REPORT OF THE AD HOC COMMITTEE ON FOSSIL FUEL USE AND CLIMATE CHANGE

Executive Summary

In June 2013 the University Committee established the **Ad Hoc Committee on Fossil Fuel Use and Climate Change** to explore whether the Faculty Senate should take a position on these critical issues. After soliciting expert input and examining a wide range of viewpoints across the campus community, the Ad Hoc Committee developed this report which addresses the science of climate change, human impacts of climate change (both observed and projected), energy profiles and co-benefits of climate mitigation, risk analysis and decision-making considerations, and recommendations for future actions.

The Committee acknowledges the pivotal role and tremendous benefits of fossil fuels to mankind. The Committee further acknowledges and accepts the science and impacts of climate change, as well as the potential peril from continuing to burn fossil fuels for energy. We further acknowledge that the University has a unique responsibility to lead on this issue. As a world-renowned public university charged with educating the next generation of leaders and citizens while conducting research and public outreach beyond the classroom, we acknowledge the urgency for actions that address global climate change.

The Committee recommends that the University undertake bold initiatives leading to near term real world impacts

1) **Prioritize Informal and Formal Education Initiatives around Climate Change**
Along with expanded course offerings in climate science, energy, economics and policy, the Ad Hoc Committee recommends developing and promoting educational opportunities for faculty, staff and the extended campus community. One example could be leveraging the "Go Big Read" initiative and hosting community discussion forums. Other suggestions include promoting the nascent peer-to-peer Climate Knowledge Project or encouraging new low-carbon Educational Innovation projects. In keeping with the Wisconsin Idea, outreach, education and extension efforts around climate change mitigation and adaptation should be prioritized across the state.

2) **Promote Interdisciplinary and Interconnected Research on Climate Change**
While acknowledging several University Centers and varied initiatives actively addressing challenges related to climate change, the Committee recommends increased interdisciplinary coordination among University personnel, offices, and programs focused on climate science, on the impacts of and adaptation to climate change, and on the transformation of our energy system. One way to do this could be establishing a central office to coordinate policy and programs to identify and increase engagement from all divisions, while promoting interdisciplinary research.

3) **Commit our Campus to Significant Emission Reduction Targets**
By transitioning away from fossil fuels for energy, the University should set and meet significant carbon emission targets over the near-term. Much has been accomplished in this realm, but recent reductions are still below what is needed to contribute significantly to the slowing of future warming. Facilities Planning and Management (FPM) should also consider observed and projected climate change impacts and co-benefits of adaptation and mitigation in infrastructure plans.

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4) **Promote Non-Fossil Fuel Investment Opportunities**
The Committee considered the divestment campaign and could not reach consensus on this course of action, but a majority advise against divestment, primarily because it could be divisive and distract from more constructive actions. (See Appendix B) There was clear consensus, however, on the need to offer opportunities for donors to invest in non fossil-fuel companies. The Committee strongly recommends that the Faculty Senate urge the UW Foundation to create this option for donors. The Committee further recommends having climate change challenges and opportunities as a central theme of the next capital campaign.

These recommended Future Actions are further elaborated upon at the end of this report.

I. INTRODUCTION

The University Committee established the Ad Hoc Committee on Climate Change and Fossil Fuels on June 19, 2013. The UC charged the committee in the following language:

> As you know, at its meeting of 6 May, the Faculty Senate voted to charge the UC with forming an *ad hoc* committee to explore whether the senate should take a position on fossil fuel use and climate change…
>
> We have selected members who bring the broad range of views and expertise required to analyze this complex topic.
>
> You are charged, with your colleagues on this committee, to determine what position, if any, the Faculty Senate should take with regard to fossil fuel use and climate change. In order to do so, you are encouraged to examine the range of possible viewpoints and positions that may exist in our campus community, solicit input from other experts on campus, and recommend a suitable position, if any, that represents our campus faculty.

Taking its charge seriously, the committee met several times; reached out to various constituencies of the campus; held two "Town Hall" meetings open to the campus and public; shared knowledge, data, and published materials among ourselves; and conducted interviews with many sources with a stake in the issue. Our committee meetings involved broad discussion and mutual respect. Eventually we assigned each member of the committee primary responsibility for a section of the report, subject to editorial input from the other members.

Members of the committee brought different professional experience, expertise, and values to the table. That said, we were able to form basic consensus on key aspects of our charge, with exceptions to be noted below.

We felt obligated to provide our own views and conclusions; but we realize that given the empirical and normative complexity of many issues in this domain, any conclusions we offer in this report are by their nature open to discussion and debate. In the end, we strove to provide the best judgment we could muster in this policy arena. We expect and hope the Senate will continue the discussion in the spirit of the "continual and fearless sifting and winnowing of ideas by which alone the truth can be found."

The Intellectual and Normative Assumptions that Frame this Report

Before we summarize our findings in this introductory section, let us say something about the intellectual and normative standards that frame and guide this report. Four points stand out in this regard.

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First, we recognize the need to acknowledge the problem of climate change, and the University's moral commitment to make appropriate choices and policies to deal with it. Our report addresses the science and human impact of climate change based on the best available knowledge, as well as the energy and risk factors associated with the problem. The University of Wisconsin is a national and international leader in the academic world, so our response can contribute to the state's and the nation's understanding and decisions regarding climate change. We also recognize our distinct moral charter as an institution dedicated to knowledge and thought, and that this distinct charter influences how we should proceed in this often highly charged arena of policy.

Accepting this obligation, the next set of questions concern the best ways to proceed.

Second, true to our charge from the UC and our understanding of the institutional norms of the University, we have striven to be duly respectful all relevant viewpoints in this domain, and to take them into consideration when recommending what the University should do to deal with climate change. Policy often entails choices and tradeoffs that affect competing or conflicting interests and norms. This has always been the case in environmental policy, which often calls for considered and sometimes contested judgments about such things as the health and economic effects of environmental phenomena and human activity; the status of actions and inactions on the future; the effects of the interactions of multiple phenomena; and the tradeoffs of such interests as economic well-being and health.

Another important issue in this respect is the relationship between means and ends. It is one thing to agree on an objective. It is another thing to decide the best means to achieve that objective. Should a problem be dealt with in an urgent fashion, or more incrementally? Should one or a small number of means be deployed, or should we encourage a variety of means? To what extent should practicality and skepticism influence the choice of means? Such questions often have (explicitly or implicitly) normative and political implications. They also often call for risk assessment and analysis.

The third set of concerns deals with the obligations of the University as an institution in our society with its own distinct moral and intellectual charter. In making recommendations regarding University actions and commitments below, we have been guided by what we consider the legitimate purposes of the University. Our role is to provide reasoned judgment based on the best available evidence, and to act in a manner consistent with intellectual standards and freedom. We must avoid being and appearing to be politicized, and we must eschew demonizing those who disagree with us in good faith. Accordingly, the committee has spoken with many stakeholders who have different views regarding certain policies.

Fourth, in accordance with the above, the thrust of our recommendations addresses the University's own actions. Numerous stakeholders with whom we spoke emphasized the need for us to get our own house in order rather than to preach to the outside world how it should behave. Many others stressed the outreach mission of the University, arguing that we should as engage, speak, write and act as forcefully as possible, given the enormous nature of the threat. To be sure, getting our own house in order will naturally have implications for the outside world. But we cannot control how others view us. What we can do is to strive to make our actions consistent with the problems we perceive, and to act in accordance with our guiding principles as an institution.

