THE GLOBAL CLEAN ENERGY RACE

HEARING

BEFORE THE

SELECT COMMITTEE ON ENERGY INDEPENDENCE AND GLOBAL WARMING HOUSE OF REPRESENTATIVES

ONE HUNDRED ELEVENTH CONGRESS

SECOND SESSION

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CONTENTS

THE GLOBAL CLEAN ENERGY RACE

WEDNESDAY, SEPTEMBER 22, 2010

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

The committee met, pursuant to call, at 10:07 a.m., in room 2325, Rayburn House Office Building, Hon. Edward J. Markey (chairman of the committee) presiding.

Present: Representatives Markey, Cleaver, and Sensenbrenner.

Staff present: Jonathan Phillips.

The CHAIRMAN. Welcome to the Select Committee on Energy Independence and Global Warming.

For generations now, America's universities, national laboratories, and innovative companies have fueled the technology breakthroughs that have put America in the lead and kept Japan, Europe, and other economic competitors in the rearview mirror. America's ability to combine innovative brains with can-do brawn has meant higher standards of living, a huge middle class, and increased economic opportunity for millions of our citizens. This is our competitive advantage. This is what makes our country a mecca for entrepreneurs and ambitious workers the world over.

Our technology incubators are still pumping out the innovations, but our entrepreneurs and workers are increasingly being blown off the road. Governments around the world recognize the opportunity of the clean energy economy and are seizing it. The world will need to invest $26 trillion—that is trillion with a T—over the next two decades in order to meet our energy needs.

Developing the clean technologies to serve that market is the scientific challenge of the generation. Harnessing the industrial might to manufacture those technologies and market them to the world is the economic opportunity of the generation.

Last year, I went to China with Mr. Sensenbrenner and with the Speaker, and we viewed the wind turbines spilling out of factories. I returned home warning of these economic missiles pointed at the heart of the U.S. economy.

Today, the clean energy investment auditors are here to share the dismal scorecard. Twice as much money was invested in clean energy in China as was invested in the United States last year. A decade ago, China made 1 percent of the world's solar panels. Today, it makes nearly half of them. The $15 billion worth of solar panels China exported last year was more valuable than America's corn, beef, and chicken exports combined.

China is no longer coming; they are here. They ate our lunch, and they are moving on to our dinner. And China is not alone. Germany, Japan, South Korea, and other countries recognize that dominating the $1 trillion market of tomorrow requires foresight and public investment today. They are throwing the kitchen sink of policies at clean energy, renewable energy requirements, financing assistance, tax incentives, government procurements, carbon pollution limits.

Here in the U.S., the longest-term Federal incentive for clean energy expires in 2 years. Senate Republicans have steadfastly stood in the way of any and all long-term policies to support the manufacture and deployment of clean energy in this country. It is notable that we have entrepreneurs willing to invest in U.S. clean manufacturing at all in such an unpredictable environment.

Some of China's clean energy incentives may be illegal violations of international trade agreements. Feeling that the future of America's clean energy sector is under threat, the United Steelworkers Union recently submitted a petition to the U.S. Trade Representative. The case alleges that China has used hundreds of billions of dollars in subsidies and other illegal trade practices to undermine foreign competitors and dominate the sector.

I am very concerned about China's use of unfair trade practices to bolster the competitiveness of its industries, and I urge prompt action to address violations found through the U.S. Trade Representative's investigation.

But we must not move forward recklessly on this trade dispute with China. In the end, competition is good. Competition is one of the chief reasons that the price of a solar panel has fallen by half in the last 2 years. Competition will ultimately make solar energy competitive with grid electricity in this decade, but this competition must be fair. It must allow American workers to play on the field. It must make it possible for us to export these technologies to other countries, especially to China. And that is why the U.S. Trade Rep must do the job that is necessary in order to protect American workers.

So if we do not act decisively to provide the long-term and short-term incentives to make America the best place to invest clean energy dollars, someone else will. So let's get real. We will trade our addiction to Middle Eastern oil with an addiction to Asian or European clean energy technologies.

From the Manhattan Project to the Apollo program to medical research to the Internet, government investments have and will continue to make America the place where the next great technological breakthroughs happen. The only question that remains is whether American industry and workers will ride this technological wave. The stakes could not be higher.

[The prepared statement of Mr. Markey follows:]

THE SELECT COMMITTEE ON
ENERGY INDEPENDENCE AND GLOBAL WARMING

Opening Statement for Chairman Edward J. Markey (D-MA)
Select Committee on Energy Independence and Global Warming

"The Global Clean Energy Race"
September 22, 2010

For generations now, America's universities, National Labs, and innovative companies have fueled the technology breakthroughs that have put America in the lead and kept Japan, Europe, and other economic competitors in the rearview mirror. America's ability to combine innovative brains with can-do brawn has meant higher standards of living, a huge middle class, and increased economic opportunity for millions of our citizens. This is our competitive advantage. This is what makes our country a Mecca for entrepreneurs and ambitious workers the world over.

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A decade ago China made 1 percent of the world's solar panels. Today it makes nearly half of them. The $15 billion worth of solar panels China exported last year was more valuable than America's corn, beef, and chicken exports combined. China is no longer coming. They are here. They ate our lunch, and they are moving on to our dinner.

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But we must not move forward recklessly on this trade dispute with China. In the end, competition is good. Competition is one of the chief reasons that the price of a solar panel has fallen by half in the last two years. Competition will ultimately make solar energy competitive with grid electricity in this decade. But this competition must be fair. It must allow American workers to play on the field.

But let's be real. If we do not act decisively to provide the long-term and short-term incentives to make America the best place to invest clean energy dollars, someone else will. We will trade our addiction to Middle Eastern oil for an addiction to Asian or European clean energy technologies.

From the Manhattan Project to the Apollo Program to medical research to the Internet, government investments have—and will continue—to make America the place where the next great technological breakthrough happens. The only question remains is whether American industry and workers will ride this technological wave. The stakes could not be higher.

Let me now turn and recognize the ranking member of the select committee, the gentleman from Wisconsin, Mr. Sensenbrenner.

Mr. SENSENBRENNER. Thank you very much, Mr. Chairman.

In today's hearings, I expect a slew of experts to tell us what we already know. If we mandate that electric companies use wind energy, it will drive private investment into the wind sector. Of course it will. What investor wouldn't want a guaranteed market? If we mandate that everyone drives cars with square tires, we will drive investment there, too. But that doesn't mean that we should.

Choosing winners and losers doesn't work. Europe proved as much with regard to clean energy investment. In Europe, government subsidies drove investment toward renewable energy sources. That investment and all associated jobs dried up as soon as the subsidies lapsed.

Just a few years ago, President Obama held Spain as the model for encouraging investment in solar energy. Today, Spanish unemployment is over 20 percent. Is that really the model we want to follow? Europe proved that jobs associated with clean energy investment will last only as long as the government pays for them.

Democrats couldn't get cap and tax through Congress, so now they are trying to circumvent voters and accomplish the same thing through the EPA. Their argument, that if we don't force investors to spend their money here they will spend it abroad, is wrong.

The reality is that the technologies the Democrats want to mandate will drive the cost of our energy up, which will drive more manufacturing jobs overseas. Given the choice between, one, forcing investment toward today's political darlings or, two, supporting sustainable, market-tested businesses, I am going to choose the latter every time.

During the coming months, the American economy will be at the mercy of several environmental regulations from the Obama administration. These regulations will not generate jobs. They will generate significant costs for the businesses that create jobs.

EPA's endangerment finding, which would allow the EPA to regulate greenhouse gas emissions, is the most widely followed and probably the most onerous example. Unless Congress stops it, these regulations will put EPA in charge of the U.S. economy.

The EPA would target more than 1.3 million commercial sources which the EPA defines to include office buildings, small businesses, schools, churches, prisons, and similar structures. The EPA estimates that an endangerment finding that doesn't include legally suspect tailoring rules would cost small entities more than $55 billion. The Heritage Foundation says that it would lead to $7 trillion—with a T—in lost economic activity between 2010 and 2029 and would kill almost 3 million manufacturing jobs by 2029.

One administration official told the Wall Street Journal that, under the endangerment finding, the EPA was going to have to regulate in a command and control way, which will probably generate even more uncertainty.

This is not the only economic threat posed by the Obama administration. The President is proposing tax increases on energy as a part of his latest $50 billion stimulus plan. One expert estimates that these new energy taxes would cost over 154,000 jobs by the

end of 2011, more than $341 billion in lost economic output, and more than $68 billion in lost wages nationwide.

EPA has termed another set of onerous regulations boiler MACT. These regulations will set emission standards for hazardous air pollutants. The Council of Industrial Boiler Owners released a study last week that showed exactly how much damage the boiler MACT regulations will inflict upon the economy. For every $1 billion spent on upgrade and compliance costs, up to 16,000 jobs and $1.2 billion in U.S. GDP will be threatened.

With regulations like these, the entire American economy is threatened. With unemployment hovering around 10 percent, America does not need more job-killing regulations. America needs Congress to focus on creating jobs and economic growth.

In our economic system, it is private investors who take risks. Financial success is the potential reward. If investors believe that renewable energy sources are the future, then I encourage them to invest in these markets. It is not, however, in America's interests to mitigate investor risk by guaranteeing them a market.

It makes sense that a Democratic Congress that responded to our economic collapse by socializing losses will now seek to shift the risk of investing from private businesses to the government.

In today's hearing, the majority is effectively arguing that government should bet on winners and losers so investors do not have to. The model is backwards and reflects a fundamental disagreement on American capitalism. While I will gladly work with Democrats to lower taxes and other disincentives for investment, I cannot support a model that I believe is at odds with how our economy works.

I thank the Chairman and yield back the balance of my time.

The CHAIRMAN. I thank the gentleman.

The chair recognize the gentleman from Missouri, Mr. Cleaver.

Mr. CLEAVER. Thank you, Mr. Chairman. I will continue to quote you about the Chinese eating our lunch and beginning on our dinner. I think that is exactly what is happening.

Mr. Chairman, in the 1870s, Thomas Edison invented the light bulb. It is a unique creation here in the United States, and those light bulbs have been a part of the industrial component of the U.S. economy since the 1870s.

General Electric will discontinue manufacturing the light bulbs that we know as incandescent bulbs at the end of this month and the United States will now purchase the CFLs from abroad, mostly from China. The glass tubes that are twisted, which helps in reducing the amount of energy needed, about 75 percent less energy, requires a lot of hand labor, and that hand labor, of course, is infinitely cheaper in China. So a unique American invention is now being manufactured almost exclusively in China and all of the people in this hearing room will in the future purchase these new CFLs after they have been imported from China.

I think that should be a wake-up call, if there is one needed, and it is my hope that this hearing this morning will allow some additional information to be brought forth that will inspire the great ingenuity that has made America what it is to continue and recapture particularly those things that began on these shores.

I yield back the balance of my time.

The CHAIRMAN. Thank you, Mr. Cleaver.

Now we will turn to our first witness, who is Michael Liebreich. He is the Chief Executive of Bloomberg New Energy Finance. He is an experienced venture capitalist and entrepreneur who has helped build more than 25 companies.

We welcome you. When you feel comfortable, please begin.

STATEMENTS OF MICHAEL LIEBREICH, CHIEF EXECUTIVE, BLOOMBERG NEW ENERGY FINANCE; RAVI VISWANATHAN, GENERAL PARTNER, NEW ENTERPRISE ASSOCIATES; TOM CARBONE, CHIEF EXECUTIVE OFFICER, NORDIC WINDPOWER; AND MARK FULTON, GLOBAL HEAD OF CLIMATE CHANGE INVESTMENT RESEARCH, DEUTSCHE BANK

STATEMENT OF MARK LIEBREICH

Mr. LIEBREICH. Good morning, Chairman Markey and gentleman of the committee, ladies and gentlemen. First, thank you for inviting me here today.

By way of background, I founded New Energy Finance in 2004 to help investors and policymakers understand the economics of clean energy. I built a team of 140 experts around the world before we were bought at the end of last year by Bloomberg, the financial information provider.

I will divide my remarks into two sections.

The CHAIRMAN. Is the microphone on there? Can you try to turn on that microphone? Is it on?

Great. Thank you.

Mr. LIEBREICH. It is on.

If you can pull up the slides.

I will divide my remarks into two sections. First, when the slides arrive, I will provide an up-to-date picture of investment activity around the world. Secondly, I will comment more generally on the related issues of jobs, policy, and international competition.

If we can move to the first slide.

As you can see from my first slide, global investment in new forms of clean energy surged from under $50 billion in 2004 to over $170 billion just 4 years later. These figures exclude traditional forms of lower carbon energy, large-scale hydro, natural gas, and nuclear, though I would be the first to agree that these will play a significant role in the energy system of the future.

In 2009, the volume of investment dropped by 7 percent to $162 billion as the sector was hit by the financial crisis. At one point, valuations of clean energy stocks were down from their peak by around 70 percent before recovering some of their losses. It is worth noting that they are still double what they were in 2003, a compound return over the last 7 years of just under 10 percent per annum.

The impact of the crisis on the industry could have been worse, and it will be tempting to think that the green stimulus programs around the world were the major factor in staving off disaster. However, although we identified a total of $184 billion of such funds allocated for clean energy alone, the fact is that in 2009 only 9 percent of it reached companies and projects in need.

In the U.S., investment fell off a cliff in the aftermath of the Lehman collapse. On an annualized basis, it was only this year that it started to climb again as the American Recovery and Reinvestment Act funds started to flow.

The world's providers of concessionary finance, the IFC, European Investment Bank, Brazil's BNDS, and so on, were much quicker in responding to the crisis, increasing their lending from just $7 billion in 2007 to $21 billion in 2009. The role of these multinational institutions and development banks has often been overlooked, and these figures do not include the Chinese banks. Their provision of cheap finance to manufacturers and developers has been a major factor in driving surging investment there.

By 2009, China is absorbing nearly three times the level of clean energy investment as the U.K., the U.S., or Spain. In just the past 5 months, the China Development Bank has provided $27 billion in concessionary finance to Chinese wind and solar companies.

China's leaders have supported the sector not only by providing cheap finance but also by creating domestic demand on a grand scale, setting local content rules, maintaining tariffs on foreign imports, as well as, of course, maintaining an undervalued currency.

Before we become too pessimistic about the state of clean energy in the U.S., we should recall that it remains by far the world's leading venue for investment. Even in clean energy technologies U.S. companies spend more as a percentage of revenue on research, and the U.S. stock markets continue to attract public offerings from companies around the world.

However, there is no question that the period 2007 to 2009 saw Asia take over from the Americas as the number two region of the world for clean energy investment; and when we compile the figures for 2010, we will see that Asia has eclipsed Europe to take a global lead.

Now, if I might turn my attention briefly to the question of U.S. policy, those who deride the U.S. for inaction are not correct. Not only do 30 States have clean energy portfolio standards, but there are also significant national programs, such as the renewable fuel standard, increasingly stringent CAFE standards, and substantial Federal R&D programs. Our research shows that ARRA, in particular its grants and loan guarantees, played a material role in keeping the flow of funding going during 2009 and 2010.

What is missing is the sort of consistent policy framework that has driven the development of clean energy, first in Denmark, Germany, and Spain, then China, and now the other major economies.

In 2008, the South Korean President, Mr. Lee Myung-Bak, presented a plan to cut the country's carbon emissions by 30 percent from business-as-usual without jeopardizing growth. The Korean government will be investing 2 percent of gross domestic product over the next 5 years, and leading Korean industrial companies have responded by announcing investments of over $80 billion between now and 2020.

Contrast this with the U.S., where the industry's production and investment tax credits have in the past been allowed to expire every 2 years. A highly effective ARRA program may not get extended, and in California proposition 23 is targeting the repeal of AB–32. Alone amongst the major economies, U.S. negotiators had

to make a commitment under the Copenhagen Accord to cut carbon emissions without national legislation in place to deliver it.

It was Winston Churchill who said the Americans will always do the right thing once they have exhausted all the alternatives. I have no doubt that the U.S. will at some point wake up to the strategic necessity and growth opportunity offered by a shift to clean energy. I only hope other countries will not in the meantime have established an unassailable industrial lead.

Many thanks for your patience in listening to me.

[The statement of Mr. Liebreich follows:]

The Global Clean Energy Race

Testimony to the US House of Representatives Select Committee for Energy Independence and Global Warming

Michael Liebreich
Chief Executive
Bloomberg New Energy Finance

Washington DC, 22 September 2010

Good morning, Chairman Markey, ladies and gentlemen. Let me thank you first of all for inviting me here today. By way of background, I founded New Energy Finance in 2004 to help investors and policymakers understand the economics of clean energy. I built a team of 140 experts around the world before we were bought at the end of last year by Bloomberg, the financial information provider.

I will divide my remarks into two sections. First – with the help of slides – I will provide an up-to-date picture of investment activity around the world. Second – I will comment more generally on the related issues of jobs, policy and international competition.

As you can see from my first slide [Slide 2], global investment in new forms of clean energy surged from under $50bn in 2004 to over $170bn just four years later. These figures exclude traditional forms of lower-carbon energy – large-scale hydro, natural gas and nuclear – although I would be the first to agree that these will play a significant role in the energy system of the future.

In 2009, the volume of investment dropped by 7% to $162bn as the sector was hit by the financial crisis. At one point, valuations of clean energy stocks were down from their peak by around 70% [Slide 3], before recovering some of their losses. It is worth noting that they are still double what they were in 2003 – a compound return over the last seven years of just under 10% per annum.

The impact of the crisis on the industry could have been worse. It would be tempting to think that the "green stimulus" programmes around the world were the major factor in staving off disaster. However, although we identified a total of $184bn of such funds allocated for clean energy alone, the fact is that in 2009 only 9% of it reached companies and projects in need [Slide 4].

In the US, investment fell off a cliff in the aftermath of the Lehman collapse; on an annualised basis it was only this year that it started to climb again, as the American Recovery and Reinvestment Act funds started to flow [Slide 5].

The world's providers of concessionary finance – the IFC, European Investment Bank, Brazil's BNDES and so on – were much quicker in responding to the crisis, increasing their lending from just $7bn in 2007 to

$21bn in 2009 [slide 6]. The role these multilateral institutions and development banks have played and continue to play often gets overlooked.

And these figures do not include the Chinese banks. Their provision of cheap finance to manufacturers and developers has been a major factor in driving surging investment there [Slide 7]. By 2009, China was absorbing nearly three times the level of clean energy investment as the UK, the US or Spain [Slide 8]. In just the past five months alone, the China Development Bank alone has provided [$27bn] in concessionary finance to Chinese wind and solar companies.

China's leaders have supported the sector not only by providing cheap finance, but also by creating domestic demand on a grand scale, setting local content rules, maintaining tariffs on foreign imports as well as, of course, maintaining an undervalued currency.

Before we become too pessimistic about the state of clean energy in the US, we should recall that it remains by far the world's leading venue for venture investment, even in clean energy technologies [Slide 9]. US companies spend more as a percentage of revenue on research, and the US stock markets continue to attract public offerings from companies around the world [Slide 10].

However, there is no question that the period 2007 to 2009 saw Asia take over from the Americas as the number two region of the world for clean energy investment [Slide 11]. And indeed, when we compile the figures for 2010, we will see that Asia has eclipsed Europe to take the global lead.

Now if I might turn my attention briefly to the question of US policy.

Those who deride the US for inaction are not correct. Not only do [30] states have clean energy portfolio standards, but there are also significant national programmes such as the Renewable Fuel Standard, increasingly stringent CAFÉ standards, and substantial Federal R&D programmes. Our research shows that ARRA – in particular its grants and loan guarantees – played a material role in keeping the flow of funding going during 2009 and 2010.

What is missing is the sort of consistent policy framework that has driven the development of clean energy first in Denmark, Germany and Spain, then China, and now other major economies. In 2008, the South Korean President, Mr. Lee Myung-bak, presented a plan to cut the country's carbon emissions by 30% from business as usual without jeopardizing growth. The Korean government will be investing 2% of gross domestic product over the next five years, and leading Korean industrial companies have responded by announcing investments of over $80 billion between now and 2020.

Contrast this with the US, where the industry's Production and Investment Tax Credits have in the past been allowed to expire every two years; a highly effective ARRA programme may not get extended; and in California, Proposition 23 is targeting the repeal of AB32. Alone amongst the major economies, the US's negotiators had to make a commitment under the Copenhagen Accord to a cut in carbon emissions without national legislation in place to deliver it.

I do not agree with some of the more pessimistic figures being thrown around for job losses if ARRA's cash grants are not extended beyond the end of this year. Most major developers will start their

projects in time, or have access to other forms of finance. The larger issue, however, is that no amount of temporary, supply-side tax breaks can substitute for the long-term creation of demand, through either a carbon tax, tariff support, energy efficiency regulations or aggressive national portfolio standard.

Winston Churchill said "the Americans will always do the right thing, once they have exhausted all the alternatives." I have no doubt that the US will at some point wake up to the strategic necessity and growth opportunity offered by a shift to clean energy. I only hope other countries will not in the meantime have established an unassailable technological lead.

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Slides to accompany testimony to the Select Committee for Energy Independence & Global Warming

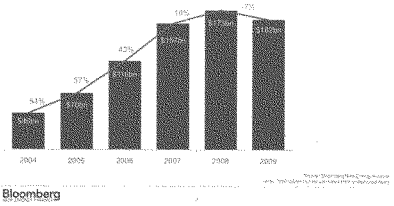
Washington DC, 22 September 2010

The Global Clean Energy Race

Michael Liebreich
Chief Executive

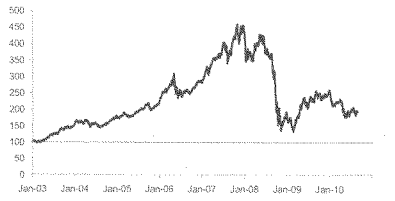
Bloomberg NEW ENERGY FINANCE

Global total new investment in clean energy
2004 – 2009 ($bn)



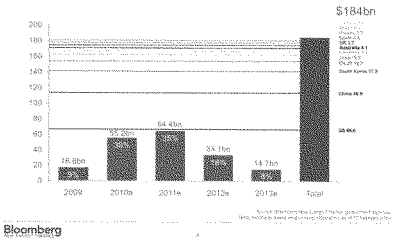
Bloomberg

Wilderhill Global Energy Innovation Index (NEX) performance
2003 – 2010 YTD (1 Jan 2003 = 100)



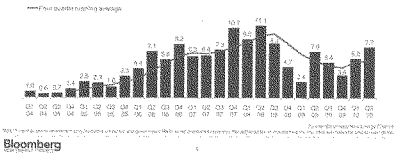
Bloomberg

Annual Global stimulus spending & stimulus components target at clean energy ($bn)



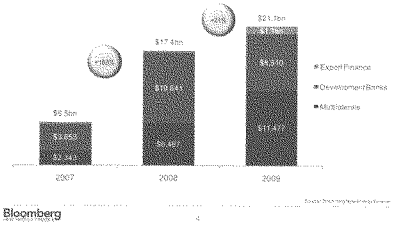
Bloomberg

New financial investment in clean energy: United States
Q1 2004 – Q2 2010($bn)



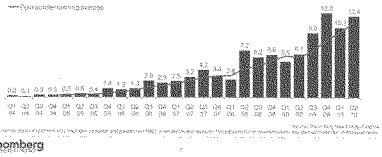
Bloomberg

Multilateral and development bank lending
($bn)



Bloomberg

New financial investment in clean energy: China
Q1 2004 – Q2 2010($bn)



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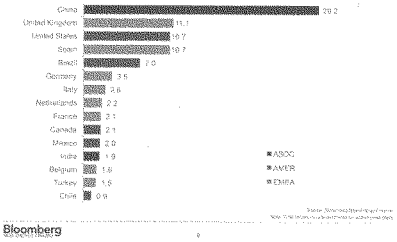
Asset finance for new build clean energy assets - top 15 countries
2009 ($bn)



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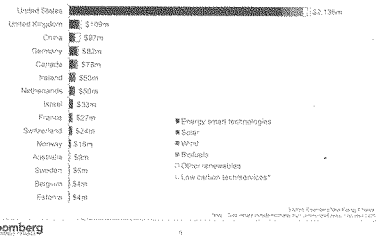
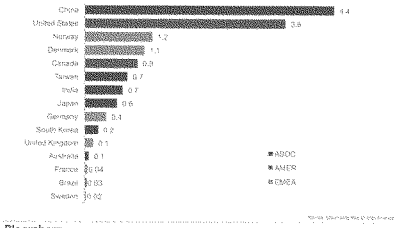
VC new investment in clean energy by sector – top 15 countries:
2009 ($m)



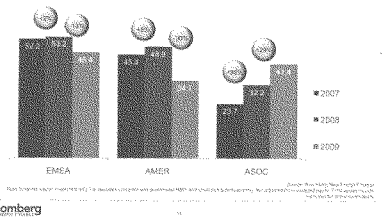
Bloomberg

Public markets new equity raised for clean energy - top 15 countries
2009 ($bn)



Bloomberg

New financial investment in clean energy by region:
2007, 2008 & 2009 ($bn)



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Additional slides

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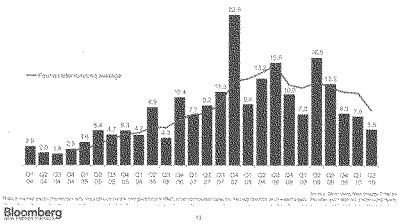
New financial investment in clean energy: Europe
Q1 2004 – Q2 2010($bn)



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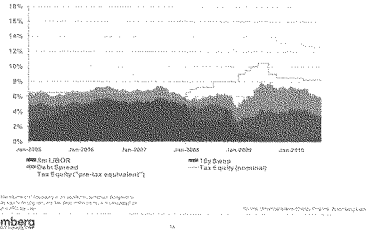
Tax equity and project debt markets - US



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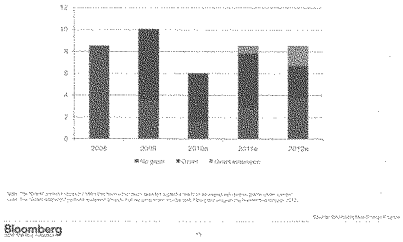
US wind build with and without Treasury grants
(GW)



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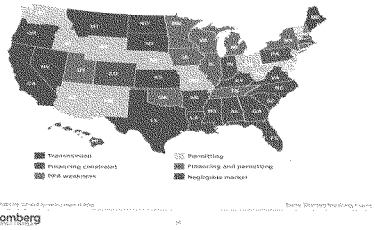
Principal regional causes of project delay



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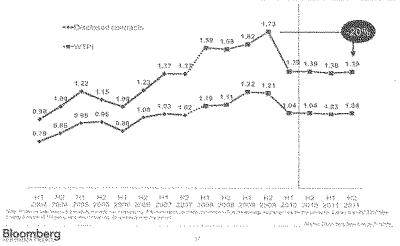
Turbine prices by delivery date, 2004 –2010 ($m & €m/MW)
Public data & NEF Wind Turbine Price Index



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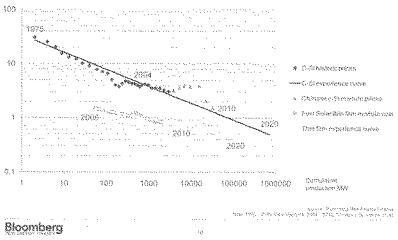
Solar PV module prices 1975 - 2010
($/Wp)



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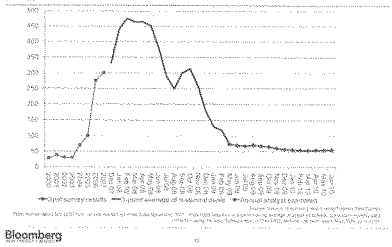
Spot price of solar-grade silicon, 2000 – June 2010 ($/kg)



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Top 10 manufacturers of photovoltaic cells (Rank order by MW)

2008

Company	Country	Production (MW)
3. Q-Cells	Germany	131
4. Schott Solar	Germany	86
5. BP Solar	USA	86
8. Shell Solar	USA	58
10. Isofoton	Spain	39

2010(e)

Company	Country	Production (MW)
1. First Solar	USA	1,322
3. Q-Cells	Germany	1,000
5. SolarWorld	Germany	710

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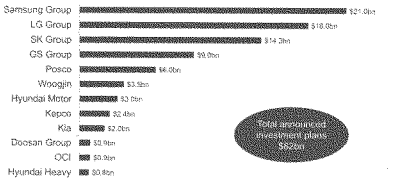
Leading Korean industrial companies, planned clean energy investment through 2020 ($bn)



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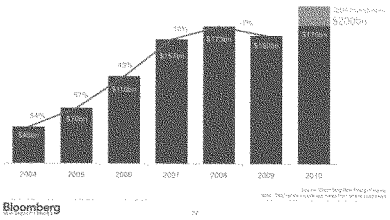
Global total new investment in clean energy – 2010 expected 2004 – 2010 ($bn)



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Thanks!

Michael Liebreich

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The CHAIRMAN. Thank you very much.

Our next witness is Dr. Ravi Viswanathan. He is a general partner at New Enterprise Associates, where he focuses on energy and growth equity investments.

We thank you for being here, Doctor. Whenever you feel comfortable, please begin.

STATEMENT OF RAVI VISWANATHAN

Mr. VISWANATHAN. Chairman Markey, Ranking Member Sensenbrenner, members, thank you very much for inviting me here. It is truly an honor.

I appear before you here today as a general partner of New Enterprise Associates, or NEA. NEA is, by assets under management, the largest venture capital firm in the country, with $11 billion under management. Through our 30 years of history, we have funded over 650 companies and have had over 160 of them go public. Our 50 largest companies have created over $65 billion in revenues and have created hundreds of thousands of jobs in this country. Today we have a global footprint, with offices in India and China and roughly 20 percent of our committed capital targeted at emerging markets.

In the past, the U.S. VC industry has played a pivotal role in developing industries such as biotechnology, computing, medical devices, semiconductors, telecommunications, and the Internet. We deploy our capital in rapidly expanding companies which have the highest potential for long-term economic growth and job creation.

According to the National Venture Capital Association, U.S. VC-backed company revenue has equated to more than 22 percent of U.S. GDP; and over the past 3 years alone VC-backed companies have accounted for three times more job creation than the private sector taken as a whole.

Today, the energy technology industry represents one of the most compelling investment opportunities in the history of venture capital. I serve as the co-head of our energy practice, overseeing more than 30 portfolio companies here in the U.S. that have raised a total of $2 billion in capital. Our portfolio includes investments in sectors such as solar, wind, nuclear, advanced battery, smart grids, electric vehicles, and energy efficient building materials.

Regarding the current U.S. clean tech landscape, the U.S. has long been the home of great innovation in clean energy technology, which continues to present a compelling opportunity for both entrepreneurs and venture capitalists.

Though the U.S. continues to be the home of the world's best clean energy innovation, the U.S. has lost its leadership to China, Japan, and Germany in clean energy manufacturing deployment and is challenged and threatened by emerging economies such as India, South Korea, Malaysia, and the Philippines. I can say that from firsthand knowledge, as I spend about a third of my time in Asia trying to understand how these economies are doing what they are doing in clean energy.

These nations have outpaced the U.S. in recruiting, incenting, and developing domestic manufacture of solar, wind, and battery technology. We are not the market leader in producing and supplying this high-growth industry and have ceded our historic lead-

ership in manufacturing of these key technologies to other nations. As one example, the U.S. market share for solar manufacturing has fallen from 45 percent in the mid-1990s to roughly 5 percent today.

Prior to the Recovery Act, this paradigm of developing innovative technology in the U.S. and exporting manufacturing to poor nations has been driven primarily by a significant imbalance between U.S. and foreign tax policies and incentives.

Contrary to popular belief, low labor costs have not been the most important variable in this equation. Up-front manufacturers' incentives, long-term tax holidays, and end-market incentives have been frequently as important, if not more important, variables influencing U.S. companies as to where they should establish their manufacturing facilities.

Incentives from foreign nations have often totaled as much as 40 or 50 percent of the costs of a new manufacturing project. In addition, healthy demand side incentives such as national renewable energy standards, feed-in tariffs, and direct government loans and tax credits for the deployment of clean energy technology have made relocating U.S. manufacturing facilities overseas even more attractive.

Without competitive incentives for companies to stay in the U.S., this Nation's best manufacturers have had no choice but to look overseas to remain competitive in their industries. The result has been a loss of both direct and indirect jobs, a loss of intellectual property, and a loss of economic growth here in the U.S. for one of the fastest-growing global industries of the 21st century.

In describing this trend, I must remind the committee that venture capitalists and entrepreneurs are by definition optimists. I believe the U.S. can be a leader in clean energy manufacturing and deployment, and I have witnessed this firsthand. We are not giving up on the American entrepreneur, and I hope you won't either.

I am grateful to this committee and the current administration for recognizing the need to level the playing field for U.S. clean energy manufacturers. With the help of the tax policies and incentives put forth in the Recovery Act, this Nation's best energy technology companies are expanding their domestic capacity, reopening and retrofitting closed factories, rehiring and retraining new workers, and rebuilding local economies depressed by the great recession.

One of the most important policies in restoring American competitiveness in clean energy is the section 48C Advanced Manufacturing Tax Credit, providing a 30 percent tax credit for investments in facilities that manufacture clean energy products such as solar panels and wind turbines.

This program awarded $2.3 billion in tax credits to over 100 companies in 43 States and was oversubscribed with requests of over $8 billion in projects. Four of our most promising companies were awarded this credit and were able to expand manufacturing here in the U.S., creating jobs, thanks to your efforts in the Recovery Act.

One of these companies was Suniva, one of our companies. They were able to expand their solar manufacturing from 33 megawatts to 170 megawatts in Norcross, Georgia, hiring an additional 60

workers and creating more than 100 construction jobs in an economically suppressed suburb of Atlanta.

This Congress has put forth very important legislation which puts a price on carbon. Putting a price on carbon by definition will reduce risk for all energy markets, decreasing the cost of capital and increasing investment in renewable energy. We believe this is an important policy for the U.S. to continue to attract capital to fuel the energy needs of our 21st century economy.

Growing a strong domestic clean energy manufacturing industry requires competitive supply and demand side incentives and policies. In order for the U.S. to be truly energy independent in a world with clean, cheap, renewable energy, we need to reinvigorate our manufacturing base. We can't substitute our dependence on foreign oil with batteries, solar cells, or wind turbines made overseas.

As I have discussed, one of the most important pieces of the Recovery Act was the section 48C Advanced Manufacturers' Tax Credit. In addition, demand side incentives such as the 1603 grant program for clean energy deployment have been critical to sustaining a healthy clean energy economy for U.S. manufacturers. We need to make these tax credits permanent and refundable, as put forth by Members of this Congress.

In addition, we need to focus on scaling up and commercializing this country's best technologies through public-private partnerships. Countries such as Germany, Japan, and China have all dedicated funds to scale up the commercialization of their technologies.

We also need an effective national renewable electricity standard and energy efficiency standard with an incentive system for utilities to move forward without delay. Today, 30 States have already adopted Statewide renewable energy standards, but those policies are at risk should the Federal Government fail to act with certainty to adopt a national standard.

In closing, we have never seen a greater opportunity to put capital to work in support of U.S. entrepreneurs. We believe this is the greatest economic opportunity for our industry, for our entrepreneurs, and for our country.

Thank you very much for inviting me today. I look forward to your questions.

[The statement of Mr. Viswanathan follows:]

Testimony of Ravi Viswanathan
General Partner
New Enterprise Associates

The Global Clean Energy Race

United States House of Representatives
Select Committee on Energy Independence and Global Warming
Wednesday, September 22, 2010

Introduction

Chairman Markey, Ranking Member Sensenbrenner, and Members of the Committee -- thank you very much for inviting me to be here today. It is truly an honor.

I appear before you here today as a general partner of New Enterprise Associates (NEA). NEA is, by assets under management, the largest US venture capital firm with ~$11 billion under management. Through our 30 years of history we've funded over 650 companies and have had over 160 of them go public. Our 50 largest companies have created over $65 billion in revenues and have created hundreds of thousands of jobs in this country. Today we have a global footprint, with offices in India and China and roughly 20% of our committed capital targeted at emerging markets.

