

Summary of Proceedings

Conference on

**CLIMATE CHANGE AND ITS IMPLICATIONS
THROUGH 2020**

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University of Maryland, College Park, MD **Climate Change and Its Implications Through 2020**

Opening Remarks

On Monday, June 28, academics and senior government officials convened to address what many see as the greatest public policy problem of the next decade: global warming. The three panels that comprised this conference focused on what we know about climate change, policy scenarios related to climate change, and the geopolitical, economic, and social implications of such policy scenarios. This paper provides a summary of the panel presentations, the issues discussed, points of contention, and the varying opinions about climate change over the next 16 years.

The following major themes were identified in the conference:

- The reality of the greenhouse effect is not in dispute, for statistics show that climate change is a very real phenomenon, although the degree of change caused by human activity is still not fully understood. There was some dispute over the level of weight granted to greenhouse gases versus issues surrounding land use, deforestation for agriculture or urban development. Overall, though, the consensus is that greenhouse gases are playing a critical role in climate change regardless.
- Recognition of perceptions of all relevant parties—scientists, policymakers, and the general public—is essential to addressing the problem of global warming. Because the major environmental changes anticipated to result from global warming will not take place until after 2020, perceptions are important to address the situation now through strategic investment.
- The United States will have a difficult time assuming a leadership position in the crusade to mitigate the effects of global warming, but there are advantages to having the U.S. at the forefront of the battle armed with advanced technology and policy measures. The U.S. has the strength of presence to carry the mantle of leader, and it has the technological and financial means to do so as well. But what it currently lacks is commitment to such an endeavor. If the United States committed to remedying the problem of climate change, it would not only be able to reinforce relations with allies but also could make deals in the climate arena – thus allowing the U.S. to shape the climate change agenda according to its preferences.
- Finally, there is no silver bullet to resolve the problem—no one scientific advance, new technology, or policy mechanism can resolve the effects of global warming.

Rather, scientists and policymakers would do well to explore a variety of solutions, focusing on six key technologies: nuclear fission, biomass, wind, solar, the decarbonization of fossil fuels, and energy efficiency.

Panel 1. What We Know About Climate Change

The first presenter of the day, **James A. Edmonds** (Joint Global Change Research Institute), laid out the issues for discussion as follows: the greenhouse effect, historical greenhouse gas concentrations, sources of CO₂ emissions, potential CO₂ emissions, fundamental drivers of CO₂ emissions, the range of potential future CO₂ emissions, and potential future global temperature regimes.

After a brief explanation of the greenhouse effect itself, Edmonds discussed related emitted gases and greenhouse gases. While most of the focus is typically on CO₂, other gases have a significant impact as well, especially when examining the issue through the lens of the next two decades. These gases include methane, with a decade lifetime in the atmosphere, and sulfur dioxide, which, because of its cooling effect, renders uncertain just what its greenhouse effect will be.

Global warming has been well established in the historical record: from 1860 to 1960, the global mean surface temperature rose by 0.4° C, and another 0.4° C from 1960 to 1990 alone. The last 1000 years, moreover, indicate that this most recent temperature change is an anomaly attributed to human intervention.

The real debate surrounding global warming is not about the reality of the greenhouse effect, and there is relatively little dispute that the earth is warmer now than it was 100 years ago. Rather, the debate concerns just how sensitive the earth's climate system is to incremental changes in the concentration of greenhouse gases such as CO₂ (which occupy the largest chunk of greenhouse gases in the atmosphere). How much will the global mean surface temperature (GMST) change, for instance, if the CO₂ concentration is doubled? The range of climate sensitivity runs from 1.5° C to 4.5° C; for a doubling of the concentration of CO₂, the current best estimate is 2.6° C. Climate sensitivity includes the direct greenhouse feedback effects of higher greenhouse gas concentrations plus indirect effects, which include water vapor (providing the biggest effect of them all), albedo (including ice and vegetation, this is the next biggest effect), and clouds. The effect of clouds, however, remains a scientific conundrum, because their ability to warm or cool depends on how high they are in the atmosphere.

The most solid piece of data in the entire climate issue is the Mauna Loa Record, which demonstrates quite convincingly (as the data was collected at 12,000 feet, from air unpolluted by local human activity) that the CO₂ concentration was 315 ppm in 1958 and 375 ppm in 2002. A separate study that examined past concentrations of CO₂ in an ice core at Siple Station confirmed the rise. But why is this piece of data rising? The ratio of ¹⁴CO₂ to ¹²CO₂ has been decreasing; this implies an increasing proportion of very old carbon sources such as from fossil fuels. And while there were other times in the earth's history where the CO₂ concentration rose above 300 ppm, that last occurred about 75 million years ago, making it difficult to compare with an earth that was far different than today's.

