1) **What are the most significant barriers to technology transfer to help developing countries become more energy efficient?**

The most significant barriers for developing countries to adopt new energy efficient technologies are: 1) access to capital for implementation and scaling, 2) a lack of basic infrastructure for deployment, and 3) the false perception that there is always a negative economic effect associated with carbon reduction.

Contrary to popular belief of some activists in Geneva, access to the latest technology via intellectual property licenses is not a barrier to adoption. The barriers to adoption relate to cost and deployment rather than the availability of technology licenses. If one freely gave away all the best technology in the United States, it would sit unused without an appropriate deployment strategy, and the necessary capital to fund it. Eventually our strategic competitors and large companies would find a way to make deals to access it, and the winners would likely be Big Oil and countries that do not need our economic support, like China and India. Meanwhile, future innovation in the United States would be mortally compromised and investment would fall.

India, China, and other smaller, developing countries, will not implement large scale carbon reduction programs if it negatively impacts economic growth. The same statement may be true in the United States. Therefore, in order to best achieve the carbon reduction on a broad scale in the developing and developed world, countries must adopt technologies that displace current practices or products with lower carbon alternatives at the same or lower long-term economic impact. Some of these technologies do exist now, and will be further improved in the future. Cost-effective wind, algae biofuel, and utility-scale solar that can compete with existing marginal energy production are in the pilot-scale phase in the United States.

2) **What policies can Congress adopt to facilitate innovation and development of new clean energy technologies? Internationally, what compensation structures could be developed to facilitate innovations, and at the same time, encourage widespread deployment of clean technology development?**

As has historically been true, most of the fundamental breakthroughs in energy technology will occur in the research laboratories of the United States. This trend is likely to continue into the next decade despite significant gains in basic research capabilities that have been achieved by our global competitors in Japan, China, and the European Union. The United States has invested literally trillions of dollars in our research infrastructure, and we have benefited from a uniquely American innovation ecosystem. This ecosystem consists of creative, risk-taking entrepreneurs and the availability of venture capital funding. Venture-backed companies funded in the last three decades today equate to 21% of GDP and employ more than 12 million Americans. This represents roughly the size of the entire German economy. U.S. venture capitalists will solve the energy problems of the day, and we will help others deploy our solutions.

Innovation and advancements in the energy technology sector have benefited greatly from the tax credits that were signed into law last year and from the many programs in the ARRA that have provided government-backed loans and grants for energy companies. We commend the attention that Congress and the White House has paid to energy policy, but there are other things that Congress can do to encourage energy innovation. My comments will focus on three areas where Congress can facilitate innovation.

1. **Increase the costs for inefficiency and offer positive financial incentives for the adoption of cleaner, more efficient energy technology and protect the innovation pipeline for unintended consequences.** The House of Representative has passed an energy bill and cap and trade bill that essentially achieves these goals. I would urge the Senate to act expeditiously to finalize their bill done so that it can be signed into law by the end of this year. The House-passed energy bill will provide significant incentives for energy conservation and will increase the cost for harmful emissions, and will incentivize the re-use of carbon.

2. **Create incentives that allow for development (grants), pilot-scale manufacturing (A Green Bank), and deployment (carbon policies, tax policies, International Green Bank.)** Congress, especially the energy-related committees in the House and Senate, is to be congratulated for recognizing the importance of basic research and for providing robust funding to programs like the Clean Energy Deployment Administration (CEDA) that will help companies "bridge the valley of death." The Senate version of CEDA is noted as one of the better models of government backed support for the truly breakthrough energy companies.

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3. **Consider policies at the macro-level and not undermine and part of the innovation ecosystem.** There exists a growing yet largely unnoticed crisis that will impair energy innovation and investment and will permanently harm the innovation infrastructure. This crisis is an accumulation of a series of legislative initiatives, which on the face seem insignificant, but taken together, could decimate key competitive advantages enjoyed by the United States and will cause energy innovation to flounder.

