this topic [climate change] is rare in science. [T]here is little room for doubt about the seriousness of the problem the world faces, and other nations, including most of our trading partners in the Organization for Economic Cooperation and Development, understand that.*"[2]

The National Academy agrees with the basic findings of the IPCC. The scientific community views the IPCC's climate science assessments as the standard reference documents on the state of the science about climate change. This was confirmed in a NAS report requested by the Bush Administration in 2001. The NAS report stated, *"The IPCC's conclusion that most of the observed warming of the last 50 years is likely to have been due to the increase in greenhouse gas concentrations accurately reflects the current thinking of the scientific community on this issue. The stated degree of confidence in the IPCC assessment is higher today than it was ten, or even five years ago, but uncertainties remains because (1) the level of natural variability inherent in the climate system on time scales of centuries to decades, (2) the questionable ability of modes to accurately simulate natural variability on long time scales, and (3) the degree of confidence that can be placed on reconstruction of global mean temperature over the past millennium based on proxy evidence. Despite these uncertainties, there is general agreement that the observed warming is real and particularly strong within the last 20 years."*[3]

National Academies from around the world confirm IPCC findings. Moreover, 17 national academies from around the world released a joint statement in May 2001 also confirming the reality of climate change, the scientific consensus as reflected in the IPCC documents, and the need for immediate action. In its conclusion, the statement said, *"The balance of scientific evidence demands effective steps now to avert damaging changes to Earth's climate."*[4]

It is the nature of scientific progress that scientists continually aim to reduce scientific uncertainties and, in the process, uncover new areas needing additional research. The vast international scientific effort over the past two decades to detect current, understand past and present, and project future climate change has produced an accumulation of evidence that overwhelmingly points to the reality of human-caused climate change and the corollary need to reduce emissions of heat-trapping greenhouse gases.

New scientific findings since the IPCC 2001 assessment confirm climate crisis. Scientific findings since the release of the 2001 IPCC assessment are very much in line with this general tendency: refinement of our understanding and reducing some uncertainties while uncovering new potential problems and uncertainties. However, none was published in a respected, peer-reviewed science journal that would fundamentally question the reality of global climate warming, and the causative role of greenhouse gases emitted from human activities in affecting the Earth's climate.

Continued unprecedented warming of surface air temperatures. The 1990's were the hottest decade of the 20th century. Temperature records dating back to 1880 indicate that six of the 10 hottest years occurred during the 1990's. This trend of ever increasing temperatures has continued into the 21st century, with 2001 and 2002 being the third and second, respectively, hottest years ever recorded. In addition, alarming warming is occurring in some regions of the globe. Despite the arguments of the RPC paper, a net warming in the Antarctic as a whole of 1.2ºC per century (approximately twice the global average) has been reported.[5] In addition, rapid warming has been well documented on the Antarctic peninsula at a rate 10 times the global average.[6] Similar rates of warming have been observed in Alaska.[7] Meanwhile, a recent paper by several expert scientists has defended the "scientific consensus" that current temperatures are unprecedented not only for the past century, but for the past millennium.[8] That paper directly contradicts recent skeptical arguments to the contrary.

Reduced disparity between satellite and surface temperature trends. Although the observed disparity in temperature trends generated by the so-called satellite record and the surface record has been quite controversial, this disparity has grown increasingly small in recent years. The latest analysis by the University of Alabama-Huntsville has identified a positive trend of 0.07ºC/decade,[9] almost twice the rate of warming reported just two years ago. In addition, another recent analysis of the satellite data has found a much greater rate of warming of 0.12ºC/decade – very similar to that generated for surface temperatures of 0.16ºC.[10]

Improved observations of current impacts of recent climate change. In addition to direct observations of temperature increases, the world's wildlife also is demonstrating that the climate is changing. Since the IPCC 2001 report, new studies have documented compelling evidence of global changes in the geographic distribution of biodiversity as species respond to warming.[11, 12]

Additional studies attribute recent climate change predominantly to human emissions of greenhouse gases. In its 2001 report, the IPCC devoted an entire chapter to the evidence for human influence on the global climate. The IPCC is not the only institution that has arrived at this conclusion, however. Other scientists presented similar findings prior the last IPCC report, and additional studies have emerged over the past two years.[13, 14] In fact, no quantitative analysis of climate data has been able to account for the warming of the past several decades without accounting for the influence of greenhouse gases, and

no other influence is as great.

