RENEWING AMERICA'S FUTURE: ENERGY VISIONS OF TOMORROW, TODAY

HEARING

BEFORE THE

SELECT COMMITTEE ON ENERGY INDEPENDENCE AND GLOBAL WARMING HOUSE OF REPRESENTATIVES

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HEARING ON RENEWING AMERICA'S FUTURE: ENERGY VISIONS OF TOMORROW, TODAY

THURSDAY, JULY 31, 2008

HOUSE OF REPRESENTATIVES,
SELECT COMMITTEE ON ENERGY INDEPENDENCE
AND GLOBAL WARMING,
Washington, DC.

The committee met, pursuant to call, at 1:30 p.m. in Room 2325 Rayburn House Office Building, Hon. Edward J. Markey (chairman of the committee) presiding.

Present: Representatives Markey, Hall, Herseth Sandlin, Inslee, Cleaver, McNerney, Sensenbrenner, and Shadegg.

Staff Present: Jonathan Phillips

The CHAIRMAN. We welcome you all to the Select Committee on Energy Independence and Global Warming for this important hearing on Renewing America's Future: Energy Visions of Tomorrow, Today.

This country stands at the precipice of a renewable energy revolution. Electricity generated from wind, and solar is flooding onto the grid at exponential rates. U.S. industry is retooling their facilities for mass production of hybrid and plug-in cars and trucks. Some of the same scientists that mapped the human genome have turned their genius to putting grasses, crop waste and algae into our gas tanks. The entrepreneurs and financial markets get it. Communities like Newton, Iowa, where wind blades are now produced by the same blue collar workers left unemployed when Maytag left town, are living the renewable energy revolution.

But Big Oil and its dreams die hard. President Bush is still continuing to block tax incentives for renewable energy and holding it hostage to Big Oil's drilling agenda. They refuse to look at the future and stubbornly hold onto policies that belong in the last century. One can understand why, because the oil allies of the two oilmen in the White House are doing very well, while the American consumer is getting tipped upside down.

This morning Exxon Mobil announced the largest quarterly profits in corporate history, raking in nearly $12 billion in profits in just the last 3 months. Analysts estimate that when 2008 profits are fully counted, all that consumer pain will add up to $160 billion in profits for the big five oil companies. This is all great news for the old guard and their supporters in Congress.

But Americans suffering with high energy prices know that old policies don't work anymore and a change is needed. Change is needed to end our addiction to high priced oil and change is needed to curb our emissions of dangerous greenhouse gasses.

Today we are fortunate to have a group of visionaries here to share with us how technology already in existence is poised to transform America's energy future.

These are not pie in the sky dreams. The technology already exists to power much of our auto fleet with clean electricity. With the right Federal policies, that transition will happen many years before oil from the Alaskan National Wildlife Refuge could possibly come online. Huge 10 megawatt wind turbines will churn out energy from deep offshore locations, long before oil platforms possibly could.

The creative thinkers of the world have been laying the foundation for this energy transition for years, and even decades. All that remains in the way is Big Oil and the old guard protecting them.

The American economy has a major leak. This year more than half a trillion dollars will gush from that leak and float into the coffers of foreign governments. It is time to plug this growing hole and redirect these energy dollars from hostile foreign governments to blue collar American workers. This will put millions of Americans back to work, rejuvenate the economy and strengthen our national security.

The term "disruptive technology" is one we will probably hear frequently today. It has been one that I encounter a lot in the telecommunications and Internet hearings that I chair. It represents a paradigm shift. It represents what is possible by working smarter instead of harder. It is what some of the visionaries here today have dedicated their careers to. But for some people getting rich off the status quo, disruptive technology represents a threat, and from this group we must expect a political struggle for America's energy future.

We are comforted by the harsh reality that our planet is undeniably warming. This dictates that carbon-free renewable energy will inevitably win out. The question that remains is whether America will be at the forefront of this once in a generation economic opportunity or whether we will cede these benefits to the global leaders of tomorrow.

This is going to be a very important hearing. I now turn and recognize the ranking member, the gentleman from Wisconsin, Mr. Sensenbrenner.

[The prepared statement of Mr. Markey follows:]

Statement of Representative Edward J. Markey

"Renewing America's Future:
Energy Visions of Tomorrow, Today."

July 31, 2008

This country stands at the precipice of a renewable energy revolution. Electricity generated from wind and solar is flooding onto the grid at exponential rates. U.S. industry is retooling their facilities for mass production of hybrid and plug-in cars and trucks. Some of the same scientists that mapped the human genome have turned their genius to putting grasses, crop wastes, and algae into our gas tanks. The entrepreneurs and the financial markets get it. Communities like Newton, Iowa—where wind blades are now produced by the same blue collar workers left unemployed when Maytag left town— are living the renewable energy revolution.

But Big Oil dreams die hard. President Bush and Republicans in Congress continue to hold tax incentives for renewable energy hostage to Big Oil's drilling agenda. They refuse to look to the future and stubbornly hold on to policies that belong in the last century. One can understand why, because the oil allies of the two oil men in the White House are doing very well, while the American consumer is getting tipped upside down.

This morning, ExxonMobil announced the largest quarterly profit in corporate history, raking in nearly $12 billion in profits in just the last 3 months. Analysts estimate that when 2008 profits are fully counted, all that consumer pain will add up to $160 billion in profits for the Big Five oil companies. This is all great news for the old guard and their supporters in Congress.

But Americans suffering with high energy prices know that old polices don't work anymore and that change is needed. Change is needed to end our addiction to high-priced oil and change is needed to curb our emissions of dangerous greenhouse gases.

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The American economy has a major leak. This year, more than half a trillion dollars will gush from that leak and flow into the coffers of foreign governments. It is time to plug this growing hole and redirect these energy dollars from hostile foreign governments to blue collar American workers. This will put

millions of Americans back to work, rejuvenate the economy, and strengthen our national security.

The term "disruptive technology" is one we will probably hear frequently today, and one that I encounter a lot in the telecommunications and Internet hearings I chair. It represents a paradigm shift. It represents what is possible by working smarter instead of harder. It is what some of the visionaries here today have dedicated their careers to. But for some people getting rich off the status quo, "disruptive technology" represents a threat. From this group we must expect a political struggle for America's energy future.

We are confronted by a harsh reality: our planet is undeniably warming. This dictates that carbon-free renewable energy will inevitably win out. The question that remains is whether America will be at the forefront of this once-in-a-generation economic opportunity, or whether we will cede these benefits to the global leaders of tomorrow.

And now I would like to recognize the Ranking Member of the Select Committee, the gentleman from Wisconsin, Mr. Sensenbrenner.

Mr. SENSENBRENNER. I thank the Chairman. I am going to do what the staff always fears, and that is ask unanimous consent that my opening statement get put in the record.

The CHAIRMAN. Without objection, so ordered.

[The prepared statement of Mr. Sensenbrenner follows:]

Mr. Sensenbrenner's Opening Statement for Select Committee on Energy Independence and Global Warming hearing: "Renewing America's Future: Energy Visions of Tomorrow, Today."

July 31, 2008

(Not Delivered)

Since the inception of this select committee last year, I have advocated that anything Congress does to confront climate change should measure up to certain common-sense principles.

Congress should not jeopardize jobs or the economy with burdensome climate change legislation, including what I like to call cap-and-tax, which has already been rejected by the Senate this congressional session. Nor should it pass legislation that fails to make measurable improvements in environmental quality. Certainly, Congress shouldn't require drastic and expensive cuts in greenhouse gas emissions in the U.S. if emerging economic powerhouses like China and India don't make the same commitments.

However, I believe our country can confront climate change and help secure our energy future while still complying with these principles. But only technology can provide the path to reach these goals.

Today's hearing will highlight a few of the promising technologies that are on the horizon.

Hybrid automobile technology holds enormous potential to help reduce demand for gasoline, and I think Congress should encourage its development. Earlier this month, the Science Committee passed a bill I introduced that will establish the first-ever Department of Energy grant for the development of hybrid and plug-in hybrid trucks.

There are fewer trucks on the road than cars, yet trucks consume 48 percent of the fuel America uses for ground transportation. In addition, industries turn their fleets over faster than consumers do their cars, so hybrid-truck technology can be adopted more quickly, and its benefits can be realized sooner. When it comes to reducing fuel use, it is trucks, not cars, that are the low-hanging fruit.

I believe the best way for the federal government to support technological innovation is to incentivize it through research and development grants and tax credits. Regulations cannot assure technological breakthroughs, especially expensive and onerous mandates like the cap-and-tax proposals that have been introduced.

Furthermore, while it's never bad to look to the future, we must always be mindful of the present, and right now, the present includes high gasoline and energy prices that are pinching people and industry alike. Just yesterday, this select committee heard how

important natural gas will be to the country's economic and energy future. This is just one of the fossil fuels we will continue to need more of in the future to sustain our energy needs and economic growth.

And yes, oil is another fossil fuel we will continue to need in the future. In its comprehensive 2007 report called Hard Truths, the National Petroleum Council said that it will take more than oil and natural gas to meet the future worldwide energy demand, and that development of all types of new technologies were essential. However, the report emphasized that oil and natural gas would have to remain a key part of the worldwide energy picture throughout the foreseeable future.

Former Vice President Al Gore recently proposed ending all CO2 emissions in 10 years. That's as realistic as me winning the 100 meter dash at this year's Olympics. I don't think it helps to propose unrealistic and wholly unworkable plans to confront climate change or secure our energy future. We have to be realistic.

That's why in addition to supporting research and development funding, I also support strengthening the U.S.'s energy production capability by expanding exploration and production to many areas that are likely to have oil and natural gas, but are currently under Congressional moratoria, including the Outer Continental Shelf.

A strong majority of Americans support expanding our oil and natural gas production and dropping the Congressional moratoria on energy exploration in certain areas of the country. If given a vote, Congress will approve a plan to expand environmentally-safe drilling and energy production.

And I think the American people would approve too. It's time for Congress to act on this important issue and I urge Speaker Pelosi to let us vote on this, so that we can provide a secure energy future for our nation.

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Mr. SENSENBRENNER. And I am going to talk extemporaneously. What you heard from the chairman is a prescription for economic disaster for this country. And a lot of the debate on what we do about our energy problem, which everybody concedes exists, is an us versus them philosophy. And the chairman has been one of the most eloquent proponents of us versus them and we just heard about 5 minutes worth of that in his opening statement.

The way we get ourselves out of the barrel that we are in now is not by taking anything off the table, but by the Congress acting in a leadership role to come up with market driven, balanced energy policies. And this is not a balanced energy policy, but it is a package of pay offs to special interest groups that have good lobbying organizations. Something that will say that whatever we can do to increase our energy supply with either traditional sources of energy or alternative sources of energy is what we need to do to get out of a situation which will be economic catastrophe if this is not addressed.

And the reason I say that this has to be market driven is that if Congress comes up with something that is more expensive than the current energy alternatives, the market is going to work and Congress' regulation is just going to make less energy flow to our consumers and at a higher price. So we need to have common sense alternatives.

What we are going to be hearing today are some of the common sense alternatives, and I don't criticize any of the witnesses here today, but the attitude of exclusivity and pointing fingers at one another is going to mean that nothing meaningful passes.

Yesterday we had a hearing talking about natural gas. And natural gas is the cleanest burning fossil fuel that we have in great supply here in this country. But if we emphasize natural gas at the expense of coal, we are going to end up driving up the price of natural gas, which a goodly number of our people in this country heat their houses with. And if we have a cap and tax response to climate change issues, which the majority party seems to be moving toward, we are going to have the market make choices based upon how much in carbon credits or how little in carbon credits you have to buy, and there are going to be winners and losers.

Now, I have heard a lot of talk about how we can put together major energy legislation where everybody is a winner. Folks, that ain't going to happen and I think we all know it. And people who say that we can draft energy legislation with no winners and losers I think are deluding themselves and deluding those who listen to what they have to say and believe it.

The fact of the matter remains that if we want to fuel a $14 trillion economy, we have to do it in a balanced manner. We shouldn't take anything off the table. We shouldn't regulate it. We shouldn't say that Congress knows best because the market and the people of this country who participate in that market collectively know a lot better than the 535 of us who have been elected to the Congress of the United States.

I thank the gentleman and yield back.

The CHAIRMAN. A frightening thing just occurred here, ladies and gentlemen, and I just wanted to comment upon it as the gentleman from Wisconsin has——

Mr. SENSENBRENNER. Well, I yield the balance of my time to the chairman.

The CHAIRMAN. I thank the gentleman. I just wanted to point out that congressional staffers everywhere are petrified that a Congressman just finished a 5-minute statement where all sentences parsed and had a beginning and a middle and an end, and that threatens job security everywhere.

Mr. SENSENBRENNER. Reclaiming my time, I got an A in English.

The CHAIRMAN. So let me turn now and recognize the gentleman from New York, Mr. Hall.

Mr. HALL. Thank you, Mr. Chairman and Mr. Ranking Member. I am looking forward to our testimony, welcome our witnesses. And I would say if we have learned anything over the last few months and years it is in fact that the market, at least under the current administration, has not solved our problems and in fact has been part of the equation that has pushed up prices to the point where people in my district are seriously concerned about home heating oil in the coming months. They are seriously concerned about the cost of gasoline for their cars. Many of them are already adopting, even those who are not so-called early adopters because they are not particularly wealthy, but they are already adopting alternative technology such as geothermal, solar and other renewables.

But we know that our relationship with energy is going to change one way or another. The sky high prices that have plagued America's drivers and undermined our economy are something that is wrong and we need to fix. And we have two choices, the policies of the past or the future. The other side of the aisle has made a vigorous argument for pursuing the policies of the past. Their none-of-the-above energy policy would reject every solution that doesn't involve old disproven drilling plans.

And by the way, I did get to speak to the chairman of Chesapeake Energy yesterday, one of the biggest oil and gas producers in the country. And I asked him is Congress, are we holding you and the natural gas industry back from drilling anywhere? Do you have enough places to drill? And he said, yes, we do, that is not our problem. We are discovering new fields all the time and we are happy with the available land for leasing today. So I would be curious to ask the same question of the oil companies.

Anyway, even T. Boone Pickens, one of the original oil wildcatters, admits that we can't drill our way out of a crisis. In fact, he said he is more excited about wind power today than he has ever been about any other oil field that he has ever discovered.

So change can happen and we are in the middle of it, and I hope you make the right choice. The time is now and we cannot fail.

I yield back.

The CHAIRMAN. Thank the gentleman very much. That completes the time for opening statements from members. We are going to turn to our very distinguished panel.

[The prepared statement of Ms. Blackburn follows:]

Ms. Blackburn's Opening Statement for Select Committee on Energy Independence and Global Warming hearing: "Renewing America's Future: Energy Visions of Tomorrow, Today."

Mr. Chairman,

Thank you for holding this hearing and I want to thank the witnesses for testifying before this committee on the future of energy in America.

American consumers are hurting from the price at the pump and are looking to alternatives to fuel and car types to save money.

Some consumers are buying flex-fuel and hybrid cars, and some are eagerly waiting for plug-in hybrids and electric cars.

I have several car manufacturers in my district who are responding to this demand. For example, Nissan recently announced their production of electric cars in 2010; and Toyota's Prius is becoming more and more popular in the market.

And these actions are driven by supply and demand from the market.

Some of my colleagues, however, advocate for Congress to mandate production of these vehicles.

Congress should not interfere in the market demand for certain vehicles. It should be left to the private sector to decide which vehicles to make.

Mr. Chairman,

Congress should not pick winners or losers in new energy technologies.

It should, instead, encourage and reduce regulatory burdens for inventors and entrepreneurs to develop the next generations of new energy technologies.

I yield the balance of my time.

[The prepared statement of Mr. Cleaver follows:]

U.S. Representative Emanuel Cleaver, II
5th District, Missouri
Statement for the Record
House Select Committee on Energy Independence and Global Warming Hearing
"Renewing America's Future: Energy Visions of Tomorrow, Today"
Thursday, July 31, 2008

Chairman Markey, Ranking Member Sensenbrenner, other Members of the Select Committee, good afternoon. I would like to welcome our distinguished panel of witnesses to the hearing today.

Emerging clean energy technologies like plug-in hybrids and biofuels have the power to wean our society off foreign energy sources, while at the same time reducing harm to the environment and public health. Utilizing American-grown fuels like ethanol can play an important role in forming our new energy portfolio. I am sure that my colleagues of the Select Committee have heard me talk about my district mobile office, which travels the Fifth District of Missouri powered by fast food grease. This may sound unusual to some people, but it is part of a growing trend in utilizing new, creative methods to produce energy from previously unlikely sources. Used grease is actually becoming a commodity that is so in-demand that there have been reports of it being stolen from fast food restaurants.

Americans are ready for an oil change. My constituents from Kansas City, Missouri ask me why Congress has not become serious about investing in renewable sources. It is long past time to show that we are committed to encouraging such investment, and I hope that the panel today can answer some of our questions about what truly is the "future of energy" for our country.

I thank all of our witnesses for their insight and suggestions, and I appreciate them taking the time to visit with our committee today.

Thank you.

Our first witness is Cathy Zoi, who is the founding CEO of the Alliance for Climate Protection, a nonprofit organization pushing for broader education on climate change. She has extensive experience in the environmental and energy sectors. She has been profiled as a global warming warrior and hero by Rolling Stone Magazine. We are honored to have you here. Whenever you are ready, please begin.

STATEMENT OF CATHY ZOI, CHIEF EXECUTIVE OFFICER, ALLIANCE FOR CLIMATE PROTECTION

Ms. ZOI. Thank you very much. And members of the committee, thank you for the opportunity to appear today. Thank you for your continued leadership.

The CHAIRMAN. Can you turn on your microphone, is that possible?

Ms. ZOI. Thank you for your continued leadership on this issue, which is perhaps the most important challenge facing the country.

As mentioned, I am Cathy Zoi, CEO of the Alliance for Climate Protection, a nonprofit organization focused on solving the climate crisis and mobilizing millions of Americans through the We Campaign. Our bipartisan Board of Directors is chaired by Al Gore.

Many Americans have a hard time thinking about our energy future, largely because their energy present is so challenging. Gas prices are hovering near $4 a gallon, electricity and heating bills are up as well, and the economy is struggling with the burden of imported oil, insecurity over future energy supplies, the urgent need to address climate change, and our troops under fire today in part due to our need to satisfy the Nation's oil appetite.

To solve these problems we must repower our economy, fast. Vice President Gore has issued a challenge for us to do just that, to generate 100 percent of our electricity from truly clean sources that do not contribute to global warming and to do so within 10 years. It is an ambitious but obtainable goal. American know-how and an industrious workforce are up to it.

Meeting this challenge will deliver affordability, stability and confidence that our economy needs, as well as a healthy environment, and it will generate millions of good American jobs that can't be outsourced, investing in clean energy technologies here at home by people's good hard work.

Meeting the challenge to repower America will involve simultaneous work on three technical fronts: One, get the most out of energy we currently produce; two, rapidly deploy the clean energy technologies we already know can work; and three, create a new, smart, integrated grid to deliver power economically from where it is generated to where people live.

The first front is about energy efficiency. The potential is vast and largely untapped. Now is the time to commence a comprehensive national energy upgrade that will reduce the energy bill of homeowners and businesses, even as cost of energy supplies may be on the rise.

The second front in meeting the repower America challenge, the expanded use of existing generation technologies, has a number of pieces. It will include accelerated growth in our wind energy industry. We have a strong running start. The U.S. was the leading in-

staller of wind technology last year. T. Boone Pickens says we can get at least 20 percent of America's electricity from wind power. We think he is right.

Solar thermal power is also booming and poised for rapid acceleration. The resource potential is so vast that a series of collectors in the American Southwest totaling just 92 miles on a side could power our entire electricity system. Utilities in Arizona, Nevada and California have already begun to tap this potential with plans for powering nearly 1 million homes already underway. And advances in thermal storage technologies, along with investments in our grid mean solar thermal power will be able to provide electricity at night, like coal power does today.