   Some examples of these policies are:

   - Proposed changes to patent law damages that without a "gatekeeper" function, could harm American competitiveness in energy by weakening the current protections and handing our best technology over to Big Oil and foreign competitors.

   - Changes in regulation and tax policy for early-stage venture capital firms who invest in the riskiest energy technologies that create jobs and could solve our carbon problems. These proposed changes could reduce net investment by venture capital firms, who will find their operating and tax costs increasing significantly at the time when their green tech investment is needed the most. Many will chose to invest in areas like China over time, rather than the United States.

   - The exclusion of the best energy technology development from Small Business Administration Research (SBIR) grants by capping venture-funded ideas at 8% of total grants rather than funding projects based on merit or the probability of helping to solve the current crisis. This cap is a sure way to ensure that the least innovative ideas get funding, and the best ideas get abandoned. This policy flies in the face of the American ideal that the best ideas win.

   - The deployment of existing DOE and other monies at a pace that does not reflect the urgency and magnitude of the crisis, and simply does not take enough risk.

\Overall, this is a time for big ideas and bold action or our children will be re-visiting these "green" issues and wondering why we dropped the ball. It is a time for incentivizing and supporting every aspect of America's innovation infrastructure, from basic research, applied research, long-term venture capital investment which fosters innovation and creates green jobs, and programs like CEDA, and other long term tax incentives that can foster the Green economy. The idea that venture capital—a green job creator, energy innovator, long term risk taker, and a large segment of the industrial base— should be supported and not be in a position of constant risk, especially at a time when policy makes are lauding innovation and asking for more investment in innovation. All aspects of the innovation economy need support to affect the change we need.

4. **Encouraging International Development:** Our goal for international development of green technologies should not be to try to recreate the innovation environment in the United States, nor to assume we can help create the major breakthroughs elsewhere, but to focus on applications development, manufacturing, and deployment. China, with its solar manufacturing, and Germany with its domestic solar market and manufacturing, are great examples of manufacturing and applications development and improvement of existing technologies. Those nations are not examples of the fundamental innovation in semiconductors that was based in the U.S., and of future innovations that will change the cost dynamics of solar and allow it to truly displace a large share of the world energy mix. Based on history and current projects we see in the labs around the world (which include the best labs in the EU, China, Japan, and the United States), major game-changing innovations will occur here in the United States, and the applications development and cost reduction can occur everywhere.

   The best way to facilitate deployment of fundamental U.S. innovation is to reward dispersion of technologies and incentivize cooperation. Compulsory action will hurt future innovation, and does not address either the capital or deployment issues, even with a breakthrough. Voluntary (and possibly subsidized) patent pools can help with incremental innovations, but does not solve the capital or deployment problems. A structure like the International Green Bank (see below), which rewards innovators who deploy their technology in developing countries, can help solve the capital deployment issues, and create jobs in the United States because the major innovations will emanate from here and healthy, international companies will be created. If we do not have a positive alternative that can help solve the problems realistically, we will end up in an unproductive debate over the red herring of intellectual property rights.

3) If you were to attend the climate change negotiations in Copenhagen in December, what message would you deliver to China and India's representatives relative to IPR?

We all have a common national goal of energy security, economic growth, and creation and implementation of carbon reducing technologies. It is in China's and India's interest, as well as in the best interest of the United States, to have major technological breakthroughs that alleviate the global competition for energy, and simultaneously reduce carbon with new energy innovations that are price competitive with current energy sources.

The only way that goal will be achieved is with major breakthroughs in energy technology. Technologies are currently being developed in the U.S. that can satisfy the goal of lowering carbon without harming the nation's economy, cutting jobs, or increasing costs for businesses. The U.S. has invested trillions of dollars in our R&D infrastructure, and will not give these technologies away. Even if the U.S. decided to try to compel businesses to license, it would be an unprecedented intervention into private markets that would stifle innovation.