Summary Findings and Full Content of the IPCC and NAS Reports

NAS and IPCC summaries adequately reflect the underlying science. The RPC document alleges that the Congressional resolution only relies on the NAS report's executive summary and the IPCC report's SPM, thus supposedly missing aspects of, and misrepresenting, the scientific consensus. If so, this would be understandable and appropriate. The established process for producing summaries of both NAS and IPCC reports is that these summaries must adequately capture and reflect the findings and tone of the full underlying document. This is assured by peer review and plenary meetings in which documents - like the IPCC Summaries of Policymakers - are approved word for word.

Established procedural guidelines for the writing of NAS reports state that, "Every report should have a brief executive summary [ ] that describes the study charge and provides a synopsis of key findings. This summary should be easily comprehensible to non-experts. While the executive summary should accurately reflect the text of the report, it need not include all of the conclusions and recommendations."[15]

IPCC procedures for producing Summaries for Policy-Makers is transparent. Procedures for the production of IPCC SPMs are equally public and stringent. The RPC document claims falsely that government representatives write the SPMs, and scientists write only the underlying reports. In fact, the SPMs result from a collaborative process with review by IPCC authors and technical experts. According to IPCC documents, the procedure is as follows:

> The SPM of each working group goes through a writing and review process that is concurrent, but separate from that of the underlying report. Drafted by the lead authors, and reviewed in two stages by technical experts, the final draft of the SPM is "approved" in the working group plenary after extensive discussion and line-by-line review and revision by the governmental representatives.[16]
>
> In this process, governmental representatives may certainly try to influence the wording in ways that support their negotiating positions. However, the overriding check in this system – and the key challenge and goal – is that the SPM must adequately and appropriately represent the underlying technical report that has been prepared by the scientific community. To ensure that this occurs, dozens of lead and several contributing authors are typically on hand at IPCC plenaries to render interpretations, suggest clarifications, and ensure scientific integrity. The entire process ensures that there are many opportunities for differing views to be expressed and included, if there is empirical evidence or plausible reasons to support them.
>
> Governmental representatives do have the right to argue for wording they prefer, but if

the many IPCC lead authors present do not agree that the proposed language is scientifically credible, the process halts until language acceptable to all parties is crafted. While painstaking, this process does not alter the tone and meaning of the SPMs perceptibly relative to the full underlying text because the lead authors - scientists, not government representatives - present at these drafting meetings do not permit it. Claims to the contrary are made either by those who have not been present at these events - and hence are inadequately informed of the process - or by those who are being disingenuous.

A similar point was made in an editorial published in the internationally renown journal *Nature* about the IPCC process that produces the SPM: "*Detailed examination of the process shows that it has a reasonable track record of producing summary documents that, while lacking all the detailed qualifications contained in the full working-group reports, honestly reflects their findings*."[17] Furthermore, a detailed review of the process, also published in *Nature*, stated, *"[The IPCC's] Working Group I SPM, concluded the NAS, is 'consistent with the main body of the report',"* even though the SPM does not fully reflect all the caveats and uncertainties discussed in the main report.[18]

By definition, a summary of only a few dozen pages cannot be expected to contain each and every detail of a report that is several hundred pages. The important criterion is whether the summary accurately reflects the key finding, the overarching messages, and the range of expert opinions on the matter.

Typically climate change skeptics in making the argument that the summary does not adequately reflect the underlying report imply that only more skeptical views are omitted from the summary. The above cited IPCC process review, however, concludes that, "*The fact that the IPCC's consensus is backed by [John] Christy, whose views on climate change have on occasion provided ammunition for global-warming skeptics, provides one indication that - despite its critics - the organization is working effectively.*"[19]

Critique of IPCC Emissions Scenarios

The RPC document claims that the IPCC's temperature projections are to be dismissed because they are based on flawed economic assumptions about future economic growth which lead to scenarios that overstate future greenhouse gas emissions. The critiques raised recently by statistician Ian Castles and economist David Henderson have been reviewed by IPCC experts, assessed through new economic studies, and refuted in a recently published article (details below).

IPCC emissions scenarios are based on many factors, not just economic growth. The claims by Castles and Henderson are simply based on the assumption that only one measure of economic product - purchasing power parity (PPP) - is appropriate for underlying analysis of emissions projections. It is indeed true that there is a large difference between the market exchange rate-based equivalence of incomes across countries and the PPP measures. But what is far more important for the calculations underlying IPCC's special report on emissions scenarios (SRES) are those relevant factors that determine population, affluence, and technology trends. PPP is but a small part of that assessment, which requires modeling of demographic, technological, and social changes, in addition to economic growth modeling. Concentrating on one equivalence measure for gross domestic product (GDP) across countries cannot tell the SRES story, not even a significant part.