In the past, the US venture capital (VC) industry has played a pivotal role in developing industries such as biotechnology, computing, medical devices, semiconductors, telecommunications, and the Internet. We deploy our capital in rapidly expanding companies which have the highest potential for long term economic growth and job creation. According to the National Venture Capital Association (NVCA), US VC-backed company revenue has equated to more than 22 percent of US GDP and over the past 3 years alone VC-backed companies have accounted for 3 times the growth rate in job creation than the private sector taken as a whole.

Today, the energy technology industry represents one of the most compelling investment opportunities in the history of venture capital. I serve as the co-head of our energy practice overseeing more than 30 portfolio companies here in the US that have raised a total of $2 billion in capital. Our enthusiasm for this emerging sector is shared by the vast majority of VC firms, with more than half of the NVCA's over 400 members expected to increase their allocation to the sector this year. NEA made its first investment in the clean energy sector in 2002 – at the time, the total capital deployed by VC and PE firms in clean energy totaled less than $500 million annually. Over the past 8 years, more than $40 billion has been invested in the sector. In spite of challenging economic conditions and a contraction in venture capital fundraising, the clean technology industry has attracted substantial venture capital investment in 2010, up more than 50 percent year over year.

Our portfolio includes investments in sectors such as Solar, Wind, Nuclear, Advanced Batteries, Smart Grids, Electric Vehicles, and Energy Efficient Building Materials. Many of our entrepreneurs are commercializing technologies developed in universities and national laboratories leveraging the historic and ongoing investment of federal funds, and have created

companies with innovation from great institutions such as Stanford, MIT, the University of Texas, NREL, NASA, and the Los Alamos National Laboratory. Energy technology is a complex industry, but the goals of our entrepreneurs are simple: create companies that enable us to make or save energy -- better, faster, cheaper, and cleaner, than anyone else in the world.

The Current US Clean Energy Landscape

The US has long been the home of great innovation in clean energy technology which continues to present a compelling opportunity for both entrepreneurs and venture capitalists. In 2010 the global clean energy market for technologies such as solar, wind, batteries, and smart grid infrastructure will exceed $100 billion with sector specific growth rates of 30-50% annually. NEA continues to pursue domestic investments in this sector as we believe that fundamental technology innovation will be able to drive down the cost of clean energy to achieve parity with fossil fuels over the next several years.

Though the US continues to be the home of the world's best clean energy innovation, the US has lost its leadership to China, Japan, and Germany in clean energy manufacturing and deployment, and is challenged and threatened by emerging economies such as India, South Korea, Malaysia, and the Philippines. These nations have outpaced the US in recruiting, incenting, and developing domestic manufacturing of solar, wind, and battery technology. We are not the market leader in producing and supplying this high growth industry, and have ceded our historic leadership in manufacturing of these key technologies to other nations.

As one example, the US's market share for solar manufacturing has fallen from 45 percent in the mid 1990's to roughly 5 percent today. In the past decade alone, the two best US solar technology companies in the world, First Solar and Sunpower, were recruited overseas to Germany, Malaysia, and the Philippines. Today these companies have developed the majority of their manufacturing overseas, creating jobs and economic growth primarily in other nations.

Prior to the Recovery Act, this paradigm of developing innovative technology in the US, and exporting manufacturing to foreign nations has been driven primarily by a significant imbalance between US and foreign tax policies and incentives. Contrary to popular belief, low labor cost has not been the most important variable in the equation -- upfront manufacturer's incentives, long term tax holidays, and end market incentives have been frequently as important, if not more important variables influencing US companies as to where they should establish their manufacturing facilities. Incentives from foreign nations have often totaled as much as 40 or 50% of the cost of a new manufacturing project. In addition, healthy demand side incentives such as national renewable energy standards, feed-in tariffs, and direct government loans and tax credits for the deployment of clean energy technology have made re-locating US manufacturing facilities overseas even more attractive. Without competitive incentives for companies to stay in the US, this nation's best manufacturers have had no choice but to look overseas to remain competitive in their industries. The result has been a loss of both direct and indirect jobs, a loss of intellectual property, and a loss of economic growth here in the US for one of the fastest growing global industries of the 21st century.

In describing this trend, I must remind the Committee that venture capitalists and entrepreneurs are by definition optimists. I believe the US can be a leader in clean energy manufacturing and deployment, and have witnessed this first hand. We are not giving up on the American entrepreneur, and I hope you won't either.

Restoring US Clean Energy Competitiveness: A Case Study in Recovery Act Success

I am grateful to this Committee and the current Administration for recognizing the need to level the playing field for US clean energy manufacturers. With the help of the tax policies and incentives put forth in the Recovery Act, this nation's best energy technology companies are expanding their domestic capacity, re-opening and retro-fitting closed factories, re-hiring and re-training new workers, and rebuilding local economies depressed by the "Great Recession".

One of the most important policies in restoring American competitiveness in clean energy manufacturing is the Section 48C Advanced Manufacturing Tax Credit, providing a 30% tax credit for investments in facilities that manufacture clean energy products such as solar panels and wind turbines. This program awarded $2.3 billion in tax credits to over 100 companies in 43 states, and was oversubscribed with requests for over $8 billion in projects. Thanks to your efforts in the Recovery Act, four of our most promising companies were awarded the credit and were able to expand manufacturing and create numerous jobs here in the US.

One Section 48C recipient, Suniva, was able to expand its solar manufacturing from 33 MW to 170 MW in Norcross, Georgia, hiring an additional 60 workers, and creating more than 100 construction jobs in an economically depressed suburb of Atlanta. Many of Suniva's full time employees were either veterans or laid-off auto workers who have now subsequently been retrained in solar manufacturing. This company, whose technology originated at the first DOE Center for Excellence in Photovoltaics at Georgia Tech, was recently named the Renewable Energy Exporter of the Year by the Export-Import bank, was recognized by President Obama and Secretary Chu, and today exports greater than 90% of its industry leading high efficiency solar cells overseas to Europe, China, and India. Their products power the first utility grid connected solar farm in India, a market which many speculate will be as large as 20 GW by 2020. Suniva has plans to expand to 400 MW in Saginaw, Michigan, a project which would create over 400 direct and over 1450 indirect and construction jobs over the life of the project. This is just one of many Recovery Act success stories.

Supporting the Key Pillars of a Domestic Clean Energy Manufacturing Industry

In order to sustain a long term competitive clean energy industry in this nation, we need to support and expand the key policies put forth in the Recovery Act, and follow through and pass critical clean energy and climate legislation as proposed by members of this Congress.

This congress has put forth very important legislation which puts a price on carbon. Investors in both renewable energy sources and traditional fossil fuels today operate in a world of regulatory uncertainty, speculating on the implied cost of carbon without any efficient market for calculating or hedging against this risk. Putting a price on carbon by definition will reduce risk for all energy markets, decreasing the cost of capital and increasing investment in both carbon-emitting and renewable energy. We believe this is an important policy for the US to continue to attract capital to fuel the energy needs of our 21st century economy.

Growing a strong domestic clean energy manufacturing industry requires competitive supply and demand side incentives and policies. In order for the US to be truly energy independent in a world with clean, cheap, renewable energy, we need to re-invigorate our manufacturing base. We can't substitute our dependence on foreign oil with batteries, solar cells, or wind turbines made overseas. As I've discussed, one of the most important pieces of the Recovery Act was the Section 48c Advanced Manufacturer's Tax Credit. In addition, demand side incentives such as the 1603 grant program for clean energy deployment have been critical to sustaining a healthy

clean energy economy for US manufacturers. We need to make these tax credits permanent and refundable as put forth by members of this Congress.

In addition, we need to focus on scaling up and commercializing this country's best technologies through public / private partnerships. Countries such as Germany, Japan, and China have all dedicated funds to scale up the commercialization of their domestic technologies, but the US has only begun to pursue similar models. The US DOE Loan Guarantee Program is a good start, and initiatives such as the Green Energy Bank as put forth by members of this congress are important pillars to driving both an energy security and economic recovery agenda.

We need an effective national Renewable Electricity Standard and Energy Efficiency Standard with an incentive system for utilities to move forward without delay. Today, 30 states have already adopted statewide renewable energy standards, but those policies are at risk should the federal government fail to act with certainty to adopt a national standard. We believe a national renewable energy and energy efficiency standard would be consistent with policies adopted by EU nations, China, and India, who have all implemented similar policies which recognize that clean energy deployment is both an economic and environmental imperative.

In closing, we have never seen a greater opportunity to put capital to work in support of US entrepreneurs. We believe this is the greatest economic opportunity for our industry, for our entrepreneurs, and for our country.

Thank you very much for inviting me to be here today. I look forward to your questions.

Biography

Dr. Ravi Viswanathan is a General Partner with New Enterprise Associates, a global venture capital firm focused on investments in energy, information technology, and healthcare with $11 billion in committed capital. Founded in 1978, NEA has invested in over 650 companies, of which over 160 have gone public and more than 250 have been successfully acquired. NEA stands out today as one of the most active investors in the energy technology industry, with a commitment of over $2 billion to the sector. NEA's currently manages 30 energy portfolio companies that have collectively raised approximately $2 billion in capital.

Ravi is on the board of Availink, Deeya Energy, ISGN Technologies, Jentro Technologies, Liquidia, Solar Junction, Suniva and ViXS and works closely with GlobalLogic, OANDA, and NEA's energy portfolio companies. Prior investments include Tele Atlas. Prior to joining NEA, Ravi worked at Goldman, Sachs & Co. where he was co-head of the technology practice in their private equity group and led direct, fund, and secondary investments in the areas of information technology and life sciences. Prior to Goldman Sachs, Ravi worked for McKinsey & Company and advised clients in the software, communications, and pharmaceutical sectors on strategy, acquisitions and new business building. Previously, Ravi worked for Raychem Corporation in the Corporate Technology Division where he focused on research and product development in semiconductors, liquid crystals, and other materials systems. Ravi received a master's degree in Business Administration from the Wharton School at the University of Pennsylvania and a PhD in Chemical Engineering from the University of California at Santa Barbara where he focused his research on materials science applications in molecular electronics, biomaterials, and nanotechnology. Prior to graduate school, Ravi received a BS in Bioengineering from the University of Pennsylvania.

The CHAIRMAN. Thank you, Doctor, very much.

Our next witness is Tom Carbone. He has had extensive experience in the renewable energy sector. He currently serves as the CEO of Nordic Windpower, the largest technology developer and manufacturer of two-bladed utility scale wind turbines. He is also chairman of the Princeton Energy Group, a California-based developer of global renewable energy projects.

Welcome, Mr. Carbone.

STATEMENT OF TOM CARBONE

Mr. CARBONE. Thank you, Chairman Markey and Congressman Cleaver. We share your passion on the topic today of The Global Clean Energy Race.

My name is Tom Carbone. I am chairman of Nordic Windpower, an early stage technology developer and manufacturer of very unique wind turbines for Community and Wind Energy products. This consists of on-site wind power and small-scale wind farms, typically less than 20 megawatts, but could be as large as 100 megawatts, locally connected to the distribution voltage, close to the load.

Our products and people are focused on making Nordic Windpower a leader in this segment. Our proven two-bladed technology provides for less weight, higher reliability, ease of installation and operation, and, most of all, the lowest cost of energy compared to traditional designs.

Our story is about technology that was born in Sweden, a company that was started in the U.K., and today we are a U.S. corporation focused on a very interesting and growing segment within our domestic wind business.

We formed the company in late 2007 as a U.K. limited corporation. We have headquarters in Berkley, California, an assembly facility in Pocatello, Idaho, and an engineering unit in the U.K. Last year, we incorporated Nordic's parent in the U.S. as a Delaware corporation.

We employ approximately 40 people—that is double what we had at the start of this year—and we will double our employment again within the next 9–12 months. There are many more people employed within our supply and installation partner chain. Each of our one megawatt wind turbines provides enough clean electricity for the annual consumption of 250 to 300 American homes and reduces 300 tons of CO_2 emissions.

We acquired the turbine technology in Sweden, which was the result of a long-term R&D prototype program which was sponsored by the Swedish government, universities, and private entities at a cost of about $75 million. We have invested well over $10 million in further improving that technology for local market needs.

Since late 2007, we have completed three rounds of financing from venture capitalists in the U.S., the U.K., and Europe, for a total committed capital investment of about $58 million.

We are the beneficiaries of two Recovery Act provisions. In July, 2009, the company secured a $16 million DOE loan guarantee which was part of a $25 million project to manufacture and commercialize this one megawatt wind turbine in the U.S.

The loan guarantee is a critical form of financing for Nordic Windpower and for our future development; and it gives us the wherewithal to create jobs, invest in the supply chain, invest in tooling to become more efficient and to offset some of our technology development costs. It is a loan. We have to pay it back. To date, we have not closed on this loan, but we are working diligently with the DOE to expedite the closing of the loan, which, as I said, is critical to our development.

It is our view that this program could be improved by adopting some of the existing application due diligence and closing processes that already exist within our government, within other agencies such as U.S. OPIC and USDA, particularly to address the needs of small business enterprises like ourselves.

We are also the recipient of $3 million in Advanced Energy Manufacturing Tax Credits, the 48C program that Dr. Viswanathan mentioned. This money will be used to expand and re-equip our manufacturing facility. This incentive will have a positive impact on our cash flow in the future when we have a tax liability.

My point is to date we have not deployed one dollar of the Recovery Act provisions, but we intend to and are grateful for the awards that we have.

Regarding our location decisions, when we started in 2007 we determined that there were three principal markets, the U.S., Europe, and China. It is our view that China was saturated with nearly 100 domestic suppliers and JVs that are competing predominantly on low cost and low margin and secondarily on quality and reliability. This market could be especially challenging for an entry foreign company like ourselves.

We saw limited opportunities for new entrants into the slower-growing European on-shore wind markets.

Thus, the strength of the U.S. market's growth and potential for success was an obvious entry point for Nordic Windpower and in particular the community wind sector, which was relatively unaddressed by the major wind turbine manufacturers.

The company is in the process of establishing and relocating to a new center of U.S. operations in the Midwest wind belt. We expect that employment at that new location will increase to 250 over the next 5 years and will require at least $18 million in investment.

To say the least, wind turbine manufacturing is capital intensive, where significant amounts of cash can be tied up in the supply chain for working capital and in equipment to manufacture these units. As such, at an early stage company like ours, a large emphasis is on near-term effective cash value of incentives being offered at the local, State, and Federal level.

We started to deliver and install wind turbines this year, and we expect to deliver and service over 100 wind turbines over the next 2 years, totaling nearly $120 million in sales revenue. Our 5-year plan includes new product introductions and shipments of more than 750 units.

We will deliver and install our sixth N–1000 wind turbine this year at Fort Wachuka in Arizona. This is the first utility scale wind turbine on a U.S. Army base. We have two wind turbines supplying power, one to a school in Indiana and another to a munici-

pality; and I would like to mention that three of our wind turbines were exported and installed in a project in Latin America with the "made-in-America" stamp of quality on them.

In closing, I would like to provide some recommendations, if I may. My recommendations are based on three programs that exist today or are contemplated that have already benefited from a considerable amount of time and bipartisan cooperation. My recommendations are intended to make the programs more effective for innovative U.S. energy companies like ours so that we can compete more effectively.

Number one—and you have heard it from Dr. Viswanathan—pass the Federal Renewable Electricity Standard, the RES. The American Wind Energy Association estimates that a quarter of a million jobs will be created by this.

The CHAIRMAN. If you could, Mr. Carbone, try to summarize quickly. You will get a chance to expand in the question and answer period.

Mr. CARBONE. Two more recommendations: Extend the Recovery Act 1603 program and allow for the 48C manufacturing tax credit to be refundable so that early stage companies like ours could use them today, as opposed to in the future when we have a tax liability.

Thank you.

[The statement of Mr. Carbone follows:]

WRITTEN TESTIMONY OF

THOMAS CARBONE, CHIEF EXECUTIVE OFFICER, NORDIC WINDPOWER

BEFORE THE HOU.S.E COMMITTEE ON

ENERGY INDEPENDENCE AND GLOBAL WARMING

SEPTEMBER 22, 2010

Thank you Chairman Markey, Ranking Member Sensenbrenner, and Members of the Committee for inviting me to provide testimony on the "The Global Clean Energy Race".

My name is Tom Carbone and I am the Chief Executive Officer of Nordic Windpower, an early stage technology developer and manufacturer of innovative utility scale wind turbines for Community and Distributed Wind Energy projects. Our proven wind turbine technology provides for less weight, higher reliability, ease of installation and operation resulting in lower cost of energy compared to traditional designs.

I. INTRODUCTION TO NORDIC WINDPOWER

Nordic Windpower is a technology developer and manufacturer of innovative utility scale wind turbines for the Community and Distributed Utility wind power segments. These segments consist of on-site wind power and small wind farms typically less than 40 MWs, and connected locally at the distribution voltage level.

Our Company's growth will come from designing, selling and servicing its one (1) MW N1000 wind turbine and future models to the North American community and distributed wind power projects in the 1 to 40 MW size range. Our products, people and processes are entirely focused on becoming a leader in this segment. Each Nordic one (1) MW N1000 wind turbine annually produces enough clean electricity for 250 to 300 America homes, and offsets 300 tons of CO_2 emissions.

We formed the Company in late 2007 as a UK Limited corporation. Given that our initial markets are predominantly in the U.S. and recent rounds of corporate funding were provided by U.S. investors, we have since incorporated a holdings company in Delaware, with operational subsidiaries in the U.S. and the UK.

Our principal operations are located in the U.S., and include corporate offices in Berkeley, California and manufacturing facilities in Pocatello, Idaho. The Company has a small

engineering design center in Bristol, UK. Nordic employs approximately 40 people (26 in the U.S. and 14 in the UK) and is currently hiring U.S.-based engineering, sales and management professionals. Many more people are employed through our suppliers our and service and installation partners.

We own, maintain and continuously improve a disruptive two-bladed wind turbine technology which resulted from a long-term R&D program funded by the Swedish government, universities and utilities at an estimated cost of $75 million. The technology is well proven in Sweden, where four prototypes have operated at high availability for up to 12 years, exceeding 100,000 hours of operation without any major component failures. This technology provides for less weight, higher reliability, and easier installation and operation, all of which result in lower cost of energy.

Since September 2007, Nordic has completed three (3) rounds of funding (Series A, B and C) which include investments by, among others, Khosla Ventures (Menlo Park CA), New Enterprise Associates (Menlo Park CA, Bethesda MD) I2BF Holdings Ltd. (New York, London) and Impax Asset Management (London), Goldman Sachs as well as investment received from management, the Board and other private entities. The Company has raised or has committed capital investment totalling $58 million, with certain investors having the option to invest additional amounts.

II. UTILIZATION OF RECOVERY ACT PROVISIONS

In July 2009, the Company secured a $16 million DOE Loan Guarantee commitment and a term sheet was executed with Energy Secretary Steven Chu. This loan will become part of a $25 million Company project for domestic manufacturing and commercialization of the Nordic N1000 wind turbine. Well over $9 million in equity for this project has already been funded by the Company. The DOE and Nordic are working toward concluding due diligence, satisfying conditions of the credit committee and moving on to close and fund this loan by the end of this year. The DOE loan guarantee is a critical form of financing for Nordic's future development. The loan provides Nordic with the wherewithal to invest in parts and components as working capital; make advanced supplier deposits to shorten lead-times; invest in equipment and tooling to be more efficient; and offset a small portion of the technology development expenditure.

In January 2010, the Company received notice that its application for an Advance Energy Manufacturing Tax Credit (section 48C of the Internal Revenue Code) for $3 million was awarded to re-equip/expand our wind turbine manufacturing facility. After a couple of

years, as we become profitable, this incentive will have positive impact on the Company's cash flow by offsetting its federal tax liability.

Finally, as a turbine manufacturer, our sales projects and future sales opportunities benefit directly from our community wind developers and end-users' ability to gain access to and utilize the ARRA 1603 Cash in Lieu of Investment Tax Credit program; USDA's Rural Energy for America Program (REAP) grants, loans and development assistance programs; the Clean Renewable Energy Bond (CREB) program as well as several State level programs. Continuation of these programs which are now fully understood and utilized by wind power developers, is critical to the positive development of the community wind and distributed renewable energy segments to which Nordic Wind power serves.

III. CORPORATE LOCATION DECISIONS

From our start, we determined there were three principal markets for our wind turbines - the U.S., Europe and China. The Chinese market would be a challenge to penetrate, especially as an early stage foreign company. In China, the wind turbine supply market is saturated with nearly one-hundred domestic suppliers and joint venture companies competing primarily for lowest cost, and secondarily on other important values such as quality and reliability. The European market was seen as mature, with slowing growth rates for on-shore wind power and having limited opportunities for new entrants. However, the U.S. market was growing strongly at the time and the potential for success for a new turbine entrant appeared promising. In particular, the community wind segment of the market in the U.S. was underserved by the established major turbine suppliers and provided an obvious point of entry for Nordic. The decision in 2008 to locate a production facility in Idaho was driven primarily by proximity to a potentially significant in-State project opportunity. There was a limited amount of incentives available from the State of Idaho; however there was a readily available facility, capable workforce and a welcoming community.

Wind turbine manufacturing is capital intensive, where significant amounts of cash can be tied up in the supply chain for net working capital and capital investments in equipment, tooling and facilities. As an early stage company, Nordic is placing a large emphasis on the near-term effective cash value of the incentives that are being offered at the local, State and Federal levels. Long-term tax credits and exemptions will be beneficial after the Company is well established and profitable. However, we need to survive now to in order to live to fight another day. Therefore, competitive loans, loan guarantees, refundable tax credits, and out-right job and training grants comprise the basket of incentives that Nordic is attempting to gather together at the local, State and Federal level. These near-term incentives would be combined with other forms of financing the Company has secured

including its equity investments to build a vibrant and innovative domestic wind turbine company.

The Company is in the process of establishing a new center of U.S. operations which will include corporate offices, engineering, sales, service and manufacturing. We have established a series of criteria for the selection of this new location including: business climate, accessibility to transportation options, access to talent, labor market characteristics, attractiveness of the location as a place to live, cost of operations, proximity to potential customers and, as a deciding factor, incentive package offered. The selection criteria have led us to three finalist communities in the Mid-West region. Before the end of 2010, the Company expects to commence relocating most of the operations currently in CA, ID and UK to the Mid-West region in close proximity to the primary wind corridor and customers. Our expectations are that employment at the new location will increase to 135 over the next two years and 250 over the next five years at its U.S. operations.

IV. SOURCES OF PROJECTED CORPORATE GROWTH

Unlike many of the major international wind turbine suppliers, our business model is based on supporting localized wind power development across a larger spectrum of smaller yet capable community wind developers by supplying them with our innovative and competitive utility scale wind turbines fit for smaller sized wind projects. According to government and industry reports[1], community wind power projects have been proven to provide significant advantages over large-scale, out-of-state investor-owned wind farms, including up to five (5) times the local economic stimulus and two (2) times local job creation.

Based on industry projections, the annual installations in these segments are anticipated to grow from 1,000 MW to 2,500 MW annually over the next five years. We expect to deliver and service over one-hundred (100) wind turbine systems over the next two years totalling over $120 million in sales revenues. Our five year plan includes new product introductions and shipments of more than 750 units. During this year, the Company has delivered and installed five (5) N1000 wind turbines to community wind projects. By the end of the year, Nordic will deliver and install its sixth N1000 wind turbine at Ft. Huachuca in Arizona – the first utility scale wind turbine on a U.S. Army Base.

Our growth estimates assume the current wind industry in North America remains stable, with on-going government support, and that project financing becomes readily available again by the end of 2011.

[1] The Energy Foundation and 25x'25 Initiative: http://www.ef.org/docs/CommWind_web.pdf.

V. RECOMMENDATIONS TO POLICY MAKERS

There are five (5) recommendations that I would like to make on behalf of my Company to our Policy Makers. These recommendations involve taking programs that we have in place today or are contemplating, and make them more effective for innovative U.S. energy sector companies like ours. These recommendations focus on policies which have already benefitted from a significant amount of time and bi-partisan cooperation to develop. The recommendations are:

1. **Pass a Federal Renewable Electricity Standard (RES).** The House passed the Waxman Markey ACES bill in June 2009, which included a 15 % RES. We have supported the U.S. wind energy industry push for stronger near term targets, and we believe the priority now should be for the Senate to pass and the President sign a bill that includes an RES this year. The rationale for giving RES top priority is that it would be the first truly long term federal policy support for wind energy - rather than start and stop tax incentives that have never been more than a couple of years long for onshore wind. Stable markets and long-term signals are the surest way to attract billions of dollars in new manufacturing investment to the U.S. Developers need demand from utilities, which then leads to orders for turbine manufacturers, which create near term jobs and leads us to a cleaner future The American Wind Energy Association estimates that a long-term national RES will create an additional quarter of a million jobs in the U.S. including construction, operations, and engineering jobs with more than 50% of the jobs in manufacturing in companies like Nordic Windpower.

2. **Extend the Recovery Act 1603 Grant Program**: This ARRA program allows wind energy project owners to receive a cash grant from the Treasury in lieu of the Investment Tax Credit (ITC). This program has worked well and sustained the industry through the recession. It is due to expire at the end of this year for projects that have not started construction. We recommend that the 1603 grant program be extended to allow projects that start construction by the end of 2012 to qualify for this incentive. The House Ways & Means is proposing an extension, but not for cash grants but rather making the ITC refundable in cash. This means that a tax return must be filed in order to receive the cash, however a tax liability is not actually required. It is our view that this is an acceptable alternative. The 1603 program has been critical to allowing community wind projects to take advantage of federal incentives.

3. **Allow for the IRS 48C Manufacturing Tax Credit to be Refundable:** As noted earlier, Nordic is a receipt of the IRS 48C manufacturing tax credit. Our recommendation would be to continue this program and make the 48C Tax Credit refundable. By being refundable, the incentive will support early stage companies like Nordic who do not have a tax liability at a critical stage of their development.

4. **Provide for a Community Wind MACRS Grant**: The American Wind Energy Association (AWEA), through the Community Wind Working Group, has been prepared a definition for Community Wind and has proposed incentives for community wind projects up to 100MW. Incentives proposed include a grant in lieu of MACRS (Modified Accelerated Cost Recovery System) depreciation. The MACRS benefit is hard for small projects to monetize since net revenue is minimal in the early years of these projects and tax equity is usually not available to efficiently monetize the benefit. Allowing the MACRS to be given as a cash grant or refundable tax credit in lieu of a tax deduction for Community Wind projects would be a true incentive. Additionally, supporting and expanding the USDA REAP programs so that we continue to have critical source of financing for community wind projects.

5. **Streamline the DOE Loan Guarantee Program Application and Funding Process for Small Business Enterprises**: Small business enterprises create a majority share of net new job growth in America. Nordic Windpower, like other small business enterprises, has learned by necessity to operate lean and with purpose. There are many other small business enterprises like ours with innovative projects that would benefit from this program. The DOE Loan Guarantee program should simply adapt the best practices already employed for loan guarantees to small business enterprises from other Government agencies such as the Overseas Private Investment Corporation and USDA. There is no need to recreate the wheel. Let's hold down costs and reduce the time to get loans to qualified small and entrepreneurial business enterprises that are capable of commercializing clean energy technologies, creating jobs and competing on a global basis.

I sincerely appreciate the opportunity to submit this testimony, participate in the hearing and look forward to answering your questions.

Thomas M. Carbone
CEO
Nordic Windpower

The CHAIRMAN. Our final witness is Mr. Mark Fulton. He is the manufacturing director and global head of climate change investment research and strategy at Deutsche Bank. He has nearly 30 years of experience as an economist and a strategist.

We welcome you, sir.

STATEMENT OF MARK FULTON

Mr. FULTON. Chairman Markey, Ranking Member Sensenbrenner, and members of the Select Committee on Energy Independence and Global Warming, thank you for the opportunity to provide testimony on the global clean energy race.

In my role in the assessment management division of Deutsche Bank, I coordinate a research team that looks at the investment opportunities that climate change and associated clean energy technologies offer around the world. Since we in asset management started issuing educational white papers on these themes in 2007, the basis of our investment thesis has been demographic pressures on resources and environmental externalities as identified from scientific sources, combined with energy security and economic opportunity, which has led to government policy response at all levels, creating new technologies and industries as companies respond.

As we sit here today, the U.S. Federal and indeed State governments are at a crucial crossroad in their policy stance on clean energy, whether to take action to deepen and extend policies or will they fall behind other countries around the world. The stakes are high in terms of energy security, new jobs and industries and the climate. Certainly in a U.S. context, policy at Federal, State, and local levels are all important.

This year in the United States has been a challenging one for those looking to invest in these new clean energy industries on a longer-term basis. Uncertainty abounds. At the Federal level, given political complexities, there has been no energy or climate bill passed out of the Senate to complement the comprehensive approach taken by the House of Representatives in passing the American Clean Energy and Security Act that directly tackled climate issues and provided significant funding to clean energy and energy efficiency. At the same time, the most comprehensive climate and clean energy provisions of any State are under threat from California's Proposition 23, which seeks to suspend the State's Global Warming Solutions Act and would have a significant impact.

Working for investors as an asset manager, these uncertainties are discouraging to capital deployment in the U.S. in the long term. We have formulated a simple but fundamental framework for assessing regulatory environments around the world which we call TLC—transparency, longevity, and certainty. Investors need transparency in policies to create understanding and a level playing field. Longevity means policy has to match the time frame of the investment and stay the course. Certainty refers to knowing that incentives are financeable. In tech terms, TLC should result in a lower cost of capital for projects while still delivering a fair and market-related return to capital.

For instance, I believe that U.S. renewable policies could include more elements of TLC. State-level renewable portfolio standards set targets for near deployment. However, in most cases, these do

not have enforcement measures nor penalties to ensure they are financed. Renewable energy projects have therefore relied much in the short term on the complementary Investment Tax Credit and Production Tax Credit equity programs to get financed. Due to lack of longevity, this has produced an on-off pattern in renewable deployment.

Since the financial crisis, the tax equity market has not been strong and so the American Recovery and Reinvestment Act of 2009 introduced the Section 1603 Treasury cash grant. This indeed has been successful in generating projects in the past year, especially when combined with the Advanced Energy Manufacturing Tax Credit to encourage domestic production. But these programs sunset in 2011, and the renewable project pipeline is already under pressure as the tax equity market still struggles. As outlined in a paper released on September 16th by U.S. PREF, this puts over 100,000 jobs at risk. The Department of Energy's sections 1703 and 1705 loan guarantee programs for early and later stage clean energy projects also sunsets in 2011.

Looking around the world, we see many countries embodying TLC in their climate and energy policies and achieving capital deployment. As a German bank, we have knowledge of the German experience in particular.

In a recent paper, we looked at the major elements of a strong policy regime. In the passage of the EEG in 2000, which was updated in 2009, Germany established a feed-in tariff regime that supports the EU-mandated goal of 20 percent renewable energy as a share of electricity by 2020. This embodies TLC for investors. The results have been 300,000 jobs, renewable energy as a 13 percent share of electricity and rising, a rapid fall in solar PV costs in particular leading to lower tariffs on the digression schedule with a forecast of grid parity by 2013.

In summary, to build a secure, vibrant, 21st century clean and green energy sector, U.S. policy has to engage in TLC in some policy package. The fully comprehensive approach, such as embodied in the American Clean Energy and Security Act, is certainly a fundamental framework with strong elements of TLC. However, that is clearly open to a great deal of debate.

In the Senate, a number of bills have been proposed. Indeed, even without a carbon market, a comprehensive and strong national renewable electricity standard complementing State RPS, combined with long-term financial incentive programs that have longevity and a clean energy bank looking at loan guarantees, as well as continued focus on energy efficiency, would be very encouraging. I happen to believe that State-level feed-in tariffs, if they spread, would be positive.

We would also like to note Congressman Inslee's national feed-in tariff proposal in the Renewable Energy Jobs and Security Act.

In closing, I thank the Select Committee on Energy Independence and Global Warming for this opportunity to testify and share our perspective. I applaud the committee's commitment to addressing these important energy and climate issues. This is not just a matter of good policy for the United States, but it is a global movement happening that is creating economic activity in a race to

scale, an so there is a question of urgency in whether U.S. citizens will share in the new wealth being created.

Right now, by extending what is already working in the Section 1603 Treasury cash grant and the Advanced Energy Manufacturing Tax Credit, Congress can help to underpin a growing industry and create or preserve valuable jobs.

Thank you.

[The statement of Mr. Fulton follows:]

Select Committee on Energy Independence and Global Warming
U.S. House of Representatives

The Global Clean Energy Race

Written Testimony of Mark Fulton
Managing Director and Global Head of Climate Change Investment Research

DB Climate Change Advisors
Deutsche Asset Management

September 22, 2010

Chairman Markey, Ranking Member Sensenbrenner, and Members of the Select Committee on Energy Independence and Global Warming, thank you for the opportunity to provide testimony on the global clean energy race. My name is Mark Fulton, and I am Managing Director and Global Head of Climate Change Investment Research at Deutsche Asset Management, headquartered in New York, a member of the Deutsche Bank group. I am based in New York.

In my role in the asset management division, I co-ordinate a research team that looks at the investment opportunities that climate change and associated clean technology offer around the world. The Asset Management division then manages money on behalf of pension funds and retail investors globally. We currently have about U.S. $6 billion of assets under management relating to climate and clean technology themes, mostly in public equities, with the majority of clients in Europe or Asia. Since we in Asset Management started issuing educational white papers on these themes in 2007, the basis of our investment thesis has been: demographic pressures on resources and environmental externalities as identified from scientific sources, combined with energy security and economic opportunity, has lead to Government policy response at all levels, creating new technologies and industries as companies respond.

As we sit here today, the U.S. federal and indeed state governments are at a crucial cross-road in their policy stance on clean energy; will they take action to deepen and extend policies or will they fall behind other countries around the world? The stakes are high in terms of energy security, new jobs and industries and the climate. Certainly, in a U.S. context, policy at federal, state and local levels are all important.

This year in the United States has been a challenging one for those looking to invest in these new clean energy industries on a longer term basis. Uncertainty abounds. At a federal level, given political complexity, there has been no energy or climate bill passed out of the Senate to compliment the comprehensive approach taken by the House of Representatives in passing the American Clean Energy and Security Act (Waxman-Markey) that directly tackled climate issues and provided significant funding to clean energy and energy efficiency.[1] At the same time, the most comprehensive climate and clean energy provisions of any state are under threat from California's proposition 23 which seeks to suspend the state's Global Warming Solutions Act (AB32), and would have a significant impact.[2]

Working for investors as an asset manager, these uncertainties are discouraging to capital deployment in the U.S. in the long-term. We have formulated a simple but fundamental framework for assessing regulatory environments around the world which we call TLC – Transparency, Longevity and Certainty.[3] Investors need transparency in policies to create understanding and a level-playing field. Longevity

means policy has to match the time frame of the investment and stay the course. Certainty refers to knowing that incentives are financeable and can be trusted in the financial return calculation and again are likely to be maintained over the course of the investment. In economic terms, TLC should result in a lower cost of capital for projects while still delivering a fair and market related return to capital.

For instance, I believe that U.S. renewable policies could include more elements of TLC. State level Renewable Portfolio Standards (RPS) set targets for renewable deployment. However, in most cases these do not have enforcement measures nor penalties to ensure that they are financed. Renewable energy projects have therefore relied much in the short term on the complementary Investment Tax Credit (ITC) and Production Tax Credit (PTC) tax equity programs to get financed. Due to lack of longevity, this produced an on – off pattern in renewable deployment.[4] Since the financial crisis, the tax equity market has not been strong and so the American Recovery and Reinvestment Act of 2009 introduced the Section 1603 Treasury cash grant. This indeed has been successful in generating projects in the past two years (especially when combined with the Advanced Energy Manufacturing Tax Credit to encourage domestic production), with the Lawrence Berkeley National Laboratory estimating a gain of 143,000 jobs as a result in wind and the Solar Energy Industries Association estimated 58,000 jobs in solar.[5] This has also allowed the U.S. to retain a strong position in project financing in the past two years or so, although China has become dominant. But these programs sunset in 2011 and the renewable project pipeline is already under pressure as the tax equity market still struggles.[6] As outlined in a paper released on September 16, 2010 by the U.S. Partnership for Renewable Energy Finance (PREF), this puts over 100,000 jobs at risk.[5] The Department of Energy's Sections 1703 and 1705 Loan Guarantee Programs for early and later stage clean energy projects also sunset in 2011. Again, the U.S. is prominent in private equity and venture capital investment, but government support for the "valley of death" funding is helpful in these new capital intensive clean tech industries.

