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QUADRENNIAL TECHNOLOGY REVIEW
CAPSTONE WORKSHOP
DAY I

MODERATED BY STEVEN E. KOONIN
UNDER SECRETARY FOR SCIENCE
DEPARTMENT OF ENERGY

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P R O C E E D I N G S

MR. HOPKINS: Good morning, everybody. We are going to get started. Good morning. Welcome to the capstone workshop for the Department of Energy's quadrennial technology review. My name is Asa Hopkins. I am a AAAS science and technology policy fellow in Under Secretary Koonin's office, working with him on this project. And I get the legalese.

I want to remind you that participants attending this workshop are not members of a federal advisory committee, nor do we intend to use this group as a federal advisory committee. We are not seeking a group decision or consensus view with respect to the issues before you, or as to any action the Federal Government should take. And we welcome your individual recommendations and advice, and we are looking forward to a productive workshop.

In addition, we note that participants in this workshop should bear in mind anti-trust laws and restrictions, should check with your counsel before engaging in certain activities, such as collecting or discussing non-public data, evaluating public data

about future prices or costs, or discussing topics whose legality you are unsure.

We ask you to refrain from disclosing any proprietary company cost, supply, or price information, or any proprietary company information. And lastly, we want to stress we do not intend this workshop to encourage any specific cooperative activity among participating companies that is not clearly authorized by current law.

So, with that, I will turn it over to Under Secretary Koonin, to get on with the business of the day.

WELCOME

UNDER SECRETARY KOONIN: Thank you. Good morning, and thanks to all of you for coming to this final public event of the quadrennial technology review exercise. This is the first exercise of its kind, at least in memory, that attempts to ask: So, what does the Department of Energy really do in its energy technology programs? What problems is it trying to solve? How does it optimally go about it? And how does it explain all of that to our various

stakeholders?

We start out, of course, with some particular goals. These are administration goals with respect to energy, reducing oil imports, and putting a million electric vehicles on the road in the next four or five years. In the stationary side, enhancing the role of clean electricity in the way the U.S. produces power, making buildings more efficient, and reducing greenhouse gas emissions by about 17 percent over the course of this decade.

As part of an effort to reaching these goals, we have kicked off the quadrennial technology review exercise. We've been at it now for about six months, and I will explain more after our keynote speaker. But let me just lay out for you the high-level goals.

The first is to define and promulgate a simple framework in which non-experts can understand and discuss our energy challenges. I have discovered now, in about seven years of talking about energy to the public, there is a lot of confusion about exactly what the problems are, and how we can go about solving them.

The second is to explain to

ourselves -- namely, the Department -- and our stakeholders the roles that the Department plays, the broader government plays, the private sector, national laboratories, academia, in reaching some of those energy goals.

And then, finally, with respect to the Department's programs, to lay down a robust conceptual framework for what the Department's energy technology programs are, and to make a rough sense of priorities among them.

We are looking for -- of course, as befits a set of scientists and engineers -- sound, techno-economic analyses that can serve to underpin policy, and are pretty clear and transparent logic for the kind of choices that we make.

I should also emphasize that this is not the budget process. The budget process for fiscal year 2013 is going on now across the government. But it is meant to inform the budget process, in terms of a sense of priorities, and also take a longer time horizon -- ideally, five years.

With that, I want to introduce our keynote

speaker, Dr. John Holdren, who is assistant to the President for science and technology, director of the Office of Science and Technology Policy, and also co-chair of the President's Council of Advisors on Science and Technology.

And, in order to give a little more substance to the introduction, I would note that there were two PCAST reports that actually begat this exercise, the QTR. The first was in November 1997 on federal energy R&D. John chaired the panel, Jack Gibbons was OSTP director at the time. And that report made a number of major specific recommendations about energy R&D, but they also recommended that the Department make a much more systematic effort in R&D portfolio analysis, comparing the different options, et cetera, et cetera.

Fast forward 13 years later. A second PCAST report accelerating the pace of change in energy technologies, chaired by Ernie Moniz, who will be here later this afternoon, and Maxine Savitz. John has now ascended to director of OSTP, and that report recommended that the government execute a quadrennial energy review, which would extend across the government

dealing with energy matters, and then, as a step toward that, that the Secretary of Energy execute a DOE component of that, focused on energy innovation, promptly.

So, that is the exercise we are now engaged upon. It is interesting to compare these two reports. First of all, you can see that the title has gotten longer in 13 years.

(Laughter.)

UNDER SECRETARY KOONIN: The second is that the report covers have gotten fancier. And the third is that the number of recommendations has increased.

But a constant in all of that has been John's presence and guidance and wisdom, and so I would like to introduce him now to say some words about the present exercise. Dr. Holdren?

(Applause.)

OPENING REMARKS

DR. HOLDREN: Well, thank you very much, Steve.

Steve and I actually didn't coordinate our two talks, as will become apparent when you notice that he

has already given part of mine.

(Laughter.)

DR. HOLDREN: But I do want to begin by thanking my friend, Steve Koonin, and all of his colleagues at DOE, for the extraordinary work they are putting in on this quadrennial technology review, and I want to thank everybody in this room for coming. I see so many familiar faces, folks that have been tilling these fields for a long time, and sometimes seemingly in vain, in terms of the meager success of our efforts to accelerate energy technology innovation.

But we think we're going to get it done, and we very much appreciate -- the President appreciates, and I know you will hear directly from Steve Chu that he appreciates -- the effort that people are putting in on this.

One of the things Steve Koonin mentioned is that there is a good deal of apparent confusion in the public about the energy challenges we face. I think part of that is because there are so many different conceptions of what the energy problem is. But I would assert that, no matter what you think the energy

problem is, energy technology innovation is a large part of the solution.

Advances in energy technology can reduce the costs of energy end use forms to consumers. It can further reduce the cost of energy services by increasing end use efficiency. It can increase the productivity of manufacturing. It can reduce the dependence of the United States and other countries on imported oil, and it is important to reduce everybody's dependence on oil, because it is a global market.

It can increase the reliability and the resilience of our energy systems, our energy infrastructure, strengthen and sustain United States competitiveness in global energy technology markets, which is, obviously, very important. Innovation can minimize the ecosystem disruption and biodiversity impacts of energy resource extraction, exploration, transport, the whole fuel cycle, reduce the emissions of air pollutants that are harmful to health and property and ecosystems. It can improve the safety and proliferation resistance of nuclear energy.

Innovation can enhance the prospects for

environmentally sustainable and politically stabilizing economic development around the world. And, not least, as I will argue further in a moment, it can reduce the energy sector's contributions to the emissions that are driving the disruption of global climate.

Indeed, I would argue that reducing energy's contributions to climate change is the most demanding driver of all of the drivers of energy technology innovation. It demands the most from us, in terms of the pace and magnitude of the progress that we need to make.