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II. THE SCIENCE OF CLIMATE CHANGE

Climate science is regularly reviewed by the IPCC, a body established by the UNEP and the WMO in 1988. The IPCC was endorsed by the UN General Assembly in the same year. This body is charged "to provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts." [1]

One hundred and ninety five countries are members of the IPCC. Scientists from these countries volunteer their time to assess the science, draft reports, and extensively review others' work. In the most recent report, the fifth assessment report (AR5), this review extended to any organization or person who wished to comment, irrespective of their expertise. For IPCC Working Group One (WG1), charged with assessing climate science, 259 authors from 39 countries contributed to the report, and a total 54,677 comments were received and addressed in the preparation of the report. The Summary for Policy Makers for IPCC AR5 WG1 was released on 27 September 2013. This is the best available assessment of recent trends in the physical climate and the best estimate of the future climate state, and thus we base the science summary herein largely on this report.

What has been observed?

Multiple independent datasets indicate that the Earth warmed 0.85 [0.65 to 1.06] ^{o}C (1.5 [1.2 to 1.9] ^{o}F). from 1880 to 2012, and each of the last three decades have been statistically significantly warmer than the decade prior to it (Figure SPM.1a, IPCC AR5 WG1 2013). Warming is clear over all the continents, except Antarctica. Warming is evident over the majority of the ocean, except in the subpolar North Atlantic where there has been slight cooling and in the polar oceans where data are too sparse to quantify a trend. (Figure SPM.1b, IPCC AR5 WG1 2013)

As water warms, it expands. The ocean has absorbed at least 93% of the heat accumulating in the climate system, and thus sea level is increasing. Multiple lines of evidence indicate that sea level rose 1.7 [1.5 to 1.9] mm/yr between 1901 and 2010, with this rate progressively increasing over time. The rate for 1993 to 2010 was 3.2 [2.8 to 3.6] mm/yr. (Figure SPM.3d, IPCC AR5 WG1 2013)

The warming of the climate has been observed to be particularly enhanced at high Northern latitudes, i.e. in the Arctic. The decline of Arctic sea ice has been a dramatic impact of the warming, and is also acts as a positive feedback to warming since the white, reflective ice is being replaced by dark water that absorbs solar radiation far more effectively. The decline of Arctic sea ice has been most dramatic at the time of the summertime sea ice minimum (July to September). Based on multiple observational datasets, the best estimate for summer Arctic sea ice decline is 9.4 to 13.6% per decade from 1979 to 2012. (Figure SPM.3b, IPCC AR5 WG1 2013)

What has driven these observed changes?

"Human influence on the climate system is clear." (IPCC AR5 WG1 SPM 2013)
The driver for the warming climate is dominantly anthropogenic emissions of CO_2 from the burning of fossil fuels and the clearing of land. Emissions of other gases make smaller contributions individually, but together are important contributors. Human emissions of aerosols both warm and cool the climate, with the net effect likely being cooling. (Figure SPM.5, IPCC AR5 WG1 2013)

[1] http://www.ipcc.ch/organization/organization.shtml#.UlhfJhbTy44

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The atmosphere insulates the surface of the Earth, protecting it from a loss of heat to space. Without this "greenhouse effect", the Earth's average temperature would be far below the freezing point of water. CO_2 and the other gases mentioned above are known as "greenhouse gases" because they are the molecules that capture the heat energy and re-radiate it back down to Earth. This "greenhouse effect" is a natural process, critical to life as we know it on Earth. Humans are now adding additional CO_2 and other greenhouse gases to the atmosphere (Figure SPM.4a, IPCC AR5 WG1 2013), and this is enhancing the insulating capacity of the atmosphere. With this added insulation, the Earth is warming. The observations, summarized above, unequivocally support this basic physical understanding.

What is projected for the climate of the 21st century?

The future climate state depends largely on the amount of greenhouse gases that humans emit to the atmosphere, and this quantity is obviously not known precisely. Thus, scenarios for potential future emissions have been developed to encompass the likely spread of possibilities for human behavior (IPCC: Moss et al. 2008). We focus on a "business as usual" emission scenario (RCP8.5) because current emissions by humans are most consistent with this trajectory and the political environment for emissions reductions is not currently promising.

With emission scenarios, the state of the climate can be estimated using computer models. These models are complex computer codes that embody scientists' understanding of the physics, chemistry and biology of the Earth. Throughout their development, these models are carefully checked for their ability to represent the climate of the recent past so as to assure that they are reasonable. They are the best tool for projecting how the complex climate system will respond to the forcing of greenhouse gas emissions.

Independent of the assumed scenario, it is projected that Earth will warm between 0.3 and 0.7 ^{o}C (0.5-1.3^{o}F) for 2016-2035. Under the RCP8.5 scenario, Earth will warm between 2.8 and 4.8 ^{o}C (5.0-8.6 ^{o}F) for 2081-2100 relative to the 1986-2005 average (Figure SPM.7, IPCC AR5 WG1 2013). Under the same scenario, global sea level will rise between 0.52 and 0.98 m for 2081-2100 relative to the 1986-2005 average (Figure SPM.9, IPCC AR5 WG1 2013). The Arctic is likely to be practically ice-free in September prior to 2050 (Figure SPM.7, IPCC AR5 WG1 2013).

What is expected for Wisconsin?

The Wisconsin Initiative on Climate Change Impacts (WICCI) has used climate model output from the previous IPCC assessment (IPCC 2007) to project the impacts of climate change for Wisconsin. In their 2011 report, they find that by mid-century (2050), Wisconsin's annual average temperature is likely to increase by 6-7^{o}F (3.3-3.9 ^{o}C). This warming will be greatest in the winter and least in the summer. Despite lower mean warming in summer, the number of summer days exceeding 90^{o}F (32 ^{o}C) is projected to increase by two-three weeks across the state. More precipitation should fall in Wisconsin by mid-century, with more of this precipitation falling in large storms. The amount of freezing rain, as opposed to snow, should increase significantly. The WICCI report (WICCI 2011) outlines a host of additional impacts expected for the State.

Uncertainty

There is no uncertainty about the absorption of long-wave heat radiation from Earth by CO_2 and the re-radiation of this energy back toward the Earth. This process has been understood since the mid-1800s (Fourier 1824, Tyndall 1861). With only pencil and paper, Arrhenius (1896) identified that a doubling of the

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atmospheric CO_2 as likely to cause a 3-4 ^oC global temperature rise. Modern estimates suggest that if the only change to the climate were a doubling of CO_2, the temperature increase would be 1.2 ^oC (Knutti and Hegerl 2008).

Of course, there are feedbacks that modify this direct response and it is of great interest to have a more precise estimate of the temperature sensitivity of the climate system to increased atmospheric CO_2. The effects of all anthropogenic forcings, including non-CO_2 greenhouse gases, should also be included. Yet despite these complexities, the basic fact remains very clear that humans have increased atmospheric CO_2 by 40%, to 391ppm in 2011 over 278 ppm in 1750, and the global mean temperature has increased 0.85 ^oC, in line with the simplest estimates. This warming is fully consistent with the basic physics that have been understood for 150 years, and is a critical underpinning to the IPCC statement "Human influence on the climate system is clear." (IPCC AR5 WG1 SPM 2013)

Key uncertainties in climate system are the focus of substantial scientific research because there do remain important questions with respect to how fast the climate will warm, what the total warming response will be for a certain amount of total CO_2 emitted, and whether the climate system could change rapidly and unexpectedly (Schiermeier 2010, Alley 2000).