Looking around the world, representing investors, we see many countries embodying TLC in their climate and energy policies and achieving capital deployment. As a German bank, we have knowledge of the German experience in particular. In our recent paper "The Green Economy: The Race is On,"[7] we looked at the major elements of a strong policy regime. While there is often focus on the European Carbon Market, complementary policies play a crucial role. In the passage of the EEG in 2000 and updated in 2009, Germany established a feed-in tariff regime that supports the EU mandated goal of 20% renewable energy as a share of electricity by 2020. This embodies TLC for investors – standard offer, transparent contracts with up to 20 years of longevity, with guaranteed certain payment streams, and to ensure "right pricing" for electricity consumers, a tariff digression over time to match all reductions in technology costs, with an end target of grid parity with fossil fuels.[3] The result has been 300,000 jobs[8], renewable energy at a 13% share of electricity and rising, a rapid fall in solar PV costs in particular leading to lower tariffs on the digression schedule with a forecast of grid parity by 2013.

To build a secure, vibrant, twenty first century green and clean energy sector, U.S. policy has to engage in TLC in some policy package. The fully comprehensive approach, such as embodied in the American Clean Energy and Security Act, with a carbon price and carbon market linked to renewable energy and energy efficiency in the context of an overall climate target is certainly a fundamental framework with strong elements of TLC. However, that is clearly open to a great deal of debate. In the Senate, the American Power Act, sponsored by Senators Kerry and Lieberman, is broad, including a carbon price element as did The Carbon Limits and Energy for America's Renewal Act, sponsored by Senators Cantwell and Collins, while many other bills, such as Senator Bingaman's American Clean Energy Leadership Act or Senator Lugar's Practical Energy and Climate Plan, look at an energy-only approach.[1] Indeed even without a carbon market, a comprehensive and strong National Renewable Electricity Standard (RES) complimenting State RPS, combined with long term financial incentive programs that

have longevity and a "Clean Energy Bank" looking at loan guarantees, as well as continued focus on energy efficiency would be very encouraging. I happen to believe that state level feed-in tariffs, if they spread, would be positive.

In closing, I thank the Select Committee on Energy Independence and Global Warming for this opportunity to testify and share our perspective. In summary, I applaud the Committee's commitment to addressing these important energy and climate issues. This is not just a matter of good policy for the United States – there is a global movement happening that is creating economic activity in a race to scale, and so there is a question of urgency and whether U.S. citizens will share in the new wealth being created.

Right now, by extending what is already working in the Section 1603 Treasury cash grant and the Advanced Energy Manufacturing Tax Credit, Congress can help to underpin a growing industry and create or preserve valuable jobs.

Thank you.

References

1. DB Climate Change Advisors, "Delivering a U.S. Energy and Climate Bill," June 2010.
2. University of California, Berkeley, "California at the Cross-Roads: Proposition 23, AB32 and Climate Change," September 2010.
3. DB Climate Change Advisors, "Paying for Renewable Energy: TLC at the Right Price," December 2009.
4. DB Climate Change Advisors, "Creating Jobs and Growth: The German Green Experience," September 2009.
5. U.S. Partnership for Renewable Energy Finance, "Impact on Jobs through the Extension of the ARRA 1603 Cash Grant," September 2010.
6. U.S. Partnership for Renewable Energy Finance, "Prospective 2010-2012: Tax Equity Market Observations (v1.2)," July 2010.
7. DB Climate Change Advisors, "The Green Economy: The Race is On," April 2010.
8. German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, "Development of Renewable Energy Sources in Germany 2009," March 2010.

The CHAIRMAN. Thank you, Mr. Fulton, very much.

Now I am going to turn and recognize the gentleman from Missouri, Mr. Cleaver, for as much time as he may consume in his question and answer period.

Mr. CLEAVER. Thank you, Mr. Chairman.

Let me apologize to the panel. I have two other committee hearings that started at 10 o'clock, Homeland Security and Financial Services. One is here, and one is in another building. So I apologize. This is, to me, extremely important.

Mr. Carbone, thank you for being here. Thank you for the great work your company is doing.

This is a somewhat convoluted question, but large Chinese windmills are selling for about $685 per megawatt of capacity. In the United States, it is about $825 per megawatt of capacity. So the Chinese are able to sell it infinitely cheaper. That is probably because of—and they probably violate some WTO rules. But, in addition to that, they are getting government-backed loans to do the work. And when you combine that—and they are doing land deals. There is a chance that China could suffer the same fate that hit us in December of 2007 at the beginning of the recession, which is the collapse of the real estate market. So their plants are connected to land deals and the government is backing the loans.

Do we have to wait on a potential collapse, do you think, in the Chinese economy before we have a chance to catch up, or is there something that we can do to not only catch up but to supersede the Chinese?

Mr. CARBONE. Thank you for the question, Congressman Cleaver.

In our view, and in particular my view, in our analysis it was difficult for us to export to China from the United States with our wind turbine. Although a large amount, the majority, of our parts are sourced here in the United States, a fair amount of the value is today imported. That was the result of a very constrained local market here in terms of the supply chain in 2008 and 2009 when we had a large booming business. It caused us to go offshore. We are currently domesticating a big part of our supply.

Since we have gone global with our supply chain, we are finding very competitive domestic supply for wind turbine components. There is capacity. I am sure that has driven down the supply.

My figures are a bit different than yours in terms of what is the wind turbine package to a wind farm here in the U.S. Our pricing and the pricing of our competitors are in excess of 1.2 to 1.5 million. We have seen Chinese supply coming at about 1 million a megawatt installed. However, we have also seen that it is more than just the product, it is the process and the people behind that products and how these products are serviced over the 20 years that they are expected to operate.

So I think today there is competitiveness within the U.S. supply chain. It is actually improving, these incentives we are talking about today, particularly the ones that Nordic is trying to employ. It will increase our productivity and, therefore, our competitiveness.

It will be a fight for sure with Chinese wind turbines and Korean wind turbines coming to the U.S., to our shores, but I think it is

a good fight. It is the one that we really, I think, have the opportunity to combat.

Mr. CLEAVER. Let me ask any or all of one question: If you were sitting here and necessarily engaging in a debate with some good people who think differently, who would say that we can't expend large amounts of taxpayer dollars at this time because we need to concentrate on reducing or eliminating the deficit, so every discussion that surfaces is going to have that as a background, do we spend money to make sure that we are a 21st century nation, or do we forget that and deal with the deficit?

I am just curious about what any of you would say that in that hypothetical—no, it is not a hypothetical. It is a very real debate.

Mr. CARBONE. Maybe I could jump in on that first.

Yes, I think, given the choice, reducing the deficit has to be a priority.

Mr. CLEAVER. Even if we fall further behind?

Mr. CARBONE. No. Let me finish my statement.

Mr. CLEAVER. Go ahead.

Mr. CARBONE. I think what we need, though, is the market signals. We need a Renewable Electricity Standard to actually provide a standard market signal and let the markets—let the supply base, let the turbine manufacturers, let the solar companies respond to it competitively. In my mind, that would be a much stronger signal, particularly a long-term policy signal.

Mr. LIEBREICH. I think, first of all, it is very difficult to have that discussion with somebody if they haven't first agreed that there is a benefit to this shift towards cleaner energy and towards, in a sense, energy that comes out of technology rather than energy that comes out of the ground. So that is first. So that is my caveat before I start.

Mr. CLEAVER. Well, that ends it, pretty much.

Mr. LIEBREICH. Well, it certainly hinders the discussion with some folks. But there are a lot of people who actually are in the middle camp, where they see the need, they see China forging ahead, Korea is about to start, Europe, and actually do see the need to take action.

And then the issue that you raised specifically around the deficit is one that I think one can deal with, because I think there are ways of designing policy that don't just require checks to be written by either Federal or State governments. So renewable portfolio standards, if they had the appropriate teeth, would actually achieve a lot of that.

It is not necessary just to incentivize, just to pay money for the good energy. You can actually mandate a volume and then let the market decide how to fulfill that. But if you go that route, then it does have to have teeth. There is no point in having a renewable portfolio standard that can be bought out at such a low price that it is essentially ineffective.

There are other areas where there are barriers to switching to clean energy. There are other areas where some of the externality costs of the alternatives ought to be priced in.

So I think that the important thing is to go through the policy and look at ways of doing it that don't hit the budget. If you believe it is important, then that is the challenge ahead.

Mr. VISWANATHAN. Congressman Cleaver, I think it is a very fair discussion on wanting to reduce the deficit. What I would say if I were in your shoes and discussing it with these other folks is that it comes down to a few things. It comes down to job creation, global competitiveness, and energy independence. If we have these incentives, jobs will be created here. If you don't have these incentives, for sure they are going to be created elsewhere.

Here is what the frightening scenario is, and I can say this from traveling in Asia: These economies, they have speed and capital and scale and they are exercising that in the manufacturing side. Now that they are getting leadership positions on the downstream part of these clean energy technologies, they are doing something that we hadn't anticipated them doing, and they are going upstream and they are starting to innovate. Once they start innovating, then our bulwark, our strength, our fortress which we have had for hundreds of years, which is innovation, starts getting compromised.

So I think with while the short term is obviously to focus on the deficit, I would encourage everyone to start thinking about intermediate and longer term, because that trend, empirical data suggests it is happening. It is happening in solar, it is happening in wind, it is happening in batteries, it is happening in electric vehicles. So that is the fear that my partners in our industry face when we look at these global factors.

Mr. FULTON. I would echo what I have heard. One obvious point about the budget, it has got a lot of numbers in it. Tax spending, it is a huge animal. And it is really up to the United States to decide where it wants to spend and tax within that balance as it brings the deficit down and how important it feels that being on the front end of the clean energy race really, in terms of its long-term competitiveness. So it is a question of priorities. And we believe that this is a strong priority.

I think the second point, bringing up what Michael said, was that there are different ways to construct incentive programs. Some run through the budget, some run directly into the rate pay base. And essentially a lot of the European do not run through the budget. So then there is a question of, do you think that is the best thing, an electricity base.

So there are ways of constructing these incentives. You can do it, as long as you do it with TLC is our point, fine, tends to get it done. And if you don't get longevity that is run through the budget, then of course that is an issue.

Mr. MARKEY. Does the gentleman need more time? He can continue.

Mr. CLEAVER. Well, of course there is no TLC up here on the Hill. I agree, we have got to make some choices if we are going to do this. But my fear is, while we are struggling with the choices, we fall further behind. And nothing moves swiftly here. And I guess, I am not looking for you to solve this dilemma, but you have helped craft, I think for me at least, an argument.

What do you say, though—I mean, Mr. Sensenbrenner my friend left. He had another commitment. But if this is always presented as some kind of new way to tax the public, you poison the public to the need to move and move swiftly to create.

Mr. Fulton.

Mr. FULTON. Well, I think it is interesting, actually, we talk a lot about costs, but there is still a big debate about how to measure those costs. So at a very narrow level we look at the so-called cash costs of deploying, say, solar against coal. But of course what we—the wider debate is what are the externalities? What are the real costs of those technologies, of those fuel sources? And that is when, of course, it gets more difficult because we are talking about economist externalities. But when you start loading in the externalities, if you happen to believe in the environmental impacts, health impacts and so on, then you get very different numbers as to what is yielding.

I think the second point I would like to say is that we hear a lot about how this is just a lot of subsidies and keeping the market going when it should just be doing it itself. I think the point is that we particularly see these, as I would like to call them, incentives to scale. Essentially, these are new industries scaling up. Every new industry, really big industry, you go look at history, gets some help from government when it is scaling, generally. And so we know fossil fuel industries around the world, by the way, have between 3- and 500 billion in subsidies, which is calculated by the IEA. So it is not a level playing field anyway.

And secondly, what I would say to you is, if you think about it, what we are trying to do is incentivize the scaled deployment of these new industries. And as we do that and their learning curve, their costs come down. And we are hearing that. The Germans believe that as they incentivize the reply side response of solar PV—and we have seen the crash in prices, which they are now reflecting—then we are going to see grid parity against the fossil fuels within 3 to 5 years maximum.

So we keep talking about, oh, always subsidized. No. These are incentives to scale, to develop industries to make the clean economy work. And you are right, at the end of the day, the next 5 years, I think the next 5 years are very crucial because grid parity is sort of coming as these industries build. And during that process have you incentivized your own manufacturing base and own economies to participate in that?

Mr. CLEAVER. Mr. Liebreich.

Mr. LIEBREICH. I have had a minute or 2 to reflect on how we can perhaps help you to persuade Mr. Sensenbrenner to approve some of the measures that you might want to. And I think that I would probably start by talking about the risk to the U.S. economy is not going to be defined by the odd program here or there and a few billion more or less of this or that grant program or loan guarantee. The issue that really is at stake here is whether the U.S. is going to be a price taker on energy in its economy for the next 2 decades, 50 years, 100 years.

If you go back in history, while the U.S. was a net exporter, was producing enough energy domestically for its own demands, that was not an issue. And what has happened, as U.S. oil has depleted and imports have gone up and up, the U.S. is a price taker on energy. And this has been at the root of a number of different episodes of economic instability which have actually destroyed enor-

mous numbers of jobs along the way, and it is because the U.S. is a price taker on energy fundamentally.

Now, you move to these technologies, and I think—and the analysis that we do and my fellow panel members will confirm—that these energy technologies will become cheaper in the long term than fossil fuels. And so the U.S. has an opportunity—so the world will shift to these technologies. It won't be fast. We are talking decades, sometimes perhaps many decades, but this is the shift that will happen.

And then the question is, is the U.S. going to be a price taker on those technologies? You used the example of compact fluorescent light bulbs, LEDs. We are going to be buying those from Taiwan. Are we going to be a price taker on our own electricity power and on our main fuel sources because we have not developed these here in the U.S.?

And I think there is an opportunity. I think this is the real debate. And so if you can win that debate about whether the U.S. has to lead in these technologies, then the discussion with Mr. Sensenbrenner and his colleagues perhaps is about how to do that, rather than about the desirability of doing that. And the evidence that perhaps could contribute to that is evidence around the economics of this stuff.

The last 5 years has been very unusual because, first of all, the amount of demand that suddenly arrived in the industry overwhelmed the supply chain. From 2004 through to 2008, the price of clean energy went up, not down. The long-term history is it comes down. There is an experience curve. This stuff is driven by developing technology, developing logistics, developing supply chain, developing skills, developing financing mechanisms, and so on, and the price comes down.

And the last 2 years we have seen that really, we have seen the costs come down in a way that has caught up with those trends. And I think that when you start to delve into the fact that you have fossil fuels getting more expensive and you have fossil fuels causing accidents like what we have seen, the tragedy in the Gulf Coast that we just all lived through, and then you contrast that with the costs coming down, and you can provide data on that, this is something that yields to analysis.

Then I think that maybe the debate moves on from whether we have this program or that, and is this just tax and spend, or is this just a subsidy and will it just stop? And the fact that Spain's solar program blew up because it was poorly constructed, Spain's wind program certainly didn't and Germany's solar program didn't and China's solar and wind program certainly didn't and Brazilian ethanol programs certainly didn't. There are plenty of examples one can bring to bear that back up this thesis that this is the future of the energy industry. And America really needs to get into the price giving and not the price taking position.

Mr. CLEAVER. Thank you very kindly.

Mr. MARKEY. We thank the gentleman very much. And I think that the gentleman from Missouri in his questions has laid out and your answers have helped to lay out the challenge for America. And a couple of you mentioned this challenge to AB 32 in California. You mentioned that there is now an attempt to repeal the

clean energy laws of California. And therein lies our challenge, because that attempt to repeal the clean energy laws in California is being financed by the Koch brothers, Tesoro, and by Valero, three companies with oil refineries in Texas. So Texas is financing—Texas refineries are financing an effort to repeal California clean energy laws. And so what is at stake there? Who are the winners if the Koch brothers, Tesoro, and Valero win? The winners are those three companies and China. Those are your two big winners up on the scoreboard.

The losers, of course, are anyone who was interested in creating a domestic renewable energy industry here in the United States with the potential to create hundreds of thousands of millions of jobs.

Mr. Fulton, can you talk about what is at stake in California in terms of this battle over AB 32 and what it represents if that law is actually repealed by these oil refineries in the United States financing that effort?

Mr. FULTON. Yeah. It is a suspension, as you know, until California reaches 5.5 percent unemployment for a number of quarters, which we haven't seen for a long, long time. But technically it is a suspension, but people would suspect it would last for quite a while.

And we actually quote the U.C.-Berkeley paper that has looked at this. The U.C.-Berkeley paper that has looked at this very comprehensively I think is very instructive. But essentially I think one of the points, apart from the fact that it would have a very significant on what is going on in California itself—and of course there is a lot of talk about how AB 32 then spills over into all of California's other green laws—but, essentially, everyone would assume that that would put a very major stop on the clean and green development in California. And I think, as was pointed out, the signal effect within the United States, and you could even say globally, might be quite significant because California has always been seen as a leader, a global leader to some extent, in this whole——

Mr. MARKEY. And why would three oil refiners in Texas want to stop that law in California?

Mr. FULTON. Well, I am not an oil expert, but I assume they feel that that is something that would be good for them. I don't know.

Mr. MARKEY. I guess you don't have to be Dick Tracy to figure out why they would be opposed to it. The oil refining industry clearly has a stake in putting an end to this clean energy revolution. Not all of them. There are some that are willing to make the transition. But these three companies are clearly intending on keeping us dependent upon imported oil on the one hand, and not putting in place a domestic policy that challenges China in terms of the manufacturing of the new technologies that inevitably are going to be deployed here in the United States, if for no other reason than States have put on the books their own laws that are going to require renewable energy to be deployed, and local governments increasingly as well.

Mr. Viswanathan, you mentioned AB 32 as well I think in your statement?

Mr. VISWANATHAN. I didn't. But I think my comment is I would echo everything you have said. I think it would be disastrous. If

you look at what has happened in innovation, and my colleagues have eloquently pointed out about how costs would come down. So the whole field of material science, which is the underpinnings of a lot of these technologies, has grown up. It used to be science projects in universities. We spun them out of universities, we helped scale them. And guess what happened? That happened 3 to 5 years ago. In that period of time, you had an economic meltdown, you had capital that fled the system, you had China with their commitment and resolve take over. And so you keep getting body blows, and this is yet another one.

So this really doesn't help us at all in what we are trying to do, which is take these technologies which have actually come of age. And this is when you want to press fast-forward and get into that next level. You know, these negative incentives can be disastrous.

Mr. MARKEY. Do any of the rest of you wish to comment on how disastrous a repeal of the California clean energy laws would be? Mr. Liebreich.

Mr. LIEBREICH. I could comment on how disastrous it would be. I think, again, we don't need to be Dick Tracy to know it would be disastrous, because California is seen not just as a U.S. leader in essentially capping its energy use per capita, but it is also actually a global leader.

But I want to comment on I think one aspect of this, which is that even with money from oil companies, it wouldn't be threatening. There would be no chance of success if they were not tapping into a strain of concern and skepticism amongst a proportion of the population. And so I think having—except that it would be catastrophic, it is something that definitely will set the industry back considerably. Perhaps some thoughts on what could be done to create a protection against that, because I think that the debate has become too much about subsidies or not.

Mr. MARKEY. Just so I can say this. You know, the Koch brothers also finance Tea Party activities. And it does tap into something that is quite deep, because 70 percent of Tea Party members do not believe in evolution. So to the extent to which they don't believe in evolution and they don't believe in clean energy, I guess they are tapping into something. The question is, are they tapping into anything that is valid scientifically? And if they pour millions of dollars into that effort, do they drive an ultimate result that is completely at odds with everything that we know scientifically and technologically that we should be advancing as a strategy in our country?

So I understand what you are saying, that you are tapping into something. But I just want to define that they are also creating the thing that they are tapping into, which is this defiance of 150 years of scientific breakthroughs in our society.

Mr. LIEBREICH. I agree. I have speculated privately as to whether there is a correlation between those who deny evolution to those who don't believe in climate change to those who don't believe we can ever change to new energy sources.

Mr. MARKEY. Well, if the same source of funding is providing the public debate on those issues, then while you are looking at the people who are reflecting what they are reading, what they are hearing, the questions that are raised, you have to understand that

it all goes back to these oil refiners that are financing these efforts—and not necessarily to advance the goals of denial of evolution—but, rather, to use those people as a way of then killing things that they believe might interfere with their own economic objectives, which is the continuation of massive importation of oil into the United States from the Middle East that they have the opportunity to refine. So I don't think—again, that is a complex formula. I think every American, every thinking American actually supports that.

Mr. LIEBREICH. But one could get into a discussion—I actually trust that people are smart about—not entirely smart, but they will figure out who is doing the talking. But I want to move——

Mr. MARKEY. See, here is the problem. As you know, there are new Supreme Court decisions that actually allow for a masking of who is financing much of what is going to be going on in America. So you have almost the worst-case scenario, you know, where the people who have an agenda are also increasingly able to mask their agenda under the guise of raising other issues that don't go to their own economic interests here, which would be oil being imported which they have the opportunity to refine and to spew it out into the atmosphere.

So I just want to make it clear that the political terrain is not such that it makes it transparently easy for the voter to understand, in fact, what is at stake as these issues are being publicly debated. So, please continue.

Mr. LIEBREICH. So what I wanted to suggest is that there is, however, a powerful constituency that one could try to—that one could try to develop to oppose that, the money that is being spent on the repeal campaign, and that is California's technology community and also those who—people need to understand that this is the way to create jobs and wealth and prosperity, so to counter this idea that all it is is about increasing taxes and giving away money to technologies that don't work.

And the particular constituency that I think has not been brought into this whole discussion is around the telecoms, the IT industry, the industry of innovation around the electrical system more broadly. Because if we are going to integrate these large quantities of clean energy, then there are all sorts of other industries, particularly around telecoms and information technology, who are going to benefit enormously. And, to a certain extent, they are sitting on the sidelines and not getting involved in the discussion. And I think that the people in California and elsewhere don't necessarily understand just how many jobs are required if we start building out the grid and we start integrating these technologies very broadly into our lives.

We saw what happened with the Internet which, again, it was funded originally through government spending, the development of it. It then went viral in the economy, and it created hundreds of thousands and then millions of jobs in very unpredictable ways, ways that could not have been predicted when the first grant appropriations were made to experiment with or to build out the first implementations.

So I think there is a constituency that needs to be educated as a counterweight to those who suggest that we should do nothing and simply cut taxes and walk away from this problem.

Mr. MARKEY. I think you point out—and I thank you for doing so—yes, the Internet was funded by the federal government, it was called DARPANET originally, but a strategy had to be developed in order to deploy it into the society as a whole. And I was the chairman of the Telecommunications Subcommittee. So that was a three-bill strategy.

Bill number one was to create an 18-inch satellite dish industry, which the cable industry opposed because they didn't want the competition. But that put pressure on the cable industry to deploy even greater capacity.

Second, was moving over 200 megahertz of spectrum in 1993 that created the third, fourth, fifth, and sixth cellphone license in the United States. They all went digital and went to under 10 cents a minute. The two incumbents, who for this purpose would be the oil refineries in a telecommunications setting, they went both analogue and 50 cents a minute with a phone the size of a brick in 1993.

And the third bill became the Telecommunications Act of 1996, which moved us from dial-up to broadband, which moved us from black rotary phones to BlackBerries.

By 1998 there is a new company called Google that can be started and HULU and YouTube and EBay, all highly anticipatable, not in terms of what they actually do, but with this incredible additional broadband, yeah, we are going to create a couple of million new jobs.

That was my strategy back in the 1990s. I knew what I wanted to accomplish, but you needed new public policies because the incumbent two companies weren't going to move rapidly in that direction. It is always good to have a monopoly or duopoly in any marketplace; you can divvy it up 50 percent apiece, which is a good business if you can get it.

So we need to do the same thing here, and we need to do the public education that explains how these new jobs are going to be created for a new economy. And, of course, they are going to be created, but they will in China. They are going to be created, but they will in Germany. They are going to be created, but they will be in other parts of the world, and we will inevitably wind up importing them into our country. That is our challenge.

So I have a chart here that I would like you each to comment upon, because I think it gets to the point that each of you have been making. This is a chart put together by 1366 Technologies, which is a photovoltaic company up in Lexington, Massachusetts. And what it does is it charts the price of photovoltaics, the installed cost of electricity per kilowatt hour in 1978 at $5 a kilowatt hour, down to about 22, 23 cents a kilowatt hour today. And it assumes annual production growth of 35 percent and an 18 percent learning-curve for photovoltaics, cost based on an 18 percent capacity factor and a 7 percent discount rate. So you can see that it is almost like a Moore's law of photovoltaics, and it keeps moving inexorably lower in terms of its costs. And they project that by the year 2020, it will be at the cost of coal, if not sooner. Mr. Fulton

and others have pointed that out. It could be sooner. And, that once you hit the cost of coal, it could almost, by 2020, because of the developing world and their need to install new energy technologies, could become 7 percent of all electricity generation in the planet.

Now, again, you have to have a little bit of vision here on this subject, because when we were basically moving over the spectrum for the third, fourth, fifth, and sixth cellphone license, our goal was of course not just to lower the price here in America, but to create a new global industry. Who would think that in 2010 there would be cellphones in villages of Africa and Asia and South America that would be the markets?

Well, you first have to have a policy that develops the products that can then open up these markets, and these countries could jump the wire-line revolution and go right to cellphones, which is what happened.

Well, the same thing can happen here with photovoltaics. You don't have to build out that entire electricity grid. So that is kind of the vision.

Do any of you want to comment on—this is Professor Emanuel Sachs at MIT. He is the guy who developed the technology that was used by Evergreen Solar Company. And now this new technology, he believes, is 40 percent more efficient than previous technology, dramatically more efficient than even is Evergreen photovoltaic technology.

Does anyone want to comment on this vision and where we can go and how we can have a domestic production capacity rather than inevitably importing it from China?

Mr. Fulton.

Mr. FULTON. It might sound technical, but I think you can even make it look more aggressive than that, because——

Mr. MARKEY. He is too conservative in terms of this revolution.

Mr. FULTON. There is in particular something that the German Environment Ministry, when they were looking at how much the entire cost, they did something called the "effect of the merit-order run of a load curve of electricity." So what they talked about was the fact that solar PV comes in at the peak load when gas peak is usually running, and gas peak is the most expensive form of electricity on the grid. Normally we look at average cost. But if you look at the gas peakers, if you replace the gas peakers, then you have a very big effect.

Now, the German Environment Ministry estimated that the whole of the feed-in tariff was entirely paid for by the cost of replacing the gas peak——

Mr. MARKEY. What is a feed?

Mr. FULTON. In simple terms it says—it is a standard offer document, about two pages long.

Mr. MARKEY. It is a stand off document? I just asked you to please explain it in English and you said stand off.

Mr. FULTON. A standard offer. So what it means is that everyone gets the same bit of paper in front of them; whether you are a utility or an independent power producer or whoever you are, you get a two-page document. You know what you are getting, what tariff you are getting. So essentially the tariffs are set by the govern-

ment, but in consultation with the market in terms of costs. They are reviewed.

And in the German system, there is a digression over time, and the digression is actually targeted at what they believe will be grid parity. Therefore, the signal that is given to the industry: You had better be off that curve, because we are not paying you to get off the curve; we are paying you to get on the curve. And that is why I call them incentives of scale.

There is a strong signal, this is a temporary incentive to get to scale, get your costs down, and they try to influence the direction of the digression of the cost curve.

Mr. MARKEY. Does this tell us, Mr. Fulton, that we had better have a strategy?

Mr. FULTON. That is what I think I said.

Mr. MARKEY. To reduce these technologies here? Because once something hits 7 percent of global energy electricity, once something reaches 7 percent of global electricity production, that is a great economic opportunity. And it will only grow as each year goes by.

And right now, in your opinion, you know, do we have a program in place that will keep these companies here in the United States, given the fact—here is the interesting thing: that last year 45 percent of the solar technology in the world was produced in China and they exported 95 percent of it. They did not deploy it in China. They exported 95 percent of it. So this gets to the U.S. Trade Representative, this gets to what the steelworkers are talking about. This gets to whether or not we have an aggressive enough across-the-board strategy to make sure that we are protecting our own potential domestic production capacity here so that it winds up with Americans with these jobs. Could you expand on that?

Mr. FULTON. Very briefly. I think I said the next 5 years I think are very important for the grid parities on solar and wind. And essentially this is when industries are being built right now. And you know, as I said, we feel that U.S. policy lacks TLC at the moment and therefore we could see more done.

Mr. MARKEY. TLC, again, stands for?

Mr. FULTON. Transparency, Longevity, and Certainty.

Mr. MARKEY. Dr. Viswanathan.

Mr. VISWANATHAN. This is one of our favorite charts. You are exactly right, it is Moore's law for photovoltaics. It is the fundamental thesis on which we invest in solar, which is a significant portion of our portfolio.

The point I would make is, you are exactly right. Basically, we are very close to grid parity, "very close" being the next few years. If we have the right incentives, we will get there in the U.S. And we are at that stage when this is where the incentives kick in. It is in the labs, it is going into deployment. If we don't have those incentives, what will happen is you will have lines coming from all of those points, and they are going to go to different countries—China, Taiwan, Korea. And that is what is scary.

Having said that, this chart—if you show it to our competitors globally—scares them, because they cannot come down that curve. They can only come down in certain ways because they fundamentally—that, from 1978 to today, is innovation.

Mr. MARKEY. And that is America.
Mr. VISWANATHAN. And that is America.
Mr. MARKEY. This is our innovation.
Mr. VISWANATHAN. Exactly.
Mr. MARKEY. These are the breakthroughs made largely in the United States. So here we are, the innovators, creating these huge technological breakthrough historical moments, and the other countries are taking note of it, putting in place policies, some of them protectionist, so that they can capture the opportunity that we created out of our universities.
Mr. VISWANATHAN. And to build on what Mr. Fulton said and also a response to Mr. Cleaver's question, the incentives we are not saying is permanent. It is a few years until we get into that large orange-red band, and then grid parity takes off and you don't need the incentives. So I think that is the fundamental tenet that needs to be reinforced over and over.
Mr. MARKEY. And by the way, let me just say this. There were huge subsidies that had to be built into the system in order to build an electricity grid in the United States, especially out to rural America. It was subsidized. It was largely subsidized by urban Americans taking care of suburban and rural Americans. In telecommunications there was a huge subsidy program so we could have a telecommunications program in the United States, and it was largely subsidized by urban Americans who subsidized suburban and rural Americans so they could have the same phone service that those in the cities had. But it was a huge multi-multibillion-dollar subsidy—that still continues to this day, by the way, still continues the subsidy, of rural America for telecommunications, for example.
So I think people are kidding themselves if they think there hasn't been an ongoing industrial policy in the United States to ensure that the electricity, the solar I mean, and the telecommunications revolution was available. It still exists. It is multibillions per year.
So then when we turn to this new technology revolution, the crocodile tears come down from, in many instances, the very companies that got subsidized to be created, in the way that the telecommunications companies didn't want a third, fourth, fifth, and six license to be put out there, in the same way that the existing companies are saying, "Why would we want broadband? We already have a monopoly. We already have all the customers that exist in America. Why would we want other independent companies?" And hundreds of them moved into this space once we had this broadband revolution. Why would we want those people in as well?
So we have to work it through in order to explain to the American people that there are millions of jobs here that we can create in the United States, because technology always triumphs. Technology always triumphs. This is going to happen. It is only a question of whether we as a country are going to start out where we are going to be forced to wind up anyway, in terms of the importation of these technologies into our country, or the development, the creation of the jobs here in the United States that will then export

them to other countries in the world. That is the only question. Not whether or not there is a Moore's law in solar. There is.

Are we going to have a plan to capture it here for our country? Mr. Carbone.

Mr. CARBONE. Yes. I was just going to say that similar laws were applied in the wind business as well. If you wind the clocks back 30 years, you see a similar curve. We took advantage, at least in the early part of this past decade, of the scale that was produced in Europe here in the U.S. in terms of bringing that price of wind power through the price of wind turbines, which was the main driver in the cost models.

Mr. MARKEY. By the way, if you have that chart, I would like to use that as well. If you have a similar chart to that in wind, I would like to use that as well, just so that people can see the inexorable inevitability of the triumph of technology, and whether or not we—rather than being in denial of whether or not this is going to happen. And we understand why the Koch brothers and Tesoro and Valero are. Okay?

But whether or not—Adlai Stevenson, someone said to him, "Every thinking voter is with you." And he said, "Yeah, but I need a majority." And the way you need to get a majority is we have hearings like this. We have a big public debate. So to a certain extent this California referendum is a great opportunity for us as well. Let's have this debate. Let's see where California wants to be. And let's also, though, show who is on the other side of the debate, because they are clearly looking at history in a rear-view mirror.

Mr. Carbone, please continue.

Mr. CARBONE. Just to finish. I think we fully agree, it is technology that will continue to drive us down that curve. Unfortunately, the wind business, a lot of the innovations were not born here. But today they are. And my company in particular is taking a different approach with the technology in order to defer the drive-down of the cost of energy. It is just—and it is all technology.

Mr. MARKEY. But America is now catching up in innovation in wind.

Mr. CARBONE. Absolutely.

Mr. MARKEY. Mr. Liebreich.

Mr. LIEBREICH. First of all, a couple examples just to confirm this is not an academic exercise, this is real. Italy is pretty much where at the moment, this year or next, the cost of solar in the sunnier parts in the south of Italy will be parity with the retail price of electricity. So in Italy you get to the point where if you want to put an air-conditioning unit in, you should generate the electricity from photovoltaic on your own roof. California, perhaps a few years—this is without subsidy—California, perhaps a few years behind, but not far.

Mr. MARKEY. And what is the difference between retail and wholesale price for solar?

Mr. LIEBREICH. Well, the price at the moment is absolutely accurate on that chart. It is about 22 cents per kilowatt hour. It depends how sunny and so on. Italy has very high daytime electricity costs and good sun; therefore, it will get that amongst the first locations. Obviously, wholesale is different. If you are generating electricity and then putting it into the grid, then you are competing

with the coal-fired power station or the gas-fired power station, and then you have to get to a lower price, which is shown on the chart.

Mr. MARKEY. So if you are a Texas oil refiner, it is very sunny in Texas; it is very sunny at Fort Huachuca, Arizona; it is very sunny in Florida. Or those ads are going to start to run again, where a bad day in Florida in winter is when one cloud goes by. So they advertise all the sun there, and there is a lot more sun there than in Italy or Germany. So——

Mr. LIEBREICH. There are lower electricity prices though.

Mr. MARKEY. Excuse me?

Mr. LIEBREICH. Italy is going to get there first because of slightly higher daytime electricity prices, which also matter.

Mr. MARKEY. But if you are an oil refiner in Texas that really wants to just continue to bring in oil from OPEC to refine, all that sun in Texas, it is going to be scary every day you go out and you have to put on sun protection. And you are an oil refiner in Texas? It has got to be a little bit—you have to be a little bit apprehensive, not only about your own personal health but the health of your future in terms of these competitive industries that—you have to go to California to slow it down or kill it first, before this epidemic of new energy technologies reaches Texas in its full-blown, market-based form that no longer needs subsidies in 5 or 10 years because you have now created a complete market for it. Do you agree with that?

Mr. LIEBREICH. Well, it should be scary, because the combination of solar with electric vehicles or plug-in hybrids is a real large-scale threat to the current way of doing business, and so it should be. I do want to raise one other——

Mr. MARKEY. You are saying that because 70 percent of all of the oil which we consume in America goes into gasoline tanks, that these oil refiners have a stake in making sure we don't have a plug-in hybrid and an all-electric vehicle revolution, because they could be using solar- and wind-generated electricity to power these vehicles and tell OPEC we don't need their oil any more than we need their sand.

But that wouldn't require oil to be imported from these countries into refiners in America and reduce our dependence upon imported oil, change our national security status in terms of where we import this oil from, and the funding that we give to these countries and other countries.

So there is a huge national security element that goes to the creation of a domestic renewable energy industry that then is providing the lower cost electricity for the plug-in hybrids and all-electric vehicles that we are using.