And the reason it is the most demanding driver is a combination of: the potentially unmanageable consequences of failing to adequately mitigate global climate change; the dominant role of the energy sector and the causes of global climate change -- most importantly, of course, via carbon dioxide, methane, and black soot from both fossil and biomass fuels; the high proportion of U.S. and global energy supply that comes from the offending fuels and technologies -- and this is one of the big public confusions.

I think very few people in the public

understand that the United States remains, in 2011, more than 85 percent dependent on fossil fuel for its energy, that the world, as a whole, remains more than 80 percent dependent on fossil fuels -- oil, natural gas, coal -- used in technologies that do not capture and sequester away from the atmosphere the carbon dioxide that their combustion releases.

A further reason that the climate change challenge is the most demanding driver is the set of barriers to new technologies achieving significant penetration in the massive energy systems of the United States and the world, and the long lead times that achieving the needed penetration requires.

And finally, the mismatch between those lead times and the pace of energy system change that adequate climate change mitigation is going to require.

And the sad fact is that we are not innovating fast enough. Today, this is the latest plot from the Department of Energy, Energy Information Administration, on U.S. carbon dioxide emissions from energy supplied. This is from the June monthly energy review. And what one sees is that, notwithstanding

much rhetoric and at least modest efforts, the curve is generally upward. The decline that one sees for a time at the end, of course, is largely economic recession, and not brilliant technological substitution.

It is not hard to see why we are not innovating fast enough, when you look at both public and private expenditures on energy research development and demonstration. This is the public side. This is courtesy of Kelly Gallagher, who is here, and Lara Anadon, the latest DOE budget authority for energy research, development, and demonstration database, maintained at Harvard. And one sees, of course, a big bump in the Recovery Act, the American Recovery and Reinvestment Act in 2009, the money really being spread over 2009, 2010, and some slopping, through clever management, into 2011.

But it is a pretty dismal picture. These are constant dollars, 2005 dollars, not current dollars. And you see, except for that spike, an extraordinary spike in the Recovery Act, we have never gotten close to the level of spending that we had in the late 1970s, notwithstanding that our economy is vastly larger. So

if you had plotted this as a percentage of GDP, it would look much worse.

Of course, the government is not the whole story. Private sector is immensely important in this domain, as well. But the picture there is not a whole lot brighter.

Steve Koonin already mentioned, in giving part of my talk, that the genesis of the quadrennial technology review that we are talking about here today is really a set of reports. I do have to correct Steve on one further point, and that is that the title didn't really get shorter. He left off part of the title of the 1997 report. It was "Federal Energy Technology R&D for the Challenges of the 21st Century," as Don Paul will remember, he was a member of that committee.

This is the cover of the one that PCAST presented to President Obama in -- last November, at the beginning of last November. And as we will go on to say, he liked it. And Steve, too, liked it. And that is why we are all here this morning.

This is a graphic from that report, from the November 2010 PCAST report, just showing public energy

RD&D spending as a share of GDP, which, as I mentioned, looks even worse. And it compares this across Japan, Korea, France, China, and the United States. This is not a terribly encouraging picture, either.

And so, having reviewed again that situation that so many of us in this room have been involved in reviewing every few years for decades, we came to this set of recommendations. This is, again, lifted straight from the report, overview of the recommendations to accelerate the pace of change in energy technologies, including establishing a full interagency quadrennial energy review, of which this DOE effort is the initial trench, if you will. That recommendation, 2.2

We also recommended that annual energy research development demonstration and accelerated deployment funding should increase to about 16 billion a year, 12 billion of that on research, development, and demonstration, the rest on incentives for accelerated deployment, and that 10 billion of that 16 billion should be generated through new revenue streams, rather than the usual budget process, since it

was recognized that, given the budget constraints we face, getting that sort of increase in energy RD&D out of the Congress in the usual manner would not be highly likely to succeed. Realign energy subsidies and incentives, and so on through the list, and specific recommendations, again, to the DOE.

Just expanding a little bit on the recommendation related to the quadrennial energy review, what it is trying to do, again, Steve has talked in slightly different terms about this same set of issues. It is a big challenge. It is a big responsibility. But it is going to be important to get it done again in a way that is compelling, that is clear, that is rigorous, and that can provide the basis for finally moving forward to get the pace of energy technology innovation that this country and the world need.

This is the elaboration of the recommendation on the DOE part of this. And, of course, I love this part that says, "PCAST encourages Congress to use the QER as a basis for a four-year authorization," and I think we would all love it if that happened. The

year-by-year authorization process is one of many thorns in our side in getting this sort of energy technology innovation effort that we need.

The last thing that I want to say in closing my remarks this morning is one of the ways that you can reliably get something done in this country is if you get the President's attention and the President's commitment. And this is PCAST getting his attention and getting his commitment on this report.

You only see the back of my head there, but I am summarizing for the President -- with the help of Ernie Moniz, who is two steps to my left, and Maxine Savitz, who is on the other side, who led this PCAST effort -- we are explaining to the President -- oh, Maxine is across the table, actually, sitting right next to the vice president -- we are actually, in this picture, in the process of explaining the recommendations to him. And, as you can see by the expression on his face, he likes it.

(Laughter.)

DR. HOLDREN: This is important to the President. He knows how important it is to the

country. He has not lost sight of the magnitude of the suite of energy challenges that we face, and the importance of energy technology innovation and getting it done. And so, it really is on behalf of the President, as well as myself, that I thank you all again for what you have been doing and what you will do in this very important workshop. Thanks.

(Applause.)

UNDER SECRETARY KOONIN: Okay. Before we start in on the substance of the program, I would like to spend a couple more minutes setting some context for this day's exercise within the QTR, as a whole.

We have been organizing the thinking and process according to three flows of logic. On the left-hand side of this chart, you see an attempt to lay out the energy landscape, clearly explain the challenges that we have, and lump them according to six strategies that can be used to tackle them, three of them in transportation, starting on the left, having to do with supply, moving through electrification, and then efficiency. And then, on the top, the stationary sector, mostly about power, but a bit about heat, as

well, generation, the grid, and efficiency.

We found these to be a serviceable, although not perfect, way of thinking about the problem. There are some things, for example, like fuel cells that straddle electrification and generation. Electrification of the fleet itself will rely on the grid, which is in a different line. There is combined heat and power, and so on.

Nevertheless, to first order, this is a pretty good way of thinking about it, and we will have two panels this morning that deal successively with transportation and stationary. So, that's about understanding the challenges some of you will have seen in the framing document, an attempt to paint that picture.

If we go over on the right, there is an exercise that is well underway to paint the status prospect's potential, schedule for developing various technologies. There are 19 separate technology assessments that have been written, or are in the process of being reviewed internally in the department that talk about some of the usual suspects, and some of

the unusual suspects, in terms of energy technologies.