Other energy sources will play a role as well. Nuclear and hydroelectric power currently, combined, contribute roughly 25 percent of America's electricity, and that will continue. Coal and natural gas can play a significant role by capturing and storing their carbon emissions safely. Our hope is that CCS emissions technology can be developed and commercialized quickly. Coal isn't clean without it.

There are reportedly a few CCS plants now proposed in the U.S., although another roughly 70 proposed coal plants have no such plans to capture their carbon pollution. This must change.

The third front to repower America challenge is the creation of a unified natural electricity grid. A supersmart grid will form the backbone and entire skeleton of our modern power system. Efficient high voltage lines will move power from remote resource rich areas to places where power is consumed. It will also allow households to make money by automatically using energy at the cheapest times, and sell electricity back to the grid when they can. A smart meter spins both ways.

Now what about the money for meeting this 100 percent clean power challenge? It will require a one-time capital investment in new infrastructure, with a bulk of funding coming from private finance. If policies reward reducing global warming pollution, private capital will flow towards clean energy solutions.

But the most important cost figures to consider may be the ones we will avoid. American utilities will spend roughly $100 billion this year on coal and natural gas to fuel existing power plants, and they will spend more next year and the year after that, until we make the switch to renewable fuels that are free and limitless.

Now why a 10-year challenge? The science, the economic pressures and our national security concerns demand swift, concerted action. The best climate scientists tell us we must make swift progress to turn the corner on global carbon emissions or the ecological consequences will be irreversible.

Second, the solutions are available now. We will hear from the fellow panelists. There are no technology or material impediments. We can and must seize this moment. Failing to move swiftly will deprive the U.S. economy of earnings from one of the fastest growing technology sectors in the world. Let's get going.

We have done this before. We mobilized the auto industry in 12 months to service the hardware needs of World War II. The Marshall plan to reconstruct Europe was executed in 4 years. And as Vice President Gore pointed out, we reached the Moon in 8 years,

not 10. We can do this. I am hopeful that with your leadership we will accept the challenge of building a safe, secure and sustainable energy future.

Thank you.

[The prepared statement of Ms. Zoi follows:]

Testimony of Cathy Zoi
Chief Executive Officer of The Alliance for Climate Protection

Before the House Select Committee on Energy Independence and Global Warming
For Delivery, July 31, 2008

Mr. Chairman, members of the Committee, thank you for the opportunity to speak with you today and thank you for your continued leadership on an issue that I believe is at the core of the most important challenges facing our country.

I am Cathy Zoi, CEO of the Alliance for Climate Protection, a nonprofit communications and grassroots organization focused on solutions to the climate crisis. Our bipartisan Board of Directors is chaired by Al Gore

Many Americans have a hard time thinking about our energy future, largely because their energy present is so challenging. With gas prices hovering near $4 per gallon, families have sustained an economic stomach punch. Gasoline prices are just the tip of the iceberg: Coal prices have skyrocketed and natural gas prices have spiked as well. Global demand for these resources is growing putting upward pressure on prices. We can now see very clearly that the suite of fossil fuels that have been the staples in our energy supply will continually be subject to wild swings in prices. And as global demand for them increases, so too will the prices consumers must pay. Staying on our present track is an invitation to sustained higher prices, greater economic uncertainty and more difficulties for American families and businesses.

Our energy policy is of course linked to our foreign affairs and defense policies. This is for one very obvious reason: dependence on foreign oil. And while our troops are under fire today for a variety of reasons, not least among them is our need to satisfy the Nation's oil appetite. Intervening in such perilous regions will be difficult to avoid unless or until we find new ways to power our economy. And there is another security element linked to energy. Last year, testifying to this Committee, retired General Gordon Sullivan described changes in food production, losses of water supplies and massive human migrations that could result from unchecked global warming. To avoid those impacts, the best first step is to reduce our carbon emissions.

Our future energy vision should be shaped by what we see today in new weather patterns. A parched American West is burning today. That disaster follows fast on a spring when floods soaked the Midwest. Those are the extremes that will continue to result from the climate crisis. And it is a crisis. The Congress has debated measures that include targets set for the years 2040 or 2050; and those are worthy debates. But the best climate scientists tell us we must make very swift progress – in the next five to ten years – in leveling off global carbon emissions. Failing to move swiftly will make those more distant targets impossible to hit. Failing to move swiftly will deprive the U.S. economy of earnings from one of the fastest growing technology sectors in the world. Failing to

move swiftly will affect every child living today, and will diminish the joys they might find by tapping a New England sugar maple, strolling through giant Sequoias in the Sierra or paddling past a moose cow and calf in Minnesota's Boundary Waters.

When we try to address these problems at once – a struggling economy, national security challenges linked to oil, and increasingly evident impacts of climate change – we tend not to get solutions. We can even make these problems worse.

What we have come to realize is that these problems may best be solved – or may only be solved – when we consider them together. There are times when reaching for more can improve the prospects for success. That's why we're convinced that the time for incremental steps and distant targets has passed. It's time to consider a goal that is on the same scale as the problems we face. It is time to consider a goal that draws out the best in America – in her leaders and in her people.

Vice President Gore has issued such a challenge: To generate 100% of our electricity from truly clean sources that do not contribute to global warming – and to do so within ten years.

It is an ambitious but attainable goal. That might not be so if this challenge were issued elsewhere. But we think American workers, families and businesses can meet this goal. We think they would be thrilled to do so. They'll embrace the challenge. They'll also be grateful for the relief. If we remain on our current path, the old days of dependable cheap energy will be gone for good. Moving instead to the path toward free fuels would offer the affordability, stability and confidence our economy desperately needs. And, as I will discuss, it will generate tens of thousands of good American jobs that can't be outsourced.

Meeting the challenge to repower America will involve simultaneous work on three technical fronts. One, get the most out of the energy we currently produce. Two, rapidly develop and commercialize the clean energy technologies that we already know can work. Three, create a new integrated grid to deliver power from where it is generated to where people live.

The first front is about energy efficiency. By helping American families save energy in their homes, we reduce demand and eliminate the need for more traditional power plants. We help families save money on their energy bills. We improve productivity of our factories and businesses, and comfort in our buildings. We give every American family a chance to directly participate – they can play a role in meeting this great challenge. A project of the Lawrence Berkeley National Laboratory, begun after the California energy crisis in 2001, showed that the average family can save 20% in energy use with existing technologies. These are the simple changes – lighting, thermostats, insulation – and don't even include the sizeable savings that would come with new appliances.

The second front, the expanded use of existing technologies, would likely start with accelerated growth in our wind energy industry. We have a strong running start. The

wind industry in this country has been growing at an annual rate of more than 20% a year, leading the world in installations in the past three years, and it will be even higher this year. T. Boone Pickens says we can get 21% of America's electricity from wind energy. We think he's right – and we might be able to get more. The Bush Administration's DOE recently provided a roadmap for achieving 30% of U.S. electricity from wind power.

Expanded use of tried and tested renewables would also involve accelerated growth in the photovoltaic sector. This industry has grown at 40% per year since 2000. The supply issues that slowed this industry in the past are no longer obstacles. Industry experts expect a four-fold increase in global production capacity for solar cells – from 90 to 100 lines in 2007 to as many as 400 lines by 2010 – each capable of 1 megawatt of production capacity.

This second front would also involve solar thermal power in the American southwest – an industry that is just beginning a period of explosive growth in both installations and manufacturing. With some of the best solar resources in the world, one company has calculated that a parcel of land in the southwest, 92 miles on a side, could power our entire electricity system. Utilities in Arizona, Nevada, and California have already announced nearly one million homes worth of solar thermal power projects to be built in the next several years. And advances in thermal storage technologies, along with investments in our grid, mean that solar thermal power will be able to provide baseload electricity at night, like coal power does today.

We must also continue expansion in geothermal energy – a mature technology and an abundant resource – as well as growth and commercialization of exciting emerging technologies using nanomaterials for solar power, wave, current, and tidal power, fuel cells, batteries, and other advanced energy systems.

The third front would involve an upgrade of our national electrical grid, which is vital to a clean and reliable electricity system. Today our grid is vulnerable, and geographically isolates our energy resources from our load centers. A smart national unified grid would allow us to efficiently carry large amounts of electricity over long distances in a network that is resistant to failure. It would allow us to connect solar power in Arizona with manufacturing centers in Ohio or allow us to move evening wind power on the East Coast to late afternoon peak demand in Nevada. A super smart grid will also allow households to sell electricity back to the grid from power generated at their homes or stored in their plug-in vehicles - a smart meter can spin both ways.

Other energy sources would play a role as well. Nuclear and hydroelectric power facilities currently combine to contribute roughly 25% of America's electricity. It would be reasonable to assume they would continue to produce at that level ten years from now, and longer. Coal and natural gas, which currently produce much of our electricity, could continue playing a significant role, but only if power plants relying on these fuels can capture and store their carbon emissions safely. Our hope is that this "CCS" emissions technology can be developed and commercialized quickly. Coal isn't "clean" without it.

There are reportedly three to five CCS plants now proposed in the U.S, compared to the roughly 70 proposed coal plants that don't include plans to capture their carbon. For coal to have a continued role in the power mix, all plants must capture their carbon pollution.

Accomplishing this 100% clean power goal would require a one-time capital investment in new infrastructure, with the bulk of funding coming from privately-financed sources. When the rules change, investors look for the safest haven for their capital. If the rules reward reducing global warming pollution, private capital will flow towards that safe haven. Smart investors have already recognized this inevitability – 2008 will be the fourth year in which more capacity was added to the grid from wind plants than from coal plants. The smart money is already moving.

The most important cost figures to consider may be the ones we'll avoid. American utilities will spend roughly $100 billion on coal and natural gas for electricity this year. It's no stretch at all to project an increase in those costs to $150 billion annually in ten years – and the costs could ultimately be much higher. If we make a switch to renewable energy sources, we no longer pay those fuels costs. The production and transmission of electricity will have costs associated with it, as is true today. But the actual fuel would be free and limitless. No foreign policy engagements to secure access to the fuel.

Tens of millions of new jobs can be expected as we implement a clean electricity system. These domestic jobs range from manufacturing, construction and installation, to engineering design and material science. And any shift should also be accompanied by programs to ensure fairness and enable a seamless transition. By commencing now, we can ensure that new jobs and training are available for workers across the country, and that clean energy industries move into communities most affected by any changes.

We've had many people ask about the timing of the ten-year "Repower America" challenge, and we have two direct responses. First, there are no technology, material or know-how impediments to achieving this goal. We can do this if we choose to do it. Second, the science, the economic pressure on American families, and our military personnel engaged overseas all either demand or deserve this swift and concerted action. To those who may doubt, I'll note that we've done this before. The Marshall Plan, the veritable reconstruction of the European economy, was executed over a four-year period. As Vice President Gore pointed out, we got to the moon in eight years, not ten. We can do this. We've done it before.

We have a choice. We can stay on the current path and rely on fuels that are subject to price swings and supply interruptions. Or we can move deliberately to a path that leads to free fuels and a great level of security. We cannot delay this. This is an ambitious goal. But a great nation can do great things. And a great nation should be willing to lead the way to a new energy economy. I'm hopeful that, with your leadership, we will accept the challenge of building a safe, secure and sustainable energy future.

Thank you.

The CHAIRMAN. Thank you, Ms. Zoi, very much.

Our second witness is Dr. Gregory Yurek, the founder, chairman, and CEO of American Superconductor Corporation, previously a professor at MIT and cofounder of their corrosion laboratory. His expertise in advanced materials has led to critical developments in energy systems and efficiency.

We look forward to your testimony, sir.

STATEMENT OF DR. GREGORY YUREK, FOUNDER, CHAIRMAN, AND CEO, AMERICAN SUPERCONDUCTOR CORPORATION

Mr. YUREK. Good afternoon, Mr. Chairman, and——

The CHAIRMAN. Turn on your microphone, please.

Mr. YUREK. I think it is. Good afternoon, Mr. Chairman and House committee members. It is a pleasure——

The CHAIRMAN. Hold on.

Ms. ZOI. Try mine.

Mr. YUREK. Good afternoon. It is a pleasure and honor to come before this committee and speak about the critical energy independence issues facing our country.

If our Nation is to continue to thrive, we must embrace new technologies that will increase our energy independence and strengthen our electricity infrastructure.

American Superconductor is a leading provider of energy technologies for the power grid and alternative energy sectors.

Before I proceed further, I would like to ask you to examine the copper cables that are in my left hand here and the superconductor wires manufactured by my company in my right hand here. Similar wire bundles are available for you to be looking at and they will be passed around. These few hair thin superconductor wires carry as much power as all of this copper that has transmitted power since the days of Thomas Edison. In fact many power cables in the U.S. grid are about a century old.

I submit that we will not solve our country's difficult energy problems with 100-year old technology. After 2 decades of development, superconductors are beginning to play a key role in powering their homes and businesses. Superconductor power distribution cables have been operating in the power grids in Albany, New York, Columbus, Ohio for 2 years now. And just a few months ago we energized the world's first superconductor power transmission cable system in a commercial power grid on Long Island.

The poster you see here shows the three conduits. That would be over here. One of the posters on your right, left-hand side shows three conduits for the superconductor power cables and the installation process on Long Island. This cable system, these three cables are able to carry 574 megawatts of power, enough to power 300,000 homes in just a 4-foot right-of-way. This is a far, far smaller right-of-way than the 300 feet needed to transmit the same amount of power by conventional overhead lines in that same picture.

To put this all in perspective, you only need seven of these electricity pipelines to carry all of the power that will be generated by Mr. T. Boone Pickens first 4,000 megawatt wind farm. These electricity pipelines can and should be a part of our drive to energy independence and reduce power plant emissions.

American Superconductor, with the support of Departments of Energy, Defense, Homeland Security, has led the world in the development of this revolutionary energy technology for more than 20 years. I am pleased to report that during this period American Superconductor has invested over $800 million in developing and employing its energy technologies, over two-thirds of which have been from private financing.

This collective private and public investment has produced breakthrough technologies that are ready to power our 21st century economy. Given the power density advantage you see and even feel when you actually feel these wires and cables, it is going to carry 10 times more power through cables of the same size made with copper. This is a tremendous benefit for our cities where power demands continue to rise rapidly and underground real estate is severely congested.

Grid modernization with superconductor cables and other energy technologies, including advanced power electronic converters we also manufacture, will provide the capacity needed for the wide use of plug-in electric vehicles. They also will reduce the likelihood of blackouts such as the one that hit the Northeast in 2003.

In addition, superconductor cables can add a layer of defense in the grid to protect our centers of commerce from severe weather or intentional acts of destruction. The superconductor cable project we are currently working on for Consolidated Edison's grid in New York City, for example, is the first leg of what will be the Internet of power in Manhattan and cities around the U.S.

Superconductor technology is also being applied in a significant way to zero emission wind generated electricity. We have in fact begun work on a program to effectively double the power capacity of today's wind turbines utilizing the power of superconductors. The largest wind turbines on the market today are rated at 5 to 6 megawatt. The generators in these turbines are massive, weighing hundreds of tons. In fact, they are so large you cannot even carry them over the roads. Superconductor technology is able to break through that by using this power density advantage to shrink down the size of the generators so that we can actually migrate over to 10 megawatt wind turbines. The impact, to put this in perspective, a single 10 megawatt turbine could provide electricity for thousands of homes and eliminate 15,000 tons per year of CO_2 generated by the mix of fossil plants in use today.

We will soon be taking the next phase of this project forward, which is to design the complete wind turbine and then build and test a prototype before commercializing the wind turbine. Our work will demonstrate that superconductor technology is the disruptive technology needed to significantly reduce the cost of wind power and enable broader deployment of this zero emission form of electricity.

In summary, superconductor technology is a fundamental weapon in our arsenal to lower the cost of energy, reduce harmful greenhouse gas emissions, and meet the goal of having wind supply 20 percent of our electricity needs by 2030.

I thank you for your time and attention.

[The prepared statement of Dr. Yurek follows:]

Select Committee On Energy Independence And Global Warming Hearing
July 31, 2008

Greg Yurek, Founder & CEO, American Superconductor Corp.

Good morning, Mr. Chairman and House Committee Members. It's a pleasure and an honor to come before this Committee and speak about the critical energy and global warming issues facing our country. If our nation is to continue to thrive, we must embrace new technologies that will increase our energy independence and strengthen our electricity infrastructure.

American Superconductor is a leading provider of energy technologies for the power grid and alternative energy sectors.

Before I proceed further, I would ask you to examine the copper cables in my left hand and the superconductor wires manufactured by American Superconductor in my right hand. Similar wire bundles are being passed among you.

These few, hair thin superconductor wires carry as much power as all of this copper. Copper has been the way we have transmitted power since the days of Thomas Edison. In fact, many power

cables in the U.S. grid are about a century old. I submit that we will not solve our country's difficult energy problems with 100-year-old technology.

After two decades of development, high temperature superconductors are beginning to play a key role in powering our homes and businesses. Superconductor power distribution cables have been operating in power grids in Albany, New York and Columbus, Ohio for two years now. And, just a few months ago, we energized the world's first superconductor power transmission cable system in a commercial power grid on Long Island, New York. The poster you see here shows the three conduits for the superconductor power cables during the installation process.

This cable system is able to carry 574 megawatts of power – enough to power 300,000 homes – in just a four-foot right of way. This is a far smaller right of way than the 300 feet needed to transmit the same amount of power by conventional overhead lines.

To put this in perspective, you only need seven of these "electricity pipelines," to carry all of the power that will be generated by Mr. T. Boone Pickens' first 4,000 megawatt wind farm. These

electricity pipelines can and should be a part of our drive to energy independence and reduced power plant emissions.

American Superconductor, with support from the Departments of Energy, Defense and Homeland Security, has led the world in the development of this revolutionary energy technology for more than 20 years. I am pleased to report that during this period, American Superconductor has invested over $800 million in developing and deploying its energy technologies, over two-thirds of which has been from private financing. This collective private and public investment has produced breakthrough technologies that are ready to power our 21st century economy.

Given the power density advantage you see and even feel here, power cables made with superconductor wire are able to carry up to 10 times as much power as traditional copper cables. This is a tremendous benefit for our cities, where power demands continue to rise rapidly and underground real estate is severely congested.

Grid modernization with superconductor cables and other energy technologies – including advanced power electronic converters we also manufacture – will provide the capacity needed for the wide use of plug-in electric vehicles. They also will reduce the

likelihood of blackouts such as the one that hit the northeast in 2003.

In addition, superconductor cables can add a layer of defense to the grid to protect our centers of commerce from severe weather or intentional acts of destruction. The superconductor cable project we are currently working on for Consolidated Edison's grid in New York City, for example, is the first leg of what will be the Internet of power in Manhattan and cities around the US. The objective is to foil attempts by terrorists to knock out Manhattan's grid through the destruction of individual electrical substations. This project, known as Project HYDRA, requires the special properties of superconductors. It is being jointly funded by the Department of Homeland Security, Consolidated Edison, American Superconductor and our subcontractors.

Superconductor technology also is being applied in a significant way to zero-emission, wind generated electricity. We have, in fact, begun work on a program to effectively double the power capacity of today's wind turbines utilizing the power of superconductors.

The largest wind turbines on the market today are rated at 5 to 6 MW. The generators in these turbines are massive - weighing

hundreds of tons. In fact, they are so large that it is nearly impossible to transport them over roads and install them at the top of towers hundreds of feet in the air.

Superconductor technology is able to break through this power capacity barrier. We are partnering with TECO Westinghouse Motor Company in Round Rock, Texas under a National Institute of Science and Technology Advanced Technology Program to develop the core technologies needed for a superconductor generator that would go into a 10-MW-class wind turbine.

To put the impact of this into perspective, a single 10MW turbine could provide electricity for thousands of homes and eliminate 15,000 tons per year of CO_2 generated by the mix of fossil fuel plants in use today. In addition, superconductor wind turbines will open the door to truly large offshore wind farms where construction costs are highest.