One set of questions surrounds the impact of human-produced atmospheric aerosols that can either absorb or reflect sunlight depending on their composition, and can also modify clouds. The IPCC finds that the net effect of aerosols has been to cool the Earth since 1750, but with significant remaining uncertainty as to the impacts on the observations to date. Given the lack of precise understanding of aerosol and cloud processes, the challenges of encoding the very small scale physics (microscale) occurring into model with resolution of 10s of kilometers, and uncertainty about human emission of aerosols, it is difficult to project the impact that aerosols will have in the future. (IPCC AR5 WG1 SPM 2013)

There is also uncertainty in the carbon cycle. Presently, the ocean and the land biosphere together absorb approximately 50% of anthropogenic CO_2 emissions to the atmosphere, and are expected to continue to absorb some CO_2. However, the rate of this uptake will likely be modified by the changing climate. The IPCC indicates that the likely direction of this change will be toward lesser uptake and, thus, more CO_2 remaining in the atmosphere. One particular area of large uncertainty in the carbon cycle is in the high-latitude permafrost. The IPCC indicates that it is "virtually certain" that permafrost will thaw, but at the same time, there is low confidence in the magnitude of the CO_2 and CH_4 emissions that should occur with this thawing. This is just one of many important potential positive feedbacks (leading to more warming) in the climate system that needs better understanding. (Chapter 6, IPCC AR5 WG1 2013)

The cryosphere is another realm of substantial uncertainty, and is of great importance to future projections of sea level rise. The IPCC states "The available evidence indicates that global warming greater than a certain threshold would lead to the near-complete loss of the Greenland Ice Sheet over a millennium or more, causing a global mean sea level rise of about 7 m." However, at the same time when it comes to quantifying this range, the IPCC states "We are unable to quantify a likely range." (Chapter 13, IPCC AR5 WG1 2013) With a worst-case sea level rise estimate of 1m by 2100 by the IPCC (Figure SPM.9, IPCC AR5 WG1 2013), and 7m of sea level locked in Greenland, understanding the vulnerability of the Greenland Ice Sheet to climate warming is critical. Unfortunately, the state of the science is that the basic physics of how glaciers melt is poorly understood because of limited research on the issue. Due to this limited knowledge, there is significant scientific controversy about how fast Greenland will melt by 2100. Some have suggested that the IPCC estimate of is far too conservative, and that it could contribute to up to a 5m sea level rise by 2100 (Hansen and Sato 2012).

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Scientists continue to deal with uncertainties by conducting research programs and field studies in order to understand the basic physics. Then the best knowledge has been embodied into the climate developed by many large modeling centers across the globe. These models are then tested against the historical record to make sure they are reasonable – but the fit is never perfect given both uncertainty and the natural internal variability of the climate system (e.g. Figure TS.12, IPCC AR5 WG1 2013). These models have then been forced with plausible future scenarios for human CO_2 and non-greenhouse gas emissions. As shown clearly in the IPCC results, the climate model results do not all agree precisely. These differences are largely due to model differences underlain by uncertainty in the physical, chemical and biological processes of the climate system (e.g. Figure SPM.7, IPCC AR5 WG1 2013). Despite the uncertainty, the directions of trends are undoubtedly consistent – i.e. warming, sea level rise, sea ice retreat, etc. These projections are the best consensus assessment of the likely future state of the climate system.

The basic physics of the Earth's climate response to increased atmospheric CO_2 is very clear and the effect of these physics is clearly evident in observations across the Earth system. There is no doubt that these physics will continue to operate in the future. Yet there is uncertainty, as must be expected in the gloriously complex Earth System that humans have only begun to study and understand. Nonetheless, it must be emphasized that this uncertainty is, in no way, large enough to obscure the very simple underlying physics, and its ability to explain past observations and to underpin reasonable projections for the future.

III. FOSSIL FUEL USE AND CLIMATE CHANGE: HUMAN IMPACT

Fossil fuels have had enormous positive impacts on human civilization. But side effects from burning fossil fuels are significant and increasingly negative. While it's true, for example, that a longer growing season has some advantages, impacts such as heat waves, extreme weather events and flooding are disruptive to society. Many features of our built environment were designed during the stable climate conditions of the 20th century, and may not easily withstand predicted increases in heavy precipitation and sea level rise.

Climate change further intensifies threats to human health as follows:

- Heat related illnesses and deaths
- Death and disease due to increased flooding
- Respiratory disease (asthma, allergies and chronic lung disease) related to increased emissions, wild fires and air pollution
- Waterborne diseases and injuries from extreme precipitation and flooding
- Vector-Borne diseases related to milder winters and hotter summers

Certain groups of people are more vulnerable to these health impacts, such as the elderly, children, the poor, and the sick. Others are more vulnerable because of where they live, including people living in floodplains, coastal zones, and urban areas.

The human impact of climate change in Wisconsin is well documented in the first report of the Wisconsin Initiative on Climate Change Impacts (WICCI). Based on the research in this report, nine place-based stories have been produced in video format and made available on-line at http://climatewisconsin.org/. These include impacts on fly-fishing, extreme heat, forestry, farming, sugaring, phenology, the Birkebeiner ski race, Great Lakes shipping, and ice fishing. Virtually everyone in Wisconsin has already experienced impacts of climate change.

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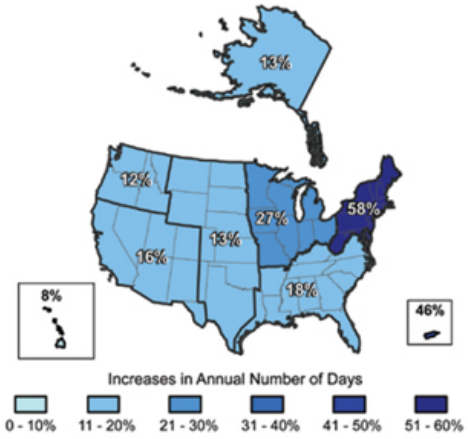
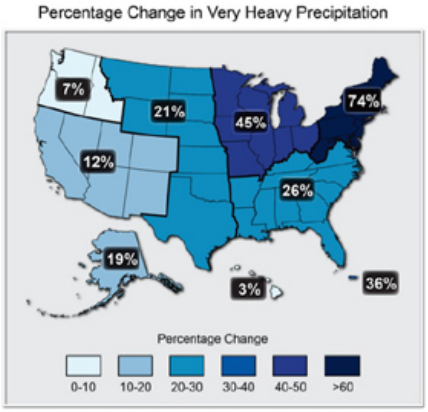
The National Climate Assessment (NCA) documents numerous examples of climate-related impacts on people across the United States. In Alaska, for example, whole communities must relocate due to the combination of melting ice, sea level rise and thawing permafrost. Across the Southwest, drought and wild fires are having huge impacts on people and communities. Since the 1970's the average number of fires over 1,000 acres each year has nearly quadrupled in Arizona and Idaho, doubling elsewhere.[2]

In the Pacific Northwest, changes in the timing of stream flow related to changing snowmelt are reducing water supply for competing demands and causing far-reaching socioeconomic consequences. Across the Great Plains, rising temperatures are leading to increased demand for water. The Southeast U.S. is also experiencing decreased water availability, while simultaneously being exceptionally vulnerable to extreme heat events. Every year, 25-35 square miles of Louisiana coastline disappears due to a combination of subsidence and global sea level rise[3]; land becomes marsh and the marshland slowly submerges.

In the Midwest and Northeast, a warmer atmosphere often means too much water as seen from the following NCA graphs depicting heavy rainfall events across the United States. Even in areas with lower average rainfall, heavy precipitation events can be devastating, as witnessed in Colorado earlier this year.



2009 National Climate Assessment
(1958-2007)



2013 National Climate Assessment
(1958 to 2011)

These maps show percent increase in the amount of precipitation falling in very heavy events (defined as the heaviest 1% of all daily events) from each region. Note the trend toward a greater amount of heavy precipitation nation-wide, and particularly in the Northeast and Great Lakes Region.