Where most of the thinking has gone on -- is, frankly, the most difficult part, in many ways -- is the center line of thinking. What are the roles of the various players? What are the principles by which DOE should construct its portfolio? And then, what are the conclusions, in terms of priorities, and the portfolio, as a whole, that one should draw? And how should those be implemented? How do we balance across these six boxes within a given strategy? How do we balance, and so on, all right? And I expect that that is what we will spend most of our time on today.

I give you a sense of where this meeting fits in the time line. As we have already said, the PCAST report came out at the end of November, and the Secretary of Energy asked me to take this task on in early January. We issued a framing document in March, received a number of public comments. Through mid-June we held five workshops to explore those six strategies. The two vehicle ones were combined. We are now executing this workshop, which is meant to put a wrapper around these five workshops that we have done

already.

And we had planned to submit to the White House OMB for approval a fully completed draft by August, early August. August 5th is the date we are shooting for. There will then be internal White House review for concurrence, and then release for public comment. Hopefully, no later than the end of the year, and more likely in September or October.

One of the things we have been doing -- perhaps unusual in such exercises -- is trying to keep the folks in the various White House councils deeply engaged in this process, as we have been through it, to hopefully smooth concurrence and release of the document.

So we don't have a document yet to put on the table and talk about. But, of course, we have had some -- a good deal of thinking and insights that is what we hope to share today. So let's see if we can go -- let me go back for a moment.

Transparency and outreach. This is important. You heard the analogy with the quadrennial defense review, this exercise. There are some analogies, but

one real difference is that defense is an intrinsically government function, and is managed, paid for, executed by the government.

Energy is mostly out in society. It is the private sector that owns, manages, constructs, operates most of the energy infrastructure. Consumers use it. And so, this is necessarily a much more public process than the quadrennial defense review. And PCAST, of course, recommended that we take input and engage all of the stakeholders.

So, this workshop, which -- is open and is part of that process. I would note that the workshop is also, then, being recorded in various ways, both text -- we have video. If things are working right, we are actually streaming live out to the web. And so we are looking, again, to engage as broad an audience as we can in this exercise.

The agenda is in your packets. I am not going to go through it, only to say that we have formed the discussion in the form of four panels: transportation and stationary this morning. The Secretary will be here at lunch to provide some of his thoughts, and an

introduction to the third panel on technology policy. And then, finishing up the day, balancing the portfolio, with some space at the end for further discussion, and so on.

It is perhaps not the most glamorous subject, a bit nerdy, but in return I can promise you a good deal of substance today. And I think the kind of folks we've got on the panel, and the subjects, I think, you will find engaging.

So, what are we after today? A couple of ground rules. One is that this discussion is about the QTR, the DOE-specific technology review. It is not about a quadrennial energy review, which would be tantamount to a national energy policy. We are concerned with DOE energy technologies, and the policies that are relevant to their development and demonstration.

We are not mostly about basic research, although, of course, some basic research touches on technologies, and hence, will be a subject today. As I said, we are not about energy policy. That is the QER. And we are not about other agencies' activities, except

to the extent that they touch on DOE's agenda.

As I mentioned, in the logic flow we are mostly about the middle stream, the roles, policies, portfolios, principles, balance that should make up the DOE's technology portfolio. We want to expose some of the thinking and the insights that we have had over the last five months, and solicit your comments and critiques to inform the document that we are in the process of putting together.

Before I then turn to bringing up the first panel, let me just note that in the package there is a set of interesting energy charts that are some of the facts that we have been using -- we found useful in putting our thinking together. They are not exclusive or exhaustive, of course, but there are some things you may wish to turn to if the discussion gets boring, or you might find them useful in asking some of the questions or comments that you might have. Okay? Good.

With that, let me bring up the first panel. Well, let me first explain how the panel will operate. We will have a number of people from diverse points of

view who are expert in the subject. We will have the panel open with some words from one of my Department of Energy colleagues. We will then have a discussion among the panel for about 30 minutes or so, and then we will open up that discussion, hopefully in some continuous way, to questions from the floor, and take that for another 40 or 45 minutes, depending upon how time is available.

We have a microphone up here for questions from those of you in the audience. And again, if things are working right, we will be able to take questions from people online.

So, let me start off by asking the first panel to come up. Stephen Brand from ConocoPhillips -- I will just say one word of introduction about each; there are extensive biographies in your panel (sic) -- he is currently a member of the SM Energy board of directors, an advisory board member, and senior executive advisor for Welltec. He is also an advisor for Glori Oil and a senior advisor for Clean Range Ventures.

He was president for a while for Australasia

for ConocoPhillips, and then vice president for worldwide exploration, and senior vice president for technology, most recently.

Andrew Brown is the executive director and chief technologist for Delphi Corporation. He also is a member, and I think still chair -- Andrew is that right -- of BEES?

MR. BROWN: Yes.

UNDER SECRETARY KOONIN: The Board of Energy and Environmental Sciences. And was chair of the Committee on Fuel Economy for Medium and Heavy Duty Vehicles.

Bill Provine is director of DuPont's biochemical science and engineering efforts, and he is responsible for their biofuels research program, including biobutanol and cellulosic ethanol.

And David Vieau is president and CEO of A123 Systems, a leading manufacturer of batteries, and he led the expansion of the company from its creation to more than 1,700 employees, globally.

And then, finally, to kick off the panel, David Sandalow, who is the assistant secretary in the

Department of Energy for policy and international affairs. David just returned from the Midwest, where I have seen pictures of him driving a Chevy Volt around the Indianapolis Motor Speedway. And I heard from his staff that Mr. Electric Car was like a kid in a candy store in that event.

So, David, the microphone is yours.

PANEL ONE: TRANSPORTATION

MR. SANDALOW: Thanks, Steve. And thank you, Steve, for all of your extraordinary leadership on this project, and thanks also to the DOE staff that is doing such a great job on this. And thanks, everybody here, for your participation.

Steve is right, I did, in the service of my country, just drive in a Chevy Volt around the Indianapolis Motor Speedway, which was, I have to say, a lot of fun. And with the instant torque that electric vehicles have, accelerating out of the curve around the Indianapolis Motor Speedway was tremendous. I was accelerating from about 20 miles per hour to 30 miles per hour.

(Laughter.)

MR. SANDALOW: But still, that happened very quickly. So it was a lot of fun.

I think my mission today is to kick us off in this panel, and to do so by really -- by suggesting some of what Steve was just calling portfolio principles. What are the principles that DOE might apply in balancing its transportation portfolio in the years ahead?

And so, let me just throw some out for discussion. These are, in some sense, straw people principles, and I look forward to people telling us why they are right, why they are wrong, how they should be modified.

But let's start out at the very high level. What are our goals? I think we have three familiar goals: accelerating economic growth, enhancing energy security, and improving environmental quality. If you work in the transport sector -- and energy technology is one that is sometimes bumping up against different perceptions of priority among those three goals. But all three of those are important goals, and DOE will focus its technology work in addressing those goals.