Mr. LIEBREICH. Indeed. I saw an interview with the Saudi Oil Minister who was asked about alternative energy and whether he considers the drive towards clean energy as a threat. And his response was to say, "No, we are absolutely happy for it to happen, because it will never in any way threaten anything we do essentially." And I just thought, well, that is spoken like somebody who hasn't seen the chart and the trends.

Mr. MARKEY. You would think that a country that is sunny 99 percent of the time—Saudi Arabia—of the times that it is not the middle of the night.

Did you ever see Lawrence of Arabia and poor Lawrence is out there in the middle of the desert? It is very windy in the middle of the night, apparently, over there in Saudi Arabia in the desert. So you would think it would be a country that would have some insight into the power of solar and wind, but they continue to finance, in fact, questions about climate change and questions about the need to move in this direction as well. Although they could be the leaders, in fact, in the development of that technology. But they are not unlike their oil refining brethren here in Texas that is going to try to slow down this domestic revolution.

Mr. LIEBREICH. Could I, if I may, comment on one other aspect of this global race which this raises? And that is, there is a caveat around how we go for those manufacturing jobs. And if you go back to the analogy of the telecoms industry, which was an enormously successful industry and created jobs through your efforts and the efforts of others in creating the frameworks, we do import almost all of our mobile phones. The manufacturing is not generally domestic U.S., but the license, the technology, the value add, very much is. And we have an analogous situation where those innovations, many of which were here in the U.S., are embedded in a lot of the technology that is coming out of China and other parts of the world.

So I would just urge caution about seeing success as whether we manufacture cells in the U.S., yes or no, because our research shows just how integrated the supply chain, the technology licensing, the financing, the search for talent, managerial talent and so on, it is very, very integrated. And the number one challenge for the shift to clean energy is to keep going down that curve, which requires all countries to be progressing and playing to their strengths.

And so I think, particularly given the drum beat of concern about China, about its exchange rate, about its potentially illegal support of its industry, what we mustn't allow to happen is for that to turn into a tit-for-tat trade war in this sector.

Mr. MARKEY. I agree with that.

Mr. LIEBREICH. And so that is my caveat, because it is important that we use their cheap manufacturing where that is appropriate.

Mr. MARKEY. But you also agree that we shouldn't be Uncle Sucker; that we shouldn't allow them to say—which I think they are trying to say to us—Why don't we do this? Why don't we take all of these brilliant innovations that you have in solar, and then allow us, with our very low-cost workforce, to manufacture it, and together we will save the world, you coming up with the ideas, we with making the products. And, by the way, in order to ensure that that is the case, engage in protectionist activity and subsidies that are questionable under World Trade Organization rules in order to create that beachhead of manufacturing capacity in our country that then makes it very difficult for you to compete.

So we clearly don't want to be left as Uncle Sucker here, investing in all the research, and then not seeing the jobs in America in its fair proportion to what it should represent given the investment that we made as a Nation.

You agree with that, Mr. Liebreich?

Mr. LIEBREICH. I would not disagree with that.

Mr. MARKEY. Thank you. Mr. Fulton.

Mr. FULTON. I just think it is interesting that the Lawrence Livermore Laboratory and the DOE did some research on the percentage of the domestic share of turbine costs, and it has risen from 15 percent in 2006 to 60 percent in 2009. So as we have seen the U.S. wind industry scale, that has brought manufacturing on shore.

Now, I think there is no doubt that these incentive programs have played a strong role there, so I don't think it is like America has to lose out here. The data suggests that America has the wherewithal, it has the companies, it has got some of the biggest multinational companies in the world, capable of producing the best technology, and it looks like they are prepared to look at manufacturing it.

Mr. MARKEY. Do you agree with that, Mr. Carbone?

Mr. CARBONE. That is what I said earlier. It is the race, it is the fight, it is the good fight.

Mr. MARKEY. Mr. Viswanathan, is there any reason the U.S. should lose their fight?

Mr. VISWANATHAN. There is no reason. And to just build on what you said earlier, just take a page out of the semiconductor industry. The innovation was done here. Intel, some of the greatest companies are here. They have outsourced manufacturing to the fabs in China and Taiwan. We have ceded nothing in terms of innovation. All of what is going on in cellphones, videos, et cetera, a lot of that is emerging. Some of that is coming from Asia, but a lot of that, the core innovation is coming from here, and that is resulting in a lot of jobs.

Mr. MARKEY. Mr. Fulton, you contributed to a report published earlier this month that looked at the claims made by global warming skeptics regarding the fundamental science of climate change. First of all, why did Deutsche Bank decide to put out that report?

Mr. FULTON. Well, that report actually came out of my research unit so I take responsibility. Deutsche Bank's name is on our research, but it is. Since I work in an asset management division that has climate change investment, it would be a means of fiduciary not to check, which is that there is climate change. So to me it is an absolute necessity to be aware of the science and then aware of the facts.

And if you have an investment thesis and you are wrong, you have to change that investment thesis. So we went to Columbia University, to the climate center there, and we said: We are not scientists, but we know you well. But could you conduct for us a very fair and balanced look at these skeptics' arguments, because we want to know what is going on in those arguments?

So they were set out in some detail in a 55-page document. And we asked, Could you give us, as best you could, peer-reviewed answers to that? And that is what they did. And at the end of that, our conclusion as—we are not scientists, but our conclusion as investors is we felt comfortable with our investment thesis. There is still a serious threat from emissions in climate change.

Mr. MARKEY. And how has that approach to the issue, and investment in climate and clean energy technology as a result, evolved over the last several years at Deutsche Bank?

Mr. FULTON. Well, we have at the moment $5 billion under management related to climate change themes, and that has gone up and down with the markets. And there is no doubt, since the financial market crisis hit and since the volatility—and I would say the volatility in policy, because these are policy-related markets. And it has been more on hold in terms of not what we are doing, but in terms of investor perception.

So I think we now are again at a very important crossroad. Because at the end of the day, as you are pointing out, unless investors get behind it, where is that trillions of dollars coming from?

So we are looking—the markets are doing their best at innovating. We have a private equity group as well. So we are trying to do our best. Everyone is. But at the end of the day, unless we have—I am afraid to go back to this TLC structure—then while we are in that scaled deployment phase, which we are in for the next——

Mr. MARKEY. TLC stands for, again?

Mr. FULTON. Transparency, Longevity, and Certainty. Unless we have that as investors, the cost of capital is going to remain high and the uncertainty is going to remain there, and you won't see the adequate flows that you are going to need to really get there. So I think at the moment a lot of us are saying, okay, let's see how policy goes in America in particular in the next few months. I think it is a very important signal.

Mr. MARKEY. Thank you.

Now, Mr. Liebreich, I have a slide that I would like to put up for a moment. I don't believe that you used this one during your presentation, but I think it is a very interesting one, if we can get it up on the screen here.

Could you explain briefly what we are looking at? I think this is the one that says that U.S. wind manufacturing supply is projected to ramp up to 14,000 to 15,000 megawatts per year over the next couple of years but projected demand falls way short of that.

Could you put that up on the screen, please?

Please, could you talk about that a little bit?

Mr. LIEBREICH. Yes. Certainly. Thank you very much. So this is output from our wind team. The years up until 2009 are historic; 2010 is our estimated out-turn for this year.

Mr. MARKEY. There is a downturn this year in wind?

Mr. LIEBREICH. There is a downturn. Financing activity, which I showed in the data that I presented in my prepared statement, slowed down quite dramatically at the end of 2008 here in the U.S. and into 2009. And, of course, the build rate drops away sometime after the financing activity.

What we are seeing in the U.S. is that over the longer period, from 2005 through till 2008, 2009, was that demand outstripped supply.

There are a number of reasons for this. There are only two domestic manufacturers, GE and a smaller company called Clipper, before Nordic Winds' arrival on the scene, a very welcomed development. And the demand that built up through the incentives, through the programs that were in place, outstripped that supply, and the supply was partly held back by the lack of what my colleague Mark Fulton would call TLC.

The fact that the production tax credit for wind expired every 2 years meant that companies were reluctant to—the European companies, principally, were reluctant to invest here in the U.S. in order to meet that demand, because there was so much uncertainty about the use of those assets.

What is happening now is that there is substantial new investment, and you can see on this chart who is doing the investing. Now, you can see GE in dark blue and Clipper at the top in light blue. But the expansion in capacity is coming from Vestas of Denmark, Siemens of Germany, Gamesa of Spain, and Nordex of Germany. And they are coming to the U.S. and they are building manufacturing or assembly plants. This is all measured at the end assembly stage.

The issue is, though, that now there is insufficient demand to fill those plants. So we are moving from a situation of undercapacity, supply constraint, to overcapacity, which is very good news for the cost of turbines, which are coming down. We produced the wind turbine price index, and we are seeing turbine prices coming down already by around 20 percent from their peaks in 2009. So we are going into a period where there is going to be a lower level of installations because of the difficulty of financing in the post-crisis environment at the same time as——

Mr. MARKEY. You are saying that the derivatives-driven financial meltdown has now had an impact. The fact that we didn't regulate derivatives accurately, wisely, inside of the financial system now has a collateral consequence in terms of now receiving financing for something that obviously has seen a reduction in the overall cost of producing this new technology.

Mr. LIEBREICH. Well, I don't think I mentioned derivatives.

Mr. MARKEY. I just want everyone—when you say the "catastrophe", we know the catastrophe is that unfortunately, around the world, people were buying derivatives packed with all kinds of very poorly structured investment vehicles that were not well understood by the global investment community that unfortunately has come back to haunt all other industries as well.

And I am not sure Tea Party activists fully understand that counterparties actually don't have a stake in policing the derivatives global marketplace, since the CEOs of most of these companies who produced the derivatives don't even understand what a derivative is, except that it was a center of economic profit for them.

But ultimately the bubble bust, and it is having an impact in other economic areas as well. I only say that just to point out—I was the chairman over Wall Street for 14 years as well, so I bring that knowledge in, as well as telecom from the 1990s, just to add it in as an extra factor of what the consequences are of turning a blind eye to things that were completely knowable in terms of the impact that derivatives and subprime mortgages would have upon not only ours, but the global economy. So I just throw that in as an editorial comment.

Mr. Liebreich.

Mr. LIEBREICH. So there was a crisis.

Mr. MARKEY. There was a crisis.

Mr. LIEBREICH. And it did have a substantial impact on this sector, and the sector is still suffering from that. If you step away from the various support mechanisms, the availability of capital is much reduced, and the cost of capital in the private markets, the debt markets, the equity markets, remains stubbornly high even now, 2 years after.

And so that is why there is such a focus on programs like the cash grants, because it is impossible otherwise to get the same level of projects financed. Some projects will get financed, but there is a chunk that will not happen without the continuance of some of these programs here in the U.S.

And what we are seeing here in terms of the dotted line that you see on the chart, which is the line of demand, that is on the assumption that the cash grants continue in place, the Recovery Act cash grants continue in place. We will see a bad year this year, a drop to 6 gigawatts of installation, and then bouncing back somewhat. But that bounce-back is in jeopardy if those grants are not continued.

Mr. MARKEY. So you want a continuation of the grant programs, the loan programs, the tax programs that are on the books. And would you also want a national renewable electricity standard to be put on the books, so that you have a belt-and-suspenders program where there is a policy that is established, combined within the financing programs that are put in place that help to facilitate the installation of the renewable energy sources that create a much more—TLC stands for what again?

Mr. FULTON. Transparency, Longevity, and Certainty.

Mr. MARKEY. Longevity and certainty for the investment community, right? So that is really what we are trying to do here.

I have to keep repeating that in English, because we are going to have a big public debate in the United States, and TLC means something completely different than what you mean it to mean. It means more the way Aretha Franklin used it in the song Respect. So TLC means something else.

Mr. FULTON. We sort of hope people might relate to it.

Mr. MARKEY. Right. They should. But it is the TLC for the renewable industry, but it includes the grants, the loans, plus the policy that is put in place that creates an environment where they get a lot of TLC, right? But it has to be continuous, there has to be some longevity, and there has to be some predictability to it.

Mr. Liebreich.

Mr. LIEBREICH. So when you say "we," we, one, we are an information provider so we don't—that have used that approach. But certainly the industry and our clients would be 100 percent behind the push for transparency and longevity.

Mr. MARKEY. Mr. Viswanathan, you are a financer.

Mr. VISWANATHAN. Yes.

Mr. MARKEY. You provide the money.

Mr. VISWANATHAN. Yes.

The CHAIRMAN. So, lay out for us what you need to see put in place so that we have this more predictable investment climate that leads to the reduction in cost and ultimately withdrawal of the need to have the public financing programs be put in place.

Mr. VISWANATHAN. Certainly. I think exactly what you had said, Mr. Markey. We would like a continuation of these programs, 48(c), 1603. We would like the 48(c) also to be refundable, as Mr. Carbone said, especially given a lot of these innovations are happening in startups that are starved for cash and we need to incentivize them.

I think the loan guarantee program has been very successful and there is a lot of good coming out of it. We need to have that in place.

We need to have a national electricity standard and energy efficiency standard. If you look at some of our peers across the globe, in China they have multiple of these incentives. They have a stimulus for clean energy, they have a renewable energy standard, they have a feed-in tariff, they have an energy development fund. All of these things are going to be very, very helpful as we build that clean-tech economy.

The CHAIRMAN. But your firm is still putting up billions of dollars in the clean energy sector. Why is that, if you see all these pessimistic signs on the road as well? Why are you still investing so many new billions of dollars into the clean energy sector?

Mr. VISWANATHAN. Well, that is a very good question. There are two ways to answer it. Because we fundamentally believe in all of the things you said in terms of your chart. Having said that, if all of these stop, you will see investment dry up from our community, because we cannot do it ourselves.

The scale that is needed is so massive that you will see innovation dollars dry up, and then that will have a spiraling effect on the actual innovation that is trying to get to market.

The CHAIRMAN. Okay. Now, could we pull up Mr. Liebreich's slide number 9, please, so that we could have a little bit of discussion about that.

So this is Venture Capital new investment in clean energy by sector, the top 15 countries. The United States is in the lead, looking over at its shoulder at number 2, 3, 4, 5 and 6 in the world. That is a reason to be optimistic.

Mr. Carbone, can you take a look at that chart and tell us why that is happening, and are you optimistic that it can continue?

Mr. CARBONE. Well, while Michael provides information and Ravi provides the money, we initially consume the money but we hope to make the money as well.

The CHAIRMAN. Great.

Mr. CARBONE. Yes, I would have to say, and we showed in our chart as well, that this money is for the most part financing innovation and technology development, and a lot of those early stage startup companies are actually starting here in the U.S. And actually our company is one of them, and Mr. Viswanathan is actually one of the investors in our company as well.

We initially were invested in by U.K. and European-based investors, and just recently in the rounds of financing we did late last year, we were able to attract investment from the U.S. community and actually establish ourselves here in the U.S. So we are part of that, somewhere, a small part, but part of that top bar on this chart.

The CHAIRMAN. Thank you.

So, Mr. Liebreich, thank you so much for providing these great graphs. It is very, very important for us to understand it.

Mr. Fulton, last month your colleague at Deutsche Bank, Kevin Parker, was quoted in a Reuters article. Here is what he said. "They are asleep at the wheel on climate change, asleep at the wheel on job growth, asleep at the wheel on this industrial revolution taking place in the industry. You just throw up your hands and say, we are going to take our money elsewhere.

Now, this is your company's global head of asset management. Can you give us some context here, what Mr. Parker was talking about? This is testimony ultimately before the United States Senate as they were trying to pass a climate and clean energy bill that ultimately was stopped by, I hate to say it, but it is basically the oil Senators from Oklahoma and the coal Senators from Kentucky, the Republicans that basically just stop it over there. So, again, we continue to have this tension that exists.

Can you talk a little bit about what Mr. Parker was making reference to?

Mr. FULTON. Well, I can't talk for him directly, but I think as I understand it, what we are saying, what he is saying and what I believe is that it is very simple. The U.S. Congress has not passed anything this year and it has been an important year. So that is just a fact. We don't have a climate or energy bill coming out into law, so, as I say, that is just fact.

In terms of capital deployment, again, I think the point is that particularly in the longer term, where is capital going to go in the next 5 to 10 years? And unless the United States has this policy package and structure that is going to encourage that flow, it is not going to take place.

The CHAIRMAN. It is not going to take place. Now, I understand that none of you are international trade lawyers, but I would like to get your views on the United Steelworkers petition to the U.S. Trade Representative regarding China's violations of trade rules in the clean energy sector.

As I mentioned in my testimony, I believe that we very much need a climate of intense Darwinian paranoia inducing competition in the renewable energy sector so that we can drive down the cost of each of these technologies as quickly as possible. But if China is violating international trade laws, our domestic workers and domestic industry as a whole are put at an obvious disadvantage.

I would like to ask each of you how important this issue is in terms of leveling the playing field so that all countries feel that they have a stake in this competition to create a manufacturing sector that induces the paranoia that lowers the cost for production as quickly as possible.

Mr. Fulton, and right across, you can each disclaim any knowledge of international trade law.

Mr. FULTON. Yes, indeed I do disclaim any knowledge of international trade law and obviously would make the point that we have to wait and see what is determined in that situation.

I would make one comment about China's policy. It is very comprehensive. We have heard from other participants. They are tackling this issue at many, many levels. We even note that they will

have been talking about looking at carbon markets domestically in China.

So one thing I would say is I think sometimes people say the Chinese may not be doing anything. Well, the Chinese are certainly taking action here. The question is if it happens to be contravening WTO, which I don't know, then that is up to the WTO.

The CHAIRMAN. Mr. Carbone.

Mr. CARBONE. Yes, my knowledge on the situation isn't entirely what it should be, what you would like to have. But I think there is a relationship, we discussed some of it here earlier, between technology development, manufacturing, the financing of it and the deployment of it.

I am not sure, because I haven't educated myself enough to really understand what the U.S. steelworkers are trying to accomplish and what in particular technologies are they really trying to tackle here.

The CHAIRMAN. Thank you.

Mr. Viswanathan.

Mr. VISWANATHAN. Yes, I would build on what you said about leveling the playing field, and that is what this whole discussion has been. A lot of it has been around incentives and spurring that innovation. But the flip side of that is making sure we have policies where if there are trade violations, we figure out what it is and make sure we have policies so globally no country can arbitrage the system to get away with it.

The CHAIRMAN. Mr. Liebreich.

Mr. LIEBREICH. Again, I will make the caveat that I am not an international trade lawyer. But on the economics of it, I think that first of all, the big opportunity for U.S. wind turbine manufacturers is not exporting to China. Likewise, I suspect that Chinese manufacturers are going to find it easier to export to some of the other markets where their technology might be more appropriate. So their technology is not as productive, the yields are not as high and so on.

I was recently in Brazil and came across a number of representatives of Chinese wind turbine manufacturers. So the battle between U.S. wind technology and Chinese wind technology might well be happening elsewhere in the world.

I think in terms of the case, if you look at some of those elements, it will be very difficult, without knowing, without claiming to be a lawyer, very difficult to prevail in terms of cheap loans and so on. It is hard to distinguish some of those programs from some of the programs here.

One element of what China is doing gives me great cause for economic concern, and that is anything to do with restricting the export of rare Earth minerals has to achieve a different status of attention, I believe, from all of the normal trade law and trade—the tit-for-tat and the to-and-fro around trade. We can deal with that through WTO.

Rare Earth minerals are different because there are no other substantial sources on this planet that have been developed, that have been found.

The CHAIRMAN. Outside of China. Which minerals are you referring to?

Mr. LIEBREICH. We are talking about some of the exotic dysprosium and some of the doping minerals that you need to make permanent magnets in some of the solar technologies, and the permanent magnets that go into the most advanced sorts of wind turbines to reduce their weight and increase their power outputs.

These are essential technologies also around the smart grid. We are not going to have a smart grid without rare Earth minerals. So I think that we should be prioritizing, ensuring that there is a global and open market for these minerals, perhaps over some of the more eye-catching issues around cheap loans where one can get into an argument about who is doing what to whom and take our eye off the ball.

The CHAIRMAN. So you are saying that we need to ensure the raw materials are there so that other countries have the capacity to participate in this global competition, because the denial of access to the rare materials makes it impossible, really, for a level playing field to be created.

Mr. LIEBREICH. Indeed. If the manufacturers in the rest of the world can't have access to the rare Earth minerals or the products that they go into, the magnets and so on, then it is going to put those countries at a very, very substantial disadvantage.

The CHAIRMAN. Yet the Department of Energy is actually considering loan guarantees for U.S. rare Earth production, which is something that I also think is very important; that we begin to recognize that as something that should be specially focused upon in terms of rare Earth minerals here in the United States and the extent to which we are also financing that development as well.

Mr. Liebreich, could you put the Recovery Act in context for us a little bit? How important was that legislation last February of 2009 in making sure that we did not see a precipitous drop-off, almost catastrophic in terms of the deployment of wind and solar and geothermal and biomass technologies in the United States?

Mr. LIEBREICH. Well, there are two parts to that answer. The big part to the answer is that it played a very substantial role, and had that act not been passed, we would not see the level of installations and also the level of factory openings and job creation that we are seeing now.

The caveat, the small part of the answer is that there was actually a period where the industry was actually waiting, because they were waiting for that act to be first passed and then for it to be clarified and so on. So the stimulus for a period acted as an anti-stimulus. And I say that only because we are through that period and I say it only for the record that it was actually a difficult period. We saw the end of 2008, the beginning of 2009, a drop that is perhaps more precipitous as companies waited to see whether they would qualify, what the detailed rules would be.

The CHAIRMAN. What did it mean for you, Mr. Carbone, that the stimulus bill passed?

Mr. CARBONE. Actually little this year, but a lot next year, if we get it passed.

The CHAIRMAN. A lot next year. So it is giving you an investment climate.

Mr. CARBONE. Absolutely. We have customers lined up, actually TLC, who are looking for that certainty.

The CHAIRMAN. TLC stands for?

Mr. CARBONE. Transparency, Longevity and Certainty.

The CHAIRMAN. Got it. Thank you.

Let me finally move to this question of the renewable electricity standard. We have to live here in Congress in an acronym-free world because we are trying to talk to all of these people that Mr. Liebreich says if they get all the information, you know, in a digestible form, they will make the right decision. But part of our responsibility is to be the translators out of the world of experts.

There is no such thing as a congressional expert compared to real experts. It is an oxymoron, like jumbo shrimp or Salt Lake City nightlife. There is no such thing as a congressional expert, except to the extent we help to translate it into English and other languages spoken in the United States that help to ensure that voters understand what exactly is at stake.

So, in terms of a renewable electricity standard, how important do each of you believe that is for a long-term TLC for all of these technologies that you are talking about?

We will go with you first, Mr. Liebreich.

Mr. LIEBREICH. Sir, I think an aggressive renewable industry standard in terms of its ambition and also in terms of its penalties for non-achievement could be the single most important long-term factor in the development of the market here in the U.S.

But I do say that it has to be ambitious, not something that is easily achieved. The good things in life tend to be hard to achieve. And if it doesn't spur changes in investment practices and so on, then it is not going to be substantial. So, ambitious in scale, and with penalties that are meaningful.

In other words, of the various companies, utilities can't simply pay the penalty and go on with business as usual. That, in place over a long period, setting a long-term target, would be very important.

The single critical thing that has to happen, whether it is through a feed-in tariff, whether it is through a portfolio standard, whether it is through any other mechanism, is that it has to create demand.

We are not going to win this simply by working on the supply side. We have got to have demand so that the companies that are being financed and that are producing the technologies know that they will be able to sell and get revenues here in the U.S., not just that it will be cheap just to open a factory, but there is somebody to sell the products from.

So I think it is critically important. The States have shown great leadership in moving ahead with their own renewable energy standards. As I mentioned, 30 States have got some sort of standard. And a national standard which builds on that, which goes beyond that, would be very, very helpful.

The CHAIRMAN. As you know, maybe I am going to inform you of this, but on June 26, 2009, inside of the Waxman-Markey bill, was language, my language actually, that created a 15 percent renewable electricity standard by the year 2020 in the United States for all 50 States, not for 30 States, and another 5 percent that would have to be extracted by the utilities in new energy effi-

ciencies, in the way in which they generate electricity. So it would be 20 percent by 2020.

Would that meet your standard for challenging the system?

Mr. LIEBREICH. It would most certainly help, there is no question. My own view is if you look at those cost curves, one should err on the side of being aggressive and ambitious.

The CHAIRMAN. What I am saying to you is if they are all right and that curve is just going to continue, adding in 20 more States, setting that goal, we will probably beat that anyway just because of the market that we open up? So while you are right, AT&T testified before Congress in 1981 that 1 million people would have cell phones in the United States in the year 2000. One million. A big goal for AT&T, as a monopoly.

But as I was moving over the third, fourth, fifth and sixth spectrum license, I wasn't going to predict that everyone would have two devices in their pocket by 2010, and children would have their own little devices as well that they could be walking around with. But I kind of have confidence that technology ultimately triumphs, and once you set this larger goal, actually it will probably be exceeded; as long as you set something that was reasonable, that people will go over it.

Anyway, that is just the way I view it, given my experience in the cable, satellite, and telecom sector, and I think that is what will happen if we can get something passed.

Do you agree with that, Dr. Viswanathan?

Mr. VISWANATHAN. I agree very much with that. As Mr. Fulton said, 30 States have it now, but those policies are in danger unless the Federal Government adopts a national standard. So I am very much in favor of that.

The CHAIRMAN. Yes. They are in danger, of course, because oil refiners in Texas, if they win in California, they are going to go State by State.

Mr. VISWANATHAN. Exactly.

The CHAIRMAN. And they will be on a path of destruction for a renewable energy policy being in place in those States. There is no question about it. So we have to win in California.

Mr. Carbone.

Mr. CARBONE. Number one on my list, Congressman, I am not sure I would argue whether it should be 15 percent or 17 percent or 18 percent, I think it should be now. It really should be now. And then we can get ourselves out of production tax credits, investment tax credits and other things as we get the incentive to scale. It is more important that we do it now.

The CHAIRMAN. Thank you. I am with you.

Mr. Fulton.

Mr. FULTON. Yes. Yes, well, particularly I echo Michael's point that it should be ambitious, and if it is going to stand alone it has to have enforcement and penalty on it or else, again, you need this whole structure underneath it of incentives. So you can do it in different formats.

The other point I would make is that at a technical level, a national REC market, renewable energy credit market, is probably more efficient than a pure State-based one. So it has actually a

technical side to it. When you go and talk to the guys that are actually trading these RECs, they actually like a national standard.

The CHAIRMAN. Thank you. And here is the perverse position that we are in; the Edison Electrical Institute signed off on that standard in that bill on June 26th, 2009. So that is where American public policy is right now, trapped over in the Senate, with a minority of Senators coming from and representing the perspective of oil and coal from Kentucky and Oklahoma, kind of denying the rest of this country this revolution, while we were still funding in this bill, by the way, $60 billion for carbon capture and sequestration, research development and deployment.

Sixty billion dollars in the bill, so that the older industries could move along as well as part of this clean energy revolution. So it wasn't as though it was just all one side, it was going to be a comprehensive all-of-the-above strategy.

So we are going to wrap up the hearing right here, and we are going to ask each of you to give us the 1 minute you want the American public to remember from your presentation as we go forward on this clean energy debate here in the United States.

We are going to go in reverse order of the original testimony so that you can each give us your summary.

So we will begin with you, Mr. Fulton. Again, if you could move over to that microphone, we would very much appreciate it.

Mr. FULTON. Again, we would say that creating transparency, longevity, and certainty in policy structures is crucial to creating a new clean and green energy sector which will stand the United States in great stead in the long run. And in doing that, at the moment there is a lot of discussion about national renewable electricity standards, about extending the incentives coming out of the stimulus package. And all of these should be looked at very carefully at the moment, because this is a critical moment.

The United States needs to get on the job in the next 5 years. This is when the cost curves are falling. This is when the manufacturing and the industries are being created.

The CHAIRMAN. Thank you. Mr. Carbone.

Mr. CARBONE. Yes, thank you. Look, we are an early-stage company and we will require some support. We have very supportive customers and investors. But support in the way of real, near-term, cash-based incentives like a refundable 48(c) manufacturer's tax credit or cash grant in lieu of taxes for our customers or near-term benefits that will support an early-stage company.

Long-term, renewable electricity standards is really something. It is a market signal that will absolutely benefit us. We encourage your bill, the Senate to get on and the President to get on with that this year.

The CHAIRMAN. Thank you, Mr. Carbone.

Dr. Viswanathan.

Mr. VISWANATHAN. So my firm invests in innovation, and that has been the hallmark of the United States for decades and it has led to the creation of massive industries resulting in millions of jobs. That spilled over into clean tech, which we are very excited about.

Having said that, we risk losing that competitiveness based on the commitment and resolve of a lot of the global players, particu-

larly in Asia. To stem that tide, we absolutely need to have some of the policies we discussed. And, in your words, Mr. Markey, I would use "all of the above."

The CHAIRMAN. Thank you.

Mr. Liebreich.

Mr. LIEBREICH. Sir, I would like to highlight, the world is undertaking this shift to a lower carbon energy future. This is not something that is debatable, this is something that is happening, maybe in the earlier stages, but it is happening.

That shift will be enormously profound. It will echo not just through the energy industry, but through the sorts of housing, the sorts of transportation. All industries will be impacted by the shift to lower carbon energy. And in so doing, it will create an enormous wealth of new technologies, a wealth of new jobs, and a wealth of new wealth.

And I think that the U.S. is at a pivotal point where it has to decide whether it is going to be a price taker for the next century on energy, or whether it is going to be a price giver, whether it is going to be leading that revolution or accepting the technologies from other players. That is what is at stake.

Then finally, I would also like to highlight the importance of what is happening for investors. By "investors" I don't just mean investment banks or asset management companies. I mean every American who has a 401(k) or who is saving. And that is, that if you see what is happening in the world in terms of the trends in clean energy, then inevitably you conclude that it is riskier to invest in fossil fuels than it is to invest in clean energy. The perception still is the other way around, but the perception is incorrect.

The CHAIRMAN. Thank you, Mr. Liebreich.

Thank each of you for your very important testimony, because we are at a critical juncture in this clean energy debate. For the last several years, the opponents of dealing with climate change have said, "Well, what is China going to do? We shouldn't do anything until China moves." Well, China is moving. China has targeted this sector. China has a plan.

The United States needs a plan. When the United States has a plan, the United States wins. If the United States does not have a plan, we are going to lose. That chart will have China, Germany, India, country after country, ahead of us in terms of capturing the full economic benefits of this clean energy revolution. So we really don't have a choice.

To use this analogy, that is, the telecommunications sector, the United States Government had to invest in DARPANET. We had to put up the money initially. When Al Gore was talking about the Internet, we actually had to pass a bill here in Congress in 1991 to take DARPANET and to turn it into the Internet. That is what he was talking about.

It was privatized, but it was a public sector investment to create it, not only here but globally. It was a plan which the United States had. And because we had a plan, and because we then privatized it in 1991, we were able to capture the lion's share of the benefits, as long as we then in 1992, 1993, and 1996 passed the accompanying legislation to make sure it was deployed here in the United States more rapidly, more quickly, than in other parts of

the world, because then the development of the ancillary ideas would be here as well.

We need a similar plan here in the energy sector. The rest of the world is moving. If America put a plan in place, which is what the Waxman-Markey bill was, a green energy bank, a renewable electricity standard, a 50 percent improvement in the efficiency of all new buildings by 2016, a dramatic increase in the appliance efficiency standards in our country, it would incentivize our own country to make the breakthroughs. Sixty billion dollars in carbon capture and sequestration for research, development and deployment.

We would be the leader. We would be exporting. We would be the price maker, not the price taker. We would be telling the rest of the world, here it is. If you want it, let's have a negotiation over how we share it with you. Instead, we are now confronted with real plans, some of them borderline legal, that have been put in place in other countries, so that they are able to get the lion's share.

So I agree with all of you. We need a national renewable electricity standard. We have to put on the books, on a permanent basis, these incentives—the tax, the loans, the other programs—so that over a period of time we create the industries. Then we can pull away the incentives because they have reached grid parity. Then they don't need the government anymore. They are off and running and our private sector has been the winner.

So, in the same way that we deployed telephone service across America, we deployed electricity service across the country, we invested in the Internet in the early years with government money, you can then pull away. You don't have to do it any longer. Because those people who want to be millionaires and billionaires move in, and they are going to move a lot faster than the government would ever move.

Whoever makes that breakthrough in photovoltaic will become the wealthiest person on the planet. They will dwarf Bill Gates. They will dwarf other billionaires. That is a lot of electricity for a lot of people around the planet. It is a race to be the wealthiest person on the planet.

We have to have a strategy so the names come from the United States. That is our goal. Some of them are sitting at this table. And that is who they want to be, the people who ultimately, from the planning, from the financing, then make this stuff and get rich. That is what it should be all about.

Right now, my goal, Henry Waxman's goal, Nancy Pelosi's goal, is to create a whole new generation of millionaires and billionaires in our country. And what we are going to need is the venture capital, the banking industry, the technology sector, to get into this fight. They have to get on the playing field. We cannot have Texas oil refineries defining the fight. We need these other industries that are the beneficiaries.

We need the future billionaires to get into this, the people who believe in the technology sector, so that we have a level playing field politically, because we are quite confident that our vision is correct.

Let me just say again, it is not that we leave behind coal, that we leave behind oil, because we make the investment in them as well to ensure that they become a cleaner set of technologies as

well. We need all of the above. That is what our plan has to be, and then America will win, looking over its shoulder at number two and three in the world. Thank you all so much for your participation today.

I have a report and a letter on clean energy investment prepared by the accounting firm of Ernst & Young that I would like to put into the record, without objection. And hearing no objection, it will be in the record.

[The information follows:]

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20 September 2010

The Honorable Edward J. Markey
Chairman
House Select Committee on Energy Independence
And Global Warming
B-243 Longworth House Office Building
Washington, D.C. 20515

The Honorable F. James Sensenbrenner, Jr.
Ranking Member
House Select Committee on Energy Independence
And Global Warming
H2-344 Ford House Office Building
Washington, D.C. 20515

Dear Chairman Markey and Ranking Member Sensenbrenner:

Pursuant to the House Select Committee on Energy Independence and Global Warming's request, Ernst & Young is happy to furnish you with the most recent copy of our *Renewable Energy Country Attractiveness Indices* for the Committee's hearing on "The Global Clean Energy Race," scheduled for Wednesday, September 22, 2010 at 10:00 a.m.

Ernst & Young started its quarterly *Renewable Energy (RE) Country Attractiveness Indices* (CAI) back in early 2003 to provide a more objective and quantitative way of assessing investment attractiveness between countries and between renewable energy technologies within those countries. Today, these indices track the relative attractiveness of 27 countries, providing more transparency on the renewable energy markets across the globe. The Country Attractiveness Indices have been driven by the recognition that regulatory frameworks vary greatly from one market to another and across technologies - and over time can change often.

Our findings indicate that, for the first time since entering the Renewable Energy Country Attractiveness Indices tables, China has succeeded the US as the most attractive location in which to invest in renewable energy projects. China had entered the CAI table in December 2004 and, since then, has progressed steadily to the top of the "All Renewables Index." In the first quarter of 2010, it was tied with the US. China's steady rise to pole position has been underpinned by strong and consistent government support for renewable energy, together with substantial commitment from industry and the sheer scale of its natural resources. The Chinese Government has set out ambitious renewable energy targets for 2020 to help cut carbon emissions per unit of GDP by up to 45% of 2005 levels.

We have been asked how China gained the top position. We believe this finding must be considered within the context of an inexorable global shift to a resource-efficient and low carbon economy. A number of factors are combining to drive a worldwide transformation in the way that natural resources, including energy and

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water, are produced, distributed, stored, managed and consumed. These include the continuous growth in world population, the increasing consumption power of the middle class in emerging markets and the growing scarcity of natural resources around the globe. The need to ensure energy security, rising energy and commodity prices and the business response to climate change are also important drivers of change. Cleantech represents the technology and business model innovation that enables the transformation to a more resource-efficient and lower carbon-consumed economy.