In addition, the concentrations of non-CO₂ greenhouse gases have also been rising, including methane, nitrous oxide, and sulfur. In fact, the earth will see a transition in which sulfur emissions from Europe and North America are declining while those in Asia and India are rising. Moreover, while currently the most-used fossil fuel is oil and the next biggest is gas, those

amounts will change in the future. Differences in use according to region have to do with population density and the mix of fuels that each economy uses. The United States is the biggest user, followed by the European Union, but this is because the U.S. simply has more available space; it is thus possible that a study that examined particle emissions per square mile would show the U.S. more comparable to other countries if evaluated that way. Then, too, a heightened green awareness in Europe may also be a reason for the difference between the two economies. Moreover, as John Baskin added, the United States experienced recently the greatest increase in its population in history, while Europe has not seen the same population surge. The United States also experiences greater extremes of temperature than does Europe. Baskin suggested that we penetrate the surface numbers and the rhetoric to better see that, in fact, renewable energies are moving slowly in the EU.

On the subject of land-use emissions production, the vast majority—75 percent—of all emissions are produced from just a handful of countries. All other countries account for the remaining 25 percent. The most land-use carbon emissions come from the tropics (Asia, the Americas, and Africa), whereas the United States is in the process of regrowing. Global energy production from 1850 to 1994 indicates a huge increase in energy use in the last 50 years, with oil as the chief fuel, followed most recently by gas, nuclear power, and hydropower. And while the percentage shares of coal and wood use have declined, the absolute numbers have not; in fact, there is today almost twice as much coal used as there was 100 years ago.

Richard Benedick noted a recent publication by a prominent University of Maryland researcher that correlated the rising temperatures in the United States with changes in land use, particularly urbanization. He thus wondered how much we need to consider these factors in addressing the problem of climate change. Edmonds reasserted that climate change is very real, and that it is impossible to load the earth's atmosphere with greenhouse gases and expect no consequence. As before, he stressed that the real debate is not that there will be a change, but rather how much of a change there will be. Steve Fetter concurred, observing that the charts used in the presentation were created with an eye to filtering out the urban island effect for more accurate data.

Will the climate change problem go away by itself? The fear that the earth will run out of fossil fuels is little more than a myth; "limited" conventional oil and gas will not force a move toward renewable energy. But what, then, are some scenarios for future emissions? There are literally thousands of parameters that each potential model has within it. An uncertainty analysis conducted on this matter found that there are four key factors to consider: labor productivity (GDP), income elasticity of demand for energy services, the rate of energy technology change (on both the demand and supply sides), and population. The final factor is an important one to consider, for while future global population growth is relatively certain in the near term, it is uncertain over the long term. Population estimates have declined recently with aging populations and declining fertility rates, and many scenarios show the global population leveling off at the end of the 21st century to a median of around 8 billion.

This element of uncertainty is seen, too, in the range of energy scenarios – the projected use by century's end is a great unknown. Likewise, the range of carbon emissions in 2100 is also unclear. What is known is that, to stabilize the concentration of greenhouse gases, emissions of CO₂ must peak and decline in the 21st century. The earlier the peak, the lower the eventual steady-state CO₂ concentration. Even with assumed advances in fossil fuels, energy intensity, nuclear energy, and renewables, the increase in carbon emissions is striking. The increased concentration of CO₂ in the atmosphere is already being reflected in pH levels that are changing dramatically. Because stabilization of CO₂ concentrations requires emissions to peak and decline, technologies that reduce emissions must expand their role in the global energy system. Gap

technologies that could potentially provide energy without increasing CO₂ emissions include both technologies with which we are familiar, such as energy efficiency, wind, solar power, nuclear power, and other renewables, as well as less familiar technologies such as carbon capture and disposal, H₂ and advanced transportation, and biotechnologies. Emissions reductions eventually become so large that no single technology can provide all of the increase in global energy needs. The reality is that there is never a single “silver bullet” that can alone solve the climate problem. Furthermore, advances in technology alone will not necessarily stabilize CO₂ concentrations – technological advances can dramatically reduce the cost of achieving a stabilization goal but, eventually, a credible commitment to limit cumulative carbon emissions is required.

In a brief discussion on land-use emissions, Edmonds stressed that they depend on five factors: population, income, technology, climate, and policy. Sensitive to agricultural production growth rates and to energy policy, Edmonds noted that, while such emissions are uncertain, they are generally lower than fossil-fuel emissions.

While temperature change will not be especially striking by 2020, the bulk of analysis points to a 2.3°C change in temperature by the year 2100—and some analyses point to a figure as high as 9°C. A critical factor to bear in mind is that temperature and sea levels go hand in hand, and while the time scale is tough to gauge, estimates indicate that the sea levels will rise by about 15 centimeters by 2020—enough of a rise to cause the Maldives to disappear.