A detailed rebuttal to Castles/Henderson from a team of 15 scientists, technologists and policy analysts can be found at Reference number 20.[20] Their basic findings are as follows:

- The IPCC SRES are based on reviews of the existing literature, most of which is based on Market Exchange Rates (MER), including reports from the World Bank, IEA, and U.S. Department of Energy;
- Scenarios of GDP growth are typically expressed as MER (the preferred measure for GDP growth, as opposed to PPP, which is a preferred measure for assessing differences in economic welfare);
- IPCC scenarios did include PPP-based scenarios, which Mr. Castles and Mr. Henderson have apparently ignored;
- Contrary to Mr. Castles' and Mr. Henderson's claim, IPCC scenarios are consistent with historical data, including those from 1990 to 2000, and they are also consistent with the most recent near term (up to 2020) projections published by other institutions;
- Long-term emissions are based on multiple, interdependent driving forces, and not just economic growth. Castles' and Henderson's focus is limited only to GDP and, therefore, is woefully inadequate to fully capture SRES scenarios; and
- The IPCC scenarios provide information for four world regions, not for specific countries. Thus, Mr. Castles' and Mr. Henderson's critique directed at country-specific projections of economic development are irrelevant to the SRES, because it represents work unrelated to the SRES process.

A radical revision of IPCC emissions scenarios is not needed. Mr. Castles and Mr. Henderson have constructed a "problem" that does not exist. SRES scenarios are sound and the IPCC has responded seriously and conscientiously by reviewing the points of critique thoroughly and by initiating follow-up studies to assess the impact of using different economic measures on emissions scenarios. Moreover, after attending a recent meeting of IPCC experts, Mr. Henderson stated in response to the question whether " a radical revision need[s] to be put in place, or attempted, specifically for AR4 (the IPCC's Fourth Assessment Report)? I think the answer is no."[21]

This conclusion was upheld in a recent study by Richard Richels of EPRI and Alan Manne of Stanford University, whose original calculations used market exchange rates, rather than PPP, in calculations of emissions projections. These experts recalculated their emissions profiles using PPP and concluded that, "we find that the choice of conversion factor makes only a small difference when projecting future temperature change."[22] It is ironic to note that John Reilly of the Massachusetts Institute of Technology (MIT), who is quoted in the RPC document as severely critical of the IPCC climate scenarios, produced with his MIT research team a similar range of temperature projections by 2100 as the IPCC, though based on different methods than SRES.[23]

SRES scenarios have been peer reviewed. Stephen Schneider is quoted in the RPC document (p. 7) as stating in a *Nature* article that the IPCC scenarios have not undergone scientific peer review. The *Nature* article contains no such statement. In fact, Schneider is actually quoted in the *Nature* article as saying after attending a preliminary meeting of the SRES group, "I was impressed by the broad representation of the group: academic scientists, environmental organizations, industrial scientists, engineers, economics, and systems analysts." Also to the contrary, in an article published in *Scientific American*, Dr. Schneider noted clearly the peer reviewed nature of SRES in rebutting Bjorn Lomborg's false claims against climate change science.[24]

IPCC 2001 temperature projections are higher than in 1995 because of more realistic treatment aerosols. One of the contributing authors to the IPCC Working Group I report stated that, "although climate modeling has advanced during the past five years, this is not the main reason for the revised range in temperature projections. The higher estimates of maximum warming by the year 2100 [compared to those made in 1995] stem from a more realistic view of sulphate aerosol emissions. The new emissions assume [aerosol] emissions will be reduced substantially in the coming decades, as this becomes technically and economically feasible, to avoid acid rain. Sulphate emissions have a cooling effect, so reducing them leads to higher estimates of warming."[25]

New climate science suggests future temperatures could be even higher than those projected in IPCC reports. In arguing that the IPCC's latest temperature projections are based on the allegedly flawed emissions scenarios and, hence, not to be taken seriously, the RPC document misinterprets scientific findings by T. Wigley and S. Raper (paper cited in RPC document). In that paper, Wigley and Raper did not "charge" the IPCC with anything. Their only critique, repeated by Schneider and Moss[26] was the lack of probabilistic evaluation of either climate sensitivities or SRES. An even more recent scientific paper[27] argues, in fact, for a considerable increase of the upper limit of 2100 temperature projections presented in the IPCC report. Wigley and Raper did not have this latest study available, thus underestimating the range of temperature projections. What these latest scientific findings suggest, however, is that significant emissions reductions are required to avert even more catastrophic change at the upper end of the probability distribution. Additionally, Dr. Wigley has written to alert me of the RPC's paper misrepresentation of his work (see Attachment B).