Since there is a mutual incentive among China, India, and the United States to lower costs and lower carbon, the governments must cooperate to incentivize private business to deploy worldwide. This translates into investing substantial amounts of public dollars privately so that all stakeholders win if the technology succeeds and is widely dispersed. It also requires a high-level of government protection of IPR from infringement and significant, joint capital investment by the U.S., China, and India in United State's in technologies that are deployed within their borders, no matter where they have originated. Without joint investment, comes joint responsibility for IPR and for the deployment. Forums like the U.S./China Strategic & Economic Dialogue could be important for such efforts.

If China and India expect to further develop their own research infrastructure and strategic industries, they must respect existing agreements like the Treaty on Trade Related Aspects of Intellectual Property Rights (TRIPS). The importance of IPR in the energy debate is actually even more critical than that of other industries because of the huge investments that will need to be made and the complexity of the technologies. In addition, China and India's own efforts to build leadership in energy will never work without IPR protection of their own technologies. If we were to ask China if they are willing to share the IP for their solar technology industry, where they are a leader in manufacturing and deployment, the answer would and should be "no." Just as with United States' technology, other nations will respond to incentives to deploy in the developing world much more readily than penalties. Carrots will work better than sticks.

4) **Do you believe that IPR issues should be taken off the climate change discussion table in Copenhagen?**

The position of the United States should be clear — intellectual property protection provides an essential incentive for investment in the development of innovation, and efforts to devalue intellectual property are counterproductive to goals to address global warming. These efforts are also counter to U.S. interests. We have invested trillions in an innovation ecosystem that produces new technologies. The hundreds of billions more coming from the ARRA will never translate into green industries of the future unless there is a predictable and enforceable trading system that values intellectual property assets.

We will not and cannot enter into compulsory deals and all IP issues must be voluntary. We cannot sacrifice our children's future by allowing our crown jewel businesses to relinquish their lead and competitive advantage to China and India. Most less-developed countries do not have the capital or infrastructure to deploy new technologies without some subsidy. Therefore, giving IP to those countries without structure will be stripping the United States of its core competitive advantage to create the new green industries of the future.

Often we hear the argument that compulsory licensing is analogous to HIV drugs in Africa (which was solved by voluntary means). This is a misleading and dangerous comparison. While the medicines developed for AIDS cost billions to develop, as do breakthrough energy solutions which impact carbon, the total manufacturing costs of all these medicines for all the patients in Africa are less than a single biofuels refinery. Drugs, once produced, can be easily transported, and the marginal cost of providing medicines to Africa is small. The capital cost of deployment of large scale biofuels, wind, solar, and other advanced technologies can be tens of billions of dollars, and in the case of transportation fuels, those produced in one region may be transported to compete across borders.

Not only will compulsory licensing impact future investment in innovation in the United States, most of the developing world will not have the capital access to scale up the technologies even if they were given to them for free. The whole debate over compulsory licensing is missing the point and risks overlooking the real issues that need to be solved. The problem is deployment, scale, and capital access, not TRIP. The issue is being raised purely as a negotiating tactic by those who do not like the United States and EU position on carbon and feel that it will restrict growth. Thus, they are focusing on a provision that they know would cause the United States to mortgage its future to accept. We should stand up to it, and propose an alternative that is in everyone's interest.

These proposals would not benefit the poor. Even royalty bearing licenses would end up having the opposite result than what is intended. The poorest companies would have LESS capital invested because the resultant products could not be protected. Our competitors would take advantage of trillions of dollars of our own innovation to compete with us in applications, scale-up, and develop world projects with U.S. technology. Large scale transportation fuels technology transfer would benefit big multinational companies and countries with large capital reserves, which would use the developing world to deploy our advanced technology, keeping the spoils, and not enabling developing countries to profit.