The overarching question, suggested John Steinbruner in the discussion that followed, is the extent to which the projected implications of climate change are accepted as a problem of policy; at what point and in what way society reacts to the expectation is critical. This, after all, is the key reason for the conference—because the change to the environment between now and 2020 that we actually see will be marginal, the real issue for the conference becomes expectation, and what policymakers and scientists intend to do with that. Part of the problem with global warming, added Edmonds, is that there is no precedent. Instead, people need to expect the unexpected and unanticipated when dealing with it. People also need to consider the ecosystem loss that may likely result, including, for example, a loss of the earth’s tundra and even the North Pole.

Jay Okey inquired about the level of confidence, suggesting that there are four levels of confidence: a causal debate (which seems to have the most consensus), a change debate (how much of a difference it makes), an impact debate (regarding, for instance, agricultural production and water availability), and a mitigation debate. Edmonds concurred with Okey’s summary, and noted that there is little debate over causal issues, but what is subject to disagreement is how much of a change in temperature has resulted from human beings and how much is the result of the inconsistency of nature (a question akin to climate sensitivity). What matters more, Steinbruner contended, is that the numbers with which scientists and policymakers are dealing are historically associated with major changes.

The discussion shifted to a focus on the need for policy action. Climate change raises the related issue of risk aversion and how risk averse people are to these potential changes. Steinbruner stressed that there are actions that we can take to remedy the problem, and he questioned whether the risk involved motivated radical shifts in policy. It will, after all, require major changes in technology to address a CO₂ concentration of 500-550 ppm. While such a level indicates a big problem for the environment, it is not an insurmountable problem, and it is one that we can address, should we choose.

Steinbruner cautioned that, if we have not decided by 2020 to radically shift our energy production arrangements, then such a shift cannot happen in time to hold a reasonable standard of prudence (atmospheric concentrations around 500 ppm) derived from the IPCC report. The biggest impact, Baskin noted, will be policy responses. The big story of global warming will be policies from the developing world and the developed world in effect “bumping up” against each other. The problem of climate change will force a dramatic reshifting of policy in the time frame between now and 2020, even though it currently occupies such a small portion of policymakers’ focus. Loy suggested that we will see little policy difference between now and 2020 (apart from the usual issues concerning water resources and the like). Rather, we need to think of this as a continuum, one that requires policymakers to get started on this immediately.

Panel 2. Policy Scenarios Related to Climate Change

Frank Loy (former Undersecretary of State for Global Affairs) opened the panel with an examination of a scenario with the United States as a “green” leader in the world. Loy addressed three key issues: (1) what it will take to be a leader, (2) what consequences would flow from such a role (and what will be the response of others to such U.S. leadership), and (3) how the United States might negotiate such a role of leader. He noted that at this moment the United States is not a leader in any sense in the struggle to address the problem of climate change. Some within the current administration would disagree, pointing to the research and development dollars committed to climate change. But, while, indeed, the program is a reasonably sound one, it is generally dismissed as a substitute for real and effective regulatory or legislative action. Fair or not, that is a very common perception of others. In addition, the research program is shaped in such a way that renewables and conservation are not given the priority that would seem to be necessary if the program is to achieve the emission reduction objectives it seeks.

If the United States served as a leader, the question arose, would it be required to thus participate in the Kyoto Protocol? Loy argued that if the United States had a credible domestic program of reducing greenhouse gas emissions, it could begin to play a sound leadership role even without participating in the protocol. In the longer run, participation in Kyoto or some substitute international regime would establish the leadership role of the United States and thus permit it to lead in the effort to address climate change – as the U.S. has led in so many other environmental areas.

However, Loy contended that the key for international credibility as a leader is a solid domestic program, which, as a realistic matter, means a credible economy-wide cap and trade system. Today the United States undermines its credibility not only because of the absence of such a program but also by ambivalent pronouncements about whether a genuine climate change problem exists at all, and failure to meet head on climate skeptics. These can be found both among friends of the administration and in the administration itself.

The international response to an American movement toward such green measures would be great. Loy suspected that most countries would welcome American leadership, because most countries do have a solid, popular consensus that climate change is a problem that needs to be remedied. The European Union (EU), for instance, has a huge political stake internationally in climate change and thus a huge stake in the Kyoto protocol. The EU has aggressively dealt with – and paid off – Russia, in an effort to join, and thereby bring Kyoto into effect. Loy posited that if the United States took greater interest in addressing the concerns of climate change, it would not only be able to strengthen relations with allies generally, but also could make deals in the

climate arena, thus allowing the United States to shape the climate regime according to its own preferences.