Cleantech has also risen to the top of national priorities for many countries, developed and developing, around the globe. Governments view cleantech as an important source of job creation, especially during the recovery period following the recent global financial crisis. More importantly, selected governments, in both established and emerging markets, have deployed a cleantech strategy as major element of national competitive advantage as they try to foster innovation-based economies, drive growth and define their role and position in the world of tomorrow. It is also clear that corporations from various industries invest, develop and deploy clean technologies to enhance their global competitive advantage.

Over the last several years global progress has been made in cleantech, as evidenced by increased investments by the private and public sectors, supportive new policies and regulations, as well as a robust pipeline of technology and business model innovation. Public and private investments in cleantech worldwide have increased substantially in recent years and are expected to reach more than US$175 billion this year. A 2009 EY survey of more than 300 executives of billion dollar companies worldwide found that corporations are rapidly adopting cleantech to gain efficiency, address sustainability and pursue cleantech revenue opportunities.

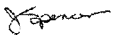
Released at the end of August 2010, the 'Electricity Market Regulatory Risk' parameter, which is one of 11 quantitative parameters that are weighted to form the indices, was also a factor impacting the US ranking. This particular parameter was reduced due to the failure of the proposed energy bill to include a provision for a Federal Renewable Energy Standard (RES). In addition, a 'Power Off-take Attractiveness' parameter was impacted by low natural gas prices and slack electricity consumption leading to a lack of demand from utilities for renewable Power Purchase Agreements. 'Market Growth Potential' parameter also fell due to the imminent expiration of the 1603 treasury grant program at the end of 2010. The combined effect of the above changes meant that the US fell two points in the All Renewables Index, losing the top rank for the first time since mid-2006.

Furthermore, the rapid evolution of the electric vehicle eco-system is another example of the dynamic, fast moving and complex cleantech marketplace. The shift to electric vehicles is transforming both the automotive industry and the power and utilities industry, engendering new business opportunities and spurring innovation in technology and business models. Earlier this year Ernst & Young hosted a global series of executive roundtables on the electrification of transportation that highlighted the transformational nature of cleantech, the resulting opportunities and the challenges ahead. The sessions—in Munich, Shanghai, and Silicon Valley—brought together more than 150 executives representing the full range of stakeholders, including innovators, corporations, investors, government, automotive manufacturers and suppliers, utilities, regulators and NGOs. The participants underscored the need for more cross-industry coordination, increased cross-border collaboration within a context of healthy competition and greater government engagement to accelerate adoption.

Ernst & Young is committed to supporting the development of cleantech and recently launched a Global Cleantech Center to bring additional resources and focus to the cleantech initiatives that we have been advancing for the past six years. If we can provide you with additional information or assistance on this matter, please do not hesitate to contact Gil Forer at gil.forer@ey.com or+1-212-773-0335 or Jay Spencer at jay.spencer@ey.com or +1-617-585-1882.

Sincerely,

Gil Forer
Global Cleantech Leader
Ernst & Young LLP



Jay Spencer
Americas Cleantech Leader
Ernst & Young LLP

Ben Warren
Energy Infrastructure Advisory Leader
Ernst & Young LLP

Attachments: Renewable Energy Country Attractiveness Index slide presentation
Cleantech Matters - The Electrification of Transportation: From Vision to Reality report

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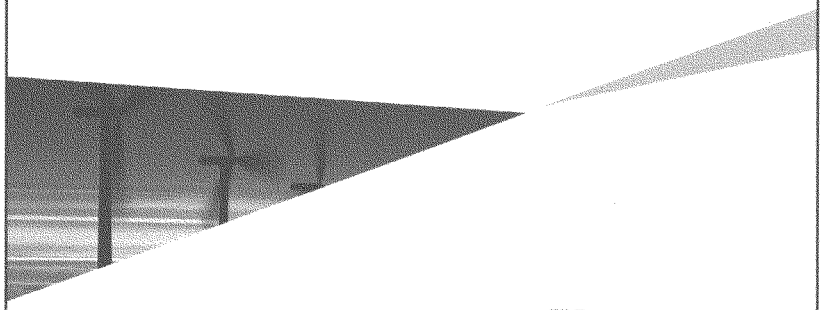
Country Attractiveness Indices (CAI)



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Introduction to the Ernst & Young Country Attractiveness Indices (CAI)

The CAI publication

- In production since 2003
- Produced quarterly
- Distributed to over 3,500 industry specialists and investors

What is the CAI's purpose?

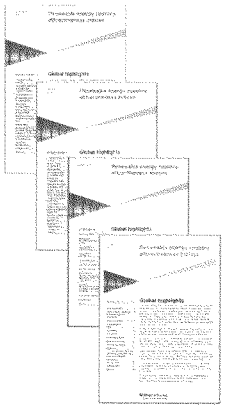
- Quantifies the attractiveness of a renewable energy market for investment
- Distinguishes by technology
- Distinguishes by country

What is the investment horizon?

- The All Renewables and Long-term indices – consider a long-term (~5 year) horizon
- The Near-Term Index – considers the wind markets over a 2 to 5 year forward period

CAI website:

- http://www.ey.com/GL/en/Industries/Oil---Gas/Oil_Gas_Renewable_Energy_Attractiveness-Indices



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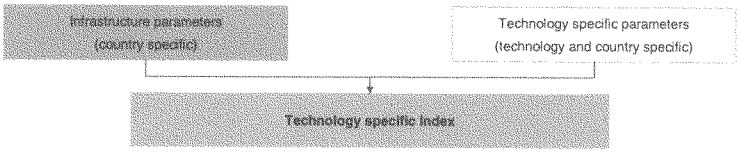
CAI methodology



Infrastructure parameters

- **Electricity market regulatory risk (29%)** – ranks countries based on potential risks inherent in generating renewable energy. E.g. what type of electricity market exists: is it fully deregulated, stable, and reliable? What is the relative level and consistency of political support for renewable energy?
- **Planning issues (21%)** – ranks difficulty in obtaining planning permission for renewable energy projects. E.g. How strong is local opposition to development and are there high levels of red tape? Are there fewer planning delays and restrictions, and therefore faster growth?
- **Grid connection issues (21%)** – ranks the quality of grid connection, waiting times for connection and availability of connection to renewable projects. E.g. What is the coverage of suitable grid infrastructure? Are there incentives for grid providers? Also does renewable electricity have "priority of dispatch", which means, that in case of excess generation in an area, conventional generation must be reduced first?
- **Access to finance (29%)** – ranks the availability of finance for renewable developments. E.g. Are there easy and/or cheap financing opportunities from local/international banks? How mature is the renewable energy financing environment?

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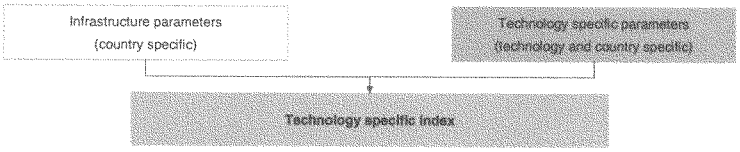
CAI methodology (cont'd)



Technology specific parameters

- **Power offtake attractiveness (19%)** – based on the price received for energy output and considers price fluctuations. Type of financial incentive (e.g. FiT, GC, etc.), price, longevity, and security affect the score.
- **Tax climate (11%)** – Low corporate tax rates and accelerated depreciation in some markets for renewables projects lead to enhanced scores. E.g. investment costs that are tax deductable
- **Grant/soft loan availability (9%)** – influenced by grants and/or soft loans made available for specific technologies or renewable energy as a whole. E.g. government backed loans or international grants
- **Market growth potential (18.5%)** – influenced by current capacity against expected future capacity, based on analysts reports, market forecasts, studies and published government targets
- **Current installed base (8%)** – measures how established a market is, based on total current capacity that the country has in place, updated annually from market reports. Can indicate existence of local supply chain.
- **Resource quality (19%)** – quality/quantity of natural resource e.g., wind speed, solar intensity, etc. This is based on resource maps and is unlikely to be changed unless new resource becomes available (e.g. new biomass source)
- **Project size (15.5%)** – this measure is related to the size of available land and scope for large installations, as larger projects indicate the potential for larger economies of scale.

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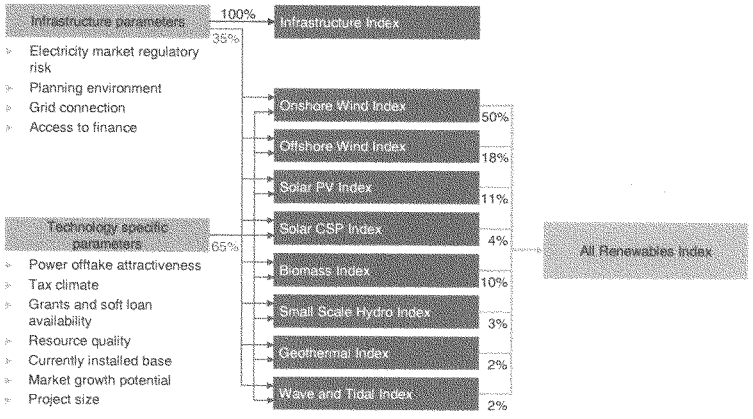
CAI methodology (cont'd)



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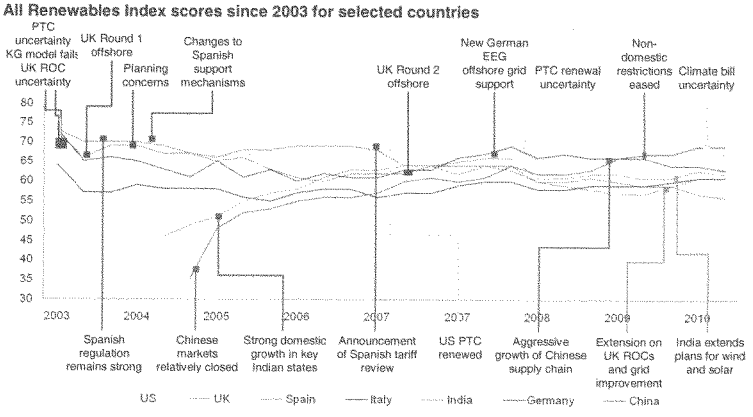
CAI All Renewables Index history

All Renewables Index scores since 2003 for selected countries



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2010 Q2 Ernst & Young Country Attractiveness Indices

Rank 2010 Q2	Rank 2010 Q1	Country	All Renewables	Wind Index[a][b]	Onshore Wind[c]	Offshore Wind[c]	Solar Index	Solar PV	Solar CSP	Biomass/ Other	Geothermal	Infra-structure[b]
1	(1)	China	69	75	78	67	59	66	40	57	51	74
2	(1)	US[c]	67	66	72	56	72	71	74	62	67	61
3	(3)	Germany	63	65	63	71	55	66	22	63	54	62
4	(4)	India	62	53	71	42	65	66	62	58	44	63
5	(5)	Italy	61	62	65	53	55	67	59	56	66	57
5	(5)	UK	61	67	64	77	38	51	0	59	38	70
7	(7)	France	58	60	62	56	53	64	24	58	30	62
8	(8)	Spain	56	57	62	42	54	63	68	50	33	55
9	(9)	Canada	53	60	65	46	32	44	0	49	34	52
10	(10)	Portugal	51	54	58	42	48	57	22	45	32	56
10	(10)	Ireland	51	58	58	57	26	36	0	48	28	61
12	(12)	Greece	50	52	56	41	55	60	41	41	32	52
12	(12)	Australia	50	50	54	41	54	57	46	45	59	53
14	(14)	Sweden	49	52	52	53	32	43	0	55	34	51
15	(15)	Netherlands	47	53	51	57	34	47	0	40	21	43
16	(16)	Poland	46	51	54	42	32	43	0	42	23	47
16	(16)	Belgium	46	52	50	57	31	42	0	39	28	52
16	(16)	Brazil	46	47	51	35	41	46	30	48	22	46
19	(19)	Japan	45	45	48	39	51	61	25	35	40	49
20	(19)	Denmark	44	47	44	56	29	40	0	45	32	51
21	(21)	Norway	43	48	49	45	22	30	0	44	30	49
22	(22)	New Zealand	42	47	51	36	24	32	0	34	50	45
23	(23)	Turkey	41	43	46	35	39	43	28	36	43	44
24	(24)	South Africa	40	43	46	34	37	34	44	34	31	41
25	(25)	Austria	37	34	46	0	40	54	0	49	34	52
26	(26)	Czech Republic	35	33	45	0	40	55	0	38	30	41
27	(26)	Finland	34	35	34	37	19	26	0	49	23	37

(a) Wind indices are for long-term investment horizon
(b) Combines with each set of technology factors to generate the individual technology indices
(c) This indicates US states with RPS and favourable renewable energy regimes

Source: Ernst & Young LLP

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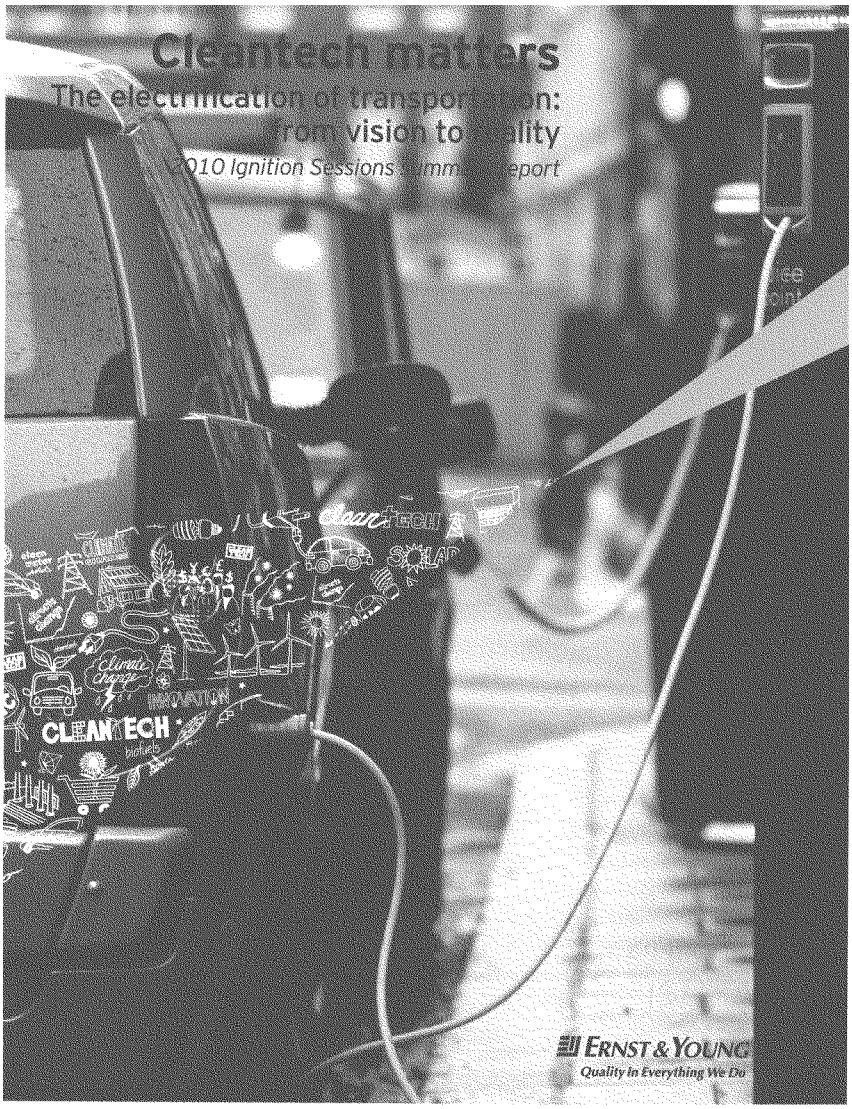
Cleantech matters
The electrification of transportation:
from vision to reality
2010 Ignition Sessions summary report
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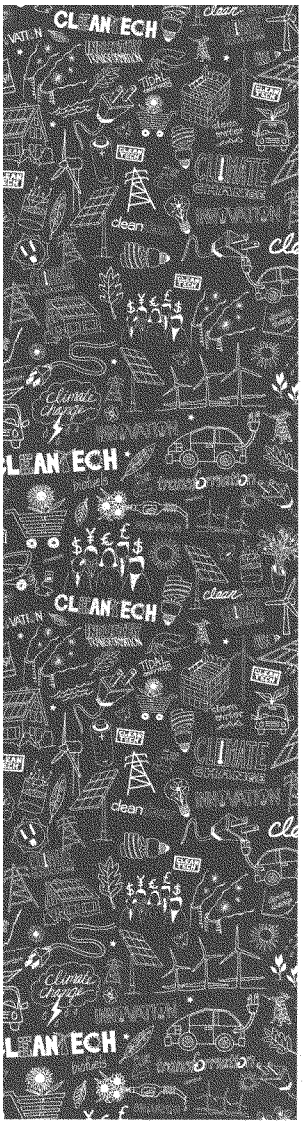


Co-host:

Bloomberg
NEW ENERGY FINANCE

Global strategic supporting organizations:

THE CLIMATE GROUP

INNOSIGHT

US strategic supporting organizations:

Electrification Coalition

SVB

Foreword

For the fifth straight year, Ernst & Young hosted a global series of cleantech ignition sessions, executive roundtables that convene key stakeholders to discuss important cleantech issues. This year's sessions focused on electric vehicles (EVs) because the transformational change under way in this industry cuts across many sectors and has profound implications for automakers, utility companies, battery developers, smart grid operators and renewable energy suppliers.

The sessions – in Munich, Shanghai and Silicon Valley – were jointly hosted by Ernst & Young's Global Cleantech, Automotive and Power & Utilities Centers. Each meeting brought together the full range of stakeholders, including innovators, corporations, investors, government, utilities and NGOs. They discussed the urgent actions related to customers, supply chain and infrastructure needed to bring EVs to an adoption tipping point. Although there were understandable regional differences of opinion on the real opportunity and issues inhibiting EV rollouts, a climate of optimism permeated all three meetings.

The Chatham House Rule applied to the discussions. While insights arising from the discussions are distilled in this follow-up report, no comments are attributed to a specific person or organization. To share the findings of these discussions with the broader cleantech community and support the development of the EV agenda, this report provides:

- A summary of key insights arising from the discussions in Munich, Shanghai and Silicon Valley
- Detailed discussion summaries synthesizing the high notes, common threads and contrasting points of view under the sessions' major themes of customers, value and supply chains, and infrastructure and business models
- Conclusions and recommendations for accelerating EV adoption
- Supplemental sidebars, interviews and graphics to add to the discussion of EV challenges and opportunities

We would like to once again extend our thanks to our co-host, Bloomberg New Energy Finance; to our global strategic supporters, the Climate Group and Innosight; and to our US session supporters, the Electrification Coalition and Silicon Valley Bank.

The EV industry is in its infancy but developing very rapidly. This report serves both as a source of collective wisdom and a call to action for its many participants. In this fast-moving, evolving landscape where divergent opinions still abound, we hope it will help guide today's EV stakeholders toward consensus and action plans to push past today's inflection point. Forging creative partnerships and business models and executing smoothly in the coming years will be critical for sustainable, long-term success. Ernst & Young will continue to foster discussions that serve to catalyze these important industry relationships.

Sincerely,

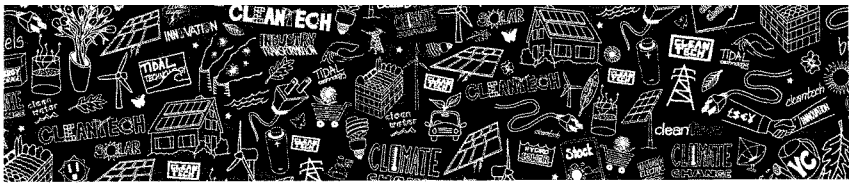
Gil Forer
Global Cleantech Leader

Michael Hanley
Global Automotive Leader

Ben van Gils
Global Power & Utilities Leader


CLEANTECH
SOLAR
Policy
INNOVATION
Climate Change
Stock
VC
biofuels
transformation
TIDAL
INDUSTRY TRANSITION
ENERGY STORAGE
HYDRO POWER
CLEAN TECH

Contents



Participants

Munich

Dr. Markus Eder, Head of Division, Bavarian State Chancellery

Siegfried Schneider, State Minister, Head of the State Chancellery, Bavaria

Markus Blume, Member of the Bavarian State Parliament

Albert Cheung, Associate, Energy Smart Technologies, Bloomberg New Energy Finance

Michael Wilshire, Head of Analysis, Bloomberg New Energy Finance

Kristina Sisseck Christensen, Business Development Executive, Bright Ignite

Jesper Boie Rasmussen, CEO, Cleantechmotors

Birgit Ruderer, Business Attaché, Délégation générale du Québec

Hugo Geluk, Head of Emobility Initiative, Asset Finance & Leasing Team, Deutsche Bank

Torben Holm, Electric Car Scheme, Project Manager, Dong Energy

Bianca Kretzer, Electric Mobility Project Manager, EnBW Energie Baden Württemberg AG

Dr. Jörg Überla, Venture Partner, Environmental Technology Fund

Christian Thiel, Scientific Officer, European Commission Joint Research Center – Institute for Energy

Andreas von Richter, Leader, VC Activities, Europe and Middle East, GE Global Research Europe

Jan Borghuis, Director, Collect Car B.V./ Greenwheels

Prof. Dr. Roger Moser, Faculty EADS-SMI Endowed Chair, Indian Institute of Management, Bangalore (IIMB)

Dr. Jan-Olaf Willums, Chairman and Founder, Inspire Invest

David Cue, Executive Director, European System Integration Center, Johnson Controls – Saft Advanced Power Solutions

Dr. Uwe Albrecht, Managing Director, Ludwig-Bölkow-Systemtechnik GmbH

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Jim Lyons, Partner & CTO, Novus Energy Partners

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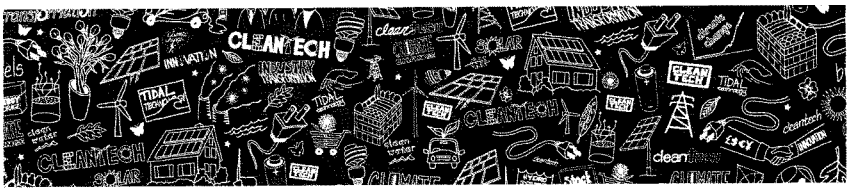

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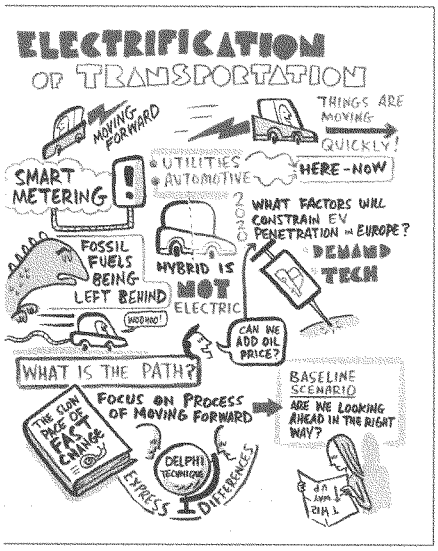
The electrification of transportation: from vision to reality

Discussion agenda: Munich – Shanghai – Silicon Valley

Welcome and opening remarks

By 2020, EV-based transportation will have reached the tipping point. But what needs to happen in the next decade to reach this tipping point? What are the challenges? Who will be the players? What are the critical success factors? How do current and new players need to work together to successfully navigate this unprecedented industry transformation?



Munich executive roundtable discussion

I. Customers

- What is the compelling value proposition that will change consumer behavior?
- What is the path from no acceptance to a tipping point of acceptance? Is it via plug-in hybrids, the luxury segment or the "second car" market? Are there other possible paths? Who will be the early adopters?
- What technology and business model innovations are needed to create the killer application that consumers will prefer over the alternatives?
- What are some of the lessons learned from other industries that have gone through a transformation, such as telecommunications?
- What is the role of fleet managers in advancing the EV agenda?
- What is required from a policy perspective?
- How will current and new players work together to reach the tipping point? What is the role of different industries (automotive, utilities, oil and gas, consumer products and such)?
- What are the potential pitfalls that could destroy momentum?

II. Infrastructure and value chains

- What will happen to the current value chain? What are the triggers, accelerators and winning factors? Where in the chain will value migrate to, and where are differentiation and innovation occurring?
- The power and utility industry is entering into a symbiotic relationship with the automotive industry, which will change the dynamics in the value chain. How do we build constructive, cooperative relationships from the outset so that both industries can tackle the EV challenges together?
- What is the impact on power and utility companies? What is their role? What is their roadmap to enter the EV value chain successfully? How do you integrate the smart grid value chain evolution with the EV value chain evolution? What are the challenges or gaps in integrating these value chains? Can utilities help the EV transformation, or will they slow it down?
- What are the challenges and risks from the battery perspective?

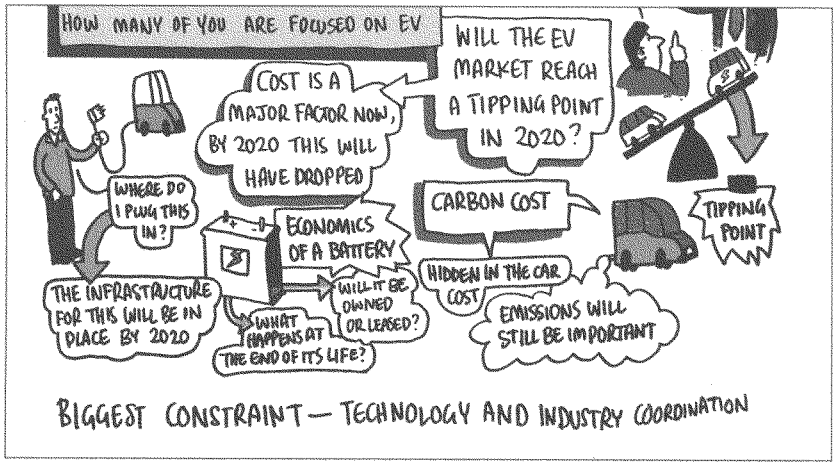
III. Business models and partnerships

Technology innovation alone will not be enough to drive the EV transformation. Instead, a new system of technologies, business models, markets and government will be needed to replace the existing system.

- What would the fully realized EV system look like?
- What business model innovations are needed to enable EV infrastructure, in both the short and long term?
- What would the components be? Who are the stakeholders?
- What are the primary accelerators and barriers? How should the different players work together to leverage the accelerators?
- What are the lessons learned from other industries? Are they applicable?
- What type of partnerships will arise? What will trigger them? Where will the value added be?
- What are the right technology and business model innovations to enable the EV infrastructure? Are they viable? What other alternatives will enable the EV transformation in the short and long term? Who will own certain elements of the needed infrastructure?
- Who will pay?
- What needs to be done from a policy perspective to accelerate the EV agenda in your market?

IV. Reaching the tipping point: an interactive group exercise on potential accelerating events

V. The road ahead



Shanghai executive roundtable discussion

Summary of key insights

After several decades of stops and starts, the global EV industry is poised to fulfill its promise: battery makers have made major strides; cleantech innovation is being supported by big stimulus money; car makers are shifting gears to EVs; governments have begun to set needed EV standards. The industry is finally in take-off mode. Major milestones just since June 2010 include:

- The introduction of the Chevrolet Volt and Nissan Leaf EVs
- GE's launch of an EV charging-station business
- Tesla Motors' initial public offering and US$50 million in strategic investments by Toyota
- European auto manufacturers' agreement on standard plug and socket specifications for overnight or slow EV charging, allowing drivers to use the same charging cables in different cities, regions and countries throughout Europe
- China's completion of construction of its largest EV charging station in Shandong province, 1 of 75 slated to be completed by State Grid Corporation of China

Key unanswered questions

The discussions in Munich, Shanghai and Silicon Valley highlighted a number of key questions that remain to be answered by global EV stakeholders as they bring the industry to global scale. Here are some of the most important ones:

1. Who will make EVs in the end – large OEMs, start-ups or both?
2. Who will ultimately own the customer in the electric car business – car makers, utilities or integrators?
3. Who will manage data flows between the home, utility, car battery management systems and car manufacturer, and how will they do it?
4. What will be the value of EV battery storage for the grid, and who will own it?
5. What should we do with EV batteries at the end of their life, and what will their residual value be?
6. How do we factor renewable energy into the EV infrastructure – its availability, storage and impact on price?
7. To what degree will utilities own EV infrastructure?
8. Can battery makers improve performance, reduce cost and increase supply quickly enough to meet global demand? Is battery performance or cost the most important variable?
9. How much would any of the following inhibit EV adoption: lithium supply constraints; continuing improvement in gasoline/diesel engines; or lack of an oil price shock?

This pace will continue: at least 18 battery electric vehicles (BEVs) are slated to arrive between 2010 and 2013 from both incumbent automakers, such as Ford, Fiat, Mitsubishi and Renault, and new entrants including Tesla Motors, Coda Automotive and BYD. As one participant put it, "The train is clearly gone. It's just a question of how to make it happen in the best possible way. It's not philosophical anymore. It's now very tactical."

Many challenges remain: opinion varies widely as to the technology and business model path to adoption, and EV stakeholder interests are often misaligned. "As far as we've come, many are still not on the same page," one participant said. "We need to focus on execution and moving forward together." For a smooth ride over the inevitable bumps, dialogue, coordination, creativity and partnerships between government and industry will be critical.

To make sense of this rapidly evolving landscape, session participants shared their insights about business models that work and ongoing issues that companies, utilities, governments and EV charging aggregators face as the industry ramps up from pilots to commercial-scale production. Below are a few key observations:

- The train has left the station. Auto manufacturers, utilities, aggregators and parts makers are taking major steps to capitalize on the EV opportunity. Those with realistic plans and strong partnerships will benefit most, but there is no turning back now.
- Market drivers vary regionally. Market forces, including government support, the enabling infrastructure, customer attitudes and the EV's value proposition, will determine the type of customer, as well as the timing and trajectory of EV sales. In Europe, take-up triggers include EV availability, pricing, convenience, safety and a continent-wide focus on sustainability; commercial fleets are likely to be the first adopters. In the US,

likewise, the economics and availability of EVs are key drivers, but with a leading role for early-adopting consumers of new technologies. Winning over a mass market will be more difficult, and commercial applications will lag those in Europe because of lower gas prices and lagging commitment to sustainability. In China, by contrast, the primary driving force is the Government's desire to reduce oil consumption and curtail pollution and its ability and willingness to mandate EVs for government and many commercial uses. The state's key role in coordinating the EV industry through standards, technology norms and the establishment of charging stations to spur demand will also accelerate adoption.

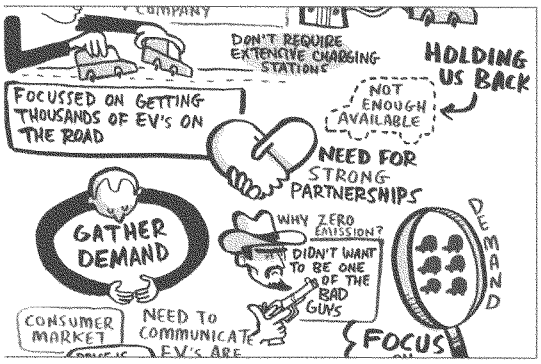
- Worldwide, fleets – particularly those that are government-backed – are ideal candidates to begin the conversion to EVs because their load requirements match EV capabilities; they own the support infrastructure as well as the vehicles; and they are concerned with total cost of ownership rather than solely up-front costs. The light-duty vehicle fleet's disproportionate contribution to carbon emissions – some 60% of US oil demand, according to the Electrification Coalition – also makes it ideal from an environmental standpoint.
- Coordination between the automobile and utility industries – and their regulators – is crucial to developing an EV ecosystem as these two industries undergo rapid change. The shift will be transformative for both industries and open opportunities to new entrants. Clearly articulated and smoothly executed goals at each consumer interface point will bring faster payback and public acceptance of EVs. Given the capital-intensive nature of the EV transformation, confidence that the elements will come together smoothly will be crucial to players' willingness to invest.
- Technological challenges remain crucial. The arrival of stronger, lighter and more affordable batteries that operate at longer ranges will accelerate EV adoption. Power train technologies also can be improved. The interoperability of batteries at charging stations, likewise, could boost the comfort level of drivers mulling EV purchases.
- Batteries pose separate business model questions. A number of factors related to batteries deter the purchase of EVs: their high cost; expectations of their rapid obsolescence due to continuing innovation; safety and performance risks; and the question of what to do with spent batteries. Various business models can shift these technological and financial risks of batteries to manufacturers or insurers. In addition, the residual value of batteries depends on what uses may be available for them at the end of their useful automotive life.
- EVs are only one element of the transformation of utilities. Utilities have the capacity to generate and perhaps even deliver the power EVs will need. The broader challenge is the creation of an electrical grid that can manage alternative (hence intermittent) energy sources, distributed power generation, energy storage and feed-in tariffs. The path forward is very uncertain.
- The role of government in setting standards, granting funds, mandating purchases and spearheading industry coordination efforts is critical. Insufficiently supportive government policies were cited often as a top constraint to adoption. This is particularly true in the US, where more coordinated regulations across the country and regions are urgently needed. Diverse state and federal policies and entrenched internal combustion engine (ICE) legacy issues are another key obstacle to US take-up. Adoption is further hindered by the different approaches of the nation's more than 3,000 utilities, which operate under a variety of regulatory arrangements. Better coordination is needed.
- Innovative business models are needed to help accelerate rollouts. Among new and emerging business models around the globe are aggregators, or intermediaries setting up charging stations. Niche EV makers and their unique ownership and pricing structures were also considered novel in both the US and Europe. Mobile storage in cars, too, was viewed as a unique revenue-generating model and opportunity. Chinese participants pointed to storage company networks modeled on today's gas station structure as pioneers. Further innovation in business models is needed to address the challenge of cross-industry coordination and to develop consumer options.
- Creative partnerships can break infrastructure gridlock. In Europe and the US, cross-sector collaboration was seen as essential to integrating a highly complex value chain. Americans also underscored the importance of consistent EV messages from both vehicle makers and utilities to win support from consumers and regulators. Cross-border industry partnerships are considered more critical in China.

Customers

Discussion summary

Today, key customer segments are consumers, business delivery vehicles and government fleets. For all those groups globally, performance, price, safety and the availability of a supportive infrastructure will drive demand for EVs. But many obstacles remain.

Worldwide, the consumer is viewed as the laggard adopter, with the exception of a small population of early adopters in the US, because of inconsistent messages related to the availability, cost, performance and safety record of EVs and insufficient information about where and when to charge. Resolving these concerns and creating a compelling EV value proposition for consumers are essential. Consumers want a simple and easy migration from ICEs to EVs.



Munich executive roundtable discussion

Munich

Europeans are generally optimistic about electric vehicles, with a broad groundswell of support from industry, governments and NGOs bolstered by strong regulatory forces. But participants in Europe voiced concern on how to get past the chicken-egg scenario to trigger consumer demand while investing in the required infrastructure upgrades and charging stations. A failure in execution in this window of opportunity, they said, could bring catastrophic consequences.

At a minimum, European consumers seek the same price, comfort and convenience levels in EVs that they experience with conventional automobiles. In Europe, the ability to cut both one's fuel bill and one's carbon footprint also affects the buying decision. Even among early-adopting consumers, economics and practical concerns tend to dominate more than in the US, perhaps because gas prices are higher. Business customers are also motivated by a social pact to cut carbon emissions and reduce their country's dependence on foreign oil. Consumers are thus positively predisposed toward EVs, but they will move only after the standards, technology and service risks are sorted out.

Private delivery fleet owners are seen as ideal early adopters because of their green agenda, total cost-of-ownership focus, deeper pockets, central depot structure, collective reaping of benefits and urgent need to access city centers. But fleet owners still express concern about vehicle availability issues, the longevity of government-backed incentives that justify the business case for buying today instead of tomorrow and the possible obsolescence of batteries. Government fleets are also seen as good candidates to serve as test beds and showcases for EVs because they are willing to pay higher costs for green benefits. To court this small but influential group of potential early adopters, strong partnerships between fleets, original equipment manufacturers (OEMs), financiers, utilities and governments are critical to pool both risk and investment.

To grow the EV community beyond fleets to affluent, environmentally aware and aspirational drivers who can serve as ambassadors to the mass market, government incentives at all levels are needed. These include tax breaks, subsidies and ease of EV entry into city centers with congestion pricing and dedicated lanes and parking spots.