There is a clear human fingerprint on the Earth's atmosphere and climate. The RPC claim that humans do not exert a significant impact on the Earth's climate is a non-conclusion from the discussion about the adequacy of *future* emissions scenarios and climate projections. The IPCC has devoted substantial attention and effort to the question of attributing observed climatic changes to natural and human drivers of climate change. The overwhelming balance of evidence suggests that there is a clear human "fingerprint" on the Earth's atmosphere and observed climatic changes.[28] Scientific arguments in support of this conclusion include:

- The energy balance of the atmosphere is determined by three factors: solar radiation entering the atmosphere, the chemical composition affecting the retention of heat; and the Earth's capacity to reflect incoming radiation back into space. The only factor that has significantly changed over the last few hundred years is the chemical composition of the atmosphere. Emissions of heat-trapping gases and aerosols due to human activities continue to alter the atmosphere in ways that affect the climate (based on the physical principle of radiative forcing, i.e., the ability of gases and particles to cause warming or cooling).
- Different forcings display different patterns of response, also known as characteristic "fingerprints," e.g., temperature increase varies by latitude, longitude, height above the Earth's surface, and through time. Based on the comparison of observed patterns and model simulations, it is clear that the human factor is needed to account for the observed changes.
- There now are longer and more closely scrutinized temperature records, underscoring earlier findings that the observed temperature increase is a statistically significant deviation from earlier temperature records.
- There also is a better understanding of natural climate variability and forcing, leading scientists to conclude that it is very unlikely that the observed warming is simply a high in the naturally varying record.
- A wide range of detection techniques is being employed to test the robustness of findings under varying modeling assumptions. While specific results are sensitive to temporal and spatial scales considered, the signals and patterns pointing to human causation hold across the studies.
- Simulations of the response to natural causes (e.g., solar irradiance and volcanic eruptions) cannot explain the warming observed in the second half of the 20th century.

Mitigating Climate Change and the U.S. Economy

The RPC document relies on a single study from the American Council for Capital Formation to claim that implementing emissions reduction policies would be too expensive for the U.S. economy to shoulder. Moreover, it states that the expense for implementing the Kyoto Protocol would only make a negligible difference in the future climate.

No reasonable scientist, economist, or policy-maker today believes that the initial reduction commitments of the Kyoto Protocol are the complete solution to the global climate

crisis. Far greater emissions reductions will be required to stabilize the climate - using and building on flexible, multi-lateral approaches with significant leadership from the United States.

U.S. studies find that climate change mitigation is affordable and beneficial. Several studies have demonstrated that climate mitigation is affordable and beneficial in the U.S. For example, a 2000 Interlaboratory Working Group report found that smart public policies can significantly reduce not only carbon dioxide emissions, but also air pollution, petroleum dependence, and inefficiencies in energy production and use. A range of policies exists - including voluntary agreements; efficiency standards; increased research, development, and demonstration; electric sector restructuring; and domestic carbon trading - that could move the United States a long way toward returning its carbon dioxide emissions to 1990 levels by 2010. Additional means would be needed to achieve further reductions, such as international carbon trading and stronger domestic policies. The overall economic benefits of these policies appear to be comparable to their overall costs. Using revenues from carbon trading and directing them back to consumers, either directly (with a lump sum transfer) or through tax shifts to offset distortionary taxes on wages and or capital, can lead to strong "double dividends" - increasing income and economic activity.[29] Policies promoting a clean energy future could produce direct benefits, including energy savings, which exceed their direct costs (e.g., technology and policy investments). Indirect macroeconomic costs are in the same range as these net direct benefits.[30]

Meeting Kyoto reduction goals would not be costly or unfair to U.S. Another study[31] found that the perception that emissions reduction targets such as those of the Kyoto Protocol are unavoidably costly or unfair is the result of outdated modeling assessments. In fact, the study demonstrated how the U.S. could meet targets in the Kyoto Protocol by 2010 and exceed them by 2020 while increasing economic output from baseline growth projections. By 2010, an integrated least-cost strategy would produce an annual net gain of $50-60 billion per year. By 2020, this gain could grow to $120 billion per year, or 1% of GDP. On a cumulative net present value basis, the U.S. would gain $250 billion by 2010 and $600 billion by 2020. Moreover, the experts found that a strong synergy exists between a national energy policy aimed at safeguarding the economy and a least-cost policy aimed at slowing climate change. By reducing consumption of oil and natural gas relative to rising business-as-usual trends, a climate policy would help protect the U.S. against energy price shocks.