There is a strong connection between heavy rain events and pollutants entering the Great Lakes, which has significant ramifications for economic productivity, public recreation and human health. Events such as the 1993 Milwaukee cryotosporidium outbreak, in which 400,000 people became ill from drinking contaminated water, could become more common. Declines in Great Lakes ice cover is lengthening the commercial navigation season, bringing both positive and negative results. This is true for the Arctic as well where melting sea ice has resulted in a dramatic increase in marine shipping and fossil fuel exploration, which can provide employment and support the economy, but could also lead to additional greenhouse gas emissions, threatening our future.

[2] http://www.climatecentral.org/news/report-the-age-of-western-wildfires-14873
[3] climate.gov/news-features/featured-images/underwater-land-loss-coastal-louisiana-1932#.Uo0_MhC0d24

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Across North America, Europe and the rest of the world, hundreds of millions of people are experiencing numerous and largely negative impacts from climate change. Communities in developing countries suffer the greatest impact, as they are typically more vulnerable and less resilient. For a poor family that eats the food they grow, a flood or a drought might mean hunger, devastating illness, or homelessness. As noted by the IPCC, the character and severity of impacts from climate extremes depend not only on the extremes themselves but also on exposure and vulnerability. A timely example of this would be the low-lying islands of the Philippines where Super Typhoon Haiyan recently made landfall, inspiring the following statement by Philippine Commissioner Yeb Sano with examples of how climate change is impacting people's lives:

> "To anyone who continues to deny the reality that is climate change … I dare you to go to the islands of the Pacific, the islands of the Caribbean and the islands of the Indian ocean and see the impacts of rising sea levels; to the mountainous regions of the Himalayas and the Andes to see communities confronting glacial floods, to the Arctic where communities grapple with the fast dwindling polar ice caps, to the large deltas of the Mekong, the Ganges, the Amazon, and the Nile where lives and livelihoods are drowned, to the hills of Central America that confronts similar monstrous hurricanes, to the vast savannas of Africa where climate change has likewise become a matter of life and death as food and water becomes scarce. Not to forget the massive hurricanes in the Gulf of Mexico and the eastern seaboard of North America. And if that is not enough, you may want to pay a visit to the Philippines right now."

There is of course no way to accurately predict the full future impact of global warming and climate change. There are large uncertainties in some areas of climate prediction, such as the speed at which the polar ice caps will melt, the rate of sea level rise, and the frequency and severity of extreme weather events. However, as authoritative reports by the IPCC and the National Research Council make clear, the nature and severity of impact will depend largely on the ability of human societies to reduce greenhouse gas emissions from fossil fuel use.

The potential range of climate change impact on human societies runs from highly challenging to absolutely horrifying. Already, more than one billion people are threatened by food scarcity and/or lack of access to potable water each year. As populations increase and resources become more scarce, some degree of social disruption and conflict is virtually inevitable, even without adversities brought on by climate change. Adding in climate-related heat stress, drought, severe weather events, erratic precipitation, flooding and sea level rise may tilt the equations governing social stability in terrible directions. If, for example, melting of the northern permafrost and Greenland and Antarctic ice shields continue to accelerate, the resultant sea level rises may outpace the ability of island and coastal populations to adapt, migrate and continue their societies. Many of the world's most populous cities lie at the ocean's edge, where typhoons and hurricanes combine with rising seas to seriously threaten life-sustaining infrastructure. If predicted multi-meter sea level rises occur within decades rather than centuries, many low-lying cities will need to be radically restructured or partially abandoned, providing serious challenges to social stability.

Whether, how, and to what extent human civilization can adapt to changes resulting from climate change is difficult to forecast. As the science has made increasingly clear, some level of global warming and climate change is inevitable, and will continue to affect human civilization far into the future. Clearly, however, the magnitude and rapidity of challenges wrought by climate change will both threaten human societies and limit our ability to adapt. The greatest single factor influencing these processes is the quantity of greenhouse gases that will be emitted over the coming years. Major reductions in the combustion of fossil fuels and radical restructuring of energy systems are urgently required if we hope to mitigate the negative impacts of climate change on Wisconsin, the United States, and the world. The University of Wisconsin could play an important and positive role.

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IV. ENERGY POLICY AND CO-BENEFITS

There are certainly large benefits to the use of fossil fuels. They have provided a primary driver of economic growth in developed countries for the past 200 years. They have been essential to the lifting of several hundred million people out of poverty over the past two decades in rapidly developing countries (Karekezi, McDade et al. 2012). But there are also substantial costs that in the longer term outweigh these benefits. Recent research also shows that benefits exceed costs even in the near term when co-benefits of pollution abatement, such as improved health, are considered (West, Smith et al. 2013).

Despite this well-established set of results, addressing climate change remains a difficult problem. It raises the question of how societies should address a truly global public goods problem, under deep uncertainty about future impacts and costs to address, with diverse perspectives about tolerance for risk time preferences over the course of several decades.

A first comment is to appreciate the scale of the transformation required to stabilize emissions, never mind stabilize concentrations, of greenhouse gases. Basic changes in the way the world produces and consumes energy are required to affordably stabilize the climate while accommodating the billions of individuals who aspire to use more energy services. Within a few decades greenhouse gas emissions need to be less than a quarter of today's levels while demand for energy services grows and roughly doubles (Steven, Long et al. 2013). Incremental improvements in efficiency of existing technologies and costs reductions in low-carbon technologies are insufficient (Hoffert, Caldeira et al. 2002). To put it another way, the carbon intensity of the world economy (tCO2/$GDP) needs to fall at 5%/year for several decades (Nemet 2013). Looking at the last 40 years across OECD and BRIC countries, there are only six cases in which a country decarbonized at that rate for a decade or more: China's modernization in the 1980s; Russia, Poland, and Slovakia post-communism; and Sweden's and France's adoption of nuclear power in the 1980s. Whatever set of policies are put in place to address climate change needs to be on par with these historic transformations, but applied to the entire world and sustained for decades. Incremental change to the current energy system is insufficient to address climate change without incurring substantial risk of widespread suffering.

A consequence of the scale of the transformation required is that current methods of combusting fossil fuels for heat, power, and transportation will be limited to very high value niche markets in which substitutes are not available. It may be possible to capture CO2 at the source of emission so that fossil fuels can be used and the emissions stored underground via carbon capture and storage ({IPCC} 2005). But current methods of decarbonizing fossil fuels—such as substituting gas for coal and improving the efficiency of power plants—are insufficient. Thus in the not too distant future, Wisconsin, the U.S., and other countries face the prospect of phasing out their use of fossil fuels, possibly in combination with massive deployment of carbon capture and storage technology.

Co-benefits are becoming an increasingly discussed aspect associated with phasing out fossil fuels (Nemet, Holloway et al. 2010). Reducing fossil fuel consumption provides an array of other benefits to society in addition to reducing future damages from climate instability. Most important, it would improve air quality and consequently reduce hospitalizations, avoid health care costs, and increase quality of life for those exposed to ground level ozone and particulate matter. These benefits are non-trivial. They are highest in developing countries where air quality is currently very poor (West, Smith et al. 2013). But these co-benefits exceed pollution abatement costs even in developed countries where air quality is generally much better than it was 40 years ago. Benefits would be substantial in Wisconsin where several counties are not in attainment of federal air quality standards (Spak and Holloway 2009). Several other benefits of reducing consumption of fossil fuels have been studied and valued including: avoiding macro-economic shocks associated with

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price volatility; reducing expenditures associated with protecting sea lanes; and improving negotiating positions on non-energy issues (Nemet and Kammen 2007). There are near term and local benefits of efforts to reduce fossil fuel use. Crucially, research has shown that they are substantial and generally in excess of the costs to reduce pollution.