In doing so, we will reduce oil consumption and critically diversify fuel sources within the transportation sector in order to achieve those goals.

So, considerations that DOE can use to prioritize technologies include the following. First, infrastructure compatibility. There is today a ubiquitous fueling infrastructure for the current fleet.

Technologies that use or leverage this infrastructure -- electric grid or natural gas networks -- are more likely to be alternatives to the existing infrastructure, or more likely to be adopted quickly, than those that don't. And so, compatibility with infrastructure, potentially an important principle. Fleet operators can choose to develop their own fueling infrastructure, but giving priority in this area is potentially a pretty important principle.

Second, environmental impacts. John Holdren and Steve have both talked about the importance of this. The transportation sector accounts for about a third of the nation's greenhouse gas emissions. You know, should DOE support technologies that emit more

carbon than incumbents, and seek -- or should we seek to reduce other environmental impacts, along with carbon, as a critical priority for our investments?

Vehicle class. This is an important issue, as well. Heavy-duty vehicles, light-duty vehicles are different, to state the obvious. The have different owners. They have different use patterns, purposes, and forms. So, a question for us is how to balance the investment between light-duty vehicles and heavy-duty vehicles, as we go forward with our transportation sector technologies.

Another point here -- and I think I look forward to discussion on this -- technology development is critical in this area, but deployment, per se, may be driven by policies such as CAF□ standards, renewable fuel standards, and others. And so, how do we think about balancing between the role of broad technology -- broad policy, such as CAF□, or greenhouse gas standards in the fleet and renewable fuel standards -- versus technology investments, per se?

As Steve was saying, energy use is out in the world in the private sector. It is in contrast to the

defense analysis, you know, QTR -- a lot of the work we are doing focuses on the broad world, as a whole, in the private sector. And so, these types of policies will be critical, from a deployment standpoint. How do we think about balancing these policies with technology investments?

So, there are at least three strategies, three top-line strategies, for reducing oil dependence, and diversifying our fleet. One of them is -- to state the obvious -- increasing vehicle efficiency. Efficiency is the first fuel in this context, as in -- with stationary sources.

And, in this context, in transportation, there is significant headroom to increase the efficiency of conventional vehicles through improvements in internal combustion engine, variable timing, light-weighting, aerodynamics, and others. DOE is certainly giving priority to efficiency improvements for both heavy-duty vehicles and light-duty vehicles, and that is an important strategy.

Second is electrifying the light-duty vehicle fleet. I drove here today in a plug-in. It's a lot of

fun. I plug in a converted Prius in my garage at night. I get about -- on average -- about 80 miles a gallon as I drive around Washington, D.C., depending -- I have learned you cannot optimize both fuel usage and speed.

(Laughter.)

MR. SANDALOW: So you need to alternate between those two. But by driving carefully, I actually get well over 80 miles an hour -- 80 miles a gallon, on average in town.

So, electrifying the fleet, certainly a hugely important priority, and DOE is investing, in the Recovery Act and other contexts, in batteries, power electronic technologies, and also in research in hydrogen fuel cells, by the way.

And then, finally, deploying alternative fuels -- biofuels, natural gas, and others. Certainly investments in biofuels have hugely important impacts, in terms of balance of payments and other issues.

One point that has arisen in our discussion is that liquid fuels, per se, additional deployment of liquid fuels, don't decouple transportation from global

oil prices. But they have very important benefits, overall.

So, I will just conclude with -- I thought John Holden made an important point in his introduction, in which he emphasized something that is not often emphasized in the dialogue, which is that moving away from oil dependence in all countries is critical. It is a global oil market out there, and so what happens in other countries, in terms of diversifying the fuel fleet, has a hugely important impact in the United States, as a whole.

And with that, I will turn it back to Steve, to introduce the rest of the panel. Thanks very much.

(Applause.)

UNDER SECRETARY KOONIN: So, let me start off by posing for the rest of the panel this question of motivation of the drivers here. We have many different drivers in transportation: balance of payments, price at the pump, environmental impacts. One can go on and on. David mentioned three of them at the highest level: competitiveness, security, and environmental impacts.

We have many different technologies that we can think about that would address these. But many of the technologies don't address them all. And how should we try to prioritize among those goals?

The facile answer, of course, is to say they are all important. But there is no silver bullet here. Or maybe there is. And how do we think about balancing those goals, in particular the Department's role in moving the system toward those goals?

So, I -- we will start with the drivers. And I am happy for anyone to -- Bill?

MR. PROVINE: Well, I think -- when I think about it, I think about overall sustainability as a broad concept here. But really, around life cycle analysis. And if we're not doing something that long-term, you know, benefits the environment, I think we're at risk. So I think keeping the environment and the impact on the environment as a precursor to decisions, I think, is an important framing problem.

And with that -- behind that, I guess -- I would go to diversification and supply. Within that, I think you can deal with the issues such as security of

supply and price dynamics together in that.

I think when you look across the options, from electrification of biofuels, you know, different ones of them, depending on how you go through the portfolio, from energy origin to supply, give, as you said, different combinations. But also, a number of them give multiple impacts.

As an example, of course, we go from clean power through electrification of vehicles. You get both reduction of greenhouse gases, as well as diversification of supply, as well as, of course, biofuels providing that same opportunity. We can go down different paths and maybe only get one dimension of that problem.

MR. VIEAU: Interesting. You are going to find, I think, a diverse set of views on this subject and priority. And that's the reason I think it's a very good question.

Our view is that the issue that is causing the greatest urgency here is the economy, and the economic impact that all of this is having on us, and has had on us for the last 40 years, so that, at the highest

level, the economic impact of the utilization of foreign oil has been damaging our economy. It has put us in a very difficult position right now. We are in a, basically, locked-up mode in Washington, D.C. over the spending that we have had to do, and it has reached a high degree of difficulty for the country to operate.

The second issue for me is the competitiveness that we have, as a nation, our manufacturing competitiveness. We have lost a third of our manufacturing base in the last 20 years. There isn't any indication of that coming back by any normal means. And it is an issue that we have got to deal with if we are going to basically pay our people. We now have pretty close to double-digit unemployment across the country. It's a significant issue.

And we happen to have a problem with independence on our energy sources and national security issues associated with that. Across town they are holding an oil shock wave simulation associated with that problem.

So I think the environmental problem, which I hold near and dear to my heart, is a significant one.

But we haven't been able to get the American public to embrace that. We do have, in priority order, in my view: an economy problem, a U.S. competitiveness problem, and an energy independence and security problem.

And so, the two tools I think that need to be employed here, number one, is innovation, the ability to create a unique solution that will give us an answer to some of these questions, and give us the independence and the economic benefit. But that comes also with the need to hook that into an American competitiveness position, so we can actually rebuild a little bit of our manufacturing base.

UNDER SECRETARY KOONIN: Okay, good. Stephen, and then Andrew.