Loy pointed to the Kyoto Protocol as an example of how the United States could shape the character of the agreement. For the end product of that negotiation – adopted at Marrakech – had critical characteristics that would not have been there had it not been for persistent negotiations by the United States over a period of years. Characteristics – such as the role of carbon sequestration and the role of emission trading – that were essential to American efforts to reduce the costs of achieving the targets, would presumably have to be found in any subsequent agreement in which the United States participated at some future time. Furthermore, the strength of U.S. leadership would be influential enough to bring on board other countries, such as Australia, that would otherwise be holdouts to such a climate change regime.

When the United States looks at developing countries in this scenario, Americans need to take three steps if they are to assume a leadership position: (1) agree to go first on emission reduction measures, essentially without conditions (forgoing an “if you do this, we’ll do this” situation); (2) structure the system in such a way to allow the developing countries to benefit from it; and (3) determine the optimum forum in which to pursue negotiations. Going first does not mean that the developing countries should be given a pass. They need to take on obligations. We can obligate ourselves to do more than our first step when and if the developing countries take on some obligations.

These steps are necessary because the developing countries hold several widespread beliefs and must deal with several political realities. The first is that the industrialized countries caused the climate change problem in the first place and in fact became rich in doing so. Second, the developing countries believe that the West has not followed through with its implied promise of levels of foreign assistance to developing countries in efforts to mitigate climate change effects. Lastly, the reality is that generally in developing countries environmental outcomes are seldom sufficient drivers of political actions.

All of this means that the West’s paying in part for the necessary actions on the part of developing countries is likely to be a part of any final policy arrangement.

As for the process of achieving an agreement we can support, we need to ask the hard question whether negotiations in a forum that operates under “UN rules” – participation by all countries, and decisions by consensus – would be the most likely to produce results. Is that the best forum in which to exercise a leadership position? Loy expressed several concerns in this regard: the (unjustified and unhelpful) hostile sentiment in the U.S. Congress to United Nations treaties; the tendency of developing countries to vote as a bloc; and a tendency by many countries to be suspicious toward market solutions as a useful tool regarding environmental problems.

How, then, to respond? Loy called for a coalition of the willing. Start the process by bringing to the table those countries that want the United States in a system and are willing to commit to take specific domestic measures or unspecified measures but with specified results, to help stem global warming. Don’t make the first step too tough. A domestic economy-wide cap and trade system would be one such measure. This would be accompanied by a promise to take more stringent measures or hit more stringent targets if others follow. If the United States exercised leadership in this way, it would elicit positive responses from other countries, including those that have historically been hesitant and/or stubborn.

Ambassador Richard E. Benedick (Joint Global Change Research Institute) explored the issue from the perspective of the U.S. continuing to be reluctant in enacting climate mitigation policies while other industrialized nations maintain more progressive policies to reduce greenhouse gas emissions. By 2020 fossil fuels will almost certainly remain the world's chief source of energy not only because reserves are more than sufficient, but also because renewable energy sources will not, for various reasons, have made major inroads. The only way this prediction might not hold would be if there were some major unforeseen climate cataclysm that immediately elevated the climate issue to the top of the political agenda or, similarly, if scientists discovered that the rise in carbon dioxide concentrations was caused by an alien civilization from outer space, in which case the climate issue would become the number one priority for every office and defense ministry in the world.

Benedick posited a 2020 scenario wherein the Kyoto Protocol would have entered into force with Russia ratifying; with at least 14 subsidiary bodies and an extremely lengthy and complicated body of new provisions and interpretations; and with the Parties mired in endless disputes over allocations of emissions trading rights and accounting for sinks. (These ideas are all based on projection of actual developments since the original signing of the treaty in 1997.) Attitudes in the United States would be characterized by a continuing passionate aversion to regulation, relying instead on faith-based initiatives – faith in the market and a faith and optimism in technology resolving the problem – such technology probably including the development of a new generation of nuclear power and the criss-crossing of Alaska with oil pipelines.

Benedick predicted that between now and 2020 the world will suffer a number of extreme weather events, including enormous hurricanes and massive flooding. This is so because in any 15-year period in history the chances are likely that such events will occur. The difference now, however, is that the rest of the world will increasingly see these events as a consequence of climate change. Since the United States remains the world's leading emitter and, in this scenario, does little to address the climate change problem, they will blame the United States for these disasters. U.S. climate change policies – or rather the lack thereof – will therefore become by 2020 a foreign policy liability of major significance.