We will soon be taking on the next phases of this project, which are to design the complete wind turbine and then build and test a prototype before commercializing the wind turbine.

Our work will demonstrate that superconductor technology is the 'disruptive technology' needed to significantly reduce the cost of

wind power and enable broader deployment of this zero-emission form of electricity.

In summary, superconductor technology is a fundamental weapon in our arsenal to lower the costs of energy, reduce harmful greenhouse gas emissions and meet the goal of having wind supply 20% of our electricity needs by 2030.

To accelerate the development and deployment of superconductor materials and high capacity wind turbines, we encourage Congress to pass a multi-year extension for wind production tax credits. We believe funding from the DOE for the development and testing of a 10MW class superconductor wind turbine would significantly accelerate the deployment of this technology. Finally, implementing tax incentives to recognize the energy efficiency benefits of power grid technologies like superconductor cables would enable electric utilities to implement these solutions faster and help spare our nation from costly blackouts.

I thank you for your time and attention.

The CHAIRMAN. Thank you, Dr. Yurek, very much.

Our next witness is Dr. Andrew Frank, who joins us from the University of California at Davis, where he is a professor in the Mechanical and Aeronautical Engineering Department. He has specialized in the development of fuel efficient hybrid electric cars and is widely known as the father of the plug-in hybrid vehicle. It is our honor to have you with us here today, Dr. Frank.

STATEMENT OF DR. ANDREW FRANK, PROFESSOR, MECHANICAL AND AERONAUTICAL ENGINEERING, UNIVERSITY OF CALIFORNIA AT DAVIS

Mr. FRANK. Thank you. Father means I am an old guy. I think that is what it means.

Okay, deployment hybrid vehicle I think was mentioned earlier. What is it? And what could be its impact on society?

This is what a plug-in hybrid is. It takes energy from the wall and displaces gas, oil, gasoline. And if you do it right, you could take 90 percent of the energy to drive a car on an annual basis from the wall and only 10 percent from gasoline. Does that mean we are going to put the oil companies out of business? I don't think so because oil is still a very important commodity worldwide, and the issue is we can use oil for other things.

But the most important things, once we shift from using oil to electricity, we can go to using solar, wind, and biofuels to power our entire fleet. We can't use biofuels to power our fleet today because we use too much of it, but when you use this kind of thing, you are displacing oil, 90 percent with electricity, then that 10 percent can be supplied by biofuels and we have enough land to do that.

Now what is this impact in the future? Here is a little issue of the price of—this is for the price for a tank of gas essentially. If you don't go to something like plug-in hybrids, the price of gasoline is going to continue to go up, and there is no doubt about that. You can be pessimistic or you can be optimistic, it is going to go up. But with plug-in hybrids we can level the cost, and we can begin to bring it down with solar and wind.

Current movement in plug-in hybrids, there is already movement, General Motors, Ford, all the car companies are thinking about it. They are moving much slower than we need, but the most important thing is new car fleets cannot replace cars and make them into plug-in hybrids fast enough to do any good for our country. It would take 20 years to displace a fleet to get enough cars out there to displace oil.

By the way, the key is not oil fuel efficiency, the key is oil displacement.

I see Mr. Sensenbrenner left, but what we want to do is to displace the use of oil for energy and not displace the use of oil. The oil could be used for other commodities, like this right here is made out of plastic. That is what we should be using oil for. This is what we should be using coal for. As a matter of fact, we can use oil and coal to replace 2 by 4s. And if we did that we would save the forest too.

So let's let the oil companies pump, and let's not use oil and coal for combustion. This is the key.

So how do we accelerate—oh, one quick thing, there are all kinds of plug-in hybrids. Plug-in hybrids can range from 10 miles all electric to 60 miles all electric. And I have built cars all along the range. If you have a plug-in hybrid that only has a 10-mile all electric range, that kind of car may displace only 10 percent of the oil with electricity and be 90 percent oil. But if you use—go to 60 miles, that will give you a car that will displace 90 percent of the gasoline used with electricity and use only 10 percent on an annual basis. And that is the key difference. This is a range of plug-in hybrids out there. General Motors actually is building the Volt, which is on the right-hand side and the Vue, which is on the left-hand side.

How do we accelerate plug-in hybrids introduction? This is the key. We have to accelerate. So what we need to do really is to focus on legacy vehicles and modify those as well as focus on new vehicles, because a new car fleet cannot give us a displacement of oil fast enough to counter the rise in the price of oil.

We have also an improvement in the grid. The plug-in hybrid can improve the grid because it represents energy storage. Our electric system, as pointed out by a previous speaker, hasn't changed since Edison. And this is a possibility for change. Once we have a plug-in hybrid it has energy storage capability, and we can improve the grid by almost 50 percent because we no longer need peaking plants, and this is the key.

So finally, how are we going to accelerate? I formed a company with patents from UC Davis, and we will work with government and industry to try to move this plug-in hybrid as fast as we can, but you know, no matter what we do in this country, we are only one of—we may be the major consumer. But don't forget that China is almost consuming as much as we are and they will exceed us in the next few years. This is a worldwide problem. This is not only this country. We should be the leaders, and that is where we are going. The most important thing is we need government support.

[The prepared testimony materials of Dr. Frank follows:]

EFFICIENT DRIVETRAINS INC.

A PRIVATELY HELD INDEPENDENT COMPANY

Impact of the PHEV on Society

Andrew A. Frank

CTO, Founder

CONFIDENTIAL

Societies current problems

- Peak oil and rising price of fuel
- Global warming and vanishing species
- Global solutions are not immediately available
- Potential solution: PHEV
  - Electrification of transportation and society
- Use of Renewable Solar and Wind energy

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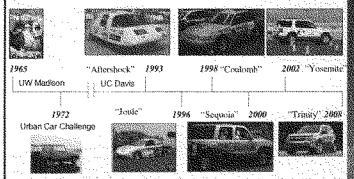
PHEV Engineering: Timeline



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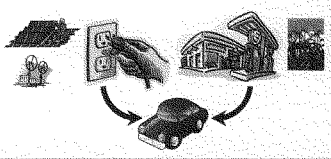
Why PHEV is most viable solution for reducing oil consumption

- Phase I: Use existing Infrastructure
- Phase II: Sustainable renewable energy



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PHEV - best alternative because:

- No infrastructure issues, such as, with H_2
- All Electric Vehicle's require high power charge
- Liquid fuel dispensing and storage-unchanged
- Use of Direct Wind and Solar Renewable Energy
  - 4 Times the effectiveness of H_2 from electricity
  - EV's can use direct renewable energy, but needs high power
- Range is not a problem
- Cost of *Zero CO_2* substitution for gasoline is less than all other concepts

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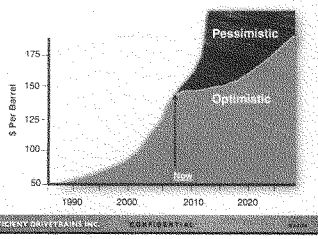
The cost of fuel in Society



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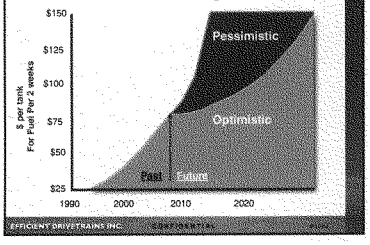
US Cost: tank of gasoline



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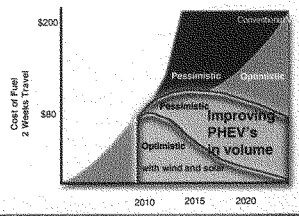
Cost of fuel using PHEV's



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The current movement of PHEV

- GM, Toyota, Ford, Nissan, and many others are all exploring high volume production of PHEV

But *issues are:*

- Need to introduce PHEV much faster than can be done simply by the new car fleet!
- ~200 million US vehicles in society
- 15 million new US cars per year~10 years ~ 5% of the new car market in PHEV's or only 750k!
- Can't get to 10 million PHEV's in 4 years as needed to slow gasoline consumption ala Andy Grove's objectives!!

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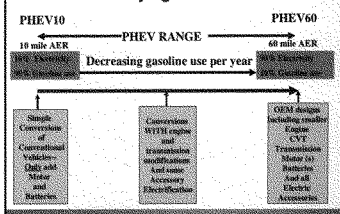
But there is a range of PHEV's with varying benefits



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Consequence of PHEV introduction

- Displacement of gasoline as soon as possible
- Provide comfortable adoption rate ie start with simple conversions for introduction PHEV's
- Gasoline use of PHEV's decreases with longer electric range but costs actually come down due to simplicity of long electric range designs!!
- Cost of making a PHEV10 from a conventional car ~~ +$15k-$20k due to added parts (conversion)
- Cost of making an OEM PHEV40 in high volume is on par with a Conventional car $0 to + $2k or 0% to 10% depending on electric range in city driving

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How do we accelerate PHEV introduction?

- Need to Replace **and** Modify existing vehicles
- Replace @ 1%-5%/year, Modify @ 10%-15%/year
- Cost must be carried by someone since savings in current cost of energy cannot fully justify current incremental cost of PHEV Modifications
  (but the time is coming soon due gasoline prices)
- Short run Government subsidies for the purchasing of PHEV's because we have to increase the PHEV volume to make a difference to the general public
- Adding plugs and solar into parking lots with **free** electricity may be necessary to create the big pull now on a mass scale- Canada already has plugs in every parking space for free electricity!!

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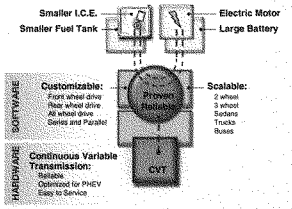
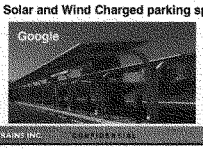
Requirements for success

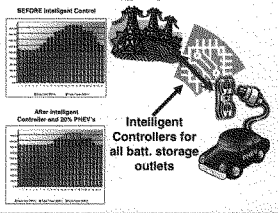


What we need to do to accomplish PHEV projections:

- Need to accelerate the introduction of PHEV Plug In infrastructure to assist in fuel replacement
  - Manual or automated charging at parking spaces!!
- Leads automatically to V2G and improved efficiency of the grid
- Leads to Solar and Wind Charged parking spaces



Electric Grid Improvement with PHEV's



EDI PHEV Drivetrains

- Uses current energy infrastructure
- Can displace 100% fossil today!
  - Nationwide oil displacement
- Makes grid more efficient
  - Enables renewable grid.
- Allows integration of Wind and Solar
  - 100% renewable energy

Why I founded Efficient Drivetrains, Inc. (EDI)

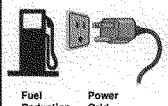
How are we accelerating PHEV development?

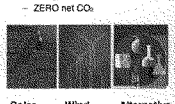
EDI is:

- Collaborating with vehicle companies to develop PHEVs
- Supplying drivetrains and system components
- Licensing existing technology solutions
- Providing substantial saving of R&D budgets and time
- Focusing on World wide vehicles 2wheels to large trucks

PHEV: only immediate viable solution

- **Phase I:**
  - Existing Infrastructure
  - Improved grid
- **Phase II:**
  - Renewable sustainable energy sources
  - ZERO net CO_2





Fuel Reduction **Power Grid** **Solar Energy** **Wind Energy** **Alternative Fuels**

Summary

My objectives are:

"To see that the world moves toward electrification of the entire society in an integrated fashion to enable greater energy efficiency for higher improvement in productivity and lifestyle with a zero CO_2 footprint"

The CHAIRMAN. Thank you, Dr. Frank, very much.

Our next witness is Dr. Ari Patrinos. He is the President of Synthetic Genomics, a private company that uses genomic solutions to address global energy challenges. He previously played a historic role with the Human Genome Project and then was Director of Department of Energy's Office of Biological and Environmental Research.

We thank you, sir, for being here. Whenever you are ready, please begin.

STATEMENT OF DR. ARISTIDES A.N. PATRINOS, PRESIDENT, SYNTHETIC GENOMICS

Mr. PATRINOS. Thank you, Mr. Chairman. I am honored to speak before this select committee in representing Synthetic Genomics, a company that was started by my colleague Craig Venter, a pioneer in the field of biology and dedicated to providing genomic solutions for our energy and environmental problems.

We are obviously at a very important crossroads with respect to the challenges we face in energy and climate change, and we have daunting energy and environmental problems. As an example, we import about 600 million tons of crude oil every year, essentially last year, and mostly from politically unstable parts of the world.

Moreover, the Intergovernmental Panel on Climate Change tells us unequivocally that the climate system is warming as is now evident from observations of increases in the global average temperature over the oceans, in land, and in the air; and that CO_2 and other greenhouse gasses are responsible for this climate change.

There have been some encouraging signs recently, like the G8, for example, agreeing to have emissions by the year 2050, which was the first for the Bush administration. They didn't say exactly which emissions they will have, but at least it is a step in the right direction. The EPA just this month issued a report claiming and explaining how climate change could have deleterious affects on human health and other very significant firsts. And ongoing, and I am very honored to be involved in, is a National Academy of Sciences study on America's energy future, which has climate change and energy security as its principal drivers.

We need to change the ways we produce and use energy and we need to accomplish a net zero carbon emissions into the atmosphere. That does not mean that we can't burn coal or other fossil fuels. It just means that the CO_2 needs to be sequestered or, better yet, converted, as I would say, into a renewable fuel, which is one of the revolutionary disruptive technologies that we believe we will accomplish.

As the committee believes, we also know that there is it no silver bullet with respect to solving this problem. It is more a silver buckshot and all technologies need to be improved.

Even if we make significant improvements, it will be difficult to remove about 100 billion tons from our economy over this particular century. However, advances in genomics, we believe in specifically synthetic genomics, which is the field Craig Venter pioneered, is in fact one of the real game changers that can help us accomplish this goal.

Dr. Venter and his team have pioneered this field and will lead to the design and synthesis of microbial systems that can provide superior capabilities in converting various feedstocks into biofuels. Recent research by Dr. Venter and others have uncovered an incredibly diverse microbial world that was heretofore unknown. We have discovered microbes, extremophiles we call them, that thrive in extreme temperatures, high temperatures, and high pressures, and can survive levels of radiation that are instantaneous lethal to us.

By studying those organisms we can uncover or discover the molecular scenery of life which we can then provide, we can then apply it to quickly and efficiently convert various feedstocks into fuels.

We have a deal with the company BP, for example, to convert coal bed methane into natural gas, and thus provide a fuel that is much cleaner than removing the coal from the ground. It is still a fossil fuel, but in terms of its global warming potential it is a step in the right direction.

We are also aggressively pursuing the conversion of various plant feedstocks, sugar and cellulose, into a wide range of next generation fuels that are superior to the traditional fuels such as ethanol and biodiesel.

We need to move beyond using foodstuff, such as corn, for the production of biofuels. For example, there are plants like jatropha that do not compete with food that can grow in marginal lands and can serve as feedstocks for biodiesel.

We have a deal also with a Malaysian company Genting Asiatic to work on jatropha in order to improve the yield and capability of producing biodiesel. Ultimately the disruptive technological goal is to use carbon dioxide as a feedstock. And there we are making significant advances using micro algae and other microbial cultures that would be in essence the Holy Grail in bioenergy to use something that we need to squirrel away in the Earth. Instead, we can actually convert it into a fuel.

We recognize there will be problems scaling up in order to replace or challenge the existing infrastructure, like for example 21 million barrels of petroleum that we process in our infrastructure here in the U.S. every day, or 2 trillion cubic feed feet of natural gas every month. However, we are confident that we can pilot our liquid biofuels within 2 years and go into large scale production within 5 years. And if we can accomplish these things that we feel confident with, I think we can accomplish stabilizing concentrations of CO_2 under 550 parts per million. We——

The CHAIRMAN. If you could summarize.

Mr. PATRINOS. Yes, indeed.

We advocate essentially the level playing field with respect to biofuels, the removal of tariffs and subsidies that distort the marketplace, as well as sensible regulations for the synthetic biology and synthetic genomics technology that we have developed.

Thank you for the opportunity to testify.

[The prepared statement of Mr. Patrinos follows:]

Testimony of Aristides Patrinos, Ph.D.
President, Synthetic Genomics Inc.
Select Committee on Energy Independence and Global Warming
"Renewing America's Future: Energy Visions of Tomorrow, Today"
July 31, 2008

Mr. Chairman and Members of the Select Committee:
Thank you for the opportunity to testify before your Committee about "Solutions to the Energy and Climate Crisis."

I am Ari Patrinos, the president of Synthetic Genomics Inc. a company dedicated to developing new genomic-driven bioenergy, environmental, and biochemical solutions. I joined Synthetic Genomics Inc. in February 2006 after serving for many years in the Department of Energy (DOE) as the director for biological and environmental research in the Office of Science.

Our nation and the world stand at an important crossroads. Decisions we make during the next few years will affect the trajectory of human civilization well into the next century.

We face daunting energy and environmental challenges:

- energy supply
- energy security
- climate change
- environmental degradation

There are many reasons for these challenges. For example:

The U.S. imported over 600 million tons of crude oil last year, most of it from politically unstable parts of the world.

Energy demand in the developing world, and especially China and India, is growing at a rate approaching 10% per year.

The 2007 report of the Intergovernmental Panel on Climate Change (IPCC) tells us that:

World carbon dioxide emissions from the burning of fossil fuels now exceed 28 billion tons per year. Carbon dioxide emissions from land-use changes are adding as much as 9 billion tons per year.

The global atmospheric concentration of carbon dioxide has increased from a pre-industrial value of about 280 parts per million to above 380 parts per million today.

Warming of our climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.

Recent events and developments

This month the leaders of the Group of Eight industrial nations (G-8) gathered in Japan and agreed to halve greenhouse gas emissions by 2050. This was a "first" for the Bush Administration.

Also this month, the Environment Protection Agency (EPA) issued a report stating that climate change will pose "substantial" threats to human health in the coming decades.

The National Academy of Sciences is completing a study on America's Energy Future (AEF) to provide the incoming Administration with data and analyses that will help shape energy policies. Energy security and climate change are the two most important drivers of this study.

The Path Forward

It is imperative that we significantly change the ways we produce and use energy. We need to stabilize the concentrations of greenhouse gases in the atmosphere, and for that we will have to accomplish zero "net" carbon emission into the atmosphere in the not-too-distant future.

Zero "net" carbon emission does not mean the end of fossil fuel burning. However, it will require the capture and permanent storage

of emitted carbon away from the atmosphere, or the conversion of the emitted carbon into renewable products (biofuels and biochemicals).

For the U.S., we also need to develop homegrown and renewable sources of energy, to eliminate or significantly reduce our dependence on foreign oil.

This Committee understands there is no "silver bullet" solution to our energy and environmental problems. Instead, we need a "silver buckshot" approach, one that includes the full spectrum of energy and environmental technologies, including enhanced energy efficiency and conservation.

Synthetic Genomics, the Disruptive Technology

Even if we make significant improvements in the traditional energy technologies (fossil fuels, nuclear, hydro, solar, geothermal, and wind), and even if we achieve advances in carbon capture and geological storage, it is difficult to see how we will be able to remove approximately 100 billion tons of carbon (367 billion tons of carbon dioxide) from the world's economy over this century.

Advances in genomics and specifically synthetic genomics are the real "game-changers" that can help us reach the goal. The company I represent, Synthetic Genomics Inc., (SGI) was founded by Dr. J. Craig Venter nearly three years ago to translate genomics advances into viable solutions to some of our most pressing energy and environmental problems. Our first goal is to put our vast knowledge and experience in the field of synthetic genomics to work in helping to solve the energy crisis.

The genome sequencing breakthroughs that Dr. Venter and his teams accomplished over the last two decades have propelled advances in biology from concepts to implementation by giving science the tools to effect change. These breakthroughs have instilled rigor into a discipline that previously was merely descriptive.