MR. BRAND: What my thoughts are on this is motivation, and who are we trying to motivate, and who is the end player here. The end player is the consumer.

And what we have to do is we have to get -- you know, competitive, greenhouse gas is all fine. But at the end of the day you have to

commoditize it. And you have an incumbent fuel, and you can buy that fuel at X dollars. If you can't get the new fuels, new transportation fuels, into the system at a competitive price -- maybe it doesn't have to be necessarily 100 percent equal, but if it is relatively close, then you'll be getting to commoditize that.

And so, I think you have to look at who the consumer is. Then you have to get all the inner action with policy -- you know, what policies come into effect. Can you drive some policy? You know, my view is the policy should be, you know, relatively short-term. In other words, over five years.

There is some policy in place that helps progressive fuel forward. But at the end of the day I think you have to look at what the consumer wants out there. It's the same thing the high-tech industry goes through all the time every day, is what does the consumer want out there. Sometimes they are willing to pay more for it. I'm not sure in the fuel industry we would be under such enamoration that that could happen. I think, you know, you have to drive it down.

And so, when we are looking at interjection of fuels in there, and then what you want to work on, is what is it that has the opportunity out there? I kind of look at five criteria -- and I know you have heard this, Steve, from me in the fuels study -- is you have to accelerate technology. You know, what are we doing to develop technology, accelerate, bring it forward from 10 years to 5 years, 5 years to 2 years?

Right along with that is what is the opportunity to reduce costs? And I think that is critical. You know, those two probably go hand-in-hand, acceleration, cost reduction.

And then, from a commoditization standpoint, you have to have scalability, and that can include a number of criteria with -- some criteria within that, such as commercialization, that sort of thing. Then you have to -- you know, there is a knock-on effect, greenhouse gas.

And then, the fifth criteria is a bit qualitative, subjective. What is the realism behind our analysis there, that we can actually do what we're saying? Sometimes we look at something, we get

blinders on, and we say we can do this, and there is not a realism check there.

And so, I think -- you know, my view is you have to have an end game. Who is the end game out there? It's the consumer. Well, what is going to drive the consumer to a different fuel pump, or whatever, out there?

UNDER SECRETARY KOONIN: Before I turn to Andrew, let me just remind people that about 25 percent of our fuel use for road transport is heavy-duty vehicles.

MR. BRAND: Right.

UNDER SECRETARY KOONIN: Which is a different story, I think, than -- well, they have different consumers.

MR. BRAND: Right.

UNDER SECRETARY KOONIN: Let's put it that way.

MR. BRAND: Yeah, right. There is different consumers out there. I mean you have the heavy-duty, the medium-duty --

UNDER SECRETARY KOONIN: Right.

MR. BRAND: -- the light duty.

UNDER SECRETARY KOONIN: Right, right. Andrew?

MR. BROWN: Thanks, Steve. I just want to build on some of Steve's comments. I mean the question was how to address the motivation of the drivers.

And I think many times, as technologists, we approach the answer as technologists. We need to approach the answer as the driver. I mean we have to look at it from the perspective of the value proposition for that driver. You know, Steve said, you know, the end game is the customer in the market.

And so, when we talk about technology, what is the benefit to that consumer, to that driver? And we need to explain the technologies. This gets to your point earlier, Steve, about confusion, about energy, et cetera. And I think a lot of it has to do with the lack of a value proposition that is posed to the consumer, so that they understand that value proposition.

What does it mean to me to electrify my vehicle? What does it mean to me to reduce the

emissions? I mean if we can crystalize the advantage of the technology in terms that the consumer can understand, I think we will do a lot better, in terms of advancing the state of technology, and acceptance of technology.

And another point that Steve touched upon had to do with cost. And, really, it's the issue of affordability. I mean what can the consumer, the driver, afford, in terms of technology? Not only in terms of near term, but longer term.

We talk about electrifying the power train, which is a longer-term strategy, as a consumer, as a driver. That doesn't mean anything to me, because I am paying for my utility, my driving utility, out of my current pocket book. So, what does that mean to me?

And so, I would encourage the Department to try to translate or define the advantages of technology, in terms of the value proposition for the driver. Once we can do that, I think we will go -- get much further down the road.

UNDER SECRETARY KOONIN: I want to turn to the various strategies that we have, but I want to pull on

a thread. I think somebody said the words "foreign oil". And so I would like to tease that apart a little bit, and take you forward to a world 10 or 20 years from now, where we have managed to reduce oil demand through efficiencies.

We have perhaps increased domestic production of oil through EOR, if that happened, to the point where our oil imports -- and we have cranked up biofuels, advanced biofuels, to the point where our oil imports have gone down dramatically.

Would that solve the price at the pump problem? My own sense -- and I would be interested to hear your opinions -- is that we would still be subject to the prices and price volatilities of the global market, because oil is, after all, a global commodity. If you cannot sell it here in the U.S. domestically produced at a high enough price, you will go sell it abroad, or we buy abroad.

David, would you like to comment on that?

MR. SANDALOW: So in this -- in 2000, the year 2000, British truckers went on strike. And they went on strike because diesel prices were rising. At the

time, the United Kingdom was energy independent. It was exporting oil and gas into world markets. But the fact that the UK was energy independent did not insulate its drivers or its consumers from the price impacts of rising global oil prices.

And I think that gets to the question that you are asking. To be clear, reducing our oil imports is a extremely important objective. It serves a variety of extremely important goals, or it would help us achieve a variety of extremely important goals, in terms of domestic competitiveness, balance of payments, a variety of other critical goals. It would not, however, decouple us from global oil prices, or address the price volatility problem.

UNDER SECRETARY KOONIN: Thank you. David?

MR. VIEAU: Yes, I think I will stay with the England theme here. It was Winston Churchill that was once faced with the problem, a dilemma of fueling his fleet, his navy, with coal, which was abundant in England, or with oil, which was abundant around the world. And it came down to this for him. He said that security, and the national security from an energy

supply standpoint, comes from diversity and diversity alone.

And I think this issue that we have, as a global market, is to ultimately create solutions that provide a diversity of solutions, so you're not tied to a single market, and you are not tied to something that has the volatility of the current liquid solution.

UNDER SECRETARY KOONIN: So let me pick up on the diversity theme, and raise the infrastructure issue, and amplify a bit some of the things David said in the form of a question.

At least for LDVs, the fueling infrastructure, the vehicle and the fuel, all go together. They are a system, and have to co-evolve. They all must work with one another. For LDVs we have a pretty ubiquitous -- well, it's not pretty, it is ubiquitous -- fueling infrastructure, in the sense that, as a consumer, I can be pretty well assured of being able to refuel my vehicle wherever and whenever I want. We also have other existing infrastructures -- the grid, natural gas, and so on.

Some of the technologies that we are talking

about can leverage that existing infrastructure. Others require a new build, whether it is the distribution, or the final fueling, or whatever. They require additional infrastructure. Can you imagine significant deployment of multiple LDV fueling infrastructures over the next 10 or 20 years?