Many of the technological and policy measures aimed at reducing energy consumption, energy waste, and greenhouse gas emissions would save money, create immediate environmental and economic co-benefits, generate new economic opportunities, ensure that the U.S. continues to be a technological and economic leader in the world, and prevent future costs and losses from climate change impacts.

Mitigating climate change will not break the bank. The IPCC Working Group III – studying mitigation options globally – came to similar conclusions reviewing many more studies and for many other countries and regions. It stated, "*Estimates of costs and benefits of mitigation actions differ because of (i) how welfare is measured, (ii) the scope and*

methodology of the analysis, and (iii) the underlying assumptions built into the analysis."[32] Thus, many economic cost and benefit analyses produce widely ranging conclusions about the economic impacts of dealing with climate change. The IPCC also concluded, however, that, "*Some sources of greenhouse gas emissions can be limited at no or negative social cost [i.e., a benefit] to the extent that the policies can exploit no regrets options.*"[33]

The IPCC review of economic studies on the cost of implementing the Kyoto Protocol concluded that implementation without emissions trading would result in 0.2% to 2% reductions in global GDP by 2010, and half that amount with emissions trading.[34] It also concluded that CO_2 stabilization at various, even the lowest, levels in this century is technologically and economically feasible, but, that the costs of stabilizing increase the lower the stabilization level and the faster such a transition has to be achieved.[35] Finally, the IPCC concluded that, "*National responses to climate change can be more effective if deployed as a portfolio of policy instruments to limit or reduce greenhouse gas emissions,*" when "*integrated with the non-climate objectives of national and sectorial policy development,*" and when "*coordinated among countries and sectors to reduce mitigation costs.*"[36]

A more recent study[37] using conventional economic models suggests that even with the large projected growth rate of global GDP (and per capita income), the most stringent greenhouse gas abatement policies would cause only a slight delay in reaching economic wealth levels five to 10 times those today. If we assume large cost estimates for climate control policies and small annual economic growth rates (the most conservative combination of assumptions), the study finds only a 3-year delay in reaching the same level of global economic wealth. Less conservative assumptions reduce that delay to 1 year. Thus, the authors conclude, "*To be ten times richer in 2100 AD versus 2102 AD would hardly be noticed and would likely be politically acceptable as an insurance policy against the spectre of potential 'dangerous' climatic changes by most risk averse people.*"[38]

The U.S. National Assessment of the Potential Consequences of Climate Variability and Change

The RPC document claims that the first U.S. National Assessment of the Potential Consequences of Climate Variability and Change – a "Clinton era report" – has been scientifically discredited and disavowed by the U.S. government. These claims are false.

The National Assessment is scientifically sound. The National Assessment was required under the 1990 Global Change Research Act and completed between 1997 and 2001. The most comprehensive assessment effort ever undertaken, it included sectoral and regional studies and two summary documents. All involved stakeholder input – an innovative approach reflecting years of learning hard lessons from previous assessment and risk management efforts – and scientific peer view. Most importantly, the summary documents were produced by a team of 14 renowned U.S. scientists, following procedures established under the Federal Advisory Committee Act (FACA).[39]

In 2002, the Bush administration released a shorter summary of the National Assessment as part of its *2002 Climate Action Report to the United Nations*.[40] While under significant legal pressure from certain interested parties to withdraw the document and any reference to it from government websites and publications, the Climate Action Report remains an officially filed document and is accessible from government agency websites.[41]

During a science workshop on December 3-5, 2002, in Washington, D.C., which was focused on soliciting input from scientists on the U.S.'s draft strategic research plan for climate and global change science, scientists called for appropriate reliance on that comprehensive assessment effort. Dr. James Mahoney, head of the U.S. Climate Change Science Program, went on public record agreeing with that call.

The NRC, in its recent review of the draft strategic research plan, reiterated the need to build on existing science and assessments, including the procedural and scientific lessons learned from the National Assessment. It stated that, "*identifying the research needs regarding vulnerability, key risk areas, and interactions with stakeholders can be gleaned from the findings of the U.S. National Assessment of the Potential Impacts of Climate Variability and Change*,"[42] and recommended that, "*the plan must build on lessons learned from the U.S. National Assessment of the Potential Impacts of Climate Variability and Change* "[43]

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