Dr. Venter and his team are pioneering the new field of synthetic genomics. This new technology will lead to the design and synthesis of microbial cells with far more superior capabilities in converting feedstock into fuels than even the most successful among the genetically modified natural cells. Vast new opportunities will emerge for optimizing cellular pathways in these "special purpose" organisms.

Recent research by Dr. Venter and others have uncovered an incredibly diverse microbial world that was heretofore unknown. We have discovered organisms – extremophiles, we call them -- that thrive in extremes of temperature and pressure and can survive levels of radiation that are instantaneously lethal to us.

The study of these organisms has given us significant new insights into the molecular machinery of life, which in turn provide ways to quickly and efficiently convert various feedstocks into fuels. These include the conversion of coal into methane that when burned has a smaller global warming impact than coal. Our company SGI has partnered with petroleum giant BP to employ the tools of synthetic genomics to increase the production of methane from coal bed mines.

SGI is also aggressively pursuing the conversion of plant feedstocks (sugar and cellulose) into a wide range of next generation fuels that are superior to traditional biofuels (ethanol and biodiesel), more adapted to the existing infra-structure and compete successfully with gasoline and other fossil fuels.

Genomics-driven technology will not only help us produce fuels from renewable feedstocks (biofuels) but also will accomplish more effective carbon capture and carbon storage. In both cases specially modified micro-organisms enable the conversion of feedstocks into renewable products (biofuels and biochemicals) and the sequestration of carbon away from the atmosphere.

For the production of biofuels we should move away from feedstocks like corn that compete with food production. The food-versus-fuel controversy is unfortunately energized by corn-based ethanol

production in the U.S. There are many plants that are not foodstuff (jatropha, for example) and grow on marginal lands that could be used for the production of biofuels. SGI has joined forces with the Malaysian company Genting Asiatic to use synthetic genomic advances to increase the yield of jatropha plantations.

The genetic engineering of plants that are to be used as feedstocks for biofuels and biochemicals will enable significant increases in the yields of sugar and oils that constitute the raw material for the biofuels. Other genomic advances, such as the study of soil microbes in the root zones of plants, can also assist in improvements of plant properties, reduce the use of fertilizers or chemical pesticides, and enhance the disease resistance of plants.

But one of the ultimate and disruptive technological goals of our synthetic genomics research is the use of carbon dioxide as a feedstock for the production of biofuels and biochemicals. Imagine that: carbon dioxide as a feedstock. This would be the "holy grail" of bioenergy production: the transformation of a fossil fuel into a renewable resource. At SGI we are working on such a solution, using multiple processes that employ micro-algae and other microbial cultures.

We recognize the challenges of scaling up the production of biofuels to match the current supply and infrastructure of the fossil fuel industry -- for example the infrastructure that enables the consumption of 20.7 million barrels of petroleum in the U.S. every day and more than 2 trillion cubic feet of natural gas every month.

Nevertheless, we are optimistic we can pilot our liquid biofuels within two years and embark on large-scale production within five years. We are convinced that by using the biofuels we are pursuing we could successfully meet and beat the recently adopted standard of reducing gasoline consumption by 20% in ten years.

We are also confident that the technological approaches using carbon dioxide as a feedstock for our biofuels will go a long way toward accomplishing the zero net emission of carbon into the atmosphere

and enable the stabilization of the concentration of carbon dioxide in the atmosphere much below 550 parts per million.

However, to be successful we will need the support of the Administration and Congress to level the playing field in our competition with the fossil fuel industry by openly communicating the risks of continued reliance on imported fossil fuels and the dangers to our climate system from the burning of fossil fuels. We must quickly reach agreement on placing a value on emitted carbon. We also need to free the market for alternatives to fossil fuels from distortion by eliminating the tariffs on imported sugar and ethanol as well as the subsidies for corn-based ethanol.

We are also advocating sensible regulations for the emerging field of synthetic biology and for the new biofuels it will enable. Dr. Venter and his teams have since the earliest experiments in this field, been leading the public dialogue and education efforts about this new science. We along with those in academia, government and outside institutions have come together to discuss the potential associated risks and concerns and have demonstrated the appropriate measures that can safeguard against potential dangers. Finally, we encourage increases in the public funding of the associated basic research as well as for projects that can demonstrate the scaling-up of biofuels production.

President Kennedy said that "There are risks and costs to a program of action. But they are far less than the long-range risks and costs of comfortable inaction. Mr. Chairman and members of the Committee, the time has come for us to act by embracing and using the advances from biology and genomics to tackle our energy and environmental challenges.

Thank you for your time today. I'm happy to answer your questions.

The CHAIRMAN. Thank you, Dr. Patrinos.

Our final witness is Steve Lockard, as the President and CEO of TPI Composites, a leading manufacturer of wind energy components. Mr. Lockard has experienced firsthand the impact renewable energy can have on local communities and economics.

We are very happy to have you with us, sir. Whenever you are ready please begin.

STATEMENT OF STEVEN LOCKARD, PRESIDENT AND CEO, TPI COMPOSITES, INC.

Mr. LOCKARD. Thank you. Good afternoon, Chairman Markey, Mr. Sensenbrenner, members of the committee. Thank you for the chance to join you this afternoon to talk about a tremendous opportunity to renew America's future through the creation of U.S. manufacturing jobs to supply the rapidly expanding wind energy industry. I am appearing before this committee as a CEO of TPI Composites and as a corporate member of the American Wind Energy Association. TPI is a manufacturer of blades for leading wind turbine makers.

Wind energy has now moved into the mainstream of U.S. electricity generation. Wind represented 35 percent of all new U.S. electrical generation equipment installed in 2007 and generated $9 billion of U.S. commerce. The dramatic recent growth in the wind industry is just the beginning. Today wind electricity accounts for a little over 1 percent of our Nation's generation capacity. According to a U.S. DOE report, wind power could provide 20 percent of U.S. electricity needs by the year 2030, which would create 500,000 U.S. jobs and provide a critical contribution to the climate solution. With this potential growth in wind comes a tremendous opportunity to create a complete supply chain.

Since 2007, 28 new wind industry manufacturing plants have opened or been announced in 15 States. By the end of this year the U.S. will have a total of 11 wind blade manufacturing locations, employing over 5,000 people. In 2005, there were only two U.S. facilities.

TPI selected Iowa for a blade plant because of its ability to serve the north central wind region. We selected Newton, Iowa specifically due to the available, skilled workforce and the support provided by the State and local community. Newton is a city of about 16,000 residents. For many years Maytag washers and dryers were made there. Maytag also maintained its corporate headquarters in Newton.

After being acquired by Whirlpool in 2006, the remaining 1900 employees in Newton lost their jobs, the last of which in October of 2007. TPI announced plans 1 month later to open a wind blade manufacturing facility in Newton. We committed to create a minimum of 500 jobs to manufacture blades for our customer GE Energy. The impact that TPI has had on the Newton community and economy, according to its Mayor Charles Allen, was to add jobs at a crucial time, paying competitive wages, providing great benefits to many who just months earlier were questioning their ability to stay and work in the area.

Allen also noted that TPI primed the pump, causing all wind turbine related companies to consider Newton. Trinity committed to

adding 140 jobs in Newton to both towers for wind turbines. The wind energy industry has restored a sense of hope to this manufacturing community. The value according to Mayor Allen is immeasurable.

Competing with Mexico, China and even Brazil with wind blades is difficult. It comes down to a tradeoff between labor costs, transportation costs and incentives. Meaningful cash incentives at the front end of these projects in many cases are required to get a U.S. plant approved.

Another critical need for U.S. competitiveness is for the volume to be high and, most importantly, to remain stable. It is impossible for U.S. blade plants to be competitive when demand swings up and down. To achieve this desired economic and energy growth, the U.S. will need to surmount important challenges, planning and building transmission lines, providing a stable Federal policy support, reducing capital costs, continuing to build wind turbine manufacturing capacity.

Federal policies needed to advance wind energy and reduce climate change include an immediate and full value extension of the wind energy tax credit, a national renewable electricity standard, a national electric transmission plan designed to promote renewable energy and climate change legislation.

Increases in Federal R&D funding and related appropriations to spur continuing innovation will be needed to bring down capital costs. The outlook for 2009 is bleak due to the pending expiration of the PTC. Already the delay in extending renewable energy credits is reducing investment in wind energy projects scheduled to come online in 2009.

A long-term PTC extension will enable the wind industry to continue our rapid growth, generate higher volume and more stability and demand, provide investors with the confidence needed to fund new regional manufacturing facilities. There is broad support across the political spectrum for extending the credit. It is absolutely critical that this Congress act quickly to find a way through the current impasse and enact a full value of long-term extension to the PTC. This is the starting point for U.S. job creation, a healthier economy and a cleaner energy future.

Thank you.

[The prepared statement of Mr. Lockard follows:]

Testimony of

TPI Composites, Inc.

(a member of the American Wind Energy Association)

before the

House of Representatives
Select Committee on Energy Independence and Global Warming
The Honorable Edward J. Markey, Chairman

"Renewing America's Future: Energy Visions of Tomorrow, Today"

July 31, 2008

Steven C. Lockard
President & CEO
TPI Composites, Inc.
Scottsdale, AZ

Good morning. Chairman Markey, Mr. Sensenbrenner, Members of the Committee, thank you for the chance to join you this morning to talk about a tremendous opportunity to renew America's future through the creation of U.S. manufacturing jobs to supply the rapidly expanding wind energy industry.

I am appearing before this committee as the President and CEO of TPI Composites and as a corporate member of the American Wind Energy Association (AWEA). TPI is a manufacturer of blades for leading wind turbine makers including GE Energy and Mitsubishi Power Systems. With 1,800 employees, TPI is headquartered in Scottsdale, Arizona and operates factories in Rhode Island, Ohio, Mexico, China, and most recently in Newton, Iowa, formerly the home of Maytag appliance manufacturing.

Wind energy has now moved into the mainstream of U.S. electricity generation. The U.S. currently boasts more than 18,000 megawatts of wind generating capacity spanning 34 states and producing enough electricity to power 5 million homes. For three consecutive years, wind has been second only to natural gas as a source of new electrical capacity. Wind represented 35 percent of all new U.S. electrical generation equipment installed in 2007 and generated $9 billion of U.S. commerce.

The dramatic recent growth in the wind industry is just the beginning. Today, wind electricity accounts for a little over 1% of the nation's generation capacity. But, the opportunity for wind is significant. According to a May U.S. Department of Energy

report wind power could provide 20% of U.S. electricity needs by the year 2030. It is estimated that meeting this goal from wind would:

- Create 500,000 U.S. jobs
- Reduce by nearly 50% the current electric sector gas consumption
- Provide a critical contribution to the climate solution, reducing greenhouse pollution equivalent to taking 140 million vehicles off the road
- Reduce cumulative water consumption in the electric sector by 8%, significant portions coming from the arid states of the interior west

With this potential growth in wind comes a tremendous opportunity to create a complete supply chain. Wind turbines are made up of thousands of component parts, most of which are assembled into a major component called the nacelle, the large box containing the generator that sits at the top of a wind turbine tower. A nacelle assembly plant can be expected to purchase parts from some 400 sub-suppliers. Additional large components such as composite wind blades and steel towers should be fabricated in the same region as the wind farm sites in order to manage very expensive transportation costs.

Since January 2007, 28 new wind industry manufacturing plants have opened or been announced in 15 states including Arkansas, California, Colorado, Idaho, Illinois, Iowa, Michigan, Montana, Nebraska, New York, North Carolina, Oklahoma, South Dakota, Texas and Wisconsin.

By the end of this year, the U.S. will have at least eight different wind blade manufacturers with a total of eleven U.S. manufacturing locations employing over 5,000 people. In 2005 there were only two U.S. facilities.

The wind power supply chain is also spurring an expansion in demand for raw materials and manufactured parts from other industries. Suppliers to the automotive and other heavy-equipment industries, such as foundries and fabricators, are now providing metal castings and machining for wind turbines. Nearly all of the raw materials we use in blades, including fiberglass fabrics and resin, come from U.S. plants as well.

States such as Iowa and Pennsylvania have been quick to seize the wind opportunity, creating task forces and plans to capture wind component manufacturing. Massachusetts and Texas have landed important wind blade test facilities. Since 2005, Iowa alone has brought half-a-dozen wind energy companies and thousands of new jobs to its state.

The combination of explosive growth in the wind industry and states that have been aggressive in assisting companies locate in the U.S. has created market and manufacturing opportunities for TPI and its partners that did not exist a few years ago.

TPI selected Iowa for a blade plant because of its ability to serve the North Central region of the U.S. wind market. We chose Newton specifically due to the available skilled work force and the support provided by the local community. Newton is a city of 15,800 residents, located 35 miles east of Des Moines. For many years, Maytag manufactured

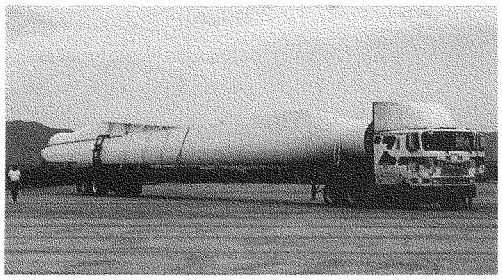
washers and dryers and maintained its corporate headquarters in Newton, employing 3,500 at its peak. After being acquired by Whirlpool in 2006, plans were made to consolidate manufacturing into existing facilities in Ohio and Mexico. The remaining 1,900 employees in Newton lost their jobs, the last on October 25, 2007.

TPI announced plans one month later to open a wind blade manufacturing facility in Newton. We committed to create a minimum of 500 jobs to manufacture blades for our customer GE Energy. Construction of our new 316,000 square foot building is nearly complete. We currently have about 100 employees and are adding to our team at a rate of 15-20 people per week.

The impact that TPI has had on the Newton community and economy, according to its mayor Charles Allen, was to add jobs at a crucial time, paying competitive wages and providing great benefits to many who, just months earlier, were questioning their ability to stay and work in the area. Allen also noted that TPI primed the pump causing other wind turbine related companies to consider Newton. In April 2008, Trinity Structural Towers committed to adding 140 jobs to Newton to build towers for wind turbines. The wind energy industry has restored a sense of hope to this manufacturing community. The value of this is immeasurable.

Now let me move to some of the challenges and opportunities facing the wind blade business. Today's wind blades are very large composite structures measuring 100 to 150 feet in length and weighing 10,000 to 20,000 pounds each. As you might imagine,

transportation of such large components is expensive and challenging. Trucking blades requires special permits, dedicated trailers and expensive escorts. This high transportation cost creates an opportunity to create sustainable U.S. manufacturing jobs, that cannot be easily moved offshore.



The cost metric that matters most in our business is the total delivered cost to the wind farm site, including the cost of transportation. With the growth of wind farms in the central U.S. corridor, it made sense for TPI to manufacture blades in that region to cost-effectively serve a multi-state regional market. Other regions of the country, including the Pacific Northwest, the Southwest, the South Central U.S. and the Northeast, provide similarly attractive opportunities.

However, competing with Mexico, China and even Brazil in wind blades is difficult. It comes down to a tradeoff between labor cost, transportation cost and incentives, if any are available. Community, county, state and federal incentives in the form of training grants, building buy-downs, and other meaningful cash incentives at the front end of these projects can make a big difference in the project return on investment and, in many cases, are required to get a U.S. blade plant approved. Further gains in manufacturing productivity will help U.S. plants remain cost effective over time as well.

Another critical need for U.S. competitiveness in wind blades is for the volume to be high and, most importantly, to remain stable. It is impossible for U.S. blade plants to be competitive when demand swings up and down on an annual basis.

While there are challenges in the current supply chain, the opportunity to fulfill the wind energy industry potential is too important and too large for the U.S. not to forge ahead. Our work is not yet done. To achieve this desired economic and energy growth, the U.S. will need to surmount important challenges: planning and building transmission lines, providing stable federal policy support, reducing capital cost and continuing to build wind turbine manufacturing capacity.

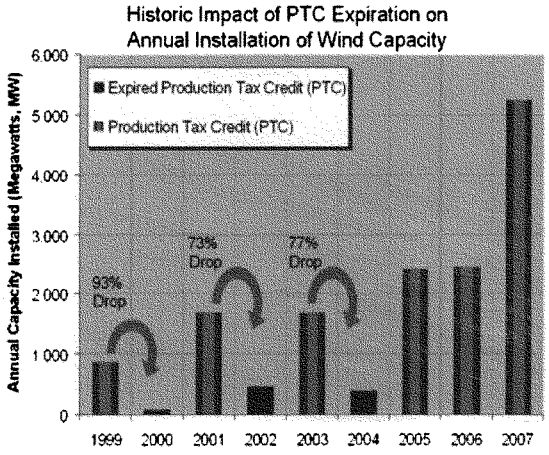
Federal policies needed to significantly advance wind energy & reduce climate change include:

- An immediate, full-value extension of the wind energy Production Tax Credit (PTC)
- A national Renewable Electricity Standard, requiring at significant percentage of American electricity to be generated by renewables
- A national electric transmission plan designed to promote renewable energy
- Climate Change legislation that provides value for generation of clean renewable energy

No major technological breakthroughs are needed to achieve the 20% wind vision by 2030. However, increases in federal R&D funding and related appropriations to spur

continuing innovation will be needed to bring down capital costs and increase turbine performance. Support of improvements in reliability, systems integration, siting, education and work force development are all high priority initiatives that should be included in the federal wind program. For FY 2008, the DOE wind program received a mere $49.5 million, less than 3% of the total DOE budget on electricity related R&D. AWEA is requesting growth in the federal wind program to a minimum of $120 million per year which, when combined with available state and industry cost-share programs, will provide the necessary support.

Wind energy has been a source of important economic growth over the past three years. But, the outlook for 2009 is bleak due to the pending expiration of the PTC. This tax credit has expired three times since 1999 leading, in each case, to dramatic declines (70 to 90 percent) in new wind power development.



Already the delay in extending the renewable energy credits is reducing investment in wind energy projects scheduled to come on line in 2009. Investors want to know what tax policies will apply before they commit to projects for the next calendar year. A study by Navigant Consulting concluded that expiration of the tax credits would place at risk 76,000 wind industry jobs and more than $11 billion in clean energy investment.

A long-term PTC extension will:

- Enable the wind industry to continue its rapid growth as we chart a course to providing 20% or more of our nation's electricity from wind by 2030
- Generate higher volume and more stability in demand - the lifeline to any successful manufacturing operation
- Provide investors with the confidence needed to fund new regional manufacturing facilities, which will create more cost-effective U.S. plants, which will, in turn, create stable U.S. manufacturing jobs

There is broad support across the political spectrum for extending the credit. It is absolutely critical that this Congress act quickly to find a way through the current impasse and enact a full-value, long-term extension of the PTC. This is the starting point for U.S. job creation, a healthier economy and a cleaner energy future.

Steven C. Lockard
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The CHAIRMAN. Thank you, Mr. Lockard, very much.

The Chair will now recognize himself for a round of questions.

Mr. Lockard, last year 35 percent of electricity, new electricity, came from wind. That was about 5,400 new megawatts. How many new megawatts will be put online this year, do you know?

Mr. LOCKARD. It is an increase from that number, estimated to be probably 20 percent more than that or so.

The CHAIRMAN. So, perhaps 7,000 megawatts this year?

Mr. LOCKARD. On the order. Those numbers tend to be refined a bit toward the tail-end of the year. What I would say is there is a tremendous push——

The CHAIRMAN. It could go over 40 percent of new electrical generation?

Mr. LOCKARD. It will increase for sure.

The CHAIRMAN. For sure. That is quite a news story. Combined with what Dr. Yurek is talking about with his technology, that might make it possible for the same old turbines to generate 10 megawatts of electricity.

And how confident are you, Dr. Yurek, that you are going to be able to make that breakthrough and what is the time frame?

Mr. YUREK. We are very confident. If I look at that poster to your right over there, that is a ship propulsion motor we are putting together for the U.S. Navy based on the same power density advantage of superconductors over copper. 75-ton motor replaces a 300-ton conventional motor for ship propulsion. We are using that same technology to develop generators——

The CHAIRMAN. What is your time frame?