And if you can, fine. How do we fund that? And if you can't, how do we down-select from the current multiplicity of technologies that we have that start to deal with some of these problems?

In the QTR, we have -- infrastructure looms large in our mind. Is that the right stance, or are there other ways to get around this infrastructure dilemma? Stephen?

MR. BRAND: Yes, I think infrastructure is very critical. You know, it's been, you know, 75-plus years it's taken to get to the current gasoline infrastructure in place, you know, what we use for fuel, basically what we use for fuel now.

I think infrastructure is a significant what I call pinch point along the value chain. And, you know, what we have to look at are those pinch points, you

know, and what are the values at those pinch points. And each one of the value chains -- whether it's biofuels or whatever, electric, whatever -- each has a pinch point that we have to look at.

And, you know, one of the ways I think, you know, we have to do a critical analysis of this is what are those pinch points, how realistically can we rid ourselves of those pinch points?

You know, when you look at the infrastructure pinch points, that goes back to, you know, my first comments about cost. Well, that's an add-on cost. Somebody has to pay for that at the end of the day. The consumer is probably going to pay for that. So you know, you look at that analysis.

You come back to the value proposition for the consumer out there. How are you going to reduce that cost of that fuel, to get it back to the incumbent? And I think you have to do a very inward-looking analysis on that and say, you know, "This one can do it, this one can't do it," and, you know, it's back to that realism check out there of what can really work and what can't work.

Maybe there are some in the near term -- I'm not saying over the next 30, 50 years -- let's just say 1 opportunity, because I agree that, I think, with the point that, you know, you probably will always have spikes if you have a true commodity market out there. Maybe it's not as severe as it is today, but diversity will help you with that.

But then you have to come back and say, "Well, what's the economics for the producer of those, again?"

And so, it is a vicious circle that we are kind of going through And we have to do some analysis. And you go back to efficiencies. Right now, probably the best thing, immediate, lowest cost, you do efficiencies. Then you look at the next opportunity out there that can come on in, say, the next 15 or 20 years, the next 50 years, et cetera, and what can we do out there, and take a very stepwise, very critical analysis of that.

That is kind of my very subjective thoughts on it. But, you know, you look at it that way --

UNDER SECRETARY KOONIN: So, we will come back to efficiency -- just to allay the concerns of the

panel, we will come back to efficiency in a moment or two. I would like to focus this one on infrastructure. Andrew?

MR. BROWN: The -- I think the issue of infrastructure really -- we need to look at infrastructure for what it really is, and that is, as an enabler to strategy.

I think we need to start by first understanding where we want to go. I mean what are the objectives we want to achieve? What are the activities we want to put in place? And then decide, all right, what are the infrastructure needs to enable that?

Going back to the issue of diversity, okay, of solutions, you don't want to lock yourself in, necessarily, to a defined infrastructure, because you may negate certain solutions. So, from my perspective, you need to start with the solutions you want to put in place, and then decide how do you get there, what is the right infrastructure?

There is another dimension, which is that the infrastructure could, in fact, diminish or negate certain innovation. Because you say, "Here is my

solution set, and everything has to fit that solution set."

I will give you a real world example, near term. Plug-in hybrids, right? When we started designing what that plug-in device was going to look like, there was a range of solutions, right? And we said, really, what we needed to do was look at it from the perspective of the user. And the user said, "If I'm going to use a plug-in hybrid, when I go to church I want something that looks like what I am using today," right? "I want something that looks like that fueling nozzle that I have today." And guess what? The designs have started to emulate that, and then to also -- to mitigate some of the negative perceptions around electric charging.

So, we ended up with a solution, okay, that was facilitated by current infrastructure, but yet allowed for the innovation. And where are we going next?

The next solution set that is being explored from a technology perspective is wireless charging. So, if we had said we're going to lock in to an

infrastructure that is based on a fueling technology, or looks like a fueling technology, would we enable wireless charging, which is the next wave of technology implementation?

So, if you fixate around infrastructure solution, you may negate the innovation that would enable further improvements.

UNDER SECRETARY KOONIN: Very good.

MR. BROWN: So --

UNDER SECRETARY KOONIN: Got it.

MR. BROWN: -- I will leave it at that.

UNDER SECRETARY KOONIN: Good, thank you.

MR. BROWN: Thank you.

UNDER SECRETARY KOONIN: David?

MR. VIEAU: Yes, I think the Chevy Volt architecture addresses this subject in a -- actually, a very clean way. The fundamentals of that design would allow us to move from internal combustion engine driving the wheels to an electric motor driving the wheels, which was to open up, I would call, the infrastructure pass for the supply of the extended range.

So, they put a genset on there that runs on gasoline, but could run on biofuels, that could be replaced by a fuel cell, as an alternative.

Now, the question we would have -- and I think, back to your point, was would we today be building a hydrogen highway to every home because that fuel cell might be there? The answer is I don't think so, because it's not there yet. But it should open up the opportunity for that to occur.

So, if we find that the technology over the next 10 years, based off an electric drive system, brings us to a fuel cell alternative, and we have access to that hydrogen, we have access to it, then I think the infrastructure should be ultimately deployed to do that. But not until it does.

And today, we have got a really strong infrastructure in the electrical system that has been built up over the last 100 years. It works quite well. It is effectively plumbed to all the homes that we've got. You take advantage of that for a starting point, and then go off of that into whether or not we want to go with natural gas as a supply, or we want to go with

some alternate fuel system.

UNDER SECRETARY KOONIN: Bill, do you want to say something about --

MR. PROVINE: Yeah, just to add to the comments here, part of the equation to me is, like, who is going to wind up funding that infrastructure? Almost any avenue we look at, there is some incremental infrastructure. And overall, yes, ones that require the least amount of investment are probably going to be some of the better ones. But as different constituents look at that investment, the return on that investment can be significant.

And the question is, if it's relying entirely on the private sector, looking at where you sit in that value chain is going to be important, and whether that person can get a return on that investment. And as the value gets split up across the value chain, will it drive the investment in that infrastructure?

So, it is a -- who is going to pay for it? And I think an analysis needs to be done on both sides of the equation.

And, two, to not only necessarily look at a

one-stop, one solution for the entire country. I would encourage us to look at potential regional solutions, as well as one-size-fits-all. The U.S., by itself, is a fairly diversified landscape.

UNDER SECRETARY KOONIN: Right.

MR. PROVINE: I think when you look at the Midwest versus California versus the East Coast and Florida, you can find different optimal solutions.

UNDER SECRETARY KOONIN: David?

MR. SANDALOW: Just to quickly make a point on this question with respect to biofuels, because it is very important, and I mean with biofuels, there is infrastructure required that goes from the production to the distribution to the vehicle. We should think of the vehicle fleet, actually, as part of the infrastructure for biofuels.