Some prominent companies that produce or rely heavily on fossil fuel are now accepting limits or constraints on carbon production. A recent *New York Times* article, for example, reveals how many major oil companies are beginning to support policies that restrict carbon emissions, especially the growing movement to tax carbon emissions or production. A report by the data company CDP discusses how at least 29 companies, including Exxon Mobile, Wal-Mart, American Electric Power, Conoco Philips, Chevron, BP, and Shell are incorporating a price on carbon into their long-term financial plans. http://www.nytimes.com/2013/12/05/business/energy-environment/large-companies-prepared-to-pay-price-on-carbon.html?_r=0

Until now, it appears that the investments that oil/gas/coal companies are making in non-fossil energy are trivial relative to the size of the investments they are making in fossil fuels, probably on the order of 1% at most. These investments, while potentially appearing small in terms of percentage, are not trivial relative to other sources of investment for non-fossil energy. So these investments are potentially important, particularly in a university setting in which tens of millions can go a long way. To wit: Stanford (ExxonMobil), Princeton (BP), and Berkeley (BP) have received significant investments in non-fossil energy (Washburn 2010). The problem, however, is that these non-fossil investments seem to come and go, possibly in part because they do not comprise the companies' core business and detract from earnings and the focus each company. For example, BP sold off its solar business in 2011. Many oil companies were burned in the late 1970s and early 1980s with their investments in alternative energy and that memory seems to play an important role today (Miller 2013), making them risk averse and with a preference for keeping these investments small if at all.

V. RISK ANALYSIS

Debates over what (if anything) to do about the issue of climate change often end up polarized between two relatively extreme viewpoints. On the one hand, climate "skeptics" often claim that "The scientific base for a greenhouse warming is too uncertain to justify drastic action at this time" (Singer et al., 1992). On the other hand, proponents of action to prevent climate change often cite some version of the precautionary principle—e.g., "When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically" (Wingspread Conference, 1998).

Both of these arguments may seem compelling, and in fact they have strong historical roots; for example, the precautionary principle is closely related to the mini-max principle ("minimizing the possible loss for a worst case…scenario"; Wikipedia). However, both of these decision rules or principles are also wrong (or at least far too limited), and can easily lead to poor decisions in many real-world cases. In practice, we often do NOT wait for uncertainty to be resolved before taking drastic action, if the consequences of inaction may be especially severe; consider for example prophylactic mastectomies for women at risk of breast cancer (but unsure about whether they will actually develop breast cancer). Likewise, however, many risks to human health and the environment are accepted every day, often without significant preventive measures; consider dashing across a busy street to avoid missing a bus, or the widespread use of the automobile, which kills hundreds of thousands of people per year (Augustine, 2002).

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By contrast with these simple but polarizing decision rules, decision theory (e.g., Hammond et al., 1999) tells us that, rather than focusing exclusively on uncertainty (as the skeptics often do) or on worst-case scenarios (as proponents for action on climate typically do), each outcome should in fact be weighted by its probability. So, for example, we may take into account the POSSIBILITY that fossil fuels may not lead to climate change, or that climate change may have beneficial rather than deleterious effects, without being precluded from taking action on climate change if we think the probability of undesirable effects is high. Such a decision rule is not as easily "fooled" into recommending poor decisions, because it looks at all aspects of the problem at hand, and combines them in a logical way.

Thus, uncertainty about possible consequences does not preclude action—but it MIGHT argue for actions that keep one's options open. For example, Lauren Azar (2009) of the Public Service Commission of Wisconsin challenged listeners on campus to "Assume that in the near future (6-18 months)… you are going to have between 5 and 30 children moving into your house. But, you don't know the specifics. Are you going to start making plans today?" Someone in such a situation would not necessarily prepare for the worst (sell the house and buy a hotel or orphanage), but might well invest in preparations that provide greater flexibility in the future (getting the house READY to sell in case it turns out to be necessary, saving more money in case a small hotel is needed).

Yet another concept needs to be considered, in addition to weighting consequences by their probabilities—namely, the severity of a given consequence (e.g., amount of temperature rise, or carbon dioxide in the atmosphere) may be highly nonlinear. This concept goes by the name of "utility theory" in economics and decision analysis. On the plus side, many people feel that winning $10 million, while clearly better than winning $1 million, is much less than 10 times as good; the first $1 million would provide the greatest benefit, followed by (nonlinear) diminishing marginal returns thereafter. On the down side, the same person who would be delighted by the prospect of winning $1 million may find that losing even just $100,000 would be enough to cause a personal bankruptcy, and great emotional distress! From this perspective, if climate change is anticipated to have catastrophic results, we are not only justified, but perhaps even obligated, to put disproportionate weight on that outcome, relative to less severe or dramatic outcomes (e.g., the possibility that climate change may be benign or innocuous). As Heal and Kristrom (2002) state, "…even though an event is very unlikely, if it is costly and we are risk averse we may invest significantly in avoiding it or insuring against it. By way of illustration, our houses rarely burn down, yet most of us insure them against this event on terms that are actuarially unfair."

Heal and Kristrom further point out that action to prevent climate change will be particularly worthwhile if "many of the changes in climate, and changes in the natural environment driven by climate change [e.g., species extinctions, reversal of the Gulf Stream] will be irreversible… If climate change or its consequences are indeed irreversible and there is a chance of learning more over time, then there may be a real option value associated with preserving the present climate regime, i.e. with freezing all actions that are likely to contribute to climate change." They also note that time lags in both climate change and the effects of carbon reduction may make it necessary to take action early (possibly well before the likelihood of severe consequences is known), to prevent the possibility of undesirable outcomes in a few decades. In another context (prevention of animal disease), Jin et al. (2009) note that prevention will be especially important (compared to post-disaster response) when the likelihood or consequences of a disaster are high, when post-disaster response is likely to be costly and/or ineffective relative to prevention, and when the disaster unfolds quickly enough to make post-disaster response impractical (a factor that is related to irreversibility).

Another important aspect of most real-world decisions (including decisions about climate change) is that they typically involve multiple attributes that must be traded off against each other, rather than just a single

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attribute. So, divestment proponents should ideally be considering not only the possible benefits of divestment for the environment, but also the possible costs (e.g., to the endowment of the university, or to our political support among Wisconsin legislators). Likewise, climate skeptics should be considering not only the possible adverse economic impacts of overly drastic action on climate, but also the environmental impacts of insufficient action.

Finally, but perhaps of the greatest importance, most decision problems involve not just two possible choices (e.g., divest or not, take action or not), but multiple choices. In fact, Hammond et al. (1999) note that "people don't tend to think a lot about their decision alternatives… they assume they know the options open to them. Too many decisions, as a result, are made from an overly narrow or poorly constructed set of alternatives." In the context of climate change, Nordhaus (2013) argues that options for adaptation to climate change "may be part of a strategy of risk management," but "cannot completely offset the damaging impacts of carbon accumulation and climate change." By contrast, Stern (2007) emphasizes the importance of taking strong and early steps to reduce carbon emissions, but has sometimes been criticized for underestimating the potential benefits of adaptation.

VI. WHAT THE UNIVERSITY HAS BEEN DOING

The University has made significant efforts to address climate change through investments in infrastructure that improve energy efficiency, educational programs that develop awareness and promote change in human behavior, research into technologies and strategies that reduce energy consumption and greenhouse gas emissions, and outreach that shares knowledge and influences policy.