The mantle of leadership will thus fall to the European Union. The EU will (in this scenario) by 2020 have more Green Party coalitions than at present and will speak with even stronger environmental rhetoric. Yet there will be increasing difficulty in harmonizing climate policies in what will likely be an even larger EU (perhaps 35 members extending south to North Africa and east across the Caucasus). Income inequities among EU members, backlash over subsidies for renewables versus other budget priorities, and damage to the landscape by alternative energy sources such as wind towers will all limit the effectiveness of green actions. Moreover, the continuing high relative cost of renewables will mean that fossil fuels will still command most of the energy market – perhaps as much as 95 percent. The emissions trading market will flourish, for, as Benedick observed, the EU cannot achieve its reduction targets without such trading, e.g. with Russia. The EU will also probably promote the movement offshore of aluminum production and other emissions-intensive activities while subsidizing solar and wind power.

By 2020 the developing countries will have passed the industrial countries in terms of emissions – in fact, 7 out of the 10 biggest polluters will be developing countries. China will still be using cheap coal, and emissions will continue to rise sharply as a result of the rise in population. And, in sum, without U.S. leadership the global approach will falter, as the EU and China will demonstrate that neither has the necessary political will or capability to meet the challenge.

Elizabeth Chalecki asked about the viability of a cap/trade scenario, and Loy contended that such a scenario would in fact be successful and that safety valves installed into the scenario can ensure

it. Furthermore, should other countries – including Russia and the developing countries – choose not to follow the scenario, the alternative is devastating.

Benedick observed that part of the problem in the current global approach is the belief that convening “mega-conferences” involving thousands of government delegates, nongovernmental “observers,” and media, will come up with practical solutions rather than political rhetoric. These meetings, however, are not well-suited for reaching serious compromises on complicated, long-term issues characterized by scientific uncertainties.

Benedick suggested that we should consider assembling smaller groups of like-minded or regional countries around the table rather than trying to solve all problems for all countries at the same time and place. Since the EU is nearly desperate for the United States to put any climate change initiative on the table, it would probably welcome such an effort by the United States. Parallel regimes and partial solutions (for example, a transport sector protocol, or a cooperative energy research agreement) could serve as a way to begin meaningful progress toward international cooperation measures to address the risks of climate change. International actors need not restrict themselves to the straitjacket of Kyoto. Indeed, such an approach has a precedent in the history of the ozone layer problem, when informal agreements among several like-minded nations to ban CFCs from aerosols actually preceded the negotiations of the global treaty: the historic 1987 Montreal Protocol.

What other policy mechanisms might actors invoke to get at the climate change problem? Carbon taxes, cap and trade policies, and tariffs have all been suggested, but what others exist? Edmonds asserted that policies will fall into one of three baskets: fiscal, cap and trade, and regulatory. While it is possible to have infinite numbers of variations on a theme, all variations fall within these three bundles.

Another scenario offers an image of the United States in an even stronger leadership role – leading a global initiative in serious energy technology R&D efforts with pre-market investments and targeted venues in the developing world for technology transfer and improvements in energy efficiency. For example, China and India, with their enormous populations, have obvious tremendous potential for economic growth – as well as, in the worst case, for huge emissions. Quite apart from Kyoto, policy makers need to address the issue of transferring new generations of technology to developing countries. While this could require a substantial commitment from the United States, it could also bring substantial political and even longer term commercial gains.

In discussions of the potential for U.S. commitment, Zhong Xiang Zhang shared Loy’s view that a solid domestic cap and trade system would be a very positive development for two reasons. First, it would create the possibility of linking a U.S. trading scheme with, e.g. an EU emissions trading scheme, thus reducing competitiveness concerns by industries in Kyoto parties. Second, with the United States widely expected to be a net buyer of Kyoto permits, this increases overall demand for Kyoto permits and pushes up the price of permits, thus increasing incentives to invest in clean development projects in developing countries. Loy noted that, if the United States used the Kyoto Protocol as originally conceived as the first of several steps, then it becomes an even more difficult scenario that is made impossible by the nonparticipation of the United States. Loy expressed concern about the procedure involved in getting to the point of a viable commitment to Kyoto – the lack of interest among OPEC countries and the difficulty in getting it through the U.S. Senate make it a daunting task. He would prefer to use Kyoto as the means to achieve the most reductions the fastest, but, he admitted, that is simply not practical.

Benedick observed that the United States had been a pioneer in developing a cap and trade system, as evidenced by its successful program to reduce sulfur dioxide emissions. Its past history, therefore, gives the United States credibility in starting a similar domestic program addressed at carbon dioxide. Benedick expressed concern, however, that cap and trade has never been addressed on a global scale. The bottom line is that we need more advanced technology. As the Montreal ozone protocol history has demonstrated, once such advanced technologies are developed, the developing countries will express great interest in adopting them and in accepting corresponding commitments to reduce their emissions. Benedick concluded that strong energy technology R&D, in collaboration with private companies and with developing nations, can thus lead to substantial political and economic benefits, including (as in the space program) lucrative commercial spin-offs.