But this was a very challenging set of problems, when it comes to matching the scale-up of the infrastructure at all three stages with biofuels. And I think one would expect, over the course of a decade or so, that there would be mismatches. You might find capacity in the production that isn't matched by

capacity in distribution of the vehicle fleet, or some other combination. And that could create bottlenecks and challenges.

So, it is a very difficult set of issues, requires discussion --

UNDER SECRETARY KOONIN: So do you all think that there has to be a government role here, in this infrastructure build-out choice, or can we just -- as sometimes the DOE takes the posture -- we just develop technologies, and it is up to the private sector to refine them and deploy them?

Can you imagine any infrastructure transition happening with a more passive government role?

MR. VIEAU: Well, I think that the government role in the innovation side -- to create unique solutions for faster charging mechanisms, wireless charging technologies -- stimulating this is a critical role, to provide a common base of investment knowledge, the kind of work that you are doing here, I think plays a good role.

But I do think at that point, once this -- the fundamentals of it make economic sense, it is up to the

private sector to go out and execute.

UNDER SECRETARY KOONIN: Okay. Let me turn to efficiency. And, as has already been mentioned, it is the perhaps fastest way to get started on some of our goals.

First of all, maybe three questions, and I will let you choose them as you might.

Do you agree? Is there an end point for efficiency improvements? Let's say 55, 60 miles a gallon, beyond which were effectively done? Because, after all -- because we measure it in miles per gallon, it is the inverse of what a sensible engineer would use. And so successive increments have less of an impact as you get higher in miles.

The vehicle industry, of course, has got lots of R&D going on efficiency. What is the right DOE role in helping that, or should we simply leave it to the private sector, under the influence of standards?

What is the sweet spot for DOE investment in efficiency, and how far could we really go, as a society, in pushing the efficiency before one switches to other technical pathways?

So, that's a general set of questions, and I will --

MR. PROVINE: Maybe I will start to tackle them. And I mean, just conceptually at the level right when you speak about efficiency, I think, generally speaking, industry will do a better job at efficiency improvements, as a general tone, than government -- government more in the enablement phase of technology.

So I think that, you know -- and over the course of time, that has proven to be the case. So I would say that -- leave the incremental nature to the private sector to optimize, and work on enablement from a government perspective.

UNDER SECRETARY KOONIN: Okay. I mean just one of the things we think the DOE may have a particular role -- actually, two. One is in light-weighting of materials, and --

MR. PROVINE: Yes, and I think -- I mean in DuPont, in particular, I mean we're working a lot on light-weighting vehicles, and engineering polymers, and I think that's core to our business, which we're going

to do for a variety of sectors.

UNDER SECRETARY KOONIN: Yes.

MR. PROVINE: I do think the support of policy drivers, which you mentioned, are important, the CAF standards, things that are going to drive industry, so you must get to a certain threshold of performance. I think that is critical --

UNDER SECRETARY KOONIN: Yes.

MR. PROVINE: -- to enable. And, again, maybe the first time I will mention it today, maybe not the last time, but consistency in policy. When you look at research and research time lines and creating innovation and delivering on innovation, well, why have we not delivered over the course of time?

Well, one, we haven't had a consistent-enough policy, I think, with the level of funding that sustains that force. So I would encourage us to have a very strong policy base to that --

UNDER SECRETARY KOONIN: Stephen and then David.

MR. BRAND: Yes. Your first point is -- yes, I agree, and have sort of alluded to it already, that

efficiencies are -- should be paramount, because I think that, you know, it is sitting there -- I don't -- there is a lot of technology that is -- you know, probably needs to be done, but a lot of it is all very far along, quite a ways along.

And so, you know, you -- we are looking at deployment, how do we deploy it. I think, from a DOE standpoint, it is not necessarily what you can do on research or, you know, facilitating that sort of thing, it is more about are there some particular enabling policies that can be put in place to help enhance and accelerate it, you know, its further deployment out there.

Because, really, I think you are in the deployment -- large part, in the deployment stage now. And so, what is it that would actually enhance getting it out there? I know there is a number of OEMs they are looking at, and you know, there is carbon fibers, that sort of thing.

And so, there is a significant amount of work out there. And I think it just takes that kind of a little push to move it along. I wouldn't say it's a

great, significant policy issue, but it is just, you know, something to move it along quicker.

UNDER SECRETARY KOONIN: Andrew, in your day job, this must be a big part of your thinking. What can you tell us about efficiency?

MR. BROWN: Yes. In fact, I was waiting for my turn here. Thank you.

I think this efficiency -- I would make two points. The first point is the opportunities that exist in medium-duty/heavy-duty vehicles versus light-duty, there has been a lot of work done relative to light-duty. But yet, on medium-duty and heavy-duty, there continues to be opportunity to improve the efficiency in that sector of the marketplace.

The R&D that has been done has been largely focused on the light-duty side. There has been some on medium-duty/heavy-duty. But I think there is still this opportunity, a great opportunity, in the medium and heavy-duty vehicle arena.

Because, for instance, those vehicles still use almost 25 percent of the transportation fuels in this country. And yet, we are only now starting to

address the opportunity space in that arena.

Secondly, a point I would like to make is that what about the current car park? I mean there is over 130 million vehicles out there on the road. And yet, when we talk about technology, we are talking about new technology, new vehicles. And we need that. But, from my perspective, there are still things that we could do with the existing car park. Take some of the proven technologies that are coming from our ongoing R&D, and translate those into commercial products that can help the average driver improve their fuel economy, to improve their efficiency.

What about having a bolt on hybrid solution for existing vehicles? I mean there are people thinking about that, but yet there is not a lot of active R&D or pursuit around those kinds of solution sets.

If you are talking about reducing our dependency on oil, I mean, doing something with the existing car park that can immediately improve efficiency would get us more bang for the invested dollar than working on two or three generations down

the road.

Something to think about. I am not saying we should stop doing the future stuff. I am saying we should also take a critical look at the existing car park, and what we can do to improve that efficiency.

UNDER SECRETARY KOONIN: And again, to echo some of your previous comments, it will depend on the value proposition --

MR. BROWN: Absolutely, absolutely. I mean what's the investment, what's my return as a user.

UNDER SECRETARY KOONIN: Right. We are about to open up this discussion to the broader audience, but I want to hit one point on biofuels which we haven't talked about much.

How should we -- we, the Department, have been working hard to reduce the costs and improve the economics of advanced biofuels. Should we worry about the broader systems issues, as we think about biofuels? In particular, water use, land use. Are those things that we, the Department, should be worried about? Other government agencies are concerned with that? How does the private sector think about those broader

systems issues?

Bill, do you want to take a crack at that before we open up to discussion --

MR. PROVINE: Yes. I think you have to look at how the suite comes together. And when you look across -- depending on which technology platform you look at, it is a very different prospect. So I think you don't ignore that.