Changes to campus infrastructure implemented by Facilities Planning and Management, including the We Conserve Program, have resulted in appreciable energy savings and corresponding reductions in greenhouse gas emissions. For example, the University constructed the state-of-the-art West Campus Cogeneration Facility, which generates steam for heating and electricity, and reconstructed the Charter Street Power Station with natural gas as the fuel rather than coal. These plans generate electricity and steam more efficiently, an use fuels that are less carbon intensive. New buildings on campus are designed and constructed with energy efficiency and sustainability as a priority. For example, the Wisconsin Institutes for Discovery employs state-of-the-art heating and cooling systems, including a highly efficient geothermal exchange system. New buildings generally are designed with a LEED Silver rating as a minimum expectation. Five new buildings have received LEED Gold or Platinum certification as sustainable buildings, and nine new buildings currently are undergoing LEED certification.

The We Conserve campaign offered by Facilities Planning and Management has made major investments in renovations that reduce energy consumption and water waste, which results in corresponding reductions in greenhouse gas emissions. Reducing water waste is an important element in energy conservation, as water distribution and treatment is the sixth largest source of energy consumption in the US. The energy efficient lighting, occupancy sensors, modern ventilation systems, and low-flow bathroom fixtures employed in renovations have had dramatic impacts on energy and water consumption and greenhouse gas emissions. From FY06 through FY12, energy use on campus decreased by 12.5% and water use dropped by 41%, even though total floor space in campus buildings grew by 16.4%, On a per unit area basis, energy consumption decreased by 25% between FY06 and FY12 (personal communication, 2013, Faramarz Vakili, Director of Sustainability Operations). These changes have resulted in a reduction of 125,000 Mg of $CO_{2,eq}$ annually.

The University has also hosts a growing portfolio of courses and programs addressing sustainability and climate change. Within the last five years, a new Environmental Studies degree was launched by the Nelson

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Institute for Environmental Studies to complement the highly successful Environmental Studies Certificate, the College of Agriculture and Life Sciences and the College of Letters and Science developed and began offering undergraduate degrees in Environmental Science, and the Wisconsin Energy Institute developed and began offering the Certificate in Energy Sustainability through the College of Engineering. The Nelson Institute for Environmental Studies and the Office of Sustainability have developed a campus-wide undergraduate Sustainability Certificate, and anticipate enrolling the first cohort of students in 2014. This new certificate program address climate change in the curriculum, and engages students in practical experiential learning activities that involve campus sustainability efforts in operations. These new programs, which include curriculum related to climate change, complement existing programs in energy, climate, and environment on campus that have been offered historically by a variety of schools and colleges. A partial list of courses directly related to climate change issues is in Appendix A.

Climate issues are also being tackled directly and indirectly by the University's research enterprise and outreach efforts. Examples of centers for research activity include the Center for Climatic Research (CCR) and Center for Sustainability and the Global Environment in the Nelson Institute for Environmental Studies, the Great Lakes Bioenergy Research Center in the Wisconsin Energy Institute, the Engine Research Center and the Recycled Materials Resource Center in the College of Engineering, and the Center for Integrated Agricultural Systems and the Wisconsin Institute for Sustainable Agriculture in the College of Agriculture and Life Sciences. The Wisconsin Initiative on Climate Change Impacts (WICCI) has built strong partnerships between UW-Madison scientists and public and private stakeholders engaged in assessing vulnerability to climate change and increasing resilience.

While these activities in facilities, education, research, and outreach at the University are significant, the urgency associated with climate change requires bolder and broader actions that will result in transformative advances that are actionable within the next decade. The University, with its history in conservation and reputation for excellence in environmental studies, engineering, and policy, has an obligation to lead in developing *solutions* to climate change. These solutions may involve technology, but will need to address social and economic issues, including changes in human behavior. Broader and deeper investments in traditional and non-traditional initiatives will be required to achieve transformative advances.

VII. FUTURE ACTIONS

To enhance a position of leadership on the issue of climate change in a manner befitting a leading institution of higher education, we recommend a set of policies the University should adopt or consider adopting. We do not mean for these recommendations to be either definitive or non-controversial. We present them in the spirit of beginning the campus-wide discussion and deliberation about how to proceed.

1. Education and Outreach, Formal and Informal.

   - Education and Outreach. The University should promote interdisciplinary and interconnected research on climate change. Much world-class research is already undertaken by our faculty, staff, and students on climate science, on the impacts of and adaptation to climate change, and on the transformation of our energy system. But this research is often dispersed across campus, only loosely connected, and often is incremental. As a result, the whole may currently be less than the sum of its parts. Given that these parts are in place, the University is in a unique position to establish itself as a leader in this field. The University should promote integration of existing intellectual resources and targeted new investments in the science, economics, and policy of climate change. The following is a partial list of things that could be considered:

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- Develop a Climate Knowledge Project of experts for peer-to-peer sharing of knowledge and public interchange
- Use the Go Big Read program as a vehicle to familiarize incoming students with the relevant and competing issues, including reading on climate change and the use of forums and invited speakers
- Provide further educational opportunities for all students, faculty, and staff by fostering innovative education programs through the Wisconsin Idea and Outreach and Extension
- Expand existing course offerings, making sure to cover such matters as Climate Science, Energy Policy, Economic Policy Issues, and Politics and Government Regulation

- Curricular Changes. The University should also make curriculum changes that ensure that graduates from this University have a meaningful opportunity to have a basic understanding of climate change. Democracy requires an informed citizenry, and climate change is one of the defining issues of the current and future generations. We understand the problems associated with the University as an entity dictating curricular matters, so we are wary of endorsing a required course in this area. Strong claims could also be made about other curricular topics involving citizenship and the national interest. (For example, what about a requirement that all students take a basic course on the constitutional system, out of which national climate policy must emerge?) And the policy complexity of climate change, including the tradeoffs mentioned above, render mandating a single course open to question. But the University should give serious thought to how our teaching mission can make students more aware of the problems and issues associated with climate change.
- Make sure a sufficient enrollment space is available for courses such that all students will have the opportunity to take at least one course in such subjects as earth system science, climate science, or climate policy. In order to increase offerings, additional faculty in key areas may be needed.
- Establish stronger integration of climate science and policy into existing undergraduate majors and professional programs, and the creation of new programs specifically focused on climate change. This could include more explicit incorporation of climate science and policy into existing majors such international studies, environmental studies, atmospheric and oceanic sciences and environmental sciences, and/or the development of new programs. Examples of the latter could include professional programs in green business or new programs in climate science and policy. In the name of academic freedom, such changes would have to seek the consent of the departments or programs involved.

2. Research and Coordination.

- As mentioned above, the University should establish more coordination among University personnel, offices, and programs dealing with climate change. For example, the administration could consider establishing a central office to coordinate policy and programs. It should also strive to increase faculty engagement across the four main divisions of research (Biological Sciences; Arts and Humanities; Physical Sciences; Social Studies), and enhance its efforts to encourage interdisciplinary research.
- The University should undertake bold new initiatives that embrace the diversity of the University's intellectual capacity and lead to transformative advances that result in actionable change in the near term. These initiatives should include, but not be limited to technology development. Transformations are also needed socially and economically. The University can lead in identifying the most important changes required for society to address the impacts of climate change, and provide the knowledge essential to make these changes.

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3. Facilities and Planning.

   - Energy Consumption. The University should commit our campus to significant reduction targets regarding carbon emissions consistent with economic feasibility. Many sources told the Ad Hoc Committee that the University's first order of business should be to get its own house in order, and this is an appropriate way to start. The exact formulation and levels of these emission reduction targets require further discussion. Regarding the University's energy generation, one possibility could be a system similar to the Renewable Portfolio Standards that electricity generators follow to produce a specific fraction of their electricity from renewable energy sources. Targets for meaningful carbon emission reductions could be set for certain time horizons, such as the next 10-25 years, and thereafter. Such reductions should take into consideration scientific evidence regarding climactic conditions as well as economic feasibility. The conversion of the University power plants from coal to natural gas in recent times has been a constructive first step in this direction, but we should create more room to expand our portfolio of renewable energy sources such as wind and solar if such sources are economically feasible for the University. The considerations of alternative energy sources may also recognize that stabilizing greenhouse gas concentrations may require the expansion of nuclear energy sources, and analyze the economic and environmental tradeoffs of this energy source as well.
   - Climate Change Impacts on the Campus. The University should develop plans for dealing with the potential physical and economic impact of severe climate-related events on the campus, such as storms, water runoff, and the like.