Such scenarios also encourage companies to not release information on innovative technologies. The beauty of the patent system is that in exchange for patent rights, an inventor is required to publicly disclose the invention to the world. This enables other inventors everywhere to build upon this innovation and produce new technology. Closing off large parts of the world to patent rights would encourage companies to hoard technology. Patent licensing also sets the contract rules to facilitate technology transfer. The activists have it backwards. If your goal is to transfer technology, patents are not a barrier – they are essential.

5) **Would ARCH Venture partners continue to invest in new technologies as prolifically as it currently does if IPR were weakened in Copenhagen as a result of the demands of countries like China and India?**

ARCH Ventures would immediately reduce investing in greentech if we believed that compulsory licensing or weakening of the patent regime was a possible outcome of the December 2009 Copenhagen negotiations. We believe other venture investors would feel similarly. Even the serious consideration of such policies will have a material impact on investment, prior to actual enactment, due to the uncertainty that such a decision would have on future returns for venture investing. Greentech investors base investment decisions on the potential of international markets. Since most of these products (fuels,

energy) are transportable to some degree, enabling a competitor by requiring compulsory licensing of technology is akin to giving away a company's proprietary secrets. The cost of such a mandate would be borne by the innovators—and is a bad precedent if one believes our energy problems will be solved by future innovation.

6) **One of our witnesses today (Govi Rao) has proposed the creation of an IP clearinghouse/bazaar, as a means to assist innovators and their innovations? As a venture capitalist, what are your thoughts on that?**

Mr. Rao's proposal is worthy of consideration, as long as participation is voluntary. IP markets exist today and are an effective means of reducing transaction costs for mature industries with many incremental inventions like software and semiconductors. It is likely that small incentives on a world scale or even just market forces could attract private industry to invest in the energy area pool. It is also an area more fit for the nimble, transaction-oriented private sector, than large world government bodies.

Some proposals for "clearinghouses" have features that resemble patent pools. While patent pools may reduce transaction costs in some incremental technologies, they do not solve the problem of what to do with the breakthrough innovations which reduce carbon in ways that will significantly impact total carbon output. The inventors and holders of the true breakthroughs (likely companies in the United States) will be unlikely to contribute them to the pool because the return they could expect and the loss of control would not justify it, and also because they are likely to conclude that IPR is not a barrier, but a necessity to attract the large capital pools and deployment skills for scale-up in the developing world.

The key point to emphasize is that if there are truly the 5-10 breakthrough technologies that will change the climate equation, the economic incentive to broadly deploy those technologies is extremely strong. Additional incentives to move faster into the developed world can be created to accelerate the process of broad deployment further, but they must be voluntary.

7) **Mr. Nelsen, can you explain in a little more detail how you see the 'World Green Bank' working?**

The International Green Bank would be a public/private partnership funded by the G8 major industrialized nations, to provide incentives to deploy innovative green technologies in developing countries. The bank would provide loans guarantees and grants, similar to the current Senate legislation for the Clean Energy Deployment Administration (Green Bank), and analogous organizations such as OPIC, African Development Bank, and the Asian Development Bank.

The International Green Bank would provide loan guarantees and capital, which would be partially matched with private capital on a project basis, to private companies, foundations, states, or combinations thereof. The metric for obtaining grants would be based on: 1) net carbon reduction, 2) economic impact, 3) feasibility, and 4) level of long-term impact on emissions or beneficial re-use of carbon. The IGB would be independent of current United Nations structures, and would have its own Board comprised of representatives from member nations based on a ratio of contribution. The Board would administer and select private gatekeepers to qualify private, NGO, or public organizations for project funding.

Loan targets would be $400 billion over 20 years on a 5:1 leverage target (versus 10:1 for CEDA), which would represent a net contribution of $4 billion per year. Contributions would be proportional to GDP of the G8 member nations. A hypothetical example could be a breakthrough large-scale biofuel project in Africa, with technology from the United States, and funding project ownership from the home country, a major G8 sovereign wealth investor like China or India, additional private funding from the United States, and International Green Bank funding. Innovation is preserved, and all parties win.