Mr. YUREK. Three or 4 years we will have that done.

The CHAIRMAN. So Dr. Frank over here has a plug-in hybrid, he needs electricity and your industries, you and Mr. Lockard, providing this new electricity that would also be carbon free.

Let me ask this question of the whole panel. Given what we have heard today from the panel, do you believe that it is possible for the United States, deploying new technologies and engaging in energy efficiency, to reduce our greenhouse gasses by 80 percent by the year 2050 while still seeing economic growth and innovation as the driving characteristic of our economy? Ms. Zoi.

Ms. ZOI. Without a doubt, without a doubt. Of course we can do that.

The CHAIRMAN. Dr. Yurek.

Mr. YUREK. I think it has every chance in the world if we get going now.

The CHAIRMAN. Dr. Frank.

Mr. FRANK. Well, you know the—it is possible, but it cannot be done without energy storage, electrical energy storage, and that is what the plug-in hybrid really represents.

The CHAIRMAN. So if we adopt your ideas, can we get an 80 percent reduction?

Mr. FRANK. Yes, you can.

The CHAIRMAN. That's the key. Dr. Patrinos.

Mr. PATRINOS. Absolutely and much sooner than even our most optimistic——

The CHAIRMAN. And again your company is the one that basically cracked the human genome, I mean, Dr. Venter and yourself were

making that huge breakthrough that would have been incomprehensible just 10 or 15 years ago.

Mr. PATRINOS. Indeed.

The CHAIRMAN. Mr. Lockard.

Mr. LOCKARD. We are happy to see wind contribute to 20 percent or more than that in that time frame.

The CHAIRMAN. Do you think that is a conservative number, Mr. Lockard?

Mr. LOCKARD. I think there are major issues in the wind energy space to get to 20 percent. Transmission is a significant issue. There are a number of issues that we need to address together, assuming we address those in a big way, there is limitless potential for wind. The question is getting to work on some of the big constraints to 20 percent. We have identified those constraints.

The CHAIRMAN. Let me get back to you, Ms. Zoi, talking about solar, and you made a mention of it. Can you talk a little bit about that and the role that you believe that can play in solving this greenhouse gas problem?

Ms. ZOI. The world is rich with solar thermal, which we can put in the sunny places in the Southwest that I mentioned, but also photovoltaic. I live in Silicon Valley, and just about every week a company has a new announcement about a way to make solar voltaic sunlight directed electricity more efficiently. They are now making it in rolls where they can roll out 100 feet at a time sheets of solar of which you can put anywhere.

The CHAIRMAN. There is a company up in Boston, Evergreen, the Germans just bought their entire production capacity for the next 4 years, 160 megawatts of photovoltaics per year, and the Germans bought it, which is a shame. This should be happening more and more in the United States. What is the roadblock to that, Ms. Zoi, in your opinion?

Ms. ZOI. Well, we do need—one of the reasons that I had talked a lot about the supersmart grid is that we do need to be able to get the power from where it is generated, often in remote places, to where it is consumed, often big cities. Investing in that supersmart grid is something that is important. The storage technologies that were mentioned by my copanelists, but again that is all doable and within our reach.

The CHAIRMAN. Let's go to you, Dr. Yurek. You are the expert on electrical transmission issues. What is the biggest obstacle in ensuring that we get the change in the electrical transmission system that we need in our country?

Mr. YUREK. Well, I think the superconductor electricity pipelines are really ready to break into the marketplace on their own. Utilities really need to start investing in this, and that is about to happen. But we need to push across that last 10 yards to get across the goal line in demonstrating this technology for broader use.

The CHAIRMAN. I have been working with you for 20 years now, Dr. Yurek, on this issue. Do you think we are at that point right now?

Mr. YUREK. We are definitely at the tipping point. Again we have cables operating commercial grids in Columbus, Albany, Long Island. We are about to go into Midtown Manhattan. So we are really at that tipping point. We just need to cross that goal line. I think

that is going to happen in a couple of years. So that will become available as electricity pipelines to move that power through the grids.

The CHAIRMAN. And in conclusion, how much are utilities still fighting you on this? I don't mean Long Island, but across the country. Is there an acceptance of the need for change to redo this grid?

Mr. YUREK. Oh, I absolutely believe that. The utilities are not fighting it. It is a matter of adoption of new technologies, and so the help that we have gotten from the Department of Energy and Defense and Homeland Security over the last years has helped bring that technology out of the lab to the marketplace. We now have just got to get across that goal. They are ready to go.

The CHAIRMAN. Over the years I have worked with you on the military adoption of it, but you now think it is ready for the commercial.

Mr. YUREK. Absolutely, and the utilities are now working with us on commercial quotes in fact, so it is about to get going.

The CHAIRMAN. Thank you, sir. The gentleman from Arizona, Mr. Shadegg.

Mr. SHADEGG. Thank you, Mr. Chairman. I apologize for arriving late. Had I gotten here on time, I would have welcomed Steve Lockard. I used to represent a part of Scottsdale where his company is located. However, they took that little piece of Scottsdale away from me. But nonetheless, he is from the valley of the sun, and I welcome him here and thank him for the work his company is doing.

I want to say, Mr. Chairman, this is a very impressive panel and it continues to encourage me. When you look at the technological breakthroughs we are making and that we are on the verge of, it is indeed very encouraging, and I have enjoyed the education that I have gotten here.

I have got a number of questions, but I want to begin with one, Mr. Lockard, that kind of goes to the point you made. I want to compliment you for the jobs you created and the story you told about the plant. I presume your blades are on the windmills that I pass as I drive to either San Diego or Los Angeles to Phoenix and go through the field of windmills.

Mr. LOCKARD. Some of them. More recently in west Texas, but yes.

Mr. SHADEGG. Keep it up. It is good work. I am very, very pleased to see you say it, but I want to build on a point you made. You talked about the very critical importance of renewing the wind energy production tax credit. As you know, as you pointed out, that expires this year. We also have the solar energy production tax credit or investment tax credit, which also expires at the end of this year, and which tragically just today Arizona Public Service Company announced that if the tax credit is not renewed very, very quickly they are losing capital and may have to abandon the Solana project, which is the largest solar energy project in the world.

I am willing to bet that every single person in this panel will agree with me that it is critical that Congress renew those tax credits and do so immediately and that every day we delay causes us to lose capital. Would you agree, Mr. Lockard?

Mr. LOCKARD. Absolutely. And we do support as part of it and not just wind but the renewable sector in terms of support of tax credits. It is an important level of playing field, policy stability is critical, and we are without it right now.

Mr. SHADEGG. I just met with the Arizona Solar Energy

Industry Association. They talked about something I hadn't thought about, which was even the delay is driving capital away and doing material damage right now. No one, I take it, would disagree with that?

I don't want to run out of time. I am fascinated by this demonstration and it is encouraging to see that we are at that cutting edge. Dr. Frank, I focused for a long time in Arizona, we have dams where we actually created what are called pump back systems, where you take the peak load and they run all day and they run in the evening, when Arizona has a high energy demand. And then when demand goes way down at say 10:00 or 11:00 or midnight, we now pump water from one dam back up to the other. It looks to me like hybrid electrical vehicles, plug-in electricals have a tremendous capability of kind of evening out the demand for electricity. And I guess that is an important part of this whole process, right?

Mr. FRANK. Absolutely. The main difference is that the plug-in hybrid, the electric vehicle, can be about 90 percent efficient, pumping energy back and forth at 1 kilowatt, whereas those dams are about 60 percent efficient. So it is a better technology. Most important thing about electricity, don't forget that it is about one-eighth of the cost of gasoline today. That is the key. So that is where quality of life improvement and all this comes from is from using electricity.

Mr. SHADEGG. Dr. Patrinos, you really kind of piqued my curiosity. I have to tell you that I am somewhat of a skeptic about the notion of capturing carbon and putting it underground and storing it forever. And so when you talked about, I don't know if you called it the nirvana or the——

Mr. PATRINOS. The Holy Grail.

Mr. SHADEGG. The Holy Grail of being able to convert carbon dioxide into a usable energy source that sounds exciting to me. Can you go further into where we are in that process?

Mr. PATRINOS. We are well underway towards accomplishing this and having certainly a pilot project within the next couple of years. This is a method that has had some history, especially in the Department of Energy as long ago as 15 years ago through the use of algae that essentially take sunlight and the CO_2 that gets pumped in them, and grow and then we can farm them, basically, remove the oil and create biodiesel.

Mr. SHADEGG. And they are fed by carbon dioxide.

Mr. PATRINOS. Yes, they are fed, it is a photosynthetic creature that essentially combines the sunlight with the photons with the carbon dioxide and provides the biomass that is then converted into fuel. This program was abandoned back in the nineties at the Department of Energy when oil dropped under $10 a barrel. Also at the time biology was still in a very primitive stage. The revolution that the Human Genome Project ushered in has converted the science into a much more rigorous discipline. And therefore the

tools and capabilities we have today are vastly superior to what we even had in the nineties. And moreover, many more smart people, essentially attracted by the fascination, like you were a few minutes ago, and joined this field.

So we are extremely bullish about what biology can do for many of our problems.

Just as a note this plant is bathed by 130,000 trillion watts. And we are using as a planet 13 watts.

Mr. SHADEGG. My time is obviously out, the chairman has been generous. Arizona Public Service Company has already talked to me about a program using microbes, and I think the future is nothing but encouraging.

Mr. PATRINOS. I am aware of that program, George Post, at Arizona State University.

Mr. SHADEGG. Thank you very much.

The CHAIRMAN. The gentleman's time has expired. The Chair recognizes the gentleman from New York, Mr. Hall.

Mr. HALL. Thank you, Mr. Chairman. As I understand it, the ACSC wire has the ability to carry 300 percent of the electricity of standard copper wire. Is it safe to say that if we jumped in behind this technology with both feet we could expand transmission capacity on existing rights-of-way? Would a wholesale commitment to a semiconductor transmission grid help to obviate the need for things like the national interest electric transmission corridors or perhaps make them more acceptable to the communities that they have to run around or through?

Mr. YUREK. Well, once again going to the power density difference that you just described and you can feel here again, yes you can use existing rights-of-way, electricity pipelines, 300 feet gets shrunk down to 4 feet in terms of the right-of-way. So you can go underground, you are not subject to hurricane damages, you are not subject to ice storms, terrorist attacks and so forth. You can do all the things you said.

Mr. HALL. EMP?

Mr. YUREK. Yes, indeed.

The CHAIRMAN. It is immune if it is buried to electromagnetic pulse.

Mr. YUREK. You have the burying effect, plus these tend to be coaxial cables so there is a self shielding effect as well.

Mr. HALL. Thank you. Dr. Frank, you talk about plug-in hybrids. Are there any conversion kits you are aware of so far that are worthy of public consideration? If an individual like myself who owns a hybrid, there are a number on the Internet that are being advertised, are you aware of any that are——

Mr. FRANK. Yes. The hybrid could be converted to plug in hybrids simply by adding batteries. Now, it is going to cost you 10, 20, 10, $15,000 more to do that, but the important thing in my testimony what I was talking about was legacy vehicles, conventional cars can also be converted. There are no companies doing this in volume today. It can be done.

Mr. HALL. And that will be important considering the time it will take to switch our existing——

Mr. FRANK. Absolutely. So the most important thing is to get those legacy vehicles converted to using electricity.

Mr. HALL. And if someone were to produce a patent for a battery that got—that could carry a vehicle on all electric charge before it starts to use the gasoline a thousand miles or more, that would be considered to be a breakthrough I would say. No?

Mr. FRANK. Well, that would be a huge—but that is not in the cards as far as we can see. You might be able to get 60, 70 miles on electricity, but to go much more than that, Tesla talks about 200 miles, but one of the biggest things about the Tesla car is that they forget, they don't tell the whole story. They talk about high acceleration and high range, but you can't have both. When you accelerate hard, your range goes from 200 miles to 100 miles. So there is problems with all electric.

Mr. HALL. Given the grid that we are talking about constructing that all of you I think have mentioned at one time or another, might there be a silver bullet if we were to use in the areas where we have constant sun or near constant sun or steady reliable winds such as the Wind Belt through the middle part of the country and on the coast to use hydrogen as a storage device? We know how to store and cool and transport hydrogen much better than we did during the time of the Hindenburg which was the Three Mile Island of the hydrogen age. And it is of course a loss in efficiency every time you go back and forth from one form of energy to another, but nonetheless some of the same siting that would go into siting a nuclear plant or perhaps even a coal plant might apply to a hydrogen storage and generation plant, which could be used to store via electrolysis, splitting hydrogen from oxygen in the water and then burning it, producing emission water at the end of the process.

Again, is this something that we should be looking at, at least in areas like Lake Havasu or places where the sun shines and there is plenty of water?

Mr. YUREK. Yes, go to a remote site whether it is wind or solar, generate the electricity, do the electrolysis, make the hydrogen, condense it to make liquid hydrogen, which will cool the superconductor wire. So we can pump it out and you get hydrogen and electricity out the other end.

Mr. HALL. Better than I thought.

Mr. YUREK. Yes, the provision for that from Electric Power Research Institute.

Mr. FRANK. I will add my two bits. The problem with generating hydrogen, you are converting, as you know, the loss efficiency. If you compare a hydrogen economy versus a plug in hybrid, where you are using electricity directly, the hybrid car will go four times farther than a hydrogen car.

The CHAIRMAN. The gentleman's time—I am sorry.

Mr. HALL. I yield back.

The CHAIRMAN. I appreciate that, because we have six roll calls. This is a fantastic panel. We have a chance to recognize the gentlelady from South Dakota for her questions, but my intent, with the will of the committee agreeing with that, is that we would come back after roll calls as we continue to ask this panel questions. And I apologize to the members because of that. The gentlelady is recognized.

Ms. HERSETH SANDLIN. Thank you, Mr. Chairman. I thank the witnesses for their testimony today. I would like to pick up on questioning along the lines of transmission for wind energy that the chairman and Mr. Hall were pursuing.

I represent the entire State of South Dakota. We are rich in wind energy resources, but they are very rural, remote areas and transmission is the key along with the PTC and other incentives to unlocking, unleashing this energy source.

I would like to get your opinions on the energy corridors that will be needed. Mr. Hall was asking about that. We have some FERC authority for additional siting of the corridors that the DOE has put together, started the work on the map for the transmission. But also this issue of private investment versus the public infrastructure investment like the interstate highway system and on the timeline we are working on. And just maybe Mr. Lockard, Dr. Yurek and Ms. Zoi, if you could comment on your thoughts about the private investment, will that be sufficient without additional congressional support and guidance? And does FERC need any additional authority as it relates to siting the energy corridors?

Mr. YUREK. If I may comment on that, the FERC would allow toll roads to be put in place with a private investment and then charge a toll for moving the electricity. You can't do that in our alternating current grid, you disturb power flows through very wide regions.

However, with superconductor cables, the ones I am showing up here, you can actually allow that control, they act like DC, direct current cables. So the FERC has already given permission for DC cables made with copper. I believe they should be able to give that for superconductor alternating current cables which would allow them to do exactly what you want. And then you would have encouragement for private investment, because if I can put that cable system in to take power from South Dakota to Chicago and somebody will pay me a fee for that, I will make the investment.

The CHAIRMAN. If the gentlelady will yield. There is only 3 minutes left on the 6 roll calls. If the gentlelady would like to continue at this point she can at the risk of——

Ms. HERSETH SANDLIN. How about I resume my time when we come back from votes?

The CHAIRMAN. Why don't we stop right there with the gentlelady having 4 minutes left to go? And we will come back, if you don't mind. It is really a great, great panel and there is a lot of interest in it. We will take a recess until the six roll calls are completed.

[Recess.]

The CHAIRMAN. We are about to reconvene the Select Committee on Energy Independence and Global Warming. The interest level is high; our control over the floor schedule is low. As a result there is a delay that we apologize to everyone for having to endure.

But it gives us a chance to once again recognize the gentlewoman from South Dakota, and we will give her her full 5 minutes back on the clock.

Ms. HERSETH SANDLIN. Thank you, Mr. Chairman.

Just to start off where we left off, any other responses on the wind—the transmission capability issue and the issue of private in-

vestment versus maybe more of the public investment, like we have done with the interstate highway system.

Ms. Zoi.

Ms. ZOI. I will chime in my 2 cents.

I think the notion of a supersmart grid or national integrated grid is a great opportunity for the Congress. I think that the technologies are available; we have heard about some of them today.

If the rules are set, I don't think access to capital is going to be the issue. I think what is paralyzing us now are the institutional barriers. We have got fights between the Federal Government and the State governments. We have fights between the various land authorities at the State level. We have got fights between environmentalists on the one hand and environmentalists on another hand with different issues.

And there is just such an opportunity for you all to lead and say, this has got to be the grid, which has never been a really sexy thing. But the grid has got to be a top priority, and let's sit together and hash it out.

Ms. HERSETH SANDLIN. Thank you.

And, Dr. Yurek, I appreciated your comments before we had to break about how the technologies that you have been working on may make some of this easier as it relates to authority FERC currently has versus what may be necessary if we don't move as quickly as we should with some of the new technologies that you have been at the forefront of.

Mr. YUREK. Yes, and I think part of the challenge here is that FERC and other agencies, regulators, even Congress, really don't know what is available. This hearing is so valuable to reveal some of the new things that are possible. Once you take that into account, we could start implementing.

Ms. HERSETH SANDLIN. That is a good segue to my question for Dr. Patrinos in terms of Congress or Federal agencies or regulators not knowing what is available.

I wanted to talk to you about advanced biofuels. Your written testimony states that you are optimistic that within 5 years SGI can move to large-scale—and by that I assume you mean commercial scale—production of liquid biofuels.

You should know when this Select Committee met in June we took testimony from Guy Caruso, the Administrator of the Energy Information Administration, and he testified that while, "very uncertain, EIA projected that available quantities of cellulosic biofuels prior to 2022 will be insufficient to meet the new RFS targets for cellulosic biofuels triggering both waivers and a modification of applicable volumes," such that the overall RFS target in 2022 would be reduced from 36 billion gallons to 32.5 billion gallons. At the same time, he acknowledged in response to questioning that EIA's assessment was based on the view of the current state of the technology.

Do you agree with EIA's projection or do you agree that its view is unduly pessimistic, particularly as it relates to the quantities of cellulosic biofuels that would be commercially available, as envisioned by the original RFS—not the original, but the new RFS that we passed in December.

Mr. PATRINOS. I agree that the organizations such as the IEA and the EIA—and I have good friends and colleagues in both organizations that I have worked with for many years; these organizations have to be conservative in their projections.

I certainly disagree about their pessimism with respect to the ability of this new science; genomics-driven bioenergy, can deliver much, much faster than they are predicting, and in a sense, they are projecting on the basis of old technology that is already in many ways obsolete.

Ms. HERSETH SANDLIN. Thank you.

Is SGI pursuing any other processes? We were just taking testimony yesterday as it relates to fossil fuel and natural gas. But renewable methane gas and biogas through processes such as fermentation, paralysis, gasification, is SGI pursuing any of that as well?

Mr. PATRINOS. I mentioned this partnership that we have with the oil giant BP, where we are investing considerable time and effort in understanding the processes by which methane is produced in coal beds.

Most of the methane in coal beds is producing biogenically. It is essentially microbial communities that chew up the coal deep in the Earth and produce methane, which we then can pump out. Understanding how this happens can give us opportunities to add amendments or make other changes that can certainly stimulate the production significantly.

We estimate that even 1 or 2 percent improvement in the yields could be translated into billions of dollars. And certainly it is so much better to convert the coal into methane and burn methane, as opposed to digging out the coal and burning that. In terms of its greenhouse warming potential, it is 10 times better when you factor in all the processes involved in producing CO_2.

Ms. HERSETH SANDLIN. I thank you for that. And one of the areas—and I appreciate especially, given some of my neighbors up in the northern Great Plains, like North Dakota and Montana and Wyoming with the vast coal reserves. One of the things we focus on in South Dakota is the issue with dairies, large hog farms and in some cities it is municipal waste where we can find renewable biogas available.