But again, across all these platforms, I think they have similar sort of environmental demands from air, water quality, you know, across the gamut of solutions here, especially as you get into manufacturing and manufacturing demands.

I think with biofuels I would like to say -- it's not to ignore the current realities, as well as the future realities. Today, biofuels, in terms of grain ethanol, sugar cane ethanol, biodiesel, are here today and are in good supply. Ten percent of our fuel supply is already there today.

You know, next generation technologies are about ready to come. Cellolosic ethanol is not a pipedream. We are looking at plant sites today to

build plants for that. You know, drop-in biofuels, biobutanol and other hydrocarbons are well into innovation. The DOE has funded a lot of nice work through bioenergy science centers.

So, I say there is a platform of innovation that -- the supply chain is already there. Say cellolosic ethanol -- so in terms of enabling all those supply chains, we are taking corn off fields today. We are enabling those supply chains. We are piling technology to convert that into effective cellolosic ethanol. We are -- you know, once you get that, getting it into the cars, and the proliferation within the car park.

And that really suggests there is not one size fits all. Again, I get back to diversity of supply. So, getting back to your -- premise of your question, I think the environmental parameters for biofuels are different, but not grossly different, from other technologies that we are speaking about today.

UNDER SECRETARY KOONIN: Good. Thanks. We will have an opportunity to come back to all of these topics, as you all pose questions.

1 So, I believe at this point the floor is open.
2 There are microphones. As you pose your question,
3 please state your name and affiliation. And I will
4 reserve the chairman's right to intervene to try to
5 get -- to maximize information flow as we go through
6 these things.
7 MODERATOR: Not only are we asking everyone to
8 state their names and affiliation, but also, the way
9 that we will manage this is we will -- my colleague and
10 I -- will each allow one question, and then -- from the
11 floor. So we will have two questions. We will follow
12 that with a question from the Internet, and then we
13 will allow the panel to address the questions.
14 UNDER SECRETARY KOONIN: Okay. So we will
15 gang the questions together.
16 MODERATOR: Yes.
17 UNDER SECRETARY KOONIN: Okay, very good.
18 MODERATOR: And we will limit it to two
19 minutes, out of respect for all the other questions
20 that we are trying to address.
21 UNDER SECRETARY KOONIN: So -- please. I had
22 already pointed to the back. Let's do that one first.

MR. MIZERACK: Thanks, Dr. Koonin. I am John Mizerack, I'm with a firm called WSGR. And I am going to be a lot shorter than two minutes. I just want to know if the quadrennial technology review panelist experts have considered -- I want to pick up on something that Andrew said, which I think was actually really important and profound, going forward.

I want to know if you guys have considered the use of stop-start technology for both new vehicles and retrofitting of existing vehicles. This -- three million new vehicles in Europe are already employing this technology, and it is estimated that by 2015, 80 percent of the new vehicles sold in Europe are going to use start-stop.

You know, given the fact that the -- the potential savings of fuel is between 5 and 10 percent. And I know the OEMs and the U.S. are -- I believe, and Andrew probably would know this, as well -- considering it.

So, given that we use 140 billion, roughly, gallons of gasoline and roughly 50 billion gallons of diesel, that would be a lot of savings. And the

ability to scale is in the millions, both for original and probably for retrofitting. And we don't have to spend any federal dollars, I don't think, on this. It's just a policy issue, so --

UNDER SECRETARY KOONIN: Okay.

MR. MIZERACK: That's my question.

UNDER SECRETARY KOONIN: Thank you.

MR. MIZERACK: Thanks.

UNDER SECRETARY KOONIN: All right.

AUDIENCE PARTICIPANT: I wanted to follow up on David's comment about series hybrid vehicles and infrastructure, with respect to fuel cells.

Specifically, unfortunately, fuel cells have been linked with a hydrogen infrastructure, and that is a significant long-term investment. But there has been very limited effort at utilizing existing fuels, or biofuels, in that type of configuration.

So, for instance, fuel cells with on-board fuel reforming, or, I believe even more preferential, would be lower temperature solid oxide fuel cells. After all, Delphi has an existing solid oxide fuel cell that runs off of diesel.

And so, if there was an investment, or part of the QTR which focused on utilizing fuel cells off the existing fueling infrastructure, rather than relegating it to a hydrogen economy, I think a lot of the advances could be made in all three of the transportation strategic aspects.

One, it improves the efficiency by a factor of two. Two, it further advances electrification, because it addresses the range anxiety that people have with electric vehicles. And, three, it is a fuel-flexible technology, allowing for gasoline, diesel, now biofuels in the future, and hydrogen, if we ever get it.

UNDER SECRETARY KOONIN: All right, good. Are we going to do one from the web, or -- okay. We will take a third, and then we will turn to the gang of them.

MR. GRONICH: My name is Zig Gronich, I am a private consultant. While there is an all-out effort on battery electric options, including infrastructure cost sharing and vehicle tax credits, there is no market development activity within the DOE program on hydrogen fuel cell vehicles.

Contrary to popular belief, when you actually do a comparison between a hydrogen fuel cell vehicle that meets the 2010 targets that are already accomplished in the program, and compare that to a plug-in hybrid vehicle 40-mile range, which needs a battery which DOE says will not be developed until 2014, those vehicles are comparable on a cents-per-mile basis, and would competitive in the marketplace.

The industry, Europe, Japan, Korean, China, all see hydrogen fuel cell commercialization activities starting in 2015 or sooner. We presented to DOE a California fuel cell partnership study where they polled their members. And they indicated they would like to provide 50,000 hydrogen fuel cell vehicles, starting in 2015.

Given that information and data, shouldn't DOE be responsive in looking at providing and supporting a hydrogen infrastructure for those 50,000 vehicles? That would amount to about 50 stations with a $50 million investment over 4 years. It can be done within the existing 2012 budget by -- through the techval program, by allocating 4 million of that as the first

increment.

The -- that, in contrast to the budget submission of $224 million for electric vehicle infrastructure, by comparison is quite small. The investment costs for a hydrogen infrastructure cost is drastically different, and is likely to be less than an electric infrastructure, and the result of which technology will be superior down the road, post-2015, is not determined at this point in time.

UNDER SECRETARY KOONIN: Okay --

MR. GRONICH: The question is, should DOE proceed --

UNDER SECRETARY KOONIN: Got it.

MR. GRONICH: -- with a hydrogen infrastructure?

UNDER SECRETARY KOONIN: Okay. So we've got a trio of questions, one about stop-start technology, one about fuel cells that work off of non-hydrogen or liquid fuels, and a third about whether the Department should be supporting an infrastructure investment in hydrogen.

So, Andrew?

MR. BROWN: Yes, I would like to respond to the first set of questions there.

Going back to my earlier remarks about value proposition, things that we could do in the near term to get more bang for the buck, get more return, I mean the stop-start technology, to me, should be a given. I mean it is demonstrated, it is