EV shortcomings in Europe include a limited infrastructure and safety concerns about sudden stops when batteries lose their charge. High prices, vehicle availability and practical questions like where to park and charge are additional worries. Generally, consumers are flexible, but radical behavioral change is unlikely.

Looking forward, participants expressed concern that expected EV rollouts may lose steam amid budget cuts and European austerity programs. Job losses and diminished spending power likewise will weigh on individual consumer buying decisions, they said. "The man on the street, he doesn't worry about climate change. He worries about annual salary decreases and his short-term survival. With today's austerity programs, there is a higher likelihood of surprises in the coming years. This will not make the case for EVs easy," one participant cautioned.

Participant outlook for EV adoption

We polled participants in each of the three sessions to gain an indication of their outlook on EV adoption, asking: "In 2020, what percentage of new vehicles sold in your home market will be battery electric vehicles (BEVs)?" Home market was defined as Europe for the Munich participants, China for the Shanghai participants and North America for the Silicon Valley participants. There was a surprising consistency across geographies in the responses from these leading EV stakeholders. About half foresaw BEV adoption of less than 10% of new vehicle sales, about half anticipated BEV sales of 10% to 25% and a slim minority looked to BEV sales in the 25% to 50% range.

Participant poll: BEVs as a percentage of new sales in home market by 2020

New sales as percentage BEV	Munich participants: Europe	Shanghai participants: China	Silicon Valley participants: North America
Less than 10%	48%	41%	48%
10%–25%	48%	55%	51%
25%–50%	4%	4%	1%

Shanghai

Participants also struck a hopeful but realistic tone in Shanghai, with an overwhelming focus on technology and standards. Both need to improve considerably for broader buy-in, they said. Those present underscored China's social, political and economic culture, in which the state-owned enterprise model still dominates. And they singled out the country's incredible diversity as both a challenge and an opportunity. Cities are a particularly promising market with their more affluent residents (some 300 million people today), they said. Shenzhen already boasts 1 million vehicles. That said, nationwide, many varied drivers and barriers remain.

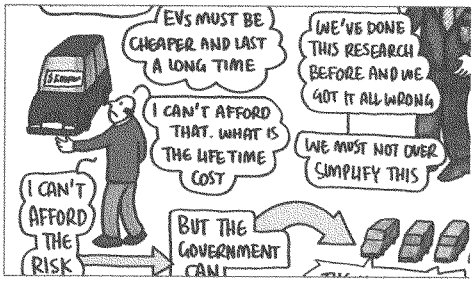
In contrast with Europe, Chinese consumers initially seek "just good enough" vehicles because 80% of them are first-time buyers, participants at the Shanghai session said. In China, price and reliability generally dictate purchasing decisions, and environmental issues rarely enter the picture, they added. As one participant put it: "Ninety-nine percent of consumers are not interested in the technology under the hood. They have other values. They want freedom; they want to be taken safely from point A to point B. So we've sort of sidestepped the issue."

For that reason, and due to strong state involvement in many sectors, state-backed fleets are likely first adopters. The government has clear pro-EV objectives: it wants to cut the country's overwhelming dependence on foreign oil, reduce exhaust emissions in inner cities and gain grid efficiencies. As a result, government-supported players, incentives and entrants are seen as the primary drivers of adoption. As one participant optimistically noted: "I've been in the EV business for over 30 years and seen attention to the industry rise and fall. But this up is different. Previously, it was the subject of academic conferences, but now government and business are leading the charge."

Business fleets, too, are promising early EV buyers for similar reasons to those cited in Munich. But buses in China are not good candidates for the early adoption of EV technology because they cover vast distances that are often beyond required charging ranges with few non-passenger stops.

To overcome resistance among urban drivers, participants proposed additional ICE bans in city centers, which might motivate urban drivers and delivery truck companies to consider an EV purchase.

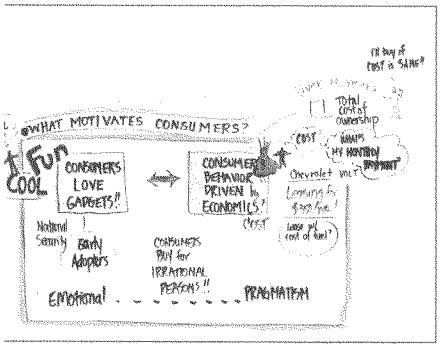
As China's infrastructure rolls out at lightning speed, future challenges include the rapid build-out of roads and longer travel times. But many wonder if an EV-focused infrastructure rollout will keep pace. More pro-EV investment and policy initiatives may be needed to support China's emerging industry.



Shanghai executive roundtable discussion

Silicon Valley

Overall, US participants shared the optimism of the other geographies about early consumer take-up of electric vehicles. They singled out a small but influential segment of affluent, socially conscious early-adopting individual consumers who are typically the first to purchase new technology. But they also voiced concern about how to expand the customer base to mass market buyers.



Silicon Valley executive roundtable discussion

Participants pointed to a desire to reduce dependency on foreign oil and sustainability concerns as key drivers. Rental car companies are already leading the charge by forging pacts with vehicle makers to offer green options to customers, particularly in cities with good charging infrastructure. One participant from that industry noted anecdotal evidence from hybrid rental car demand suggesting that Americans welcome the opportunity to drive ICE alternatives. The anticipated US$250 billion value chain expected for EVs by 2020 is an amazingly big opportunity, one participant noted, that dwarfs that of the solar market several times over.

As in Europe and China, US fleets are eager to use EVs for similar total cost of ownership and centralized, overnight charging reasons, as well as to avoid business disruptions related to changes in the price or availability of oil.

Fleet owners are purchasing or leasing short-range light EV trucks for deliveries in major metropolitan areas. To lower the up-front cost, which is currently triple or more what a company would pay for a conventional delivery vehicle, some suggested tailoring smaller-capacity batteries to these inner city trucks. But the lack of vehicle availability for longer-range, medium- and heavy-duty EV trucks has held back scaling up, as have concerns about who ultimately will foot the bill for storage substation installations. To overcome concern about the functional range for larger trucks covering longer distances, prices must fall and performance improve. The lack of a consistent policy among all states so that the public and regulatory agencies could line up behind the EV push was also cited as a stumbling block.

These consumers – rental car companies, truck delivery fleets and price-insensitive early adopters – help meet the critical mass of demand needed to achieve economies of scale and are contributors to a roadmap to the smooth and broad deployment of EVs.

Participants' perspectives were mixed about the role that pricing would play in the early stage of EV rollouts among consumers. For many, and particularly the early-adopting individual, design, appeal and the "ahead of the curve" factor trump economics. Price elasticity is more common for these buyers, who serve as ambassadors to the masses. Gas prices and geopolitical concerns, such as overturning the US's dependence on foreign oil or cutting carbon emissions, were considered other motivators. And as prices drop, participants noted, others will join the fray based on price, performance, reliability and overall experience. But they also cautioned that government tax credits were currently propping up the market, so OEMs need to pare costs so that subsidy-free EVs are profitable.

Executives at companies across the board pointed to battery pricing and performance as key inhibitors when considering an EV purchase. "Battery prices are halving by 2013 – that's good, but not good enough. Prices must come down, and we need a higher range. Penetration will depend on what options are available," one participant said.

Many other obstacles remain in the industry's quest to put more EVs on the road. A key concern is a disparity of understanding among customers about pricing and the charging infrastructure. EV availability and practical range are other concerns. Cohesive messaging for prospective buyers will help allay concerns and build confidence in the product, some said. However, much work remains in the areas of policy coordination, appropriate pricing and technology improvement.

Gauging interest in plug-in hybrid and electric vehicles in select markets: 2010 global survey by Ernst & Young's Global Automotive Center

Earlier this year, Ernst & Young polled some 4,000 drivers across China, Japan, the US and Europe to assess their interest in and likelihood of buying electric vehicles in the coming years.

The survey of 1,000 respondents in each region was conducted to collect intelligence that might help players in the EV industry value chain plan for the future. As such, it yielded some surprising results for the component suppliers, service professionals, infrastructure developers and existing vehicle manufacturers, particularly in the power train area, as they prepare for this transformational change. More than 83% of those polled paid less than US$35,000 for their vehicle and drive fewer than 50 miles a day.

The survey's findings suggest that there is already tangible demand for plug-in hybrids and EVs, particularly in China, and particularly when these vehicles are well-established. Driving forces include fuel savings, environmental concerns and government incentives to buy EVs. However, in all regions, despite this "willingness to consider," awareness remains low. Gating factors include driving range, access to charging stations and vehicle price. Also, most respondents preferred to purchase rather than lease an EV.

Of course, this is only a first step. Consumer acceptance is critical, but so is successful cross-industry collaboration between the automotive, utilities, government and other sectors.

Quantitative highlights are below; a more detailed overview of replies is available in the full report at www.ey.com:

- Between 7% and 37% of respondents in developed markets surveyed (except China) are willing to consider the purchase of a plug-in hybrid electric vehicle (PHEV) or EV as soon as it is available. When considered in terms of the total number of vehicles in service, these responses are indicative of relatively high volumes.
- 60% of respondents in China show a strong interest in purchasing a PHEV or EV – nearly five times the percentage in the US, Germany, the UK and Japan.
- 62% of respondents have never heard of PHEV technology or have heard of it but don't know what it is.
- 40% of respondents have never heard of EV technology or have heard of it but don't know what it is.
- More than 60% of respondents say they are not likely to buy a PHEV or EV until it is well-established in the market, highlighting the importance of successful launches among potential early adopters and sharing these success stories in distinct markets.
- Fuel savings is the most important favorable factor encouraging the purchase of a PHEV or EV. Other factors, such as environmental impact and government incentives, are not nearly as significant to respondents.
- Battery driving range, access to charging stations and vehicle price are the factors that make survey respondents most hesitant to purchase PHEVs or EVs. Several other factors, such as performance and handling, reliability and lack of clear understanding of cost advantage, play an important role with various levels of significance across the markets surveyed.
- The vast majority of respondents would prefer purchasing a PHEV or EV over leasing. Respondents from Europe are slightly more favorable to leasing.
- There is a clear range anxiety among respondents, as 60% believe a battery driving range of less than 100 miles is unacceptable even though only 2% drive more than 100 miles per day.
- Willingness to pay for charging stations in their respective communities is higher among respondents than their interest in purchasing PHEVs or EVs.
- Among the markets surveyed, Japan has the lowest interest in PHEVs or EVs, with only 7% potential early adopters.

Value and supply chains

Discussion summary

As discussion expanded beyond customer needs, participants agreed that close coordination across the value and supply chains, which is shifting from a product to a customer service orientation, is key to moving things forward. This spectrum includes battery makers, vehicle manufacturers, charging infrastructure suppliers, power management companies and utilities. The challenges are many, but if done right, opportunities abound in this transformative shift for the auto, energy and utility industries.

Munich

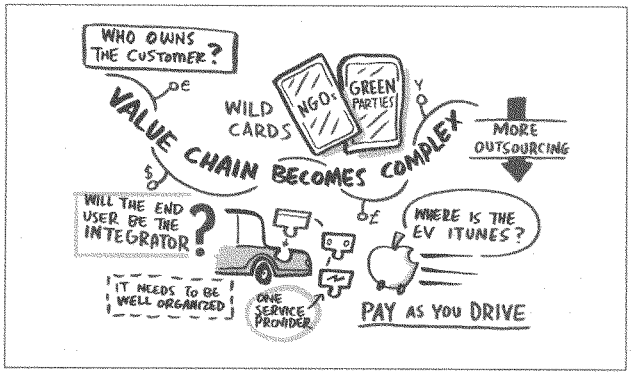
To upgrade technology and ensure that improvements ripple across the chain into successful rollouts and adoption, aligning incentives among battery makers, utilities and OEMs is critical, participants said. "Unlocking a locked system" will allow new competencies and scenarios to bubble up. But the value chain could change substantially depending on the primary integrator and how incentives are aligned.

In Munich, attendees pointed to a lack of cohesiveness along the value chain, perhaps due to misaligned objectives, a complex process, the enormous cost of shifting from ICEs to EVs and the resulting barriers to entry. Utilities, in particular, need to embrace a more customer-centered approach by building an infrastructure robust enough to avoid blackouts while ensuring that there are sufficient fast-charging and storage options. Working with other stakeholders, including OEMs and charging-station operators, regardless of who bears the risk and cost, is critical, participants said. Deregulation and competition, as occurred in the telecommunications sector in the 1990s, could accelerate this process. This creates an opportunity for service providers to step in, bridge the gap and spread risk and costs among a diverse set of players. But at what cost?

As one participant noted, "There's a lot of very impatient money in the marketplace, so money is not an issue. I think the issue is how to get the money, and what you must give up as a response to what you receive."

A key piece of the puzzle is battery management – how to charge, discharge and connect batteries to the grid. A smoothly functioning ecosystem with clear metrics for who bears the risk and reaps the reward will ensure that the main components of the chain fall into place and that others follow. However, concerns about falling costs and obsolescence remain. As one attendee asked, "Who will invest in a €30,000 battery pack, which they know will be outdated in two years? It's going to be too expensive and under capacity. Also, how do you bridge the gap between financing current technology and still take advantage of what may happen in the next 5 to 10 years?"

Participants pointed to battery technology shortcomings and the need to protect battery intellectual property as constraints on EV adoption and battery development. "It opens up a Pandora's box with privacy protection," one participant noted. Doubts also persist over how advanced, safe and reliable today's batteries



Munich executive roundtable discussion

are. Progress in two years has been amazing, but perceptions of battery capabilities often trail reality. The industry still awaits a big breakthrough. However, as one skeptic in the room noted, chemistry is chemistry, so we may be bumping up against limits. For many, the industry is still in its growth stage and far from mature. Estimating residual battery value was also discussed at length.

"There's been a whole host of academic and development work that's been spawned by this e-mobility, and there are lots of third-generation ideas running around that will solve some of the problems. So this is the very beginning. This is not mature technology by any stretch of the imagination," one participant said.

Government can help by creating frameworks that build trust among battery makers and automakers. It can also bridge the chasm among industry players by proposing pro-EV legislation, providing funds and setting standards, offering incentives such as subsidies, and promoting national and regional research and development (R&D) efforts.

As the industry marches forward, future challenges include sorting out conflicting standards, setting up and syncing charging station networks, overcoming interoperability issues between batteries and stations, and establishing cradle-to-grave processes that address operating costs and battery disposal and recycling. Both industry and government can play key roles in guaranteeing a depreciation cycle, resale market and battery warranties.

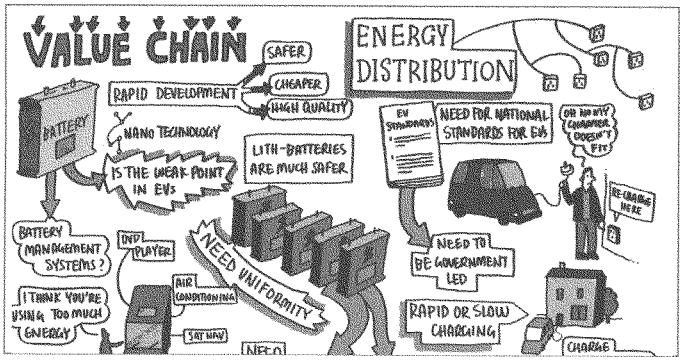
Shanghai

Government's pivotal role in fine-tuning the value chain was a key focus at the Shanghai value chain session – not surprising as the Chinese Government moves rapidly to advance EV standards, technology and infrastructure to trigger demand. As one participant put it, "The important thing is drawing a framework around the issues and making sure your strategies are robust enough and flexible, because certainly, whatever we talk about today is going to be out of date tomorrow in China."

But start-ups and foreign partners can also help fill gaps, several participants noted. Industry readiness and technology shortcomings remain principal stumbling blocks to EV adoption in China.

Once again, battery technology was a focal point for discussion, particularly its integration into the car. Despite progress via nanotechnology and new chemistry and materials, many agreed that batteries are still not yet ready for broad deployment. Problems persist with power, size and weight, and charging and discharging times. Issues related to safety and reliability remain. Yes, costs are falling and capabilities are improving as more suppliers join the fray, but a breakthrough is still needed.

"You may have very good materials and techniques and be able to produce very powerful batteries. But we also need good storage technologies to physically connect and balance batteries, so major advances are still needed. There is a long way to go in terms of battery technology," one participant said.



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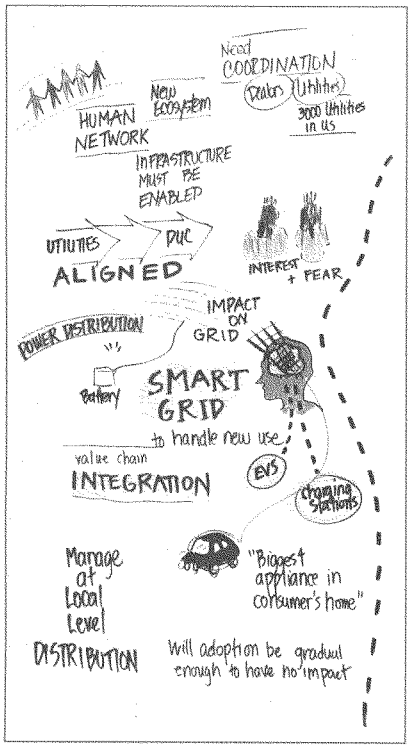


Silicon Valley executive roundtable discussion

Conflicting standards, too, were a concern. Despite strong government directives, a hodgepodge of standards and approaches is cascading across provinces, utilities and cities, several participants said. Pilot projects are also proliferating to test the market. National standards are needed for OEMs and utilities to meet broader demand and scale up. "Why invest in fast-charging stations if slow-charging becomes the standard?" one attendee asked.

Better government-specified norms for batteries and products are also necessary because there are so many players. Companies and provinces may move faster than the national government as it takes on this enormous task. For example, in Shandong Province, three ministers of science and technology are pushing directives to cut CO2 by improving the ICE first, then going to hybrid.

As one participant put it, "it's worth remembering that over the last 50 years, trillions of dollars have gone into developing the ICE and its value chain. So it's not easy to compete with that. It's a very stable internal combustion value chain."

Subsidies, demonstrations of the product in public and using EVs for state vehicles also could help jump-start the market. By priming the pump, the state might drive adoption of unproven technologies and level economic costs. "When all these technologies offer the same performance at a competitive price, consumers will adopt EVs. That is not the issue. It's getting beyond that threshold – reaching the volumes. Governments can support the tipping point to get beyond the break-even point when it comes to these new energy technologies," one attendee noted.

The role that local government can play in providing incentives for research, development, manufacturing, rollouts and adoption was also underscored. Help can come in the form of free land for grid extensions, tax breaks and resources to develop products.

Though fewer references were made to the role of the private sector, one participant singled out the invaluable role that China's start-ups might play. These hungry, nimble newcomers have great latitude to fill technology and service gaps unmet by government.

Silicon Valley

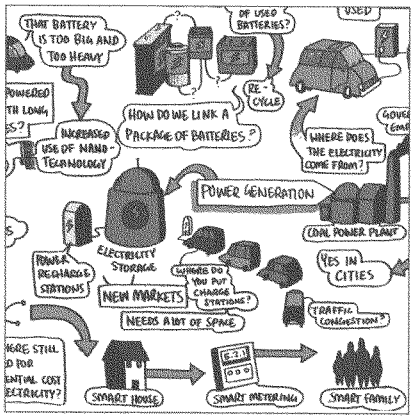
As in China, industry coordination was seen as a top stumbling block to EV adoption in the US, where forging consensus among stakeholders with diverse interests was deemed critical. Given a wide range of opinion, participants at the California meeting also singled out inconsistent messaging across the value chain as another gating factor. Information sharing and transparency at this stage, they said, are critical.

Overall, participants struck an optimistic tone although some asked if expectations were overly rosy. Those present pointed to the massive opportunity, not just in a new market but in forging ties with players in other sectors, new entrants and innovators. The US's value chain has already shifted to storage, drivetrain, power generation and distribution companies, with the post-crisis bailout and big stimulus dollars from the Government to encourage innovation, they said. But smooth policy coordination was considered critical for an operationally aligned and smoothly functioning value chain. Europe has already laid the groundwork through regulations and tariffs, and China's top-down approach enables quick policy implementation, which has already proved to be a boon to its leading-edge battery makers. Parsing the value chain to each player's core strength might provide a clearer roadmap, one participant suggested.

"This is exactly like the auto industry was in the early 1910s and 1920s," one participant noted. "There were 200 to 300 auto manufacturers; there were different standards for fuel; the gas station industry was a mess; the car industry was a mess. It was messy, and then there was a huge shakeout. It only took about 20 years and we got down to about 20 companies. But then another 20 years and you're down to 4 or 5."

Working the human network – not just supply chains – was also considered critical, as was early inclusion of key components of the current ICE chain: dealers, repair shops and credit card companies. The best technology does not always win, so looping in incumbents to join rather than cut ties is essential. As one participant put it, "In this new world, when does a utility executive talk to an OEM? When does a lithium ion battery company talk to a utility, much less to a Public Utilities Commission (PUC)? So this entire new ecosystem has to be built and operationalized. We're a lovely little microcosm here, but think about the millions of other people that have to interconnect for this thing to work. And that value chain has to stand up relatively quickly because the infrastructure has to be enabled, and we have a hell of a lot of challenges along that path, starting with the 500-pound gorilla in the system, which is the utilities and the PUCs across the 50 states that somehow have to all get aligned – unlike many other countries where you've got much less regulated utilities – for this value chain to get kick-started and operationalized."

As in China and Europe, participants pointed to high battery costs as a kink in the value chain. Until battery prices drop, they said, EVs remain out of reach for many. And further power train technology development is needed. These are ambitious targets, they noted, but the world is on a much more compressed timeline than the slow-moving ICE calendar.



Shanghai executive roundtable discussion

Among proposed policy measures to accelerate rollouts were creating incentives for research, development and production through legislation like an EV deployment bill in Congress; implementing scaled deployment in infrastructure; and guaranteeing a secondary market for batteries to lower the consumer EV price tag.

Creating consistent standards was also considered critical. A lack of common, global standards inhibits product technology. Leaving the standardization process to the international standards bodies will cut costs for chargers, battery chemistry and power electronics. Japan, China and Europe already have different standards. As a guide to where US standards may be headed, one speaker pointed to the first-moving states of California, New Jersey, New York and Massachusetts.

Participants recommended several government actions, including a climate policy, gas tax, tax credits, tailpipe CO2 emissions standards, grants for development, a national smart grid plan, passing the Electric Vehicle Drive Act and guaranteeing the secondary value of batteries. With a common framework and incentives, these measures will encourage different sectors to collaborate. And with better technology, investment and increased collaboration among stakeholders, the industry can move forward faster.

Keynote address by Siegfried Schneider, State Minister, Head of the State Chancellery, Bavaria

Profile of Bavaria's five-point strategic plan for electric mobility

Source: Foto Seybold/press

At the close of the Munich session, Siegfried Schneider, the head of the Bavarian state chancellery, spoke about his state's commitment to EVs as a way to help protect the environment, improve quality of life, gain freedom from foreign oil dependence and create green jobs in the region. His keynote focused on the framework his administration has put in place to encourage electric mobility (eMobility) and infrastructure build-out, as well as to meet industry requirements in the areas of economic development, research and policy.

The state's five-point policy focuses on training, education, basic research in energy storage, additional research in integrated systems and power electronics generation and an eMobility program that supports R&D and EV testing.

Other aspects of the program include the model eMobility towns of Garmisch and Bad Neustadt, an automotive industry cluster with focus on EV, and an eMobility Competence Atlas so that those in need can find experts. Also of note is an international eMobility exhibition in Munich, with some 190 exhibitors, which will award a state prize; the Nuremberg E-Drive center, for the transfer of knowledge from universities to industry; and initiatives to encourage consumer adoption of EVs, such as dedicated lanes for EV users.

Key messages in Schneider's speech included the need for a short distance between researchers and manufacturers to advance the industry and create products; the importance of staying technology-neutral and letting industry take the lead; and the imperative of healthy competition, both in the area and globally. His take on subsidies was especially noteworthy in its effort to focus more on innovation than regulation. For example, he was more inclined to encourage indirect subsidies and incentives to consumers, such as dedicated lanes and free parking, than outright subsidies. The profile of Bavaria's eMobility initiative below shows how government can play a pivotal role in pushing forward an emerging industry with enormous potential.

Strategic plan profile

The German state of Bavaria is home to a number of world-class corporations that have a large role to play in the electrification of mobility. The state is a leading R&D player in Germany, and many international corporations have located facilities there. It is one of the world leaders in power generated from photovoltaics, and its electricity grid has a much lower carbon footprint than the rest of Germany, complementing carbon-reduced eMobility.

Bavaria is making a concerted effort to transform itself into a leading geography for both the production and implementation of eMobility. The Bavarian Government has given it strategic importance because it wants to focus on sustainable, quality-led growth. eMobility offers the state the opportunity to:

- Serve the ever-increasing need for mobility while protecting the environment and the climate

- Significantly reduce the dependence on oil
- Improve the quality of life in cities by reducing noise and pollutants
- Create high-quality jobs in sustainable infrastructure and technology

Bavaria wants to have 200,000 electric cars on the road by 2020. To reach this goal, a coordinated interplay of R&D, testing, suppliers, automotive OEMs, government and charging infrastructure operators will be needed. Bavaria has created a five-point strategic plan to address this need and form an environment where an entire eMobility ecosystem can develop:

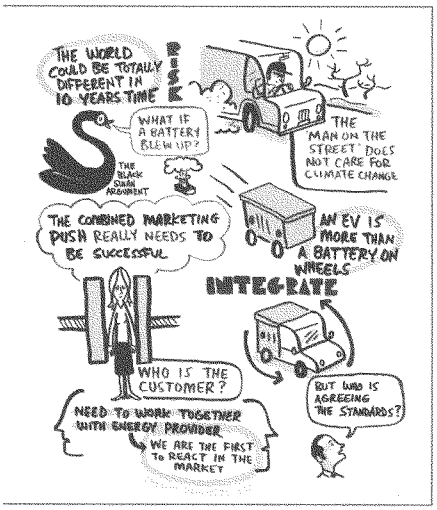
1. Research – At the Technical University Munich, 36 full professorships have been established to research eMobility. The Fraunhofer Institute for Integrated Systems in Erlangen is heavily involved in researching power electronics. A state-sponsored eMobility R&D program has been launched to fund R&D projects in industry.
2. Model regions – The German Government is funding the model eMobility Region Munich, which is part of a nationwide €500 million eMobility initiative. World-class automotive corporations, utilities and engineering firms are teaming up with researchers at TU Munich to jointly roll out electric car and van fleets in Munich. In addition, the Bavaria state has selected the small town of Bad Neustadt as a model to test applications at smaller scales.
3. Clusters – Electric mobility will be included as a new focus area in the automotive cluster strategy of the state. The cluster strategy seeks to network companies across the value chain to create a mutually reinforcing ecosystem of skills and competencies. These competencies also will be mapped in an eMobility Competence Atlas. The eCarTec, held every autumn in Munich, is fast establishing itself as one of the leading events in eMobility and will be included in this cluster strategy.
4. Flagship projects – The Bavarian Government will establish and fund a number of leading eMobility projects that will have a strong accelerating effect on the sector's activities. The first initiative will be the creation of an E-Drive Center in Nuremberg.
5. Reduced time to market – Bavaria will examine policies to accelerate the adoption of eMobility. These could include special license plates, electric car procurement, priority parking and priority lanes. Neither Bavaria nor the German Federal Government is currently planning on direct purchase incentives for electric cars, as a well-supplied market has not yet developed.

Bavaria is taking steps to be a leading player in electric propulsion, much as it currently is in ICE and many other technologies. The combined expertise and concerted efforts by government and industry provide a good basis for the dynamic growth of the complex and interdependent eMobility value chain in Bavaria.

Infrastructure and business models

Discussion summary

The infrastructure and business model session generated animated discussion on a variety of topics. They ranged from unconventional alliances that can hatch creative solutions to what the role of a utility should be and how government can help fast-track deployment. Above all, attendees agreed that finding a way to mesh all the moving parts is critical. Creative partnerships and business models, they said, will help break the gridlock between utilities and OEMs, which historically haven't worked together.



Munich executive roundtable discussion

Munich

With more than 27 member countries in the European Union, it's no surprise that Europeans at the session focused on the urgent need to set common standards. By doing this, they said, government can help provide incentives for different players to work together.

Another area of focus was car ownership. New business models for car and battery ownership such as car sharing, or "mobility on demand"; cars as mobile storage units; and battery leasing can help push the industry forward, they said. "What if large segments of the population don't want to own a car?" one participant asked. "In some UK city centers, you can rent a car for five pounds an hour. If that started to attract a significantly large number of consumer segments, EVs would be a natural because you have to walk to the sharing point to get your car. It could also be an EV charging point."

Unconventional models like utilities owning car companies or innovative computer makers getting into the car-sharing business, they added, might also accelerate demand.

But to encourage collaboration, stakeholders need to anticipate and share both risk and residual value. Participants also lamented the lack of a bird's-eye view with too many pilot projects and tests in tandem and little intelligence shared about lessons learned.

Indeed, misaligned incentives were singled out as a key stumbling block to rollouts. Both utilities and OEMs want to own the customer – and new revenue. Cultural differences among players exacerbate that conflict. Utilities, for example, take a more cautious approach and often exhibit great patience as they await government-imposed frameworks or standards. Vehicle makers, by contrast, tend to be more nimble and aggressive.

Two flash points include the slow- versus fast-charge debate and where to charge: at home, at work or at a public charging station. Utilities prefer slow charging at the home or office because they retain the customer and benefit from greater demand management options in this scenario. Utilities also view fast charging in public locations as less efficient and more costly. But car makers believe a fast-charging option will lure potential EV purchasers because they would have more options regarding where and when to top up the battery. Attendees called for closer collaboration between utilities and vehicle makers to solve these vital conflicts. But many questions remain. In particular, who will manage battery assets and charging records, and who sends the bill? Who will own the extended infrastructure, software, battery and customer?

That said, utilities do see electric vehicles as a new opportunity to generate revenue, build customer relationships and gain efficiencies. Participants singled out new smart grid capabilities that will help meet and drive demand for power, create opportunities for load-balance spending and improve efficiencies by capturing the value of excess power at night. Depending on the business model, utilities also anticipate new revenue from EV owners and, much like the "last mile" in the telecoms sector, want to own the residential connection. To capture that value, many said, utilities need to revolutionize their business models and add sophisticated services like fast-charging options. "We can do this. We have to add something more to make it really fly from an industry perspective. We need this additional business like arbitrage, like capacity grading. Infrastructure is not

free," one participant noted. Some utilities are doing this today, and some are doing it faster than others.

As one participant put it, "Utilities are looking for new ways, just like iTunes™, for a totally different system than the old industry of selling records. So when you see the utility perspective, they are opening up for new models that go beyond car ownership, the classical thing that Renault is still pursuing."

Other utilities, however, are lagging in adding capacity to meet new EV charging needs. To fill those gaps and build momentum, new business models like the aggregator approach embraced by Better Place are emerging. Many utility companies welcome the arrival of these new entrants. But to others, they pose a threat because newcomers might erode expected value. An inability to cross this chasm will hamper collaboration between prospective partners, many said.

Another open question is who will own and pay for new infrastructure. One participant cited an estimated cost of €30,000 per depot, or billions of euros total, when built out across the continent.

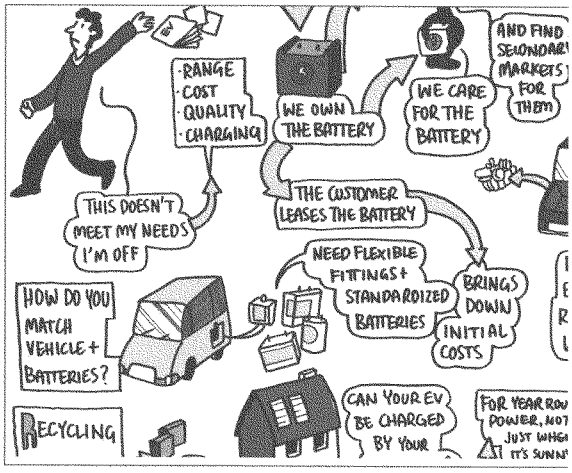
In this opaque environment, government can help by standardizing components. A common framework validates the business case for greater investment, collaboration and scale. Industry, too, can forge creative business models and unconventional partnerships among would-be competitors to share value across the spectrum. The charging station setup, in particular, is a key piece of the puzzle.

Innovative business models will help move things forward. Some possibilities include car leasing, pay-as-you-drive or the Zipcar model. For an idea of what's possible, look to the telecommunications or consumer electronics industry. Most game-changing advances came from start-ups that looked at the market and its potential in an entirely new way.

Shanghai

Integration was the overarching topic among Shanghai participants. China needs more of it, they said, because there are so many players. By setting common standards, government can help encourage different stakeholders to work together.

Attendees also called for closer cross-border collaboration among universities, research centers, component suppliers and vehicle makers that historically have not worked together. In fact, the global industry could move ahead more quickly if it emulated China's top-down approach, some said. In China, the Government coordinates and funnels funds across the value chain into state labs, component suppliers and electric motor and car manufacturing, from raw material sourcing to final vehicle sale.



Shanghai executive roundtable discussion

"We need a new business-to-government relationship that is different from the Western model and different from the China model with a lot of state-owned enterprises. It's a hybrid, and it's not just business to government but it's government to government and business to business, on an international level. In the US-China relationship, they're trying to develop collaborative research institutes. China and Germany just opened up and announced collaboration and research in this area. This is a new partnership that's different from the traditional model today that needs more

Continued on page 26

Better Place Australia and Australia's emerging market for the electrification of vehicles

Earlier this year, Ernst & Young had the opportunity to interview executives at charging operator pioneer Better Place Australia. Below are highlights from a Q & A by Marc Newson, Oceania Cleantech Leader, Ernst & Young, and Adam Green, Director and Melbourne Cleantech Leader, Ernst & Young. They interviewed Evan Thornley and Antony Cohen, CEO and CFO, respectively, of Better Place Australia, and Anthony Pascoe, CEO and CFO of Lend Lease Ventures, an investor in the company. Their conversation provides insights into Australia's emerging EV market and how Better Place is helping to pave the way to Australia's EV future.

What is the EV consumer path from no acceptance to early adoption to mass-market take-up?

Evan Thornley and Antony Cohen: Only 1% or less of the Australian market will be early adopters. We need a very different model to bridge the chasm between the niche and mass market. The early mass market will be fleet sales, particularly larger-sized sedans, SUVs and light commercials. Their value proposition will be lower total cost of ownership, reduced emissions and a superior drive experience (i.e., quiet, fast and smooth).

Marc Newson

Anthony Pascoe: A compelling aspect of the Better Place model is its focus on supporting the mass adoption of electric vehicles. This requires delivering a value proposition to high-mileage customers so they see the economic benefits of switching from a petrol engine to an EV.

What are some consumer lessons learned from other industries that went through a transformation?

Evan Thornley and Antony Cohen: The migration to EVs will be quicker than other technology shifts on both the consumer and production sides. For consumers, new technologies typically suffer from high price, solving a problem the consumer doesn't have and reliability. EVs will be reliable because they will be made by global car manufacturers, they won't have a price problem by 2013 and they are a substitute product.

Also, a few customers will constitute a large part of the business opportunity (e.g., 9% of Australian cars consume 28% of Australia's petrol), and there will be massive first-mover advantages in energy markets through early infrastructure deployment and high-mileage driver contracts.

The secondhand car market and long lead times for car manufacturing will also impact the market. Take a car designed in 2010 for 2014 release; customers want a viable resale value in 2017. As battery prices fall and petrol prices rise, the EV proposition is more attractive while the resale value of a petrol vehicle falls. The tipping point will come around 2014, so car makers need to think about whether current designs will meet consumer demand. This dynamic will speed up the production side of EV adoption and, combined with other industry dynamics, will make the speed of adoption even more profound than in other markets like digital photography.