I see my time has expired, so I will submit any further questions I have for the record.

The CHAIRMAN. And if you want, we might have more time for additional questions.

The Chair recognizes the gentleman from Washington State, Mr. Inslee.

Mr. INSLEE. Thank you.

Ms. Zoi, thanks for your organization's great work and the Vice President's leadership. We are impressed by his work, even though he has not won the Heisman Trophy yet; he has one more to go.

I want to share with you kind of a delightful comment I heard, or a disturbing comment. I was talking to a radio person the other day, and the question was, what do you think of Al Gore's time line, 10-year time line? And David Freeman, who has done great work on efficiency in California and a whole bunch of other things,

I thought had the right response. He said, "It is not Al Gore's time line; it is Mother Nature's time line. That is who set the timeline."

I thought that was a good way to approach this issue. We really don't have a choice. Failure is not an option. And you might want to quote Mr. Freeman sometime. It is a good line.

Ms. ZOI. It is a good line. I have it.

Mr. INSLEE. I wanted to ask about—we are in this debate about offshore drilling and whether or not to open up some offshore drilling areas. My approach has been, besides the environmental concerns of that whole issue, it is a relatively small amount of energy relative to our needs. My view is that we have to essentially decarbonize our industrial base, and that means we need enormous quantities of additional energy, not just for environmental purposes, but to give us a choice to compete with the oil and gas industry. Then consumers will have a choice, which will hopefully keep down the price of fuel.

My view is that we need much, much more energy than could be provided offshore.

I wanted to ask you, is there any way in orders of magnitude that you could talk about how much more energy will be available from the sources that you have talked about—from wind, solar thermal, solar photovoltaic, algae-based biofuels, enhanced geothermal, wave, efficiencies in the grid, building efficiency, which is a form of energy? Could any of you give us sort of an idea of how much that represents relative to what you might get drilling a little bit offshore?

Now, I will not hold you to mathematical precision here, but to me it has to be several-fold because we would be replacing our gasoline-based transportation system and our coal-based electrical system, by and large.

Could you venture any thoughts about that?

Ms. ZOI. I could start. One of the reasons that Vice President Gore issued the challenge that he did a week and a half ago, 2 weeks ago, was that over the past 18 months he has had a series of experts coming along to solution summits in the particular disciplines, whether they are solar experts in photovoltaics and solar thermal. There were whole bunches of experts in each area; every single one of those experts came along and always would start their presentation with, And here is the potential, and here is what we are starting to do.

In every single case, the potential dwarfed what our current needs are. So whether it was an electricity figure like the one I gave in my testimony, which was a 92-square-mile area in the Southwest can meet all of America's electricity needs; or winds, eight times as much wind blows through the Midwest corridor as what we need every year in this country; or whether it is geothermal. It is always just that it has absolutely so much potential.

So this is not limited by the potential; it is limited by our ability to mobilize. And I think some of my colleagues can talk more about the biofuels and liquid fuels stuff.

Mr. PATRINOS. I would be delighted to step in and say my piece.

I know it may sound audacious, but in my remarks earlier I spoke about this planet is bathed with 130,000 terawatts of energy. And as a planet. As humanity we consume only 13 terawatts. And

the current efficiency of photosynthesis is less than 1 percent. Processes involving biology and photosynthesis are not necessarily very efficient. Evolution does not necessarily produce the most efficient thing; evolution is a messy housewife, like I like to say.

The new science of biology is that is driven with the advances of in genomics is giving us tremendous opportunities to tinker with that biology. And if we just even double it to 2 percent with respect to efficiency, which may sound audacious—it may sound a bit like science fiction—but if we can double it, and I think it is feasible in the next couple of decades, we can double the amount of energy we can produce using conventional solar energy and also biofuels and bioenergy. And that is just doubling to 2 percent.

So there is plenty of energy there that we can harness with the technologies that we currently have and the technologies that are in the pipeline.

Mr. INSLEE. We were very impressed. You were talking about algae-based biofuels. There is a company called Sapphire Energy——

Mr. PATRINOS. I know them very well.

Mr. INSLEE. Some of their leadership is on my island in Bainbridge Island, and they believe they can have at least a precommercial plant up maybe in the next 12 to 18 months. So they are very close to significant reality here, and we are very excited about it.

I just want—a closing comment. There are a lot of things happening here. Stone cold dead as it may seem, I introduced a bill today called "The America Can" bill to start the ball rolling to develop a high capacity grid by at least directing DOE to identify the corridors where that can happen.

I think there is a fair chance of moving this bill this year. It is a small step forward. But we don't want to wait until the big year of 2009, we want to get this thing started now.

Thanks for your great testimony.

The CHAIRMAN. The gentleman's time has expired.

The Chair recognizes the gentleman from Missouri, Mr. Cleaver.

Mr. CLEAVER. Thank you, Mr. Chairman.

Dr. Yurek, in my home State of Missouri, a young man by the name of Tom Carnahan, whose brother is a Member of Congress, has a wind farm in northwest Missouri. And my question is based on the fact that the 10-megawatt turbine will reach 400 feet high. Is that——

Mr. YUREK. Yes, the turbine blades themselves will be about 400 feet in diameter.

Mr. CLEAVER. What do you predict in the way of challenges? Because, I mean, it will dwarf what many people consider to be already an intrusive garden of wind turbines.

Mr. YUREK. Two ways, I guess, you could look at that. That is a big machine to be sure, but in fact, it is going to produce twice the amount of power, compared to a conventional machine that does not use superconductors. And so that means if you want to produce 100 megawatts out of a wind farm, you only need 50 wind turbines instead of 100 wind turbines if it is a 1-megawatt wind machine. So you reduce the total amount of towers.

You also reduce construction costs overall, and this becomes really important if you start producing this wind-generated electricity offshore.

There is a tremendous amount of wind offshore. It is going to be a tremendous natural resource for the country to tap into. And construction costs go way up.

This is a real advantage, reducing construction costs.

Mr. CLEAVER. How many homes could actually receive power, potentially from one——

Mr. YUREK. From one 10-megawatt machine you would get approximately 3,000 homes.

Mr. CLEAVER. So let me make sure I understand. You are saying that in terms of, you know, the things that—"not in my back yard" kind of thing; we have seen this happen already in some places where we didn't think it would happen, in the Northeast area here, in Massachusetts. I don't want to go into details; I am a Democrat.

But you are saying that we will have fewer—they will be larger, but the fact that we will have a fewer would generate less hostility.

Mr. YUREK. I think that potential is there. On the other side of the equation, though, if I could put it this way is that the total cost of construction would be reduced. That, I believe, would encourage more wind farms to be established, because you can look for return on investments, hopefully quicker, with lower construction costs, for a given amount of power being generated.

So I think there are two factors here.

Mr. CLEAVER. If you have less construction, one of the things that would cause a community to embrace these wind farms 400 feet high is the fact that it creates jobs. And if there is an economy created around it—I mean, it is amazing the adjustments people can make if it enhances their standard of living. So, you know—but if we are talking about reducing jobs and visibility for people who live nearby, I am not sure.

Mr. YUREK. I said reduce construction costs; I did not say reduce number of jobs. So you are going to have a lot of jobs here.

We talked about this earlier—from blades to cells and generators, everything that goes into this, but the total cost of construction could be reduced here. That would be important in terms of stimulating further investment.

Mr. CLEAVER. Thank you, Mr. Chairman. I yield back.

The CHAIRMAN. The gentleman's time has expired.

The Chair recognizes the gentleman from California, Mr. McNerney.

By the way, this is unprecedented that this many Congressmen came back at 4:30 in the afternoon in order to hear a panel. Because it is a tribute to the quality of the witnesses.

Mr. MCNERNEY. Well, thank you, Mr. Chairman. And the reason I came back is because I am fascinated by this. It is a passion. It is a direction our country must and will go in.

And when I see people that are approaching me, saying that we need to drill for more oil, I tell them that within 10 years most of our new cars will be plug-in hybrids or all-electric vehicles, and the whole gas price issue will have subsided as a national issue.

But we need to move forward. I hope I will not be asking questions that have already been asked.

But I see how wind power, having been in the industry for years, as a tremendous resource. I see solar as a tremendous resource. And I see conservation—and I think the chairman agrees with me on this—as probably the greatest single resource that we have.

Do you—I am not sure who to direct to this question to, but do you see electric vehicles and plug-in hybrids as a major player in our country within the next few years? And if so, how soon do you think that is going to be an economic prospect and what would it look like?

Mr. FRANK. That sounds like my question.

The CHAIRMAN. If the gentleman would yield briefly, Dr. Frank is the father of the modern plug-in hybrid.

Mr. FRANK. Okay, yeah. I personally think that the plug-in hybrid and not pure electric cars; I think pure electric cars have a long way to go. There are still issues; you can't charge very fast and—many, many issues.

But the plug-in hybrid is a car that can begin to transition, or the substitution of gasoline directly with electricity. And don't forget that electricity is one-sixth the cost of gasoline today. So as gasoline prices go up, the differential is going to get higher.

The most important thing is, we have the technology to do that now. And the main question is, how do we get millions of cars out there? And by the way, millions of cars translates directly into jobs, because it takes people to make those things.

So we have to look at the new technologies, the OEMs they are looking at, the General Motors with the Volt and so on. But we also have to look at legacy vehicles, the vehicles that we have already constructed, the pickup trucks sitting on the lots that they can't sell right today. A $25,000 pickup truck is selling for $12,000. There is a $12,000 difference that can be used for conversion of that truck to a plug-in hybrid.

Now that, plus some help from Congress, I think, is what we need to think about, how to get that so that the people, if we bring that plug-in hybrid up to the—the pickup truck up to a plug-in hybrid standard, we can restore the value of that car; and that car can then go back into the public.

Mr. MCNERNEY. You feel that can be done at a lower cost than constructing a new vehicle with those characteristics?

Mr. FRANK. Well, yeah.

No. Actually, here is the problem with conversions, you are picking a car that has already been—you put in a lot of capital investment; you will add more capital, half the cost of it again just to convert it. So somebody is going to take that hit, and at the moment, it looks like the bank.

But if you build plug-in hybrids from the beginning by the OEMs, I calculate that when the volume gets up to a half million vehicles in a year or so, that plug-in hybrid could be par with the conventional car. Then, that is where we have to go. But that is not going to happen unless we get a little incentive to get us over that initial hump.

Mr. PATRINOS. By the way, we don't necessarily have to use gasoline for the nonelectrical part. We could use biofuels. So in a sense, we could have an entirely—based on renewable energy.

Mr. MCNERNEY. Ms. Zoi, I would like to address a general question. The whole climate change issue has the public's attention now. Do you think that that is something that we are going to be able to use to inspire and motivate the next generation to participate in scientific enterprise and move that as a forward strong issue for our Nation?

Ms. ZOI. Absolutely.

If you ever get tired of being a Congressman, you can come and join our team because we have exactly that in mind. We have this "We Campaign"; we have already recruited nearly a million and a half people. And one of the things that our research is showing us is, across the political spectrum, people from all walks of life, no matter whether they are city or country or rural, urban, young or old, all believe in the promise of clean energy. Even if they actually wonder about some of the climate change issues, they still believe wholeheartedly that going on a path to clean energy is going to help the country and their livelihoods and their kids.

A lot of our members, a lot of our We Campaign members, are young people. And we are just getting going now on a solutions campaign that will roll out in August, and you will see it at bus stops and see it everywhere, again to motivate people and get them excited about participating in this clean energy revolution that Al Gore has called for.

Mr. MCNERNEY. Thank you.

I see my time has expired and I yield back.

The CHAIRMAN. Thank you. The gentleman's time has expired.

The Chair will recognize himself on a second round of questions. I want to follow up on what Mr. McNerney was just talking about.

So, Dr. Frank, let me come back to you, I have a 2-year-old Toyota Camry hybrid that the sticker says gets 40 miles a gallon. It doesn't quite get that, but it is a lot better than a regular Camry gets.

Mr. FRANK. That's right.

The CHAIRMAN. Thirteen or 14 gal better than a regular Camry, which is the most popular midsize vehicle in the United States, and has been for 7 or 8 years. And I am very happy with it.

So what can you do for me, Dr. Frank, I have A123 that is up in my district; they do retrofits.

Mr. FRANK. Right.

The CHAIRMAN. Talk to me a little bit about what is possible in this retrofit business area over the next 10 years and how it can become appealing to people to take a vehicle that gets 40 or 30, you know, and with some investment, get it up to 60, 70, 80 miles per gallon.

What is the formula for making that work?

Mr. FRANK. There is a whole bunch of things that you brought up in that one question.

The first thing is, going to the plug-in hybrid is really not about increasing fuel economy; it is about displacing oil. And because when you go to a plug-in hybrid, you are using electricity and not gasoline. So, yes, if you calculate in some funny way, you'll get better fuel economy.

But I like to look at it—if you saw my chart on the board—as displacing oil on an annual basis. So I calculate that a plug-in hy-

brid with 50, 60 miles of all-electric range would displace 90 percent of the gasoline with electricity, and 10 percent of the gasoline will be used on that particular car for the same driving.

Now, would you say that is going from 20 miles per gallon to 200 miles per gallon? You could say it that way, but that is really not what is going on. What you are doing is, you are displacing energy from liquid fuel to electricity. And the most important thing about the electricity of course is, it is one-eighth the cost.

The CHAIRMAN. The only reason I use that term is that it makes it accessible to people, so when they invented the automobile, they called it a horseless carriage because that is all people knew. And then they called it horsepower, but it was to try to get people who were using one set of terms to get into the new technology.

Mr. FRANK. I understand.

The CHAIRMAN. When we go to wireless phones, it has nothing to do with wires, but people are used to making phone calls on wires. But that is the only reason I am using that, the analysis that I am using.

So is it something—well, take us out 10 years then, Doctor, and I would like each of your thinking—especially you, Ms. Zoi.

We sell 15, 17 million vehicles in the United States every year.

Mr. FRANK. That's right.

The CHAIRMAN. Let's go out 10 years. Let's keep the price of a gallon of gasoline at $4 a gallon, let's have this revolution coming in from Nissan—from, you know, the Chinese and others, and the innovation that is going to be spurred by us, having raised the fuel economy standards from 25 to 35 miles per gallon.

What does our fleet look like 10 years from now? I would like you, Dr. Frank and Ms. Zoi, to answer that question.

Mr. FRANK. Well, my feeling on this is, people are going to look at how much it costs them to go a mile, every mile. At the current time, cars cost 15 cents a mile roughly at $4 a gallon. And with electricity, using electricity from the grid, the current grid, it is about 22 cents a mile; and if you go to solar, it comes down even further.

So that is, I think, ultimately what people are going to do. They are going to look at how much it costs them to go a given distance and do their job. And that difference between 2 cents and—that is really the cost of living and lifestyle.

The CHAIRMAN. So you think it is going to be dramatic in 10 years?

Mr. FRANK. I think so. People are going to migrate towards something like the plug-in hybrid. The GM Volt is going to demonstrate that for us. So when people realize——

The CHAIRMAN. Even there, General Motors is still fighting increases in the fuel economy, so even if it is the same—they are going to introduce the Volt in 2010, they are saying, but don't get too excited about what will be there by 2016. So don't try to increase from 31 miles per gallon, which——

Mr. FRANK. I have seen this happen at GM. You saw what happened to the electric car; are they really sincere about it?

The CHAIRMAN. What do you think, Doctor?

Mr. FRANK. I think this time they are real, and the reason is, they look around the world, and they see a peak in the production

of oil. And actually that is why it doesn't make sense to drill, because we can't drill our way out.

The CHAIRMAN. Ms. Zoi.

Ms. ZOI. I, too, think it will look dramatically different. The question of how different is a function of how much we enable it to happen quickly.

One of my daydreams is to have an energy core that actually—I have been in the energy business for a long time—that goes up and down the streets in neighborhoods and town centers, and finally does those energy efficiency retrofits that we have been talking about for a long time.

And I know you have been talking about them. They are really simple things; it creates jobs. But it is stuff like insulation and thermostats and all that.

But as we were talking on the break, we could also provide the infrastructure so that people could plug in their cars, their existing cars, and do retrofits if we wanted the plug-in hybrid thing to happen faster. So as we go street by street, we do the car infrastructure retrofit at the same time, so people can plug in.

The CHAIRMAN. Were there any partnerships created during that break?

Mr. YUREK. There were.

The CHAIRMAN. Dr. Yurek.

Mr. YUREK. If I could add a comment to your point in the last gentleman's question on these hybrid cars, you have to have the grid to support this. There is no wireless transmission of electricity, so you need the grid.

And just one data point to consider, Con Ed, Consolidated Edison in New York City, concluded a couple of years ago that a 5 percent penetration of plug-in hybrid vehicles in Manhattan would increase the rate of electricity demand by 50 percent—50 percent—and they just don't have a grid to support that. That is what they concluded and stated publicly.

The CHAIRMAN. Who concluded that?

Mr. YUREK. Consolidated Edison.

The CHAIRMAN. What about the argument they are plugging in on off-peak hours and you don't need a dramatic increase in the electrical generating capacity?

Mr. YUREK. We have all been in New York City, and the lights stay on pretty much well into the night. It is during the day when the taxis running around they have to charge up periodically and delivery vehicles are coming in.

So, yes, there will be a lot of off-peak charging by residential folks at your home and apartment, but there are a lot of other vehicles going around that need to charge up all the time.

The 5 percent penetration gives a great increase——

The CHAIRMAN. So you are not that optimistic.

Mr. YUREK. I am optimistic in the following sense: We are working with Con Ed right now. They recognize it and are taking action. They want to create the "Internet of power" in Manhattan, and we are about to connect the first two substations in Manhattan to start that process.

All those things have to happen for the vision of 10 years from now to come to completion.

The CHAIRMAN. I will let you have the final word, Dr. Frank.

Mr. FRANK. That is the intelligent grid that we are referring to. I calculated with an intelligent grid, we don't have to increase the power at all.

As a matter of fact, PNNL, the National Lab of—Pacific Northwest Lab, they calculate that. Actually, the current grid has enough energy to support 80 percent of the cars in this country today. So there is not a problem.

The CHAIRMAN. Maybe we can get them to come in and work on New York City.

Mr. FRANK. Well, maybe. But the key is, with an intelligent grid, we have to have a smart plug. That plug doesn't take energy out. Batteries are one of those things that doesn't have to be charged all the time. You plug it in. That doesn't mean energy has to flow, it only has to flow at the right time; that is what intelligent grid is all about.

The CHAIRMAN. Thank you. The gentlelady from South Dakota.

Ms. HERSETH SANDLIN. Well, I just have a couple of quick follow-up questions.

But I do think it is interesting, Mr. Chairman, given this panel, if we've identified an area of disagreement, I think we just maybe found it. And to get at the heart of some of these questions, we need to agree on a basic set of facts. So I think it is something that we should continue to work on to see just what the grid, the existing grid, can take on, and what types of investments for other transmission that we had pursued in other lines of questioning earlier, whether there are more populated parts of the country like New York City or some of what we hope to achieve in less-populated parts of the country like South Dakota.

Ms. Zoi, your testimony mentions advances in thermal storage technologies. Have we seen similar advancements in wind energy storage capacity? And should Congress be doing more there to support research and development of renewable energy storage systems, because that has always been the knock on wind, it is intermittent.

I met with some folks, and they think the technology could be there if they had resources to really advance the research for storage of wind energy.

Could you comment?

Ms. ZOI. No. I think you are right. I think that across the board what we want to do with the intermittent style of renewable solar and wind is to make sure that the investments, that the research and storage technologies continue; and a signal from Congress and help from Washington would certainly be good.

The technologies that solar thermal are using are not rocket science technologies. Molten salt has been around for a long time, flywheels have been around for a long time; it just costs more money, but they are not breakthrough things.