Panel 3. Geopolitical, Economic, and Social Implications of Policy Scenarios

Elizabeth Chalecki (California State University at Hayward) began her presentation with an eye toward the role and power of perceptions. When examining policy scenarios, one must remember that doing so involves more than simply looking at climate change. Rather, it is a matter of public perceptions of climate change. Most people are basing these decisions not on science but what they know of science. The focus on the year 2020 is less for the science of the issue (for it will not be a breaking point), but rather for the policy. The year 2020, indeed, is not long term.

One needs to focus efforts on the current perception of climate change. Many of the drivers of the policy changes are not from climate change directly but rather are the results of climate change, including changes in water availability and water quality. Such results will cause fluctuations in innumerable trade aspects, again with the effect of altering perceptions – this time the perceptions of the stability of the market. These water changes will then drive agricultural changes and will also result in a marked increase in disease levels; this will become a big driver in policy change as governments work to mitigate humanitarian emergencies and other crises that will result. Indeed, many countries will see an out-migration of a new kind of refugee not officially recognized as a refugee by the UN: the environmental refugee.

All of these issues will have an impact on foreign policy – whether or not these issues are even real will matter less than the perception of these issues. The perception, in the end, will be the driving force of foreign policy change.

How will green policies affect economic winners and losers? The people that will be the most affected will be those who do not possess the economic wherewithal to address these issues. As a result, foreign policy itself will be affected, especially if the wealthier countries are perceived as being stingy in their aid toward the poorer countries. Indeed, blocs of countries are already forming in response.

Jennifer Turner (Woodrow Wilson International Center for Scholars) advised that the United States needs to engage China on the issue of climate change, for the trajectory that China takes matters to the entire planet. Of concern are the current Congressional restrictions on aid to China, which is greatly hampering collaboration with the Chinese on environmental issues. While the government is sponsoring some token programs (on law, sustainable development, and others), Turner likened the funding levels to no more than nickels picked up from a sidewalk. More money is needed, and more coordination is needed as well. While the NGO community has done great work in coordination with the Chinese, the U.S. government itself is behind in such

initiatives. This is because of some powerful anti-China obstacles that exist in Congress and a timidity toward working with China for fear of scandal (as the Department of Energy experienced with the Wen Ho Lee incident).

Zhong Xiang Zhang (East-West Center) explored the issue from the consumption perspective. A chart showing CO₂ emissions in the United States and China between 1990 and 2025 demonstrated that China is quickly catching up with the United States in emissions, but that it will not exceed the U.S. until the year 2040. While China is not yet at the world average for per capita emissions, it is approaching the average, and will likely reach it in another 20 years. Zhang noted that CO₂ emissions intensity in both China and the U.S. appear to be declining rapidly, especially so in China, in the period from 1990 to 2025.

Zhang displayed a chart indicating the trade balance in CO₂ emissions as a percentage of domestic production. The chart showed the West, for the most part, to the left of the zero point, indicating that these countries are net importers of energy intensive goods. Accordingly, their domestic CO₂ production figures understate their actual CO₂ emissions impact. Alternatively, CO₂ emissions for China, India, Russia, the Czech Republic, the Netherlands, and Canada, are to the right of the zero point, indicating that these countries are net exporters of energy intensive goods. As such, a portion of their domestic CO₂ emissions are used to produce goods used by other countries. Participants observed that the chart suggested that regulations and tariffs would be that much more difficult to administer.

Zhang used the recent China-EU dispute over exports of coking coal to underline the importance of a better understanding of consumption trends so that efforts by industrialized countries to address climate change are not overestimated or overstated by focusing just on in-country production emissions. In the dispute, China wished to reduce coking coal production. However, the EU, which was a major importer of Chinese coking coal and had shut down many of its coking plants for environmental reasons, pressed China to continue supplying coking coal for European steelmakers. The EU even threatened to take China to the WTO if Beijing refused to revoke the restrictions on production and thus allow the EU to import coking coal at previous levels. Furthermore, a graph indicating emissions embodied in imported goods as a percentage of domestic production (OECD 2003) shows China very low on the chart, whereas countries such as Sweden and Norway are surprisingly and strikingly higher. Still, the question of responsibility and accountability remains a sticky one: it has become a debate between producing regions and consuming regions that has perplexed international discussion.