4. Investment Opportunities.
   - UW Foundation Donations. The Ad Hoc Committee does not recommend "divestment" from fossil fuel companies by the UW Foundation. But there are other investment options that are more consistent with donor choice and free market principles than divestment ordered from the top down. For example, the University should consider encouraging the UW Foundation to offer interested donors an option to invest in non-fossil fuel portfolios. This would not entail firing or pointing fingers at present investment advisors, but simply provide an additional option for investment of donor money based on voluntary donor choice.
   - Capital Campaign. The University should consider making climate change and sustainability a central theme of the next capital campaign. This could include the following components:
     - Advancing research into clean-energy technologies and the training of students interested in pursuing careers in this field.
     - Advancing research into climate resilience and adaptation and the training of students interested in pursuing careers in this field.

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IX. COMMITTEE MEMBERSHIP OF THE AD-HOC COMMITTEE ON FOSSIL FUEL USE AND CLIMATE CHANGE

Bruce Barrett, Professor, Family Medicine, School of Medicine and Public Health

Craig Benson, Professor and Chair, Civil and Environmental Engineering

(continued)

Vicki Bier, Professor and Chair, Industrial and Systems Engineering

Donald Downs, Professor of Political Science (Chair)

Galen A. McKinley, Associate Professor, Atmospheric and Environmental Studies

Margaret Mooney, Space Science and Engineering Center

Gregory Nemet, Associate Professor, Public Affairs and Environmental Studies

Appendix A. Courses on Climate Science, Impacts, Energy and Policy

Climate Science
ATM OCN 102, Climate and Climate Change
ATM OCN 171, Global Change, Atmospheric Issues and Problems
GEOG 321, Climatology
GEOG 331, Climatic Environments of the Past
GEOG/ATM OCN/IES 332, Global Warming: Science and Impacts
GEOSCI 304, Geobiology
ATM OCN 425, Global Climate Processes
GEOSCI 551, Oceanography: Recent Marine Sediments
ATM OCN/IES 520, Bioclimatology
ATM OCN/Envir St/GEOG 528, Past Climates and Climate Change

Climate Change Impacts
GEOG/ATM OCN/IES 332, Global Warming: Science and Impacts
F&W ECOL 375/875, Climate Change and Natural Resources Agroecol/Agronomy/Envir St 724, Agroecosystems & Global Change
PHS/Envir St 740, Health Impact Assessment of Global Environmental Change

Energy
PHYS 115, Energy
ECE 355, Electromechanical Energy Conversion
ECE 356, Electric Power Processing for Alternative Energy Systems.
BSE 365 Sustainable Residential Construction
BSE/Envir St 367, Renewable Energy Systems
ME 370 Energy Systems Lab
N E / Envir St 373, Nuclear Energy and the Environment
Envir St 401, Introduction to Air Quality
GEOSCI/Envir St 411, Energy Resource
NEEP 411, Nuclear Reactor Engineering
ECE 427, Electric Power Systems
MSE 434, Intro- Thin Film Deposition.
BSE 460, Bio-refining: Energy and Products
ME 461 Thermal Systems Modeling
ME 469, Internal Combustion Engines
IES 502, Air Pollution and Human Health
CBE 562, Energy and Sustainability
ME/CBE 567, Solar Energy Technology
NEEP 571 Econ & Environmental Aspects of Nuclear Energy

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NEEP 602, Energy Resources, Technology and Sustainability
CEE 609, The Chemistry of Air Pollution.
CEE 609 Electro-Chemistry for Renewable Energy
CEE 639, Wind Energy Site and Design

Economy and Policy
AAE 246, Economic Dimensions of Climate Change
AAE/Envir St/Econ 343, Environmental Economics
AAE/Econ/Envir St 344, Environment and the Global Economy
AAE 375, Climate Change Economics and Policy
Agronomy 375, Bioengineering Sustainability: Opportunities and Challenges
CURRIC 375, Sustainability, Democracy and Education
Envir St 402 / Hist Sci 350, History of Climate Science
URPL/Envir St 449, Government and Natural Resources
AAE 531, Natural Resource Economics
IES 540, Sociology of International Development, Environment, and Sustainability
RMI 650, Sustainability, Environmental and Risk Management
AAE/Envir St 671, Energy Economics
Envir St/URPL/PubAff 809, Introduction to Energy Analysis and Policy
URPL/Envir St 821, Resource Policy Issues: Regional & National
PubAff/Envir St/AAE 881, Benefit-Cost Analysis
PubAff 866, Global Environmental Governance

Appendix B. The Divestment Issue

The divestment question is very complex, so here we provide the key points pro and con that we discussed over the course of our charge.

A. The Rationale Against Divestment (Majority of the Committee)

As this report makes clear, we acknowledge the harms posed by climate change and the University's responsibility to take responsible actions to address the problem. But is divestment something we should consider? In our considered view, the costs posed by divestment outweigh the benefits. The costs are both normative and practical in nature.

The benefits, mentioned below in the case for divestment, include making a strong symbolic gesture that would send a message about the urgency of the issue. In addition, it is possible—though hardly assured—that a divestment movement would encourage further acceptable movements away from fossil fuel investment and use. Accordingly, divestment could produce normative and practical benefits. But there are significant costs that do not justify divestment, especially because there are so many alternative actions the University can adopt that can deal with climate change in a constructive manner, as we relate in this report.

In a similar vein, many individuals involved in the environmental movement at the University told us that they consider divestment either a red herring or a distraction from the more important and difficult behavioral changes we need to consider down the road. Many campus groups—student, faculty, and staff—are working on a variety of levels to deal with climate change, including engaging with fossil fuel companies to develop other energy sources. We are presently in a state of constructive engagement that entails forming new alliances and bedfellows. We fear supporting divestment would jeopardize such synergistic engagement.

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One of the most significant problems with divestment is that many thoughtful people consider it a political movement that is unnecessarily divisive. This politicization poses two problems. First, it would make it more difficult to build a the broader consensus that is needed in order to engage the climate change problem in a constructive manner. For example, a movement in Wisconsin is developing that is bringing some Republicans and Democrats together in support of a carbon tax, which could be an important tool in dealing with climate change. According to a nationally respected engineer with whom we spoke who is very involved in this movement in Wisconsin, the fledgling coalition becomes polarized and starts to fall apart when divestment is raised as a policy tool.

Second, and more importantly for us as an institution with a distinctive role in the constitutional polity, the politicization entailed by divestment would conflict with the proper mission of the University. We agree with Harvard University President Drew Faust, who raised the issue of universities' distinct role in our society in her recent public statement announcing Harvard's refusal to divest from fossil fuel companies. In Faust's estimation, the divestment movement threatens to 'instrumentalize" the university. The university

> exists to serve an academic mission — to carry out the best possible programs of education and research. We hold our endowment funds in trust to advance that mission, which is the University's distinctive way of serving society. The funds in the endowment have been given to us by generous benefactors over many years to advance academic aims, not to serve other purposes, however worthy. As such, we maintain a strong presumption against divesting investment assets for reasons unrelated to the endowment's financial strength and its ability to advance our academic goals… We should, moreover, be very wary of steps intended to instrumentalize our endowment in ways that would appear to position the University as a political actor rather than an academic institution. Conceiving of the endowment not as an economic resource, but as a tool to inject the University into the political process or as a lever to exert economic pressure for social purposes, can entail serious risks to the independence of the academic enterprise. The endowment is a resource, not an instrument to impel social or political change.