I presume that wind—my colleagues here might be able to better comment on this, wind can similarly do those things, but that can get even better, just as the photovoltaic cells themselves have continued to improve with more deployment across Germany, et cetera, the storage technologies need do the same.

Ms. HERSETH SANDLIN. Dr. Yurek, your testimony also described your work with superconductor technology to double the output of wind turbines. Could existing wind turbines be retrofitted with this if your plan sort of goes forward?

Mr. YUREK. I don't think that would be a particularly effective way to go. There are some instances where that might be possible, but there would be very specific generators that you would have to go back and retrofit.

So I wouldn't hold that out as a terrific way to go.

Ms. HERSETH SANDLIN. Okay.

My last follow up, Mr. Lockard, you had talked about certain States and efforts of certain States to bring wind component manufacturing and test facilities to their States. And you describe incentives that are being provided at the State and local levels for training grants and building buy-downs.

What are some of those key incentives that local and State governments have offered?

Mr. LOCKARD. The State of Iowa has been very progressive in terms of training grants, building buy-down programs to offset the cost of a new building. Building large blades, for example, requires big buildings; oftentimes a building is not available somewhere already. The States of Texas, Massachusetts have both put significant money forth to develop blade test facilities that they hope will be expanded to further R&D for offshore, further manufacturing capabilities, as well as the chairman understands. So there are pretty significant dollars available.

On the R&D side, we would like to see more cost sharing, win-win-win programs, with industry, State and Federal dollars stretching the Federal dollars further, and that way doing some more of the higher-risk, higher-return R&D to drive down costs and do some of the things that have been described here.

Those monies are available.

Ms. HERSETH SANDLIN. Thank you.

Thank you.

The CHAIRMAN. It is a rare moment that a Congressperson yields back time. So I apologize to you.

The gentleman from the State of Washington, Mr. Inslee.

Mr. INSLEE. Thank you. The more that I look at this, the more the grid becomes central to our ability to electrify the transportation system and really maximize our opportunities.

When you look at metaphors on how to do this, you look at the Federal highway system. People suggested that—look what we did with the first Senator Gore on the Federal highway system; the Federal Government went out and built it, used tax revenues and just built it.

I am not sure that is the right model for this, either a high DC or just an improvement over an AC system. I would like your thoughts on really how to finance that and who should do it.

Now, I have introduced a bill that basically we call the "rural energy superhighway system" that would basically spread the cost, create a line's charge and spread the cost, at least regionally, for those who are going to build a system to get out to a renewable field—wind or solar or geothermal or whatever they are going to

use. So it would create, through a line charge system that the entity that built that line would essentially be able to benefit from.

Is that adequate? And if that is not adequate, should the Federal Government really assume responsibility for building a DC backbone? Is that really the only entity available to do this? What is the best mechanism moving forward?

I will start with Mr. Lockard maybe, if I can.

Mr. LOCKARD. Yeah, I think others may comment a little better than I about the DC–AC issue, but the 20 percent wind work that has been done recently identified transmission infrastructure that does need to be built by someone somehow, but also real constraints from a planning standpoint and just control areas.

I think it was mentioned earlier by one of our colleagues about just who has control over how wind gets generated and then distributed through multiple regions from windy regions to load centers. It is not just building the infrastructure, but also control area optimization.

The 20 percent report showed that 300,000 megawatts can be built. Transmission is one of the biggest constraints, something like $60 billion; estimates may be more like $80,000.

The CHAIRMAN. Three hundred thousand megawatts of wind.

Mr. LOCKARD. Of wind by 2030.

That transmission is going to be probably the single biggest constraint, there are other issues to getting there, but getting the wind to where load centers are effectively, it needs to be done. I am not sure that the Federal role needs to be pay for all of that.

It seems to be that there is definitely planning and logistics in dealing with—the way those decisions are controlled today is a place to start. Storage could help augment and probably reduce some of the cost of that system as well.

Mr. INSLEE. Dr. Yurek.

Mr. YUREK. We have an alternating current, an AC grid, for short. You can't legislate the physics of the grid, so the reason the FERC, Federal Energy Regulatory Commission, does not allow someone to just come in and plop a new AC transmission cable or overhead lines anywhere is because it would disturb the grid for large regions around it.

You can do that with DC. You can plug a direct current cable in there and it won't disturb power flows over long distances. To put an add in here, I guess with superconductors cables, even with AC, you can allow that to happen; you can put it in.

So your thought, I think, is in the right direction to allow somebody to charge for the use of that line and make money on it; therefore, they would make the capital investments. But you can't do it with conventional technology; once again, you will have to go to advanced technologies, or you will be forced to go to a DC, backbone as you say, which is still a good idea, anyway. But for local or rural, you probably are not going to be allowed.

Mr. INSLEE. When I said rural, that was as much marketing as anything else. I don't mean for rural usages that is where it would be located.

So let me ask you, Dr. Yurek, do we need a DC backbone in the United States? Is that investment justified, and if so, who will provide the capital?

Mr. YUREK. Well, I think ultimately if we are going to get to 300 gigawatts of wind-generated electricity in 2030, which seems quite feasible, it is possible you are going to have to have that backbone to support it. So you are going have to have these parallel paths of putting in new sources of zero-emission electricity generation along the backbone.

So South Dakota is not next door to, let's say, Chicago or New York City for sure. So you are going to have to have a backbone to support the long distance transmission of power.

Mr. INSLEE. And what is the best funding mechanism? Is it a Federal Government? Is it a coalition of utilities? Is it private enterprise supported by loan guarantees? Is it just private enterprise? What is the best mechanism to accomplish this?

Mr. YUREK. I think if there were some support loan guarantees and so forth for private enterprise—you think of this as putting the first bridge across the Hudson River; it was a toll bridge and let a lot of traffic to occur, west to east, and reverse. But it was private financing for that. We ought to give that a shot, I would say.

But if that is not going to work for some reason, if we can't handle the regulation around the grid in a proper way, I think the interstate highway approach is probably the way to go.

Ms. ZOI. Just to add something, I think speed is important. So—and I recall, unfortunately, in California last year there was a terrible road problem where a bridge or an overpass on one of interstates in the East Bay fell down. They had to fix it really fast.

So the governor of California created a contract, bid out the job to a bunch of infrastructure civil engineering companies; and the terms of the contract were, every day that you finish sooner, you get more money. And the project was anticipated with—the government department had said, this will take 12 months to fix this road. And they got the job done in like 3 months because they had a financial reason to do it fast.

So that was the innovation of private enterprise, but the bill was paid by the government.

So I think it is so important that we get this DC backbone. And I think it is such a big enabler of T. Boone Pickens projects, and all the projects in the Southwest and so many projects around the country, that it might be worth it for the government to bankroll it, because it is not that much money to get going.

Mr. INSLEE. Thank you.

Dr. Frank, may want to add something.

Mr. FRANK. Yeah, I have heard storage, storage, storage three or four times. The plug-in hybrid is the storage mechanism. We don't need additional storage. One of the things about wind, without storage 20 percent is maximum. If you had storage you had plug-in hybrids in society where you could take energy into and out of the car, you can go to 100 percent wind.

Mr. INSLEE. Dr. Frank, I got to drive one of your geniuses, a Toyota Remix yesterday. It worked like a charm. So thank you for your genius.

The CHAIRMAN. I worked my way through college driving an ice cream truck. So I had to plug it into the side of the house every night, and would jump out, it took 5 seconds, plug it in. And in the morning rather than having to go some other place, you know, my

ice cream it was already inside of my truck and ready to go and ready for sale. So the only thing is my father didn't get to park in the driveway, which was an issue. But my mother was on my side on that. There will be a lot of issues within families as to who gets to pull into the yard and plug in. We will figure that out when we hit critical mass in plug-in vehicles.

The gentleman from Missouri, Mr. Cleaver, is recognized once again.

Mr. CLEAVER. Actually Mr. Inslee pretty much dealt with what I wanted to ask you. T. Boone Pickens of course said it would cost $2- to $300 million of private investment of his own money to begin his wind farm. And I agree I think Ms. Zoi said this, any money we spend is good money as far as I am concerned. You can imagine—well, maybe you can—we don't have to imagine. We know that trying to get such an appropriation if the government is expected to be involved there it is going to be Herculean. We are still dealing with people who deny global warming. I mean in Congress.

So is this something that the private sector can do without much participation from the Federal Government?

Ms. ZOI. They can do it if the rules create a reason for them to do it. The capital is available. If you all say that a utility is not able to operate unless they access a DC line, you will have to create some policy settings that mean that the private sector can come in. But the engineers are sitting there waiting, they are ready to roll, they are ready to dig and run the wires. But unless you guys create a policy framework to do this, it may happen organically, but it may take a long time, longer than we have.

Mr. CLEAVER. Policy may be more important right now than——

Ms. ZOI. Than money.

Mr. PATRINOS. I also would like to add in the case of biofuels, in order to level the playing field we need to do away with subsidies and tariffs that distort the marketplace. There are plenty of opportunities to produce biofuels that are competitive if we level the playing field.

Mr. CLEAVER. Anyone else?

Thank you, Mr. Chairman.

The CHAIRMAN. The gentleman's time has expired. The Chair recognizes the gentleman from California, Mr. McNerney.

Mr. MCNERNEY. Mr. Patrinos, I see biofuels as a terrific opportunity for my particular district, which is Central Valley, east of the San Francisco Bay Area. There is a deepwater port there, there are agricultural assets.

One of the questions I have is how much raw biological material is there available in the country that we could use to make biofuels? I mean how many barrels equivalent of oil could we produce a year without impacting our food supply, just considering the growth potential, the green potential? How much can we plant, how much can we water? The realistic amount of oil equivalent that can be produced using bio feedstocks.

Mr. PATRINOS. So there have been several studies that have been conducted to get as good an evaluation of the available biomass, and the Department of Energy and the Department of Agriculture joined forces 3 years ago and produced a so-called billion ton study, and concluded that there were at least a billion tons per year of

biomass that could be devoted to biofuels. And if all of that was converted into biofuels we could certainly replace more than 20µpercent of the gasoline consumption in this country.

There have been other studies that question the level and whether it is a billion or whether it is 800 million. I think there is an adequate amount to make a significant dent in gasoline consumption.

Moreover, as I presented in my testimony, we are very optimistic, certainly in the company that I represent, that ultimately we can use carbon dioxide, which is what we are talking about burying in the subsurface, in the underground. We can use that as the feedstock and in many ways replace fossil fuels and convert fossil fuels into renewable fuels, because you could burn coal and the CO_2 that is produced, rather than releasing it to the atmosphere or burying it underground, you can then convert it back into another fuel, whether it is methane or potentially other ones.

Mr. MCNERNEY. So you have a pathway in mind to do that?

Mr. PATRINOS. We have several pathways in mind and we are working very aggressively because clearly if this is successful and we are optimistic that it will be, it will be the real game changer.

Mr. MCNERNEY. So you are talking about genetically modifying existing materials, existing——

Mr. PATRINOS. We are already, the community is using genetically modified organisms for conversion, Du Pont—to produce propane——

Mr. MCNERNEY. So from where we are today there is a significant amount of biological engineering that needs to be done to get to where you are talking about?

Mr. PATRINOS. We are optimistic that we will demonstrate this technology within 2 years and put it into large scale production within 5. So there are still some hurdles we have to jump, but they are within the range of our guns.

The CHAIRMAN. Would the gentleman yield briefly?

Mr. MCNERNEY. Sure.

The CHAIRMAN. So when we all kind of incant carbon capture and sequestration as the potential answer, you are saying that that might not be the answer, that there may be other pathways and you might be within 2 years of demonstrating a pathway.

Mr. PATRINOS. Indeed.

The CHAIRMAN. Convert the carbon into something more useful and doesn't require any sequestration at all?

Mr. PATRINOS. Absolutely.

Mr. MCNERNEY. I don't know how to put this in a politically correct way. Is there going to be an outcry from people who are concerned about the genetic modifications?

Mr. PATRINOS. It is a reasonable question and we have dealt with this from the very beginning whenever we started developing this technology many years ago when the Human Genome Project essentially converted biology. So we have had scholars and community leaders and the public. And the public is very involved in the deliberations in order to make sure we put in place the safeguards that will render this technology safe.

Mr. MCNERNEY. I have used all of my time on just one question, Mr. Chairman. So I will yield back and maybe I will get another chance.

The CHAIRMAN. I am afraid this is it, but you do have 32 seconds left.

Mr. MCNERNEY. I was going to talk a little bit about carbon fibers and wind turbines, but you have sort of gone off, Mr. Lockard, in talking about buildings, making more buildings efficient, which is a huge sink of energy and a huge source of carbon dioxide. I don't hear too much discussion in that. Is that an area that your company has a hold on or is there any technology out there that we can say here is a great path forward for people to rehabilitate their buildings, make them efficient, help reduce this enormous drain of resource into heating and cooling buildings?

Mr. LOCKARD. Yeah, I think my comment on the building related to State incentives that have been made available to us to help create jobs, that was a comment a little bit ago at any rate. The new buildings that we are building, we are working on trying to be conscious in that way. I am not sure there was any specific breakthrough there that I was trying to comment on.

The CHAIRMAN. The gentleman's time has expired. I apologize to him.

Mr. MCNERNEY. I yield back.

The CHAIRMAN. We are going to wrap up the hearing right now and we are going to ask each of you to give us your one-minute summation of what you want us to remember about the capacity here for technology to solve this problem, to give us a pathway to energy independence and a solution to global warming.

We will begin with you, Mr. Lockard.

Mr. LOCKARD. Yes, thanks again for the time and availability today.

I think from a wind energy perspective, 20 percent wind is a feasible goal, perhaps more with good cost effective storage. Big constraints are transmission related and Federal policy boiling it down. We have a unique opportunity in wind to create U.S. manufacturing jobs, unique in part because the size of the components we build are physically very large, transportation is therefore expensive from places like China and Mexico. We have a unique opportunity with 20 percent to create 500,000 U.S. manufacturing jobs in this time frame. Federal support is critically important to make the pie big, make the volume high, make the volume stable. So stability of policy and of course again just urgent requests really related to the current PTC. It is an issue today before recess, after recess, it is an issue today, a pretty pressing issue. Jobs will be lost in 2009 already. So just ask for urgent action on that.

The CHAIRMAN. Just a quick yes or no on this. Do the witnesses support or oppose the renewal of the production tax credit for renewables?

Mr. PATRINOS. We certainly support it.

Mr. FRANK. Support it.

Mr. YUREK. Yes.

Ms. ZOI. Support.

The CHAIRMAN. Dr. Patrinos, your conclusion.

Mr. PATRINOS. Thank you for this opportunity. The revolution of genomics led by scientists like my colleague Craig Venter have transferred biology to the game changer for the challenges we face dealing with the energy crisis and the climate crisis. These new tools, the scientific tools that have been enabled through the genomics revolution will give us the opportunity to produce the right and the copious amounts of bioenergy and especially biofuels to convert much of our transportation and energy system in a renewable way. Especially the revolution of using carbon dioxide as a feedstock for bioenergy would be a great part of the game changing element.

What we do need, as I mentioned earlier, is leveling the playing field for alternative fields as well as promoting sensible regulations with respect to the synthetic genomics technology that we have developed.

The CHAIRMAN. Thank you, Dr. Patrinos.

Dr. Frank.

Mr. FRANK. Thanks again for inviting me, I am delighted to be here to contribute.

The most important thing I think to realize about the plug-in hybrid is we are talking about a plug-in hybrid. Once we get to about 50 percent penetration into the vehicle market of reducing our oil consumption substantially and as a matter of fact——

The CHAIRMAN. Substantially is what, doctor?

Mr. FRANK. Substantially meaning 80 to 90 percent of oil.

The CHAIRMAN. Ah-hah.

Mr. FRANK. So once you get to that stage, biofuels become practical. The 20-percent that was stated earlier, we don't have to go any further. We don't even have to have more. So the point is to get there we are going to have to do more R&D. And the Federal Government—by the way I have developed these plug-in hybrids over the last 25, 30 years with no funding from the Federal Government at all. But we are going to have to step that up, because now the key is to get these cars into the hands of the public. That means development and deployment. We have to do that through government help. It is not going to happen by itself.

The CHAIRMAN. Thank you, Dr. Frank.

Dr. Yurek.

Mr. YUREK. Thanks for having me here today, thanks for the committee being formed. I think you are doing just the right things.

I think we have the genius, I think we have the inspiration, and the drive in the country to solve the problems we face. I think we can be energy independent. We need new sources of generation, whether it is solar, thermal or wind, you name it. There is more technology that has to be developed and can be developed in this country. You need energy storage devices. Whether it is flow batteries or flywheels or what have you, the technology is there. It is ready to be developed and brought to the fore. You are going to need a grid to support it all, to get it to the customers in a timely way with high efficiency.

I think everybody is agreeing, what I have heard today, about increasing the efficiency of operation of our industrial systems as well as our residential and commercial buildings. Motors use up to

two-thirds of all the electricity in this country, use is up, burn it up. We can make those much more efficient and have big savings. A lot we can do, this committee is on the right pathway, keep it up.

The CHAIRMAN. Thank you, Dr. Yurek. And Ms. Zoi.

Ms. ZOI. I would close and talk a little bit about the politics. When Al Gore issued his challenge 2 weeks ago there was some nervousness in the intellectuals about how ambitious it was. The response from across America from editorial boards and citizens has been that it is very, very enthusiastic. So I guess what I would like to leave you with is go bold, be bold. We have the technology capability, we have the know-how, we have the wherewithal. And the American people, I don't know about inside of Washington, but the American people are rising to that challenge and have an appetite for something big to demonstrate our can do spirit again.

The CHAIRMAN. Thank you very much. And thank you all for being here. You know, I realize that people want big. People want game changers. Back about 3 years ago at Boston University they gave me an honorary degree on the same day they gave one to Saul Bellow and Craig Venter. I was the lowest card in that realm, but then they saved their cheers for the final honorary degree recipient, which was Bill Belichick, who had just won three Super Bowls in a row, which seemed to be impossible in Boston until his arrival and he was being rewarded with this enthusiastic response.

Now what Craig Venter had done was of course completely change the way we view medicine. In 1900 the average age of death was 48, this year it is 79. We know with all these breakthroughs one in three children born today will live to the age of 100. It has a lot to do with what Craig Venter has done and others in all these breakthrough areas, tremendous changes.

When Al Gore was Vice President and I was the lead Democrat on the Telecommunication Subcommittee back in 1995 and 1996, when we were passing the Telecommunication Act we had analog all across America. No one had broadband in any home in the United States, but our goal was to move from narrow band to broadband, from analog to digital. That was the goal.

Well, 1997, people started getting broadband. Did we know the names of the companies? Of course we didn't. We didn't know the names were going to be Google and e-Bay and YouTube. Who knew what the names were going to be? All we knew is we were empowering technologists to go out there and do it. Ten years later the world is unrecognizable. No one even remembers before broadband. It just seems like ancient history and it is only 10 years, which is why the Vice President's goal of 10 years is realistic. As long as we get the policies right, as long as we set it up so that we are empowering the same kinds of people that we empowered in the Telecommunications Act, the same kind of game changing, technology innovating, companies and individuals that we did in telecom.

And I don't think it is a coincidence, the two wires going down the street for 100 years were the telephone wire and the electric wire. And a lot of people called this stuff low hanging fruit, but it is heavily guarded low hanging fruit. These utilities shoot with real bullets when they are fighting against innovation. And so if we want to change the paradigm it is going to be a tough battle, they

are powerful and entrenched, but the tides of history have turned against them.

And so now hopefully next year we will put on the books a mandatory cap and trade system. We will be at Copenhagen as the world's leader, not laggard. We will have a position of moral and political integrity from which we can finally be speaking and we will be empowering the great innovators who are here at the table here today. Each of you in your own way is pushing the edge of the envelope. You are trying to change the world through your technologies and through your political activism. From most of what I have heard this morning, we don't have to wait for the breakthroughs, you have already made them. We are not waiting for a new invention, you have already made them. As soon as we get them into the marketplace, the quicker they will be improved, the quicker that they will be modified, and the quicker we will get the solution that the planet needs.