Zhang displayed another chart showing the size of the Clean Development Mechanism (CDM) market and the share that China will possess in 2010. His results demonstrated that China is expected to become the world's number one host country for CDM projects. However, Zhang stressed that actually implementing CDM projects on a large scale represents a significant challenge for China, because there has been a general lack of awareness on the part of the Chinese government and business communities. He also commented on a general lack of appropriate institutional structures and implementation strategies. Zhang also challenged the view that if the United States became "green," the resulting environmental gains could be negated by rapid, "dirty" growth in China and India by saying that, if the U.S. became greener, then China and India also would have become greener. In his view, this is because increased demand for carbon credits from CDM projects in these two countries would lead to their actual emissions in the future being below the projected emissions under business as usual conditions. Loy suggested that quotas might be a possibility to solve the problem of China consuming all CDM investment, although he does not necessarily endorse such an approach. And as one participant joked, many refer to CDM as an acronym not for the Clean Development Mechanism, but rather for the *China*

Development Mechanism. It is a telling joke, one that suggests that there needs to be a reevaluation of the structure of the CDM and the means of developing and regulating projects sponsored by the CDM.

During the discussion, Okey inquired about the effect that going green would have on Middle East oil. Fetter contended that going green would have no negative effect on Middle East oil, because the cost of oil production is so low and oil so valuable. Moreover, it is simply not a factor for this short time frame; Edmonds concurred that conventional oil and gas are used in almost all scenarios.

Participants then discussed the ramifications for Saudi Arabia should there be a greater movement to go green and/or oil reserves do dry up. The Saudis, it was concluded, cannot tolerate a reduction in oil revenues, as they use those revenues to stabilize a society that is completely withdrawn from globalization apart from the oil industry. While it may not ostensibly be a big concern for the Saudis, because alternative fuels are so much more expensive than oil (as one participant argued), one must note that the market for fuel is a price-sensitive one in which a small change in demand can have a large impact in price. Again, what matters most for this issue is perception of the problem and of the solutions—the perceptions of the Saudis needs to be factored into this scenario as well.

Okey inquired about who the potential winners might be in an enhanced green scenario. He suggested that if R&D produces products that are critical to the benefit of the world, then this would have to be done at cost, as a result of public pressure. Benedick noted that, because of the investment risks involved, this is an excellent argument for the promotion of government R&D rather than relying exclusively on the private sector reacting to marginal price signals.

While there may not be any silver bullet to solve all of the earth's climate change problems, there is a set of options. Steinbruner asked what the participants would place on a list of best viable options between now and the year 2050. Fetter suggested that the key technologies rest in nuclear fission, biomass, wind, solar, and the decarbonization of fossil fuels. Edmonds added energy efficiency to the list. Edmonds also surmised that we will move from a world in which gasoline is the dominant passenger transportation fuel to a world in which researchers will test a variety of fuels to determine which one commands the market—these tests will explore hybrids, biofuels, hydrogen, and improved internal combustion engines.

Another important factor to consider is building efficiency. In the case of China, noted Turner, building efficiency (as with setting a standard for refrigeration, for instance) can have a massive impact in such a vast country at mitigating the greenhouse effect. Energy efficiency, because it encompasses so many different things, is often overlooked as an option for helping to stem the greenhouse effect. Yet models have shown that investment in building energy efficiency (even as little as 0.25 percent) can reduce emissions greatly. Indeed, underestimating the need for energy efficiency can be quite costly, with an overall impact far greater than perhaps anticipated. An advantage of a focus on energy efficiency is that it is such a vast market that one need not invest in just one aspect of it, although that also means that some losing propositions will be mixed in with some strong ones. Overall, though, agreed Benedick, it is a profitable investment.

Steinbruner argued, too, for the need for an efficiency initiative, but he lamented that it seems unwise to simply trust the market to head in this direction. Rather, the market needs guidance. Edmonds agreed, noting that this is an example of a classic innovation failure free-rider problem that in effect always leads to underinvestment. Steinbruner referred back to the six key technologies that have to be addressed, but Okey worried that market dynamics and political

motivations would make it challenging to get these technology needs underway. Edmonds suggested that one could best market such an investment not piecemeal, but instead as one complete energy R&D package (one that includes a focus on efficiency). With public investment, Steinbruner argued, alternative technology options could be brought into play. Private investment alone would not work, he asserted, because of market uncertainties. Both Edmonds and Loy called for both types of investment for such a project. In a related discussion, participants questioned which side of investment we were lacking—Steinbruner contended that it was public investment.

Loy noted that putting a price on carbon has to do in part with technology, and while public expenditure for innovation is critical, it is but a part of the problem. Edmonds and Steinbruner agreed – the whole, they stressed, is greater than the sum of the parts. Chalecki reminded participants that one needs to focus on perceptions here, too, for there needs to be a perception by policymakers and the public that this technology will be necessary if it is to move forward.