Adam Green

Anthony Pascoe: At the 2008 Frankfurt motor show, there were few EVs. A dramatic shift occurred by the 2010 show. The sector had a wake-up call. Major vehicle makers felt compelled to have EVs in their automotive portfolio. Based on history, progress will be much quicker than the market currently believes. Various new technology take-up curves (e.g., internet versus mobile telephony versus cable television) suggest that going from zero to mass adoption is happening more and more quickly. This is probably due to an ever-increasing level of global connectedness and the availability of better information.

How will the passenger car value chain change?

Evan Thornley and Antony Cohen: Two value chains will be impacted: energy and vehicle production. Everything changes for the energy value chain. The electricity, battery industry and charge network industries replace the oil industry's petrol supply. Also, some of that value chain will shift toward car makers and dealers who now get nothing from the oil sector. EVs will also significantly impact electricity supply and demand.

Evan Thornley

As for passenger cars, fundamental technology discontinuity will follow, resulting in new market entrants, growth for some existing industry participants and decline for others. This has happened in many other technology transformations. Also, the economics of car dealers will change. EV service costs are expected to fall considerably, which will force further recalibration of the dealer channel to market.

Anthony Pascoe: Energy markets have a huge opportunity to

use mass EV adoption as a load management tool to significantly reduce some of the capital needs for large-scale infrastructure upgrades. We see significant upside from the energy industry's changing dynamics and the opportunity to facilitate V2H (vehicle to home) and V2G (vehicle to grid) peaking supply.

Additionally, Australia has very relevant experience in building big cars for high mileage customers. EVs will change the rules of the game—there is an opportunity for our automotive industry to adapt and play a significant role in developing EVs for our domestic market and potentially for export, as well.

Technology innovation alone will not transform EVs. A new system of technologies, business models, markets and government will lead that charge. What are the key components, accelerators and barriers?

Antony Cohen

Evan Thornley and Antony Cohen: New business models will be required. The car and energy value chains must work together to lower car purchase costs and to ensure their integration into the charge network. The Better Place model has solved three critical barriers to mass EV adoption:

- Convenience – by supplying the infrastructure for charging while parked and extending ranges through battery swapping
- Economics – the battery subscription model cuts significant up-front capital for batteries and delivers low recurring costs to consumers
- Scalability – by enabling high levels of take-up without overloading the electricity grid through integration of the electricity demand cycles with the car's battery condition

The gating constraint is long lead time for car production. Issues around battery standardization, lithium supply for batteries and rare earth supplies for permanent magnet motor technologies are not foreseeable constraints. Accelerators for the anticipated switch will be falling battery prices and rising petrol prices, which increase the viability of EVs for customers every year.

Anthony Pascoe: Two support areas come to mind. First, the use of individual consumer subsidies for EV adoption, typically US$8,000 or more in offshore markets. The EV presents a powerful mechanism through which consumers can engage in the transition to a low-carbon economy, since a car is often the second largest acquisition many people make and with turnover quicker than housing. Second, a mechanism for aligning the numerous, diverse stakeholders to facilitate required changes to federal, state and energy-specific regulations to support the mass adoption of EVs and the full capture of load management benefits.

What innovations will enable Australia's EV infrastructure? Are they viable now?

Evan Thornley and Antony Cohen: All the required innovations are viable now. There are no fundamental technology risks. Batteries are improving over time, interconnected charge networks work with software integration at utilities and battery swapping works. In our Tokyo electric taxi trial, battery swapping takes 59 seconds.

What is the state of direct funding? What mechanisms are needed for EVs to work in Australia?

Evan Thornley and Antony Cohen: Risk capital is available for charge networks but less so for automotive engineering, which is greatly needed. This is a gating constraint to vehicle supply. Engineering new cars is costly (about A$150 million per model; A$600 million to A$1 billion for new platforms). This is risky for a new product. But there is risk capital for new entrants not held back by legacy systems, dealer channels and labor economics.

Anthony Pascoe

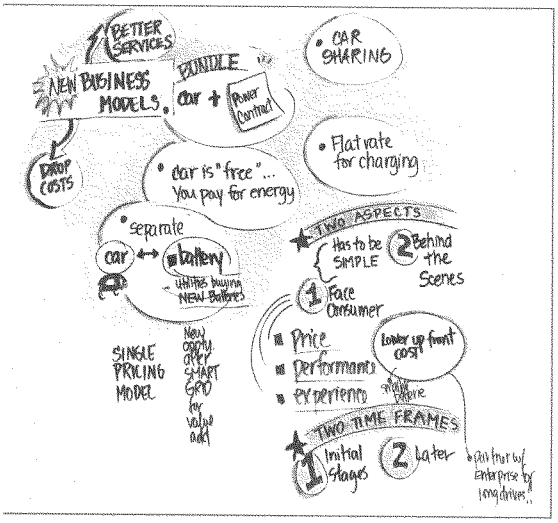
The electricity industry lacks cost-effective energy storage. EVs bring distributed and manageable storage paid for by someone else. This is a huge opportunity to improve the energy load shape, use storage to defer capital expenditure, increase volumes of energy sold through the same amount of wire and increase intermittent renewable energy technology penetration by integrating with the controls for battery recharging.

Anthony Pascoe: We plan to raise significant equity capital in the next few years. Our company's global holding company successfully raised US$350 million in equity this year, much of that from blue chip supporters including Vantage Point, Morgan Stanley, HSBC and Lazard, in one of the largest cleantech equity raisings in history. Equity will likely be supplemented by asset-based financing of batteries and physical infrastructure.

Continued from page 23

work to help accelerate the commercialization of this technology and address some of these gaps," one participant said.

The Chinese Government can also help organize fast-charging stations both to lower the investment cost and push for slow-charging equipment, all while keeping a close eye on capacity. A spike in EV use could bring down the grid, some cautioned. Roughly 20,000 EVs are planned for 2015. That would add just 1% more electricity demand but would still be a big drain on the constrained grid.



Silicon Valley executive roundtable discussion

"Views vary over the merits of fast and slow charging. For the grid, battery life span and safety, slow charging is better. Moreover, most vehicles are idle at night, when they can be slow charged. Differentiated pricing at peak and trough hours should be implemented," one participant recommended. "This also increases grid capacity during the day, when power supply is strained." However, universal adoption of slow charging might restrict ROI for fast-charging stations, reducing the potential pool of EV adopters as popular fast-charging options could be prohibitively expensive, the participant added. Government therefore should help subsidize fast-charging stations to lower the total required investment and help speed EV adoption.

Also slowing progress are differing approaches among car makers. Roughly 40% of an EV cost is in the battery, so some OEMs prefer outsourcing battery ownership and management to eliminate or reduce battery risk. Others want to own the battery. One large automaker, for example, views the battery as a core competency – not unlike an engine or electric motor – at the real heart of the vehicle. This company is pursuing partnerships but will retain battery ownership because, as an executive from the company put it, "Car makers best understand consumer behavior." But other OEMs, particularly in Asia, are pursuing alliances and forging pacts with battery makers, often in their own countries. That said, as one participant pointed out, it took a century to perfect the internal combustion engine. Now, as then, different partnerships and business models will emerge and flourish or fade away.

And for new market entrants, storage centers that capture energy from the grid at night and charge EVs during the day are emerging as a major opportunity. Start-ups are pursuing and setting up new business models for this space.

One participant noted, "Investors or financiers are all trying to get a share of the charging market in China. They try to get approvals even before making construction plans, just like 20 years ago when investors rushed into the gas station market in China. What can grid companies and utilities do against this backdrop? In the next few years, there will be an emerging market for storage. The most important thing about EVs is not batteries, electric machines or vehicles, but storage. The purpose of developing the EV industry is to conserve energy and reduce emissions. We must store unused energy at night and transmit it to EVs in the daytime without affecting the safe operation of the grid. A lot of large companies are catching up and want to build storage stations. A lot of investors and government agencies are doing this. In the second half of this year, China will start to build over 500 storage stations."

Silicon Valley

Utilities were a key focus of the infrastructure and business model session in the US, as participants wrestled with how to get past a patchwork of evolving regulations to integrate new technology and coordinate approaches for the seamless delivery of power. Policy, to many, was a starting point to set the rules of the game and create a transnational framework of predictability for a truly viable industry. This philosophy is woven more deeply into the Chinese Government, where the roles and responsibilities of stakeholders are perhaps more clear. By reducing risk through policy initiatives, many believed, companies would feel more comfortable cross-pollinating in the EV ecosystem.

Another focus area was business model innovation through new approaches to car and battery ownership. They include car sharing, bundled contracts, pay-as-you-go agreements and battery leasing arrangements. "It's the integration and the confluence of different industries coming together to do something better than the sum of all of those parts can ever feasibly do, and that will be the disruption in this market," one participant said.

This step-change in grid demand and supply will require a bigger reform of the utility industry than of the auto industry. That's because the core mission of a utility is to deliver electricity in a reliable way at a reasonable rate. Today, a US utility's role is to provide electricity in a complex tiered system of ratemaking hammered out over 150 years between utilities and state commissions. These changes and state-by-state mandates for electricity from renewable sources make integrating EVs into the discussion complex and challenging. Many therefore believed utilities should stick to their core strength and build partnerships with outsiders for charging stations and ancillary, customer-oriented services. Moreover, EVs demand a different control of power, thus placing a huge strain on the intelligence and management of the grid by its 3,000 participating utilities, each with its own level of sophistication and management. Quality of service might suffer if a utility owned the entire value chain, thus stifling innovation from outsiders, one participant said.

Nevertheless, some utilities are forging ahead, establishing constructive partnerships by setting up customer support systems, educating consumers at conferences and in their own communications, and testing the system through their own fleet. They see opportunity to grow revenue or cut costs by engaging and educating the consumer about the benefits of EVs, and they are mulling a non-utility company within a holding company structure to take charge of a charging infrastructure. As one utility representative noted, "This is really the killer app in terms of the grid. This will be the biggest appliance in a customer's home. Enabling the use of that in a positive relationship is a real opportunity for us to drive to the next level of what the grid can offer."

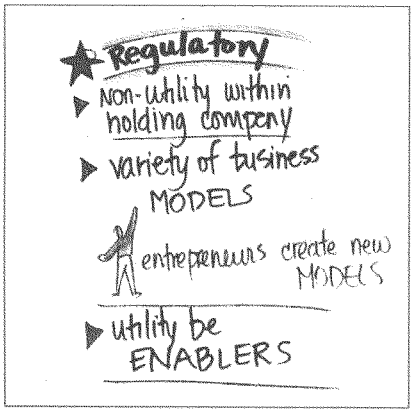
Others think utility-backed incentives like payment for car-generated power back to the grid and consumer-focused advance purchase agreements for used car batteries through utilities might help lure early adopters. One attendee proposed a state-by-state plan on how to charge EVs to avoid grid disruption.

For this colossal undertaking, others pushed for a state or national mandate or a separate structure for more national oversight over EV-related infrastructure upgrades to ensure electricity provision. "State and federal regulators need to be engaged for faster execution than what we might achieve individually," one participant said. Such a framework will pave the way for other players to take the initiative.

As one participant noted, "Historically, when you're moving from one system of creation and use to the other, the surest way to accelerate that transformation is for one concern to get its arms around as much of the value chain as possible. Because this is such a complicated, interdependent problem, going at it in a modular fashion and trying to get all these different business models and cultures to dance together is just incredibly complicated and will take an awful long time. So what we are looking for, as the key to accelerating this transformation, is the integration, similar to what Rockefeller did 100-plus years ago in oil, what Edison did in electric light, what IBM did in mainframes, what Apple does today with all its products."

Another concern is systems innovation and the seamless integration of the grid, which needs to be planned and designed to distribute electricity smoothly, with multiple charging access points. It also requires load management between the charging station and the rest of the home to handle peak use of EV charging and air conditioning, as well as security. Hackers could wreak havoc both on the power supply and the electricity use data that will flow between homes, businesses and the smart grid. Network operating systems that interface with the utility and battery operator for central load management are needed. Industry coordination is key in these early stages to avoid problems that might set the industry back several decades.

As one participant noted, "There's been a lot of misinformation and concern about smart meter installations in California. They're blamed for everything from high bills to fires. We have to have coordination between the auto manufacturers and dealers and the utilities in the early phase to avoid a similar situation with EV deployment."



Silicon Valley executive roundtable discussion

Bold utilities that are eager to enter the market will provide a minimum price of entry and capture residual value at the charging station. Most participants agreed, however, that utilities will not add public infrastructure as a business model or own the charging station. But as utilities innovate, much like the telecommunications industry, innovative approaches such as power roaming charges will help the system operate smoothly. In response to the utilities' price signals, consumers can adjust their activities to fluctuating rates. The market will do its work in bringing costs down, some said, once all the pieces are in place.

Consumers can help utilities innovate through social media networks or cloud computing programs that push information sought by consumers and collect data about the habits and needs of drivers that will help utilities upgrade according to the demands of an aging infrastructure. Blending the utility's obligation to supply electricity with the excitement of a sexy computer store instead of the plain-old-vanilla call center was also seen as an opportunity. Applications such as maps of charging stations or the types of EVs by city block will help utilities anticipate electricity demand and better serve customers through data that consumers willingly share. "People would absolutely give up ... some of their personal data if they thought it would make this go faster and better," one attendee said. Home energy management tools that track electricity use will provide more useful data, and coordination between fleets and utilities also will help test the grid. Their centralized management and charging oversight will help utilities tweak the system before thousands of consumer-driven EVs plug in.

Zipcar and Better Place were singled out as early EV business model innovators focused on different segments of the value chain. Participants cited many compelling billing and business model elements – many drawn from analogies to the telecommunications industry – that could accelerate EV adoption:

- A single pricing model, unifying utility and automaker charges in one bill, including a flat rate, charge-all-you-want option
- Selling a bundled energy and vehicle package, providing a free or discounted car with the purchase of a long-term power-provision contract (similar to today's cell phone subscription package)
- Car-sharing services in which the battery risk rests with the rental company
- Rental car companies selling a new EV package with a battery right-sized for average range and an add-on option for longer-range rental cars via a drop-off service when drivers surpass their averages
- Mobile renewable energy charging stations
- Applications with real-time information on where and when to charge or pick up EVs
- Websites that calculate total cost of ownership based on the EV location versus other models, as well as average usage rates

Just as happened in the telecommunications industry at different stages, new models will either cut costs or add value, participants said. "As an entrepreneur in the Valley, there has never been a better time to be an entrepreneur because this is a trillion-dollar market. Whoever gets this right, it is a big, big deal. If you get that efficiency down the next 5% or 10%, you will have done something not only historic but incredibly lucrative," one speaker noted.

Finally, policy-driven ideas proposed included a "race to the top" utilities-led competition with multiple small- to mid-scale demos to test how well the moving parts of a chain fit together with different players, business plans and scale for deep penetration and lessons learned. Winning municipalities would get big government backing and serve as national showcases to inspire and advise emerging projects in other locations.

Perspectives on cross-border collaboration and competition

A theme that resonated in all sessions was the importance of cross-border collaboration within the framework of spirited competition that drives all sides to excel. Each region varied in its assessment of what cross-border collaboration brings to the value chain and international integration.

Despite its enormous internal market, Chinese participants viewed joint global work as a starting point for technology development and international deployments, perhaps because its suppliers already serve the world. But both sides may need to give up something in the process. New paradigms in cross-border R&D were discussed that cut across the public sector, universities and industry. Global government involvement in standards, norms and regulatory framework setting was also considered critical to incentivize players to work together and allow customers to buy affordable, smoothly functioning products.

Participants in the US, however, viewed cross-border collaboration as a later-stage trigger for competition to advance development and open up global markets. They also underscored the importance of a positive US-China relationship for both geopolitical reasons and because of China's large car market, where many automobile components are sourced. Some participants also believed that the US should emulate China's urgent approach to the emissions problem through more coordinated public-private efforts.

Finally, broadly speaking, Europeans at the session perceived cross-border collaboration as an essential step after execution to share best practices, seed and nourish industry clusters, pilot vehicle rollouts and bring international stakeholders together to showcase advances. International demos, government incentives and industry deployments such as those singled out in Norway, the Netherlands, China and Bavaria can serve as a reference point that other geographies can emulate and improve, participants said. The great impact that actions in other countries can have on the global industry was clear in a number of references participants made to China's output, exports and internal market as a catalyst for greater global EV deployment.

Here are some insights shared in those sessions by participants, in their own words.

"China has the demand, the market and the capital. Manpower is also here. But China doesn't have very good technology. The main worry of foreign companies is IP leaks because they have invested a lot. But the market is here. If we can find out a common point and if each party has realistic expectations, we can create win-win situations." – *Shanghai participant*

"It's a race and it's actually a good race. For the US because the faster or more vigorously the Chinese compete with us, the faster we will develop the technology, the industry, and that means jobs in America. It's a race we should embrace in the spirit of Silicon Valley and competition. We need each other, and we will learn to work with each other to make it good for both countries." – *Silicon Valley participant*

"A road map has to be developed, and then it's about competition. And as soon as we are in a global competition, then the race starts. That's what we see in the US and in China." – *Munich participant*

"There needs to be collaboration between both business and government in major economies. We are putting those pieces in place, but even in US-China energy research collaboration, they don't know yet what to do. Over the next couple of years, that's going to be defined, and that could be a big enabler." – *Shanghai participant*

"All the world is challenged on the same set of parameters. Each of us brings something different to the party. There will be different solutions based on markets. Smaller players will have a niche role. For the first time, OEMs and vehicle users will work together. And there are new opportunities to improve the distribution of electricity globally." – *Silicon Valley participant*

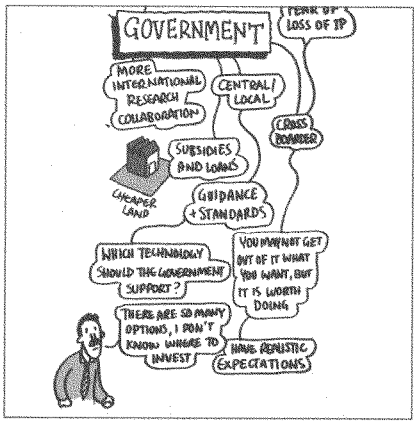
"If you look at China, they just do it. That's one call for more ambition in Europe in general, and doing more than just discussing." – *Munich participant*

The road ahead: 10 steps forward

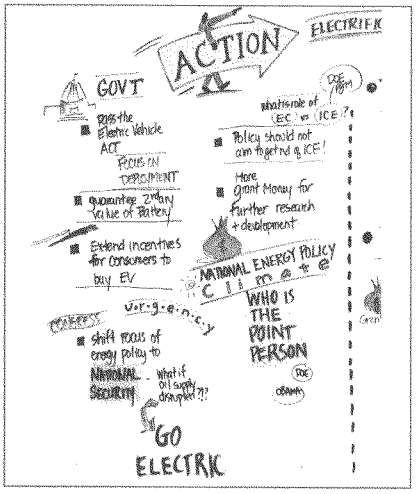
Ernst & Young convened three diverse groups of EV stakeholders at ignition sessions in Munich, Shanghai and Silicon Valley in the summer of 2010. Each group addressed a focused agenda of critical issues related to EV customer needs, value chains and business models and infrastructure. Our analysis of the debate and perspectives shared in these sessions points to the need for 10 actions to accelerate broad EV adoption:

1. **Make a commitment, internally and externally.** Stakeholders must prepare systems, infrastructure and customers for an EV future. For 30 years, automakers have tested fossil fuel substitutes, including hydrogen batteries and ethanol. Now, the industry has cast its vote unambiguously in favor of electric vehicles. Although the internal combustion engine will remain with us for many years and there will be a portfolio of transportation alternatives, the transition to electrification is certain. For OEMs, utilities, governments and consumers, the implications are profound.

2. **Avoid showstoppers.** Automakers, utilities and aggregators must manage risks conservatively and execute smoothly to retain credibility. Momentum will be high as much-publicized vehicle launches capture public and investor attention. There is little margin for error in a fickle market with a long memory for the stops and starts of EVs since the 1970s. Rollouts must work, and customer needs must be met smoothly and rapidly to reap value. In this unique moment, leveraging and maintaining momentum is crucial or the industry could stall. As one participant put it, "One black eye in one corner of this ecosystem can cause tremendous reputational harm, tremendous loss of momentum."



Shanghai executive roundtable discussion

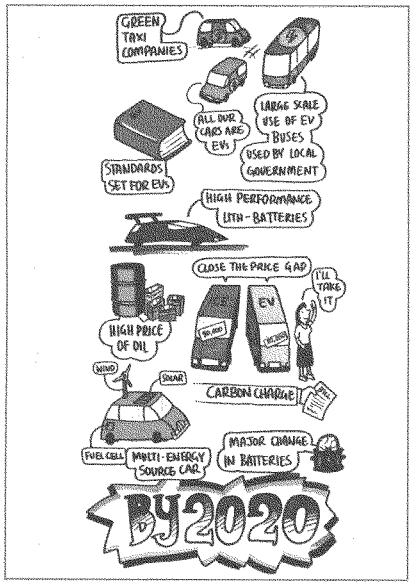


Silicon Valley executive roundtable discussion

3. **Take the industry perspective.** Stakeholders must coordinate integration across the value chain. For over a century, car makers have perfected the ICE in a complex supply chain stretching from oil drillers to electronic equipment manufacturers. The EV industry does not have this luxury of time. Stakeholders with distinct cultures and goals, including battery makers, component suppliers, vehicle manufacturers, utilities, charging station companies and other new players must align their interests, messaging and output to ensure successful rollouts, service provision and deployment. Information sharing, transparency and innovative ways to share both risks and rewards will help incentivize stakeholders to move forward together.

4. **Governments, engage!** The public sector is a catalyst across the world, and it plays a key role in accelerating adoption by laying the groundwork, providing incentives and showcasing technology. Governments should set standards to reduce technology risk and to speed development; fund R&D to accelerate breakthroughs; sponsor industry integration; set policies that create demand; and establish price signals that encourage consumer adoption.

5. **Campaign for standards.** Governments, international standards organizations and businesses must work together to create standards that form a platform for innovation, encourage economies of scale and increase the comfort level among stakeholders so that they invest and partake in complex work and negotiations across sectors and borders. Without a clear roadmap, it will be difficult for the industry to advance in a coordinated manner.



Shanghai executive roundtable discussion

6. **It's the battery, stupid!** Battery makers must deliver a step-change in performance. Though battery manufacturers have made great strides in recent years, particularly on the safety, pricing and performance fronts, much remains to be done. Car makers and consumers will move more swiftly when costs fall further and ranges trend up. Sorting out reliability and range issues is critical. A step-change in battery performance will fuel the transition from a niche to a mass market. Establishing a residual battery market to establish a value on spent batteries will also lower the up-front costs for consumer EV buyers.

7. **Focus on the entire ownership experience.** Viewing the value proposition through the customer's lens will be critical to attract and keep cautious EV buyers. Features and functions in battery management systems, billing programs, customer service offerings and incentives such as subsidies, tax breaks and perks like dedicated lanes and parking spots will make for a smooth and sustainable migration from the ICE to the EV. Stakeholders need to drill down into the details and anticipate and address problems before they escalate and alienate prospective buyers.

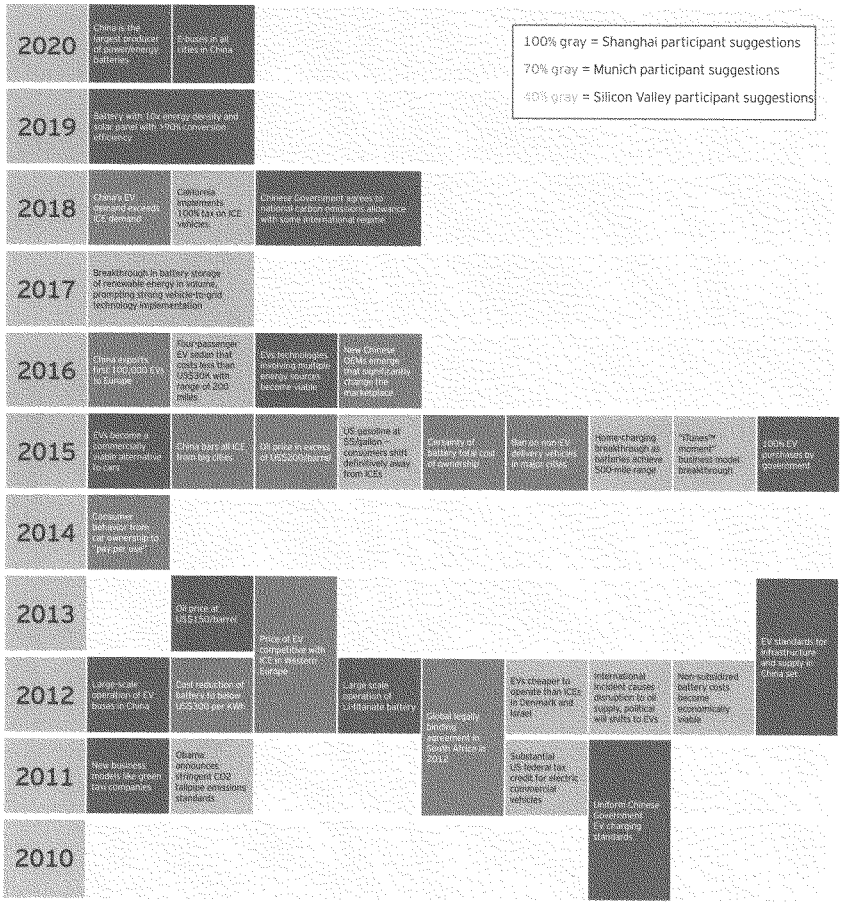
8. **Identify and cultivate first movers.** Automakers, charge suppliers and utilities should focus on first movers in key customer segments. EV stakeholders can look to first movers such as business and government fleets and affluent consumer early adopters for lessons on how to best meet the needs of a much larger market in the coming years. Stakeholders must iron out the technological and logistical challenges now to build demand and scale.

9. **Embrace new business models.** The transition to an electric transportation system demands a complete redesign of how vehicles are built, serviced and sold. Those in the value chain need to think outside the box and to look for options beyond borders as the industry wrestles with a century-long legacy of incumbent interests and moving parts. Disruptive innovators have perhaps the best shot at capturing value in this early stage.

10. **Keep talking!** Government, industry, academia and new entrants need to build bridges, collaborate and forge alliances across functional boundaries and international borders to ensure success. At this game-changing time, forging unconventional pacts that fill gaps and meet new market needs is critical so that the best technology wins in the long run. Collaborative partnerships that enable others to come up with creative, long-lasting solutions are key. Cross-border arrangements also allow the relative strengths of each country to be leveraged to common benefit. The pieces are falling into place and much is at stake, but if interests align and the many vested interests undertake open discussion and collaboration, the industry can build critical mass and leverage a once-a-century opportunity.

Reaching an EV tipping point by 2020: accelerating events

The timeline below highlights possible events that the global ignition session participants suggested could accelerate EV adoption over the next 10 years.



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The CHAIRMAN. This hearing is adjourned. Thank you all so much.

[Whereupon, at 12:30 p.m., the committee was adjourned.]

THE SELECT COMMITTEE ON
ENERGY INDEPENDENCE AND GLOBAL WARMING

October 4, 2010

Mr. Fulton:

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 3 weeks. Responses may be submitted in electronic form, at sarah.butler@mail.house.gov. Please call with any questions or concerns.

Sarah Butler
Chief Clerk
Select Committee on Energy Independence and Global Warming
(202)225-4012
sarah.butler@mail.house.gov

Question from the Majority:

1. **The term "Moore's law" was coined to describe the phenomenon in computing hardware where the number of transistors placed on an integrated circuit would double approximately every two years. Several other elements of digital technology, such as the size, cost, density and speed of components, have shown to improve at exponential rates related to Moore's law. The law is now used to guide long-term planning and R&D targets in areas of rapidly developing technology. Is there a similar phenomenon occurring with solar, wind or other renewable energy technologies? Please explain.**

Key Takeaways:

- Moore's law only applies explicitly to a specific industry – digital microprocessors. Nonetheless, cost decreases and innovation at an industry-level are impressive for renewables, and grid parity should be the target for all renewables long term.
- Clean energy assets have very high upfront capital costs and long asset lives.
- Wind energy is a more mature technology with the high relative costs of materials for wind turbines.
- Solar has followed an "S curve" with costs decreasing by about 20% with every doubling of production.
- Although there is the potential for significant future cost improvements, there are physical limits which limit the exponential growth characterized by Moore's Law.

Overview:

- The solar PV value chain leverages much of material science and production expertise of the semiconductor industry, which is where Moore's Law derives. Moore's Law describes a long-term trend where the processing power and value of technology--e.g. better performance, capacity, bandwidth etc.-- has approximately doubled every two years creating exponential growth in performance and dramatic improvements in cost. However, in contrast to integrated circuits, there are physical limits in terms of the improvement in performance that can be expected from solar PV based on current technology. Where we have seen a significant improvement, though, has been on production costs. This has been more of an "S curve" effect with costs decreasing by about 20% with every doubling of production. Solar PV appears to be on a trajectory to reach grid parity with retail electricity prices in many markets over the next 5-10 years. Wind energy, by contrast, is a more mature technology and is already competitive with fossil-fuel fired electricity generation in many markets. There is more limited scope for cost improvements in the wind value chain over the shorter term compared to solar PV due to the large bill of materials for cement, steel and copper that go into the wind units. Longer term, however, there is room for continued

performance improvements. However, like with solar PV, there are physical limits to the exponential growth characterized by Moore's Law.

Questions from the Minority:

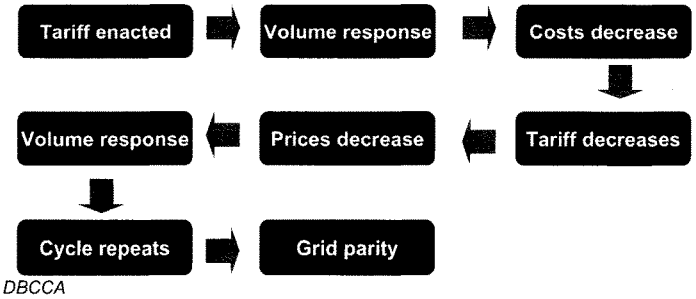
2. **What is the current investment climate for renewable energy in Europe? How has the decrease of government subsidies, such as feed-in tariffs, affected private investment?**

Key Takeaways:

- The EU has 2020 energy directives with a broad goal of 20% of primary energy supplied by renewable energy by 2020. Implementation of these policy goals is set at the country level. Feed-in tariffs have been one of the primary tools for achieving these objectives.
- The FiT programs at the country level are all structured somewhat differently, but generally they create a strong climate for investment, reflected in historical and forecasted volumes for renewable energy installations. Some FiT programs have been more successful than others, although Spain's challenges have been the exception to the rule of a broadly successful policy structure.
- Germany, in particular, has an integrated energy policy, a key component of which is its feed-in tariff, which is particularly well designed. The feed-in tariff incorporated a degression schedule which was aimed at grid parity and was meant to be reviewed every 4 years. Per the chart below, the government responded to the sharp fall in costs with an out of cycle change this year. 2010 PV volumes in Germany have remained strong. Forecasts for 2011 indicate that volume will be somewhat lower as 2010 was artificially strong as investors rushed to complete projects prior to the reduction in tariff levels. 2011 estimates for German PV look to set the year as the second highest on record. Some investment will shift to other countries where IRRs are still higher, but the German market will remain a key driver of demand. For more detail on the German tariff, see our answer to Question 7.
- Tariff changes follow cost reductions and higher volumes, which then stimulates further cost reductions, driving additional investment. When feed-in tariffs are well-designed, they can become self-sustaining policy, striking a fair balance with costs and benefits.
- Incentive policies help technologies to reach grid-parity costs with traditional sources of energy and thereby compete without further incentives
- Investment levels remain strong in Europe. For example, Germany saw near record solar installations in June, July and August 2010, with over 3 GW of modules installed according to German federal data (mostly residential, with some commercial scale). To date, Spanish solar has been boom / bust, as described in more detail below.

Overview:

- The basic structure of tariffs, volume responses, and the path to grid parity is illustrated below:

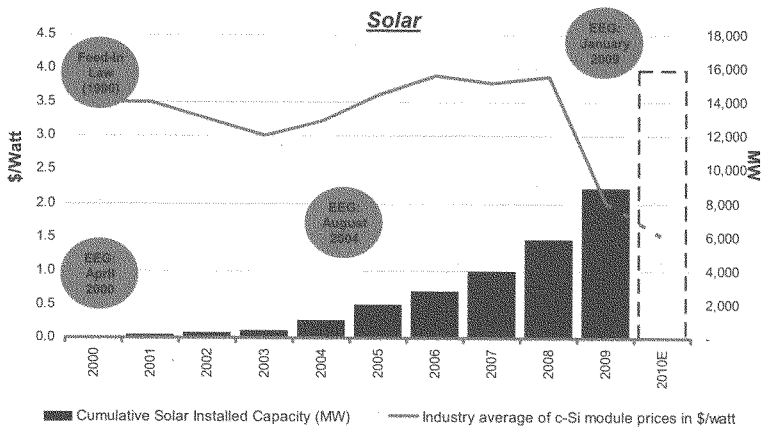


Source: DBCCA

- This trend of tariff reductions following cost decrease has been seen in Germany, per the chart below, and 2010 actual installations are on track to indicate volumes much higher than in 2009. It is worth noting that there may be some expected price increase after the initial volume response, as was seen in Germany. Prior to a supply response, elevated installations may drive price

increases as seen from 2004 to 2006. The prices then were flat, and as large amounts of supply came online to meet future demand, they decreased substantially.

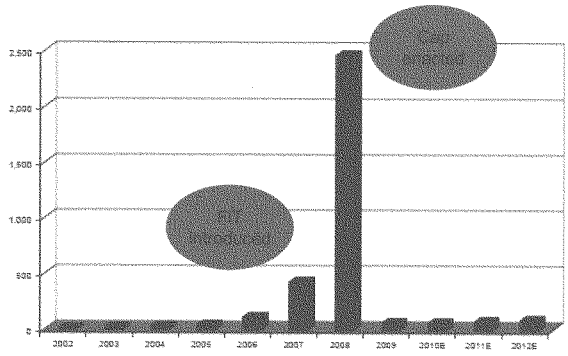
Germany: Annual Solar Installations (MW) and module price response



Source: German Federal Ministry for Environment, Nature Conservation and Nuclear Safety; Bloomberg New Energy Finance; DBCCA Analysis, 2010.

- Where policies have been appropriately structured to match this market-driven decrease in tariff levels, investment volume has remained strong. The chart above on Germany and the one below on Spain show recent annual solar installation. In Germany, the legislation was structured to utilize the degression of tariff rates in a fixed-structure to reduce the level of tariffs as industry costs came down the learning curve. As such, investment has remained strong.
- The Spanish FiT has been an example of a massive solar scale up followed by a tremendous crash because there was not a well-structured and integrated energy policy. The Spanish tariff was originally overly generously set at the same levels as Germany's despite having approximately 2-3x the average solar resources. In its National Energy Plan (PER) for 2005-2010, Spain set a PV solar target of 400 MW by 2010. Under the policy in place at the time, the RD 436/2004, the FiT prices were defined as fixed percentages of the prevailing wholesale electricity price. This link to the electricity price did not provide reliable Transparency, Longevity, and Certainty (TLC) for investors, and led to little development in solar PV.
- Note regarding TLC: Investors need transparency in policies to create understanding and a level-playing field. Longevity means policy has to match the time frame of the investment and stay the course. Certainty refers to knowing that incentives are financeable and can be trusted in the financial return calculation and again are likely to be maintained over the course of the investment. In economic terms, TLC should result in a lower cost of capital for projects while still delivering a fair and market related return to capital.
- In response to a number of shortcomings of this policy framework, Spain adopted its RD 661/2007 in May of 2007, introducing many landmark modifications to its renewable energy policy. Among other changes, this policy provided for stable, fixed price contracts for electricity generated from solar PV projects up to 50 MW in size for 25 years.