I am very confident that 2050 will be a year in which we all look back and wonder what the big debate was all about back in 2008 about the price that the economy was going to have to pay, because the world will have been so transformed. And the people sitting at this table will have played a big role in it, and we thank you for it. And we thank you for being here all afternoon.

With that, this hearing is adjourned.

[Whereupon, at 5:15 p.m., the select committee was adjourned.]

THE SELECT COMMITTEE ON
ENERGY INDEPENDENCE AND GLOBAL WARMING

Dear Mr. Frank,
Following your appearance in front of the Select Committee on Energy Independence and Global Warming, members of the committee submitted additional questions for your attention. I have attached the document with those questions to this email. Please respond at your earliest convenience, or within 2 weeks. Responses may be submitted in electronic form, at aliya.brodsky@mail.house.gov. Please call with any questions or concerns.

Thank you,
Ali Brodsky

Ali Brodsky
Chief Clerk
Select Committee on Energy Independence and Global Warming
(202)225-4012
Aliya.Brodsky@mail.house.gov

1. What policy should be the top priority for Congress to enact which will provide the most benefit to help deploy renewable technologies? Develop a Rebate program for Plug-In Hybrids or EREVs that is tied to battery size. This should replace the sun setting of the current hybrid rebate program. The objective of the Plug-In Hybrid is to displace gasoline so the larger the batteries the more gasoline displacement possible with electric energy. Additional rebate should be given for the use of solar and wind energy for electric energy for charging batteries in cars and in homes. . The objective of solar and wind generators is to displace oil and coal as well as oil used for gasoline production.
2. As a carbon free generation source, do you support nuclear energy as a part of our energy portfolio? Nuclear energy is important as part of our energy portfolio but should not be over emphasized while ignoring other large renewable energy sources.
3. Given how the economy is already struggling with high energy prices, what would be the impact on the economy of making electricity more expensive due to the cost of transitioning to renewable energy? The objective is to encourage lower cost energy technologies and distributed energy sources not encourage as much expensive alternative energy technologies. .
4. As part of your solution, you suggest retrofitting conventional cars to make them PHEV10. Further, you note that it would cost $15-$20K per car. How would you suggest consumers pay for the switch? Our calculations show that if the conversion costs can be reduced to $10,000 for a PHEV10 with lead acid batteries or a conversion that can provide 100 mpg for 30 miles, and the

driver plugs in his car or truck every time parks then he could displace as much gasoline as a PHEV40 or a conversion that will get 100mpg for 120 miles where the large battery pack systems are plugged in only once a day. The Electric grid will not be affected until the numbers of PHEV or EREV's become a significant portion of the total fleet in 10 or more years. **Would a conversion invalidate the auto manufacturer's warranty?** Maybe, but there are ways to avoid this by converting the vehicles to use electricity but yet preserve the driveline as designed but perhaps at a lighter load making the power train last longer. Some relief from emission rules y EPA and CARB should be considered since conversions are only a transition technology that will last 5 years or so and not be in enough numbers for many years and will be replaced by OEM PHEV's eventually

5. **Would cars that have batteries in them face additional disposal challenges?** To start with conversions can use lead acid batteries to keep the cost down and work on a pay back period of 3 years or so but last a minimum of 5 years. **Would disposing large batteries in junkyards pose environmental difficulties?** These lead acid batteries would be recycled along with current batteries from conventional cars. Our current recycling capacity would increase only incrementally over 3 to 5 years.
6. **What is the useful life of your plug-in battery unit?** For conversions likely :ead Acid would be used to keep the costs down and 5 years can be expected. But OEM cars will use Lithium with 150,000 mile and 10 year life capability. **How many times would the battery have to be replaced over the average life of a vehicle?** The conversions may only be replaced once since then these cars will have served their useful life of 5 years or so. The OEM lithium cars' battery can last 15 years. This means that there will not be any battery replacement needed for the life of the cars. **What is the cost?** If a replacement is needed the cost will be lower in the future since battery costs are coming down as the volumes grow.
7. **Has NHTSA conducted extensive safety analysis of how plug-ins would react in crashes?** Design standards have not yet been fully established but of course they must be able to pass safety standards needed for protecton of the public. **Would the electrical charge from the battery be dangerous for emergency personnel who are trying to get a trapped victim out of the wreck?** Safety disconnects triggered by the airbag sensors are a simple way to disconnect the batteries into small benign modules.
8. **You note that "cost must be carried by someone since savings in current cost of energy cannot fully justify current incremental cost of PHEV Modifications." How expensive would gasoline be to justify conversion?** At $4 a gallon the max cost would be about $7000 as the price rises the conversions can creep up to $10000 as the cost of gasoline gets to around $6.

9. **Do you think that adding outlets to parking lots to recharge cars is realistically feasible?** Yes since the Canadians already have plugs in every parking space for winter engine heating. If they can afford it we can. The cost of a 110 volt plug installed can be on the order of $20 per plug or less when done on a mass scale. Water proofing and new technologies need to be included. SAE is working on standards for PHEV and EV charging standards. **Who would pay for the free electricity that would be provided?** If the PHEVs' have V2g capability and the Utilities have intelligent plugs that are all built to a standard set by National committees such as the SAE and the Underwriters labs. then the Utility companies stand to either make more money due to improved efficiency and the elimination of stand by power plants or they can provide the plugs in the parking lots and offer free charge for the use of the cars batteries for balancing the grid and still make more money!! This is really a Win-Win situation for every one involved.

Prof Andy Frank

THE SELECT COMMITTEE ON
ENERGY INDEPENDENCE AND GLOBAL WARMING

Dear Dr. Patrinos,
Following your appearance in front of the Select Committee on Energy Independence and Global Warming, members of the committee submitted additional questions for your attention. I have attached the document with those questions to this email. Please respond at your earliest convenience, or within 2 weeks. Responses may be submitted in electronic form, at aliya.brodsky@mail.house.gov. Please call with any questions or concerns.

Thank you,
Ali Brodsky

Ali Brodsky
Chief Clerk
Select Committee on Energy Independence and Global Warming
(202)225-4012
Aliya.Brodsky@mail.house.gov

1. What policy should be the top priority for Congress to enact which will provide the most benefit to help deploy renewable technologies?

Answer: Update the Energy Policy Act of 2005 and Energy Independence and Security Act of 2007, so that funding authorizations fully account for and help foster the research, development, demonstration and commercial application of next generation fuels, including genomic-driven technologies that produce fuels from renewable feedstocks and carbon dioxide. Devise flexible and equitable Investment and Production Tax Credits across all forms of renewable energy. Make the credits commensurate to ecological and environmental benefits.

2. As a carbon free generation source, do you support nuclear energy as a part of our energy portfolio?

Answer: Given the staggering amount of fossil fuels consumed worldwide and in our country, the scale of needed alternative fuel is great. At SGI we believe that we will only be able to wean the world off fossil fuels through a wide array of alternative fuels. This includes solar, wind, and the various biologic and genomic-focused approaches that we and others are developing. While I believe that these sources represent a better place to put our energy focus, I support nuclear energy as a part of our energy portfolio as long as adequate safeguards against the proliferation of nuclear materials are developed and implemented.

3. Given how the economy is already struggling with high energy prices, what would be the impact on the economy of making electricity more expensive due to the cost of transitioning to renewable energy?

Answer: Several studies have shown that the cost of electricity from renewable fuels is competitive with that generated from fossil fuels when the environmental impacts from the burning of fossil fuels are factored into the calculation. The National Academy of Sciences will be releasing a report in early 2009 that will provide the hard data to perform such comparisons. The report is called "America's Energy Future."

4. Your testimony notes the "need to develop homegrown and renewable sources of energy, to eliminate or significantly reduce our dependence on foreign oil." What policies can Congress pass to attain this goal?

Answer: It is imperative that the Congress "level the playing field" with respect to alternatives to traditional (fossil) transportation fuels. For example, tariffs and subsidies that favor the production of corn-based ethanol distort the marketplace and discourage the production of other renewable liquid fuels that are vastly superior. These superior fuels are derived from feedstock that does not compete with food, can be distributed by the existing transportation infrastructure, and have higher energy content than ethanol. We need more effective federal energy R&D investment strategies and increased funding on a massive scale to attain a sustainable energy future. As I mentioned in the first question and answer, I also believe that Congress should devise flexible and equitable Investment and Production Tax Credits across all forms of renewable energy and make the credits commensurate to ecological and environmental benefits.

5. You acknowledge the difficulties associated with scaling up commercial production, but how long do you believe it will be before microbes can produce a commercially viable amount of fuel? How long will it take to make a significant contribution to our nation's transportation fuel inventory? What can best assist the industry with this challenge?

Answer: We believe that our genomic-driven approach will produce a commercially viable amount of fuel by 2011. Our fuels (and those of others in this industry) will make a significant contribution to our nation's transportation fuel inventory by 2015. Congress and the Administration can best assist our industry by leveling the playing field (see answer to question 4) and significantly increasing the public funding for R&D on renewable liquid fuels, including funds for high-risk/high-payoff research and for demonstration projects, to include funding for pilot facilities.

6. One of the key roles of the federal government is to assist with research and development. What R&D programs have you found particularly helpful in developing your technology?

Answer: We have benefited the most from the funding by the Biological and Environmental Research Program of the Office of Science in the Department of Energy (DOE) and specifically from programs that targeted the mission needs of DOE in bioenergy, bioremediation, and carbon sequestration. The benefits were the greatest when DOE was more inclined to fund high-risk basic research.

7. What kind of environmental safeguards do you believe need to be in place for biofuels to be safe for the environment?

Answer: Technologies being applied to develop advanced biofuels involve methods to construct genetic material that would be impossible to produce using conventional biotechnological approaches. I advocate for policy options with safeguards that enhance biosecurity, foster laboratory safety and protect the communities and environment outside of laboratories, such as the oversight or regulation of commercial firms that supply DNA and DNA synthesizers. SGI's CEO Dr. Venter through his policy team at his not-for profit research institute, the Venter Institute have been engaged in this dialogue for many years and most recently published a Sloan Foundation funded report (along with MIT and CSIS) on the options for governance in the field of synthetic genomics. The report can be downloaded here: http://www.jcvi.org/cms/fileadmin/site/research/projects/synthetic-genomics-report/synthetic-genomics-report.pdf

8. Have you considered restraints due to infrastructure that will limit transporting biofuels? Could SGI's products be disseminated in existing pipelines or would new infrastructure need to be built?

Answer: Obviously any new fuels will only be successful if they can be widely distributed to users where they need them. SGI is developing fuels that are compatible with the existing distribution infrastructure. However while these existing infrastructures do enable us to access fossil fuels, the distances that these fuels travel and form where have added to their cost and increased their negative carbon output. Therefore, SGI is also envisioning a future where our biologically based fuels could be produced and consumed locally, ie a vast network of regionally-based power production facilities.

Committee Follow-Up Questions for the Record

TPI Composites, Inc.

(a member of the American Wind Energy Association)

Submitted to

House of Representatives
Select Committee on Energy Independence and Global Warming
The Honorable Edward J. Markey, Chairman

"Renewing America's Future: Energy Visions of Tomorrow, Today"

October 9, 2008

Steven C. Lockard
President & CEO
TPI Composites, Inc.
Scottsdale, AZ

1. What policy should be the top priority for Congress to enact which will provide the most benefit to help deploy renewable technologies?

Enacting a long-term extension of the renewable energy production tax credit (PTC), while maintaining the credit's current structure, and the adoption of a national Renewable Electricity Standard (RES) are the two policies that would most effectively deploy renewable technologies in the short-term. Following three years of uninterrupted federal PTC support, the wind industry installed a record 5,244 megawatts (MW) of generation capacity in 2007, providing 35% of the nation's new electrical capacity and enough electricity to serve the equivalent of 1.5 million American households. An extension of at least five years, while maintaining the current PTC structure, would ensure this continued growth. Adoption of a national RES would provide long-term market stability for renewable energy industries and dramatically increase our use of clean, renewable energy. In effect, a national RES would serve as a "down payment" to attract investment capital and achieve manufacturing economies of scale until carbon regulation policies take effect.

2. As a carbon free generation source, do you support nuclear energy as a part of our energy portfolio?

I have no position on nuclear power. I do think it is important to focus on deployable technologies in the coming decade, and wind is one of few proven, low-risk, commercially available, and affordable clean technologies. Wind can meet our need for both scale and speed.

3. Given how the economy is already struggling with high energy prices, what would be the impact on the economy of making electricity more expensive due to the cost of transitioning to renewable energy?

Actually, transitioning to renewable energy would save consumers money. Diversifying the electric power supply by adding wind energy helps shield consumers from spikes in energy prices. According to a major 2007 study by the energy research firm Wood Mackenzie, a national renewable electricity standard (RES) boosting renewable energy production would save American consumers more than $100 billion in lower electricity and natural gas bills compared to a business-as-usual scenario. The same study found that by 2026, compared to the same business-as-usual assumptions, natural gas prices would decrease 15-20% due to the effects of the RES, while wholesale electricity prices would be reduced by 7-11%. Other studies have shown that states with renewable electricity standards have lower electricity prices.

4. Given the expected increase in energy demand, how much wind capacity would have to be added annually to achieve 20% of the nation's energy production by 2030? How does this translate into square miles of wind farms? How would this change if plug-in hybrids become widespread and places additional strains on the energy supply?

In order to meet the 20 percent goal annual installed wind capacity would have to increase from over 7,500 MW expected in 2008 to over 16,000 MW by 2018. Sustaining this rate of capacity level additions through 2030 would be needed to reach the 20% goal. The land area required for wind projects to meet this goal translates into 15 million acres, but 95 to 98 percent of the land covered by wind projects could be used for its original purpose, such as farming or grazing. The actual land area occupied by wind turbines would amount to just 618,000 acres, approximately half the size of Anchorage, Alaska.

Plug-in hybrids could increase the demand for electricity, expanding the market for new generation capacity, including wind. The 20 percent scenario did not assume plug-in hybrids were part of the market. Assuming that plug-in hybrids would be powered with clean generation, they would expand the market for new wind capacity beyond 305 GW and 20 percent of generation.

5. You call for a national Renewable Electricity Standard and also have ambitious goals of how much electricity wind will provide down the road. What is the current percentage of energy that is generated by wind? How many square miles of wind turbines would be necessary to generate 20% of the nation's energy needs?

Wind energy currently accounts for about 1.5 percent of the electricity generated in the United States. However, for the past three years wind energy has been the second-largest source of new generation, second only to natural gas. From 2006 to 2007, wind energy installations increased by 44 percent, and the Department of Energy has projected that wind could provide 20 percent of America's electricity by 2030, Only 618,000 acres, less land area than half the size of Anchorage, Alaska, would be occupied by wind turbines in order for wind energy to provide 20% of our nation's electricity.

6. Can you talk a little bit about offshore wind energy production? What is the potential for offshore turbines? What is the size and generating capacity compared to land-based turbines? What can be done to increase the possibility of new offshore-wind production?

Offshore wind power is still in the early stages of development compared to land-based wind. Out of the more than 94,000 MW of wind generating capacity in operation worldwide at the end of 2007, about 1,077 MW of those were offshore, all in Europe. Five countries have wind turbines installed offshore providing clean, renewable electricity: Denmark, Sweden, the United Kingdom, the Netherlands, and Ireland. Germany has approved 22 projects, with one ready to come online in 2008. No offshore wind projects have been built in the U.S., although a number of projects are moving through the development process. In May 2008, the U.S. Department of Energy's report on a 20% wind energy scenario found offshore wind capacity could be 54 gigawatts (GW) of the 300 GW envisioned.

Offshore wind projects must strike a viable balance between technological and economic challenges. Offshore technology has had to adapt to operate successfully in a more challenging environment. Tough weather conditions, which can limit access for routine maintenance, and the saline environment create the need for more robust turbine parts. This in turn means higher costs, which are not always offset by the higher productivity due to the higher offshore winds. Offshore wind turbines operating in Europe today are higher capacity machines, usually 3-5 MW compared to 1.5-3 MW machines installed onshore. Today, research and development (R&D) is underway to create even larger turbines, on the order of 5-10 MW.

For offshore wind, as for any other technology that is competing in the energy marketplace, there is a "continuing education" process on the technical and R&D front. That continuing education is occurring thanks to the growing number of projects in operation in Europe, and, hopefully sometime soon, in the U.S.

In addition, it is clear that public policy is a crucial driver in promoting offshore development. In the U.S., a supportive siting process for offshore wind projects and consistent federal support for renewable energy are essential. Favorable siting processes and federal support provide the certainty that is needed for companies to ramp up investments, including the large investments that are needed for offshore projects. The Minerals Management Service (MMS) of the U.S. Department of the Interior is still working on developing the rules for permitting offshore wind projects. MMS reports that the regulations should be complete by the end of 2008, and the wind industry is looking forward to the successful completion of that process.

7. How will wind produced in the upper Midwest reach energy consuming population centers? What sort of transmission problems has the wind industry encountered?

The bulk of our nation's best wind energy resources are located at significant distances from our population centers. Putting this plentiful, clean, and domestic source of energy to use will require an investment in a high-voltage power grid that can move large amounts of electricity long distances. High-voltage transmission offers many benefits over the lower-voltage lines that are typically built today, as a doubling in voltage allows a single transmission line to carry six times as much power. As a result, high-voltage transmission lines, on a per-MW basis, occupy less land area by a factor of 4. In addition, high-voltage transmission reduces costs by a factor of 2 and electricity losses by a factor of 10 on a per-MW basis.

A renewed investment in transmission infrastructure is needed anyway, as decades of under-investment have left us with a grid that is unreliable and congested, costing consumers over $100 billion per year. Studies like the Joint Coordinated System Plan in the Eastern U.S. and the Competitive Renewable Energy Zone analysis in Texas have found that the consumer savings from building a more robust grid are large enough to more than cover the cost of the investment. The largest obstacle to building new transmission is not the economics, but rather the policies governing transmission cost allocation and siting. Implementing policies to broadly spread the costs of new transmission to those who would

benefit and reforming siting policies to similarly recognize the broad regional benefits of transmission are the most important steps to foster the construction of new transmission.

8. Have you encountered difficulties siting wind turbines?

As a manufacturer of wind turbine components and not a developer of wind farms, I do not have any personal experience in siting wind turbines. However, I have prepared a response to this question in connection with the American Wind Energy Association.

The wind energy industry has a good track record in responsibly siting wind energy projects. The bulk of wind projects are sited on privately owned land and are subject to state and/or local permitting processes.

With respect to projects for which there is federal involvement, projects have been proposed for lands managed by the Bureau of Land Management, the Forest Service, and the Minerals Management Service. These agencies either already have (BLM) established, or are in the process of (USFS, MMS) establishing, rules for siting wind farms.

In addition, the Federal Aviation Administration must approve the construction of any object over 200 feet (wind turbines, buildings, communications towers etc.) and federal agencies like the Department of Defense and the Department of Homeland Security occasionally get involved in siting processes to ensure compatibility with their radar systems.

Successfully permitting projects does involve a number of agency reviews and can take a significant amount of time. While the industry does not dispute the need for agency approvals, and has proactively engaged with federal agencies to ensure workable rules, it has come to our attention that agencies may need additional resources to conduct these reviews in a timely manner due to the rapid growth of the industry. Without additional resources, projects proposed on federal lands could see increasing delays.

As with other energy sources, there can occasionally be challenges with siting a wind farm. But, the rapid growth of the industry proves that these challenges are not insurmountable.

More information on the siting of wind farms can be found in AWEA's Wind Energy Siting Handbook, which is available online at www.awea.org/sitinghandbook/.

9. If the U.S. passed cap-and-trade legislation, how would the price of metal inputs vary? How would this price difference affect the final price of constructing a turbine?

We have not looked in detail at the impact of climate legislation on the price of steel and other commodities. The price impact would vary with the strength and design of the legislation.