Benedick asked how we can utilize all of the things that have thus far been suggested and discussed if the current administration doesn't believe global warming to be a problem. Loy pointed to the McCain/Lieberman bill as a source of hope, for it received 43 votes even in light of criticism from the administration. Benedick agreed, but noted that some of the votes in question were soft votes, made with the assumption that the bill would not pass anyway. Benedick added that the House of Representatives is even more problematic, as it tends to think in even shorter time horizons, focused on re-election every two years. How policymakers can deal with this is a difficult question.

William Anderson questioned whether we needed any new international institutions to make great changes by 2020, or if the current ones were sufficient for the job. Steinbruner contended that they were not sufficient (not even the World Bank), and that the world needs an entity that is thinking with more of a long-term approach in terms of the decision-making required to remedy the problem. While Anderson asserted that there are plenty of people thinking in those time scales, Steinbruner cautioned that there are not any institutions making practical decisions, particularly investment decisions on those time scales, which poses a problem. Benedick expressed concern, however, over creating any more large bureaucracies, suggesting instead that if the United States were sufficiently committed to change, it could wield significant power on the world stage on this issue. Turner believed that China would be supportive of such an approach, and even that it might be easier to get the Chinese on board given that they need not worry about public opinion in their special brand of “authoritarian environmentalism.”

Okey suggested that there have, in fact, been some striking changes over the past few years in terms of public awareness, as even advertising campaigns have indicated. This could well indicate that positive changes are underway. The problem with confronting climate change is that the uncertainty level surrounding it is tremendously high, whereas traditionally we are accustomed to dealing with situations as they happen. Benedick agreed that there has been some improvement, noting that in years past generating awareness and concern over climate change was more difficult than it is today, as the science then was much more uncertain and theoretical. He cited again as an example the Montreal Protocol on protecting the ozone layer – somehow the American public came to realize that destroying the ozone layer was bad and that the problem of CFCs needed to be addressed, even though the science at the time was still uncertain.

Okey found the focus on the role of the public intriguing, particularly since the decision cycle shows that public demands tend to push government, in spite of elite derision of the public's perceived ignorance on scientific issues. As Okey argued, sometimes having the major players

“get it” is not enough if the mainstream is not aware or not supportive. Steinbruner suggested that we are now in a pre-crystallization stage – with Hollywood paying closer attention to the problem and presumably imagining public reaction to it – with the likelihood that by 2020 a major event will occur that will get us to the point of crystallization. But do we have the institutional mechanisms in place? Steinbruner said no, suggesting (as Benedick had done earlier) that an ad hoc coalition might be the best means to address the problem. Right now, however, we have neither the means nor the mechanisms to make the required investments – because it’s “nobody’s business,” nobody is doing anything about it. Thus a market incentive is also required so that entrepreneurs will sit up and take notice of the potential business opportunities. A key caveat to this is that there is always the risk that the public will focus on the wrong issue, however.

Zhang reminded the other participants of the important role that the media plays, noting that the topic of global warming actually gets no mention in the media, particularly in the United States. He is concerned, therefore, that public awareness of climate change might suffer, for the media is the outlet to which the general public will most likely turn to learn about the potential ramifications of climate change. What may result, then, is policy driven by disaster.

Concluding Remarks

In his closing remarks, John Steinbruner (University of Maryland) solicited from the group some brief comments that summed up the key points of the conference. Participants cautioned that that one should be neither optimistic nor pessimistic about policy that concerns climate change, and that there is no silver bullet – no one policy or technology that can resolve the issue. Furthermore, the prospect for the United States to adopt a leadership position in this endeavor will be extremely challenging.

Because most of the major environmental effects of climate change will not be seen or felt until after 2020, what matters the most until then is perception of the problem and what needs to be done to mitigate it. Any signs of public sensitivity to climate change will create conditions within which its importance as an issue will crystallize. This is likely to happen sometime between now and the year 2020. Yet while current attitudes will likely evolve, a critical question to address is how that evolution will come to be. Such attitudinal shifts will have dramatic implications for political relationships, reaching into issues of investment and market adjustments. Indeed, Benedick stressed again that climate change could well become a significant foreign policy liability for the United States in the coming years – particularly because the rest of the world increasingly believes that the United States is in some measure responsible for extreme weather events.

Could U.S. states be the actors that initiate change in the federal government? Fetter suggested that this is possible, and that California is but one state that is pushing the country as a whole toward a leadership role on a global level.

The level of uncertainty associated with it makes dealing with the emissions problem that much more vexing, noted Edmonds. It is, in fact, a strategic problem that requires one to move beyond traditional ways of thinking and actions guided by what is happening or present at the moment. It might help to consider addressing the problem in five-year slices of time – a series of steps that, unlike Kyoto, lead toward something in particular.