Until recently, only a handful of colleges have gone on record supporting divestment, and none with an endowment of more than $40 million. This situation did change when Cornell University's faculty voted in December to divest from fossil fuel companies. Some say we should be next in line among major institutions in order to reaffirm Wisconsin's reputation as a national leader and trend maker. But leadership means doing the right thing in a conscientious manner according to one's best lights, and a majority of the Ad Hoc Committee consider divestment the wrong way to go for the reasons stated herein.

Perhaps divestment would be worth the risk if the cause so justified it. Divestment from companies dealing with South Africa is often raised as an appropriate analogy. Divestment in that case had a clear moral rationale and, according to many sources, successful. Apartheid is inherently evil. But the apartheid analogy is flawed. Fossil fuel companies are not inherently evil, as we stress often in this report. But the divestment movement is often couched in terms that portray such companies as immoral. This stigmatization is especially problematic given the many millions of Americans who work for such companies or companies associated with them, and who could become (and are becoming) allies in the environmental movement.

As mentioned above, many major fossil fuel companies are themselves now responding to climate change and embarking on investments in alternative energy sources. Do we risk alienating such efforts by divesting from them?
The concerns raised above are normative and practical. Other practical concerns exist, which we will just list below:

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- If we divest from fossil fuel companies, where do we draw the line? There have been many divestment movements nationally, including calls for divestment from companies that make arms, alcohol, tobacco, pornography, products that assist in abortions, and many others. If we were to argue in favor of divestment of fossil fuel companies, on what grounds could we argue against other forms of divestment?
- Research shows that divestment would be difficult to be effective in a deep market in which "neutrals" could simply buy back stock sold by others. It is not at all clear that a divestment movement in this domain would be successful in a country like ours.
- One argument for divestment is "economic": fossil fuel companies' values are inflated "bubbles" because future national and local policy will make their profits shrink. But many such companies are now changing their economic and business models in a way that is adapting to climate change, as the *New York Times* recently reported. This weakens the bubble theory.
- According to the UW Foundation, many major donors to the University have already expressed their strong disapproval of divestment, and major donors would withhold their support.
- None of the outside advisors the Foundation uses to make investment decisions engages in divestment decisions based on policy concerns, and no present donors have made such stipulations.
- Investment returns could be negatively affected by eliminating fossil fuel companies as investment options. The "Monte Carlo Effect model suggests that the fewer the investment options the more likely returns will be less than optimal. For example, the Wisconsin state pension system made many millions of dollars investing in Russian oil a few years ago when a unique market opportunity arose.
- Divestment could weaken or eliminate the University's power to influence corporate behavior from within. It might be more effective to buy more stock and build shareholder pressure toward fossil fuel companies.
- The energy industry is vast, especially when we include companies that interact with it and support it (banks, financial companies, energy supply companies, tool companies, exploration companies, etc.) If we are serious about divestment, should we not divest from them, too?
- As discussed in our report, we recommend that the Foundation consider setting up a fund for donors who wish to invest in environmentally friendly funds. This would increase investor choice rather than restricting it.

B. The Rationale for Divestment (Minority of the Committee)

Global warming and climate change present an unprecedented and overwhelming threat to humanity. The scientific evidence that this threat is caused by human activity, primarily by the burning of fossil fuels, is extensive, and conclusive.

The argument for divestment is really quite simple. By calling for the removal of University of Wisconsin assets from fossil fuel companies that adhere to irresponsible and damaging corporate policies, we hope to influence those policies for the better. We also hope to focus individual and collective attention on climate change, to bring about better governmental laws and regulations, and to improve individual, organizational and societal choices and behaviors.

As the scientific analysis section of this report makes clear, the findings of the Intergovernmental Panel on Climate Change, the National Research Council of the National Academies of Science, the World Meteorological society, and numerous other authoritative bodies are based on overwhelming evidence, sound critical analysis, and cautious interpretation. As the human impacts section explains, the threats to human

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civilization range from heat waves, droughts and extreme weather events to flooded cities, infectious disease epidemics, agricultural disruption, increased immigration, and potential societal breakdown.

Already, earth has warmed about 1ºC, the seas have risen about nine inches, and a series of unprecedented extreme weather events have affected numerous societies on all inhabited continents. With each passing year, the stark reality and monumental importance of global warming and climate change reach further into local, national and global consciousness, prompting individuals, organizations and governments to seek ways to mitigate the growing threats that greenhouse gas (GHG) emissions pose.

There is now overwhelming scientific consensus that with current and projected GHG releases, earth's average temperature will rise at least 2ºC above pre-industrial levels, with increases of 4ºC or 6ºC quite possible, depending primarily on the quantity of future GHG emissions. Temperature rises in the 4ºC or 6ºC range could complete the melting of glaciers, tundra and polar ice caps, ultimately raising sea levels by approximately 200 feet. Effects on the planet's life-sustaining weather patterns and ecosystems cannot be predicted in detail, but are potentially catastrophic, and for thousands of species that may disappear in a mass extinction event that seems to have already begun.

So far, fossil fuel combustion and other human activities have increased atmospheric carbon dioxide (CO_2) levels by about 43%, from 280ppm to 400ppm (parts per million). The planet's top scientists tell us that in order to keep temperature rise to below 2ºC, we can safely emit no more than an additional 500 to 1,000 gigatons (Gt) of CO_2. If burned, currently known fossil fuel deposits would yield more than of 2,500 Gt of CO_2. Thus, the only sane and safe course for humankind is to leave the vast majority of known fossil fuels in the ground, and to rapidly and dramatically switch over to non-GHG emitting forms of energy.

And yet, in face of convincing science and overwhelming threat, the companies that own the majority of the known coal, oil and natural gas reserves are spending billions of dollars seeking new deposits, most of which are inaccessible and of low quality, so that extraction and refinement would themselves add substantively to the atmospheric pollution problem. And, given the information summarized above, these fuels must not be combusted. Those same companies, which hold hundreds of billions of dollars of assets and have many choices open to them, are investing pitifully small sums on the development of and transfer to low- and zero-carbon emission energy systems. Driven by profit motive and consumer demand, and without appropriate laws, regulations and incentives to restrain them, the major fossil fuel companies are pursuing endeavors that pose unprecedented threats to humanity's future.

There are many among us at the University of Wisconsin who feel that it is wrong to seek profit by investing in such monumentally irresponsible endeavors. We do not want our own personal assets or those of the University that we love to be invested in pathways leading towards ecological destruction and potential societal collapse. We also feel that such investments are imprudent, as we are cautiously optimistic that humanity's will for long-term survival will outmatch short-term profit drives, and that earth's people and their governments will enact and enforce laws to keep fossil fuels in the ground, which will drastically reduce the value of these "assets". We realize that the carefully considered withdrawal of the millions of dollars of assets held by the University of Wisconsin System and U.W. Foundation may on its own have little effect on corporate behavior. We realize that choice of the top 200 fossil fuel companies is somewhat arbitrary, and that setting a benchmark towards investment in carbon free technology to exempt companies from divestment has its own complexities. We feel that the University of Wisconsin is wise to refrain from frequent or excessive engagement in politics, and that telling the truth about climate change and calling for appropriate action can be mistaken for partisan political activism. But in the end, the overwhelming threat to humanity, made clear by extensive and conclusive scientific evidence, calls us to demand radical and rapid change in our energy systems.

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A number of people at the University of Wisconsin-Madison, including some on this committee, feel that calling for divestment from fossil fuels would be an appropriate and justified means toward these ends.