Spain: Annual Solar Installations (MW)



Source: Solarbuzz, Barclay's Capital

- Combined with its high quality solar resource, this made Spain a highly attractive investment environment for solar power at the time, guaranteeing higher rates of return than Germany's policy, in a market with more available land, and less oversight. This combination of conditions led to a remarkable growth in solar PV deployment, with Spain installing over 47% of new global PV capacity additions in 2008.
- As a result, Spain surpassed its 400 MW target for solar PV in September 2007, which triggered an automatic revision to its solar policy, due to come into effect one year later. This gave investors a one-year window to capitalize on the generous policy framework created by the RD 661/2007. This led to a rush of project development, creating a total deployment of over 2,600 MW in 2008 alone, and to a dramatic revision of its policy in September 2008.
- The rush of development put unexpected pressure on government budgets. In Spain, the government regulates retail electricity rates and fixes the amount that retail electricity rates can increase each year. The government then uses taxpayer funds to support the "tariff deficit" to cover any costs that are above the fixed retail electricity rate. The sharp increase in solar installation led to rate impacts above the fixed maximum, increased the taxpayer burden, and further encouraged policy makers to re-evaluate the policy. A further problem that emerged is project developers were able to string together large numbers of 100 kW projects in order to take advantage of higher electricity rates for smaller systems. This led to costlier PV development, as developers gamed the system to their advantage.
- Among other controversial provisions, Spain's new revision (the RD 1578/2008, applicable only to solar PV) imposed a 500 MW cap on annual solar development. This sudden introduction of a hard cap on solar caused the market to contract and led employers to cut over 20,000 jobs in Spain.
- The impacts of such sudden and abrupt adjustments to a FiT policy highlight the importance of sound and flexible policy design. Despite the rise and fall of its solar market, Spain is committed to improving its FiT. Its amended policy seeks to learn lessons from its mistakes, which are applicable to policy makers considering FiT regimes.
- The Spanish example demonstrates that FiTs can be powerful tools to drive investment in renewable energy, but that like all tools, they must be used carefully. Greater foresight and a quicker reaction may have blunted or prevented Spain's solar market crash. In order to be successful, feed-in tariffs need to ensure that the balance between market flexibility and TLC is frequently evaluated and adjusted.

3. **Renewable industry advocates consistently call for either a renewable electricity standard (RES) or a price on carbon, citing the need to catch up to China's market penetration; yet, China does not have either an RES or a price on carbon. How do you square your assertions with the facts on the ground?**

Key Takeaways:

- China offers one of the most comprehensive regulatory regimes supporting clean energy globally. It has both energy and carbon intensity targets at the national level as part of an integrated energy strategy.
- It has regional tariffs, a national level renewable target, financing structures via the China Development Bank, and direct support to firms.
- The country has come to dominate the project finance asset class globally, and it is seeing large scale deployment of wind turbines and significant export of solar modules.

Overview:

- China enacted a Renewable Energy Law in 2005 and amended it in 2009, which enabled more supervision of grid companies to purchase renewable power and imposed fines on grid companies for non-compliance.
- China has made clean energy and related sectors a high priority for sustainable national growth. The next 5-year plan is expected to place a strong emphasis on developing a domestic Chinese industry in new energy, energy saving and environmental protection, and clean energy vehicles.

Targets

- Announced three national targets on non-fossil fuel use: (1) 15% renewables in primary energy consumption by 2020; (2) 20% energy intensity reduction by 2010 from 2005 levels (with another 15-20% reduction to this being considered for their next Five-Year Plan); and (3) 40-45% carbon intensity reduction by 2020 from 2005 levels.
- Enacted renewable energy power capacity targets by sector for 2020: (1) 27GW of biomass power from 3GW today; (2) 3GW of waste-to-energy power from 1.5GW today; (3) 20GW of solar PV power from 300MW today; and (4) 150GW of wind power from 25.5GW today. In 2009, China installed more wind capacity than any other country, bringing its wind capabilities in line with countries such as Germany and even close to the US.
- As of August 2010, China plans to set regional targets for some provinces to reduce their greenhouse gas emissions under a climate program aimed at developing a "green" economy. The country aims to start trial runs on low-carbon projects in eight cities including Tianjin, Chongqing and Baoding and five provinces such as Guangdong and Shaanxi.

Direct Spending

- Most recently, on July 20, 2010, government officials announced a potentially staggering plan for the Chinese clean energy industry. Officials stated they are proposing a plan that would allocate approximately 5 trillion yuan ($738 billion) over the next decade as a means to develop cleaner sources of energy, including nuclear and natural gas, to reduce emissions.
- It has also been speculated that China's government may allocate 30% of its renewable energy spending over the next decade to wind power, according to an official at the National Energy Administration who spoke to 21st Century Business Herald. Spending on wind power may reach 1.5 trillion yuan ($224 billion) and solar may reach 300 billion yuan, the newspaper said, citing Liang Zhipeng, head of the administration's new energy department.

Incentives

- Approximately $490 million of incentives were allocated to 280 renewable energy projects in the first half of 2009 alone, representing a 25% increase compared with the second half of 2008. Projects in the wind, biogas and waste-to-energy sectors were the primary winners. In the second half of 2009, China almost doubled consumer incentives for renewable energy generation. Surcharges paid to wind, solar and biomass generators totaled 3.7 billion yuan ($545 million) in the second half of 2009.
- China also announced their "Golden Sun" subsidy program in 2009, and announced that this program would subsidize up to 70% of the project cost for 294 solar PV projects, representing 643MW of PV power generation.

- In September 2010, China introduced new incentives for solar power demonstration projects developed this year. The plan includes a 50% subsidy for key equipment costs of user-side PV power projects, and 70% for projects in remote rural areas, according to a statement jointly released by the Ministry of Finance, the Ministry of Science and Technology, the Ministry of Housing and Urban-Rural Development as well as the National Energy Administration. User-side projects are those where developers consume the generated power for their own use. The new incentives will also offer 4 yuan ($0.6) per watt for user-side projects, 10 yuan per watt for rural area-based solar power plants, and 6 yuan per watt for building-integrated and residential stand-alone projects. The new incentives replace previous ones under the programs that were launched last year.

FiT developments

- China's National Development and Reform Committee [NDRC Pricing Reg. (2009)1906] issued details of a new FiT program for wind energy on July 20, 2009. The tariffs for new projects were implemented in August 2009. The Chinese wind energy FiT is documented to be differentiated based on four wind energy zones. China could now be joining a growing list of developing countries such as South Africa and Mongolia with feed-in tariffs that share similar design characteristics.
- China has become the first jurisdiction outside Europe to implement wind energy tariffs differentiated by geographic location. Germany, France, and Switzerland have wind energy tariffs based on wind resource intensity. Currently, no jurisdiction outside continental Europe has implemented tariffs for wind turbines on land that are differentiated by wind resource intensity or geographic location.
- Costs of the new program above the cost of coal-fired generation will be split between provincial grid operators and the central government as in current policy.

Renewable Tariffs in China	CHN/kWh	€/kWh	CAD/kWh	USD/kWh
Wind				
Category 1 Energy Zone	0.51	0.061	0.077	0.075
Category 2 Energy Zone	0.54	0.064	0.081	0.079
Category 3 Energy Zone	0.58	0.069	0.087	0.085
Category 4 Energy Zone	0.61	0.073	0.092	0.089

The tariffs for new projects took effect August 1, 2009.

Source: NDRC Pricing Reg. (2009)1906, July 20, 2009. Translation by LBL.

- In addition to wind FiTs, local Chinese governments have created FiT systems for solar projects in certain provinces. For example, FiTs were set at CNY 1.15/kWh ($0.17/kWh) for four solar projects in the Ningxia province in April 2010, solar PV demonstration projects in the province of Zhejiang were offered CNY 0.70/kWh ($0.10/kWh) starting in November 2009 and the Jiangsu Province became the first Chinese province to set fixed FiTs for solar power in June 2009.
- Most recently, in July 2010, China announced that it would set national tariffs for electricity generated from biomass projects at CNY 0.75/kWh ($0.11/ kWh). Previously, China had provincial biomass tariffs, ranging from CNY 0.5/kWh to CNY 0.7/kWh.

Carbon management

- Finally, China has reportedly been considering the introduction of a carbon tax on its coal and oil industries starting in 2012 to help reduce carbon emissions. The Chinese Ministry of Finance (MOF) in conjunction with China's Energy Research Institute (ERI) launched a report titled, "China's Carbon Tax System Framework Design," which analyzed the feasibility of a carbon tax in China, and concluded that such a mechanism would represent the most efficient method of tackling carbon emissions, and should be implemented in China as early as 2012.
- Carbon trading scheme proposed for 2011 – 2015, possibly for one specific industry (such as power or steel).

Challenges

- China faces challenges with building a major electric grid and transmission infrastructure. Some wind assets are being installed without active connection to the grid and remain stranded. A lack of incentives for grid distribution companies to purchase renewable power is also an impediment.
- China's power needs are growing very rapidly. Renewable energies are growing strongly but are starting from a very low base. Consequently, traditional fossil fuel sources (such as coal) are expected China will still utilize a significant supply of coal power. This requires a future focus on such technologies as carbon capture and sequestration.

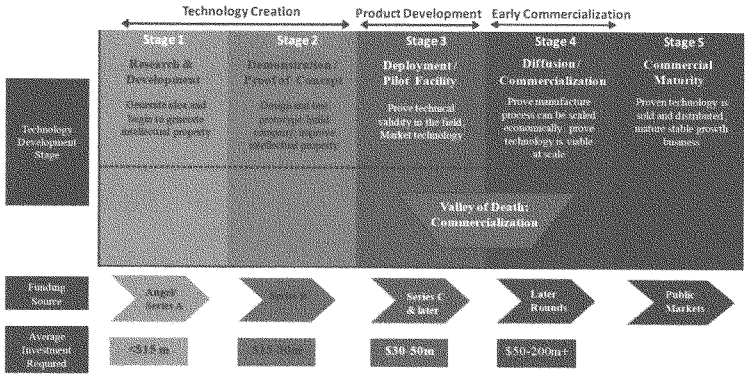
4. Isn't the very nature of venture capital and other investment firms to take risks on new technology? Is it then that firms look to the government for certainty solely to guarantee profits?

Key Takeaways:

- Investment firms look to achieve appropriate risk adjusted returns based on their investment mandate. There are broad categories of investors across different mandates that vary by their position in the capital structure and relative degrees of risk tolerance.
- Renewable energy incentives are policy structures designed to achieve policy goals, one of which may be the formation of private capital in a given sector.
- Well-structured incentives motivate private sector capital off the sidelines by enabling a fair market risk/return to help increase the scale and speed of deployment of technologies, such as lower carbon energy generation.
- Different incentives target different stages of technology maturity, as seen in the different focus of the Section 1703 and 1705 loan guarantees. Other structures, such as a "Green Bank", or CEDA, could provide support for more mature technologies.
- A major challenge for energy technology and first-commercial scale-up investments is the high-upfront capital costs and long-lived nature of generation assets. By definition, the investment / capital allocation decision is predicated on minimizing risk. The lack of energy policy TLC is a significant constraint in many markets.
- Venture capital investing is characterized by high risk investments with high expected returns (>35%). Venture capital has been most successful in industries with capital-light business models (e.g. IT). The capital intensive nature of energy projects (and the challenges of selling electrons which compete head-to head with incumbent technologies run by heavily-regulated monopoly utilities) create challenges for the venture capital model as innovative technologies scale.
- The magnitude of total energy industry investment at the later-stages dwarfs the relative size of the early-stage venture industry.
- In order to achieve successful scale, the energy industry needs to find ways to cross the so-called "valley of death." This is the gap between early-stage venture financing and later stage project financing, and is illustrated in a chart below. Valley of death is characterized as investments which are too capital intensive for VC but too risky for private equity--essentially an asset class that has a challenged risk/return profile. The 1703 program was designed to address the valley of death; though has been challenged. Efforts are needed to either underwrite risk or underwrite return in order to see private investment step in.
- Note also that some government incentives are targeted at laboratory scale and experimental work in Research and Development (R&D). R&D incentives follow in the tradition of the national laboratories and seek to provide funding support for innovative technologies prior to a first-round of financial capital.

Overview:

The Clean Energy Technology Development Chain



Adopted from New Energy Finance and Clean Energy Group. *"Clean Energy Investment Trends,"* November 4, 2009

Source: US PREF, The Clean Energy Deployment Administration (CEDA): A Comparison of the Senate, House and Green Bank Proposals, http://www.uspref.org/white-papers/

- The United States faces several overlapping challenges: creating and enhancing domestic energy security, protecting and growing high value green jobs, and slowing greenhouse gas (GHG) emissions.
- Investment firms seek different risk/return profiles depending on the stage of their target investments. An early-stage venture capital firm might be interested in assuming significant technology and execution risks (investing prior to full proof that a technology will function), while a later stage growth equity fund might only seek to bear execution risk (whether a business can successfully scale and operate using a proven technology).

US DOE Loan Guarantees

- The American Recovery and Reinvestment Act of 2009 (ARRA) is intended to address the severe financing challenges facing the US economy. ARRA has amended Department of Energy's (DOE) Section 1703 loan guarantees of the Energy Policy Act of 2005 by creating $40 billion worth of Section 1705 loan guarantees. The stated goal is to spur manufacturing and construction in the short term, thereby creating jobs, and increase the amount of renewable energy generated in the US in order to address climate change and energy independence concerns. These loan guarantees are limited to commercially proven technologies in the renewable energy, transmission, and "leading edge" bio fuels sectors to be scaled up. July of 2009 added alternative fuel vehicles, hydrogen & fuel cells, efficient buildings technologies (originally covered under Section 1703) to the approved list of 1705 projects and an additional $8.5 billion of available guarantees were made available. $6 billion was originally appropriated by Congress to cover the application costs of the 1705 loan guarantees; however, $2 billion of that amount was diverted to the "Cash for Clunkers" program in the fall of 2009 dropping the credit subsidy funds available to $4 billion. All in, $48.5 billion of loan guarantees and $4 billion of credit subsidy costs bring this program to a whopping $52.5 billion "clean energy" program.

Clean Energy Deployment Agency (CEDA)

- Legislation in both the Senate and the House of Representatives empowers the DOE to create a Clean Energy Deployment Administration (CEDA), which will combine its own mandated programs with those of the existing DOE Loan Guarantee Program (LGP), authorized under the Energy Policy Act of 2005. The LGP's mission has been to provide guaranteed financing for high-

potential projects intended to decrease air pollutants or man-made greenhouse gases; employ new or significantly improved technologies which have a reasonable prospect of repayment. CEDA (as defined in the Senate bill) is expected to be funded with $10 billion as base capital. Assuming that these funds are leveraged 20:1 would expand the low interest rate-funding base to $200 billion to encourage the private sector to invest in low-carbon technologies. Such projects would be more expansive than the current tax based renewable energy subsidy schemes and could in addition to renewable energy systems also include advanced nuclear or fossil energy technologies, and production facilities for fuel-efficient vehicles (although this latter initiative has now been separated out from CEDA). CEDA's goal is to address the innovation gap and incentivize investment in lower cost, more efficient energy technologies.

A "Green Bank"

- A national infrastructure bank modeled in part on the Overseas Private Investment Corporation (OPIC) could mobilize and facilitate capital deployment in renewable energy in scale with the goal of fostering energy security, new industries, job creation and achieving carbon emission targets. As a public benefit corporation, the bank would be structured as an independent, wholly owned US government subsidiary with tax exempt status and an independent board with relevant industry and finance domain expertise. The "Green Bank" would operate in parallel with the existing federal and state renewable energy policy framework.
- The creation of the new Green Bank could help in US energy policy, which at present lacks an integrated planning and support framework and has historically relied on tax subsides versus enhanced credit. Investors and project developers crave certainty in making capital allocation decisions. Reducing risk is important since risk has a price, expressed as the risk premium. Since clean energy deployment is at its core a scale challenge, lowering the cost of capital is certainly an important element. But cheap debt issuance alone even if backed up by the full faith and credit of the US government is unlikely to mobilize large sums of investment. Rather, it is the availability and flexibility of debt capital across a variety of tenures that conform to project specific elements and long term certainty of the capital availability that are key. The majority of the debt should conform to the technical life of the project. Providing these financing products would fill a large void in the US energy sector, providing highly rated hedgable instruments that could enable producers and financiers to dynamically adjust their capital at risk and market exposures by timeframe based on changes in fundamentals.

5. **Clearly, as energy costs rise, the production and business costs increase, which will eventually be passed on to someone. Should investors get less return on the dollar in order to pay the costs of a cap and trade system or pass that cost on to consumers?**

Key Takeaways:

- Cap-and-trade should be part of an integrated low-carbon energy plan, which seeks to adjust the relative costs of various industries to reflect the true societal cost of their activities and thereby change behaviors and reduce emissions.
- As such, it is one of many tools designed to reduce emissions and create capital formation around technologies that help to reduce emissions.
- A price signal is needed to drive consumer behavior, so the program should include a transparent means of sending that price signal to consumers.
- A key distinction should be made between the relatively small amount of capital pursuing venture capital and the very large amount of capital investment required of mature industrial and utility companies.
- For example, the cost of a single new nuclear reactor can dwarf the total market cap of a regulated utility company. These mature companies are seeking government certainty for their long run liabilities as they seek to make investment decisions for the next 20 or 30 years. For this reason, cap and trade programs such as the Waxman-Markey bill included very long lead-in periods to help industry transition. During these periods, companies were effectively "made whole," allowing them sufficient time to plan for the future increased costs of cap and trade.

6. How should nuclear energy be treated under a low carbon regime?

Key Takeaways:

- Nuclear energy will continue to be an important part of the low carbon generation portfolio mix given the stability of the entrenched capital stock. Generation from nuclear is expected to rise modestly, which will make an important contribution to emissions reductions, because nuclear is zero-emissions baseload power running at high efficiency levels.
- Nuclear will be part of a diversified asset mix; well designed policy could support this, such as a federal clean energy standard rather than a pure renewable energy standard.
- High capital costs, long lead times, financing barriers and political risk limit deployment between now and 2020 to just a few units.
- From 2020 to 2030 we expect new nuclear builds to displace some of the older coal plants for baseload generation and to complement natural gas generation for fuel diversity.
- Related to the topic of low-carbon energy alternatives, we believe that a coal to natural gas fuel switch presents a near term and economic emissions reduction alternative.
- The US electric power system is capable of delivering a major reduction in carbon by 2030 with a secure and reliable fuel mix that is based on known technology that can be easily deployed at reasonable cost.
- While both renewable and nuclear energy will continue to play important roles in achieving this, almost an equal amount of the change in the fuel mix and significant amount of the emissions reductions can come from a simple switch of coal to natural gas-fired generation. Of that, much can come from increasing the increasing utilization rate of natural gas plants as old and inefficient coal plants are retired.
- The coal to natural gas switch yields a secure and low cost alternative to coal. Through the middle of 2010 the economics of natural gas have already caused about a 3% increase in generation fuel mix in the past 2 years ended 2Q10.
- In essence by deploying "low risk" fuel solutions such as natural gas and wind and solar in the next 20 years, the power system remains reliable and flexible keeping open options beyond 2030, by which time technology advances unknown today could still prove to be "game changers."

Overview:

- Nuclear energy provides a zero-emission form of baseload energy, which allows it to act as a replacement for many forms of coal generation. However, the technology still faces high costs, technical challenges, and, unless there is policy support, extremely long permitting times, making it a difficult near-term solution. Nuclear will be part of a diversified asset mix; well designed policy could support this, such as a federal clean energy standard rather than a pure renewable energy standard. Examples of this structure have been introduced by Senator Richard Lugar (R-IN).
- While there is no doubt that industry fundamentals in the US for new nuclear development have become more constructive over the past two years with the Federal LGP gaining momentum and the potential for more government support in the 2011 budget appropriation, the barriers are still large. For the nuclear industry to meaningfully scale, much greater levels of government support will be required to de-risk the financing aspect and a national, long term storage solution for spent fuel must be put in place. Given the increasing fiscal deficit in the US, we are skeptical that there will be the commitment on the part of government to fast start a new nuclear build program—ala France in the 1970s—on the order of what would be required to make a large impact from an emissions and energy security perspective over the next decade.
- In the US, we estimate that about 70% of the 104 reactors will be eligible for 20-year life extensions; the rest will be decommissioned after they reach 40 years. The number of safety incidents and the particular technology used are the largest determinants of which reactors will be eligible for license renewals. Another factor weighing in on retirements which may accelerate the roll off of smaller, standalone units is the cooling water intake issue, which could require deploying costly new retrofits.
- The 104 reactors in the US have an average age of 30 years and represented 106 GW of capacity in 2009. In our view, less than half of the 14 plants that have applied for a combined operating license (COL) from the Nuclear Regulatory Commission (NRC) and are currently in the approval queue will move ahead at a fast enough pace to have steel in the ground and deliver electrons by 2020. Therefore, we expect fairly modest additions to the nuclear supply mix with an incremental 6 to 8 plants operational by then. We have modeled 12 GW of new nuclear capacity between now and 2020 split between new builds and capacity upgrades at existing units. By 2030

we expect 126 GW of nuclear capacity, or an incremental 22 GW from today. We expect nuclear energy's contribution to US electricity supply to increase only modestly from 20% of supply in 2009 to 21% in 2020 and 23% in 2030.

- To this end, our forecasts indicate that nuclear can potentially contribute 16% of the emissions reductions potential between 2005 and 2030.

7. Your testimony discusses the feed-in tariff regime established by Germany, yet once those feed-in tariffs are removed, private investment in renewable energy disappears. How long do feed-in tariffs and other government subsidies need to be in place before renewable energy can stand on its own merits and finances? Considering that the United States had a deficit of approximately $1.3 trillion for FY10, how should the Congress fund such subsidies? Cut spending elsewhere or raise taxes?

Key Takeaways:

- As discussed earlier, a well-constructed feed-in tariff will feature degressions that follow module cost reductions, with a target of reaching grid-parity. Feed-in tariffs offer an incentive based on actual performance – payment is only delivered for energy that is actually produced.
- Incentive policies should therefore decrease over time on a path towards grid-parity.
- Funding sources for incentive programs should not be included in the budget. Per our answer to Question 5, the ultimate consumers should receive the price signal necessary to change behaviors, as the new relative costs of different technologies reflect the total cost of the impacts caused by those technologies.
- Over longer planning horizons LCOE of course varies as the relative costs of fossil fuels shift and capital costs that are influenced by technological developments and credit/financing conditions change. Also of note, LCOE does not always capture the relative "value" of a technology over a shorter time horizon. For instance, while $0.15/kWh may be considered expensive versus average electricity prices it could be a relatively low clearing price on the dispatch curve of electricity during a particular day, while even $0.01/kWh would be expensive during a period of curtailment. In Germany, for example, the merit order effect of avoided electricity generation of the most expensive fossil fuel plants is estimated to have saved about €9.4 billion between 2004 and 2006. These electricity savings were due to the proliferation of large supplies of renewable energy from the country's Feed-in Tariff program.
- As an example of non-purely cost driven value, the US military has already extensively adopted renewables for use in conflict zones like Afghanistan, as they pursue distributed generation, which enables them to more easily protect their supply chain. This is an example of the benefits of renewables going behind a simple LCOE analysis of relative costs. For example, by "cutting" the supply chain required to resupply fossil fuel generation, many lives are potentially saved and power supplies from decentralized renewable energy suorces are more reliable in conflict zones.
- Except in the case of Spain, national FiTs in Germany and in Europe generally were passed directly into the rate base, but in the US context this can only take place at the state level.
- Applying the European model is somewhat complicated in the US because electricity is primarily regulated at a state (PUC) and regional level (ISOs).
- If a Feed-in tariff happens at the local level, federal support could still help to fund it. The Waxman-Markey bill saw federal spending being applied to the state level, which is an option to keep some of the cost out of the rate-base. When funds are supplied at the federal level, they will likely have to go through the budgetary process. Indeed the incentives for wind and solar in the US have either run through the tax code (ITC / PTC) or have counted as spending (such as the 1603 cash grant), so what has been done to date has gone through the budget.
- The choice for the US is where do spending or tax priorities occur for the budget at the federal level. In our view, well-designed incentives do drive renewables to grid parity and are therefore temporary and can be seen as stimulating jobs and the economy. For this reason, they should not remain a permanent part of the budget after the grid parity target is reached.

Overview:

- FiTs are no different from the standard utility rate making process and in many respects are much more transparent and easier to put in place than current incentives, which have high transaction costs.
- Prior to renewable energy technologies reaching grid parity the absence or removal of government incentive structures will reduce the amount of investment.

- If tariff amounts are rate-based through to the underlying electricity consumers, then the incentive program will not require new government revenue. If you place the tariff costs into the budget, as Spain indirectly did, then the cost impact can quickly become difficult for government's to maintain.
- Below, we have extracted what we consider to be the key features we would recommend to be included in a FiT, tracked against the key regimes we have examined. It is these features that we believe can deliver TLC at the right price.

FiT Design Features	Key Factors	TLC at the Right Price	France	Germany	Netherlands	Ontario	Spain
Policy & Economic Framework	"Linkage" to mandates & targets	Yes	23% by 2020	30% by 2020	20% by 2020	Halt coal use by 2014	20% by 2020
Core Elements	Eligible technologies	All renewables eligible	Wind, Solar, Geothermal, Small hydro, Biomass, Biogas	Wind, Solar, Geothermal, Small hydro, Biomass, Biogas	Wind, Solar, Biomass, Biogas, CHP	Wind, Solar, Hydro, Biomass, Biogas	Wind, Solar (PV & CSP), Geo, Small hydro, Biomass, Biogas
	Specified tariff by technology	Yes	Yes	Yes	Yes	Yes	Yes
	Standard offer/ guaranteed payment	Yes	Yes	Yes	Yes	Yes	Yes
	Interconnection	Yes	Yes	Yes	Yes	Yes	Yes
	Payment term	15-25yrs	15-20yrs	20yrs	15yrs	20yrs	15-25yrs
Supply & Demand	Must take	Yes	No	Yes	No	Yes	Yes
	Who operates (most common)	Open to all	IPPs; communities; utilities	IPPs; communities; utilities	IPPs; communities	IPPs; communities	IPPs, communities; utilities
Fixed Structure & Adjustment							
How to set price	Fixed vs. variable price	Fixed	Fixed	Fixed	Hybrid	Fixed	Both
	Generation cost vs. avoided cost	Generation	Generation	Generation	Generation	Generation	Generation
	IRR target	Yes	8%	5-7%	No	11%	7-10%
How to adjust price	Degression	Yes	Wind only	Yes	No	No	No
	Periodic review	Yes	No	Yes	Yes	Yes	Yes
	Grid parity target	Yes	No	Yes	No	No	No
Caps	Project size cap	Depends on context	Varies	No	Yes	PV only	Yes
Policy interactions	Eligible for other incentives	Yes - eligible to take choice	Yes	Yes	Yes	Yes	Yes
Streamlining	Transaction costs minimized	Yes	Yes	Yes	No	Yes	No

Source: DBCCA analysis, 2009.

Time frame

- Long term payments are a core principle of basic and advanced FiTs. The timeframe over which generators receive payments for electricity ranges from 15-40 years in the case study jurisdictions, with the majority of payments lasting for 20 years. Germany and Ontario authorize payments for 20 years for all sources except hydropower, which has a term of 15 years in Germany and 40 years in Ontario. Spain provides between 15 and 25 years of payments if generators elect the fixed pricing payments (see Section 5.1.1 below). If they choose a premium pricing scheme, the payments continue for the full project lifetime. France differentiates the most: geothermal, biogas, biomass and onshore wind have longevity of 15 years, PV, offshore wind and hydropower receive payments for 20 years.
- Renewable energy has a long lifetime. From an investor's perspective, a pre-determined contract length is a transparent way of satisfying longevity criteria. Matching the revenue stream with the length (or a substantial portion of the length) of the project life increases investor certainty. Differentiating contract lengths by technology can account for the range in project costs and risks.

Cost reduction

- The overarching objective of most feed-in tariff policies is to accelerate the process of making renewable technologies cost competitive with conventional fossil fuels. In aiming to reach the fine balance of setting strong TLC signals and allowing room for price discovery and market flexibility, FiT policies have introduced several forms of pricing adjustments, the main three types being degression, periodic review and inflation indexing. These adjustments do not change the payment terms of current facilities but affect the tariff rates of future renewable energy installations that have yet to come online. Based on the criteria for identifying a least cost path to grid parity, we feel that the opportunities to encourage future producers to reach grid parity are best achieved through using a degression and/or a periodic review.
- These pricing adjustment mechanisms are transparent and provide a high level of investor certainty. A degression and a set review utilize current market fundamentals to set and adjust the generation cost, which we explain in below as the ideal way to reach grid parity. We recommend establishing a review that occurs at fixed intervals to set investor expectations. If the review is coupled with a degression then the timing between reviews could possibly be more spread out. An approach that could better integrate price developments is the use of a volume cap under which once a volume level is reached, it triggers a review. This system poses risks of speculative queuing and gaming. Transparent procedures regarding how operators get, and stay, in line are essential to minimize reducing TLC.

Degression

- Germany is the only case study country that uses a degression rate for all of its eligible technologies. France uses a 2% degression rate for wind. Under the German system, the 20-year fixed payment amount that generators can lock into adjusts annually. With a degression rate, the later plant operation begins, the lower the payment level the producer receives. Unlike other price adjustment mechanisms, this method is predictable and transparent for investors. Additionally, the degression eventually lowers the FiT payments so that it eliminates them completely. This is unique compared to other FiT schemes which do not have a projected sunset date. Germany uses a degression rate for payments to decrease as the technologies become less expensive to ensure that generators are not overpaid.
- The goal of a degression is to track objective changes in technology costs. Historically, these have trended downward, so a degression attempts to mirror this decreasing trend to ensure that FiT payments continue to target grid parity, while avoiding overpayment. Ontario and Spain, for instance, choose to track objective changes in technology costs via biennial (every two years) and annual revisions, respectively, removing the need for degression. Germany opts for revisions every 4 years instead with incremental degression in between, thereby increasing TLC and providing a longer horizon for investors.
- A degression level is difficult to set because it requires advance forecasting of future renewable energy costs. As the prices decrease and the payment level changes, the rate should still guarantee profitability and cover project costs. Additionally, it should decrease at the same rate that technology reaches grid parity. Exhibit 11 highlights the rates for PV, which receives the highest tariff and the steepest degression. This indicates how far away solar technology is from being competitive and that it also has the most to gain by advancing down its learning curve through economies of scale.

Periodic Pricing Review:

- Pricing reviews vary significantly: France as needed, Spain quarterly for some technologies and annually for others, Ontario biennially, Germany and the Netherlands every 4 years.
- France conducts periodic pricing reviews as under "Material Adverse Conditions" (MACs). It does not have scheduled formal reviews but rather relies on market evaluations and the political desire to reevaluate pricing. Wind is the only technology that has a formal review because pricing is potentially adjusted after the first 10 years of onshore generation.
- Spain's quarterly reviews tie in with its advanced "responsive scheme" for solar PV price adjustment. The government sets out a series of 4 calls for renewable energy projects per year. Calls can vary – i.e. call 1 can be for 100MW PV and call 2 can be for 150 MW PV. Developers then submit applications. If the call is met by more than 75% then the tariff does not change. If the first 2 calls are not met by 50% then the tariff prices increase. With this plan, prices change quarterly, leading to higher uncertainty and creating complications for developers and manufacturers. It causes a start-stop effect because they do not know when calls will occur or when demand has been met. The upside of this system is that pricing rates can be adjusted upwards or downwards unlike Germany's degression adjustment, which only decreases.
- Ontario has replaced a need for a degression rate by mandating ongoing market research to check price development and formal biennial reviews.
- The Netherlands and Germany have the least frequent reviews: every 4 years. While the tariff prices in the Netherlands are variable, the government sets the cap payment levels every 4 years. These reviews establish the range for the tariff payments. Germany can issue reviews more frequently as it is currently doing if sufficient political motivation is present.

Grid Parity Target:

- The main outcome of most feed-in tariff policies is an acceleration of the process of making renewable energy technologies competitive with conventional fossil fuels. This is also known as reaching grid parity and is obtained through price adjustments. The FiT scheme that comes closest to emphasizing reaching grid parity is Germany. Its use of a degression rate so that FiT payments phase out once grid parity is reached. Each regime implicitly factors in technological progress towards grid parity because tariff payments are determined based upon project costs. Incorporating price adjustments allows policy makers to account for the price changes that come with future technological development. DBCCA encourages legislators to formalize their grid parity objective in their FiT policy as a way to emphasize their push to make renewables competitive.

Paying for Incentives

- When governments intervene to accelerate the rate of renewable energy uptake, there is a cost no matter the type of policy. Policy makers must decide who should carry the added cost of a feed-in tariff: the ratepayer and/or the taxpayer. The FiT costs can be passed to the ratepayer, to the taxpayer (individual citizens and businesses), or to a combination of both.
- This choice frequently results in an ideological discussion over which is the most efficient and transparent. Distributing costs among taxpayers is less transparent than ratepayer distribution because it relies on government budget appropriations, which may not actually be appropriated or may be redirected. When the ratepayer carries the FiT the costs, this can directly increase the price of electricity.[1]

- **Surcharge to ratepayer electricity bill (Germany, Ontario, France):** In Germany, large industrial ratepayers can apply for partial exemption with a €0.05/kWh cap on FiT payments and the burden is distributed to the rest of the rate paying population.[2] The added cost of purchasing more expensive electricity is passed onto the ratepayer by incorporating the payments into the electricity rate through an EEG surcharge on the monthly bill. The fee is determined by the National Equalization Scheme, which accounts for regions with larger renewable energy production capacity.[3] For example, Southern Germany has a greater number of installed solar collection facilities which receive the highest tariff rate. Transmission operators may buy more from local solar electricity generators than those in areas with less solar capacity. Grid operators who purchase beyond the national average receive compensation from other transmission

[1] *Recent studies in Germany, Spain, and Denmark have found that wind power has helped put downward pressure on electricity spot market prices (see Sensfuss et al. 2008; de Miera et al. 2008; Munkgaard and Morthorst 2008, respectively).*
[2] *German Government, Gesetz für den Vorrang Erneuerbarer Energien, 2008.*
[43] *Ibid.*

system operators who paid a below-average proportion. These equalized prices are then passed to the ratepayer through the distribution companies.

- In Ontario, any increases in costs will be passed onto the ratepayer in the form of a higher electricity bill. The province takes individual electricity consumption level into consideration and has provisions to help disadvantaged population groups.
- In France, the ratepayer must pay into the Contribution au Service Public de l'Électricité (CSPE), which is raised through a quarterly ratepayer surcharge.[4] Payments are determined annually and help support the costs borne to large utilities for connecting renewables. Large industrial ratepayers are exempted from the surcharge if they produce a portion of their electricity onsite.

- **Charge through taxpayer revenues (Netherlands):** The Dutch Treasury pays for FiT costs directly from its budget (generated by tax revenues). The amount paid is determined by the target renewable energy capacity which the government establishes every 4 years.[5] The budget for 2009 for renewable energy FiT support is estimated at €2,585 million.[6] In this way, taxpayers pay for the FiT and the costs are shared equally without taking individual electricity consumption level into consideration.

- **Combine the charge to ratepayer and taxpayer (Spain):** The Spanish system distributes the cost to both ratepayers and taxpayers.[7] The grid operator initially pays for the FiT costs and passes it along to the ratepayers through an electricity bill surcharge. Taxpayers also contribute because the National Energy Committee (CNE) compensates grid operators should their extra expenses due to the FiT outweigh the revenues they derive from retail electricity sales.[8]

US Tax Equity Market

- Regarding other government subsidies, the tax equity market provided a source of renewable energy financial support until the recession. Entities with tax appetite entered into highly structured flip partnerships in which they received the PTC tax benefits for a defined period of time with the equity ownership ultimately reversing back to the project developer after the PTC value had been harvested from the project. However, given the downward cyclical change in the economy and abundance of net operating loss (NOL) carry forwards, the US tax equity market has effectively dried up since the cost of capital to finance such structures has increased substantially. The ITC cash grant was designed by policy makers to fill the cyclical gap through 2011 under the presumption that the tax equity market will open up again as the economy recovers and companies once again become interested in tax shields.

[4] *BMU, RES Legal Database, 2008.*
[5] *Ron van Erck, "New Dutch feed-in premium scheme "SDE" opened April 1st", 2007.*
[6] *BMU, RES Legal Database, 2008.*
[7] *Gonzalez, Pablo del Rio, "Ten Years of Renewable Energy Policies in Spain: An Analysis of Successive Feed-in Tariff Reforms", Energy Policy, 2008.*
[8] *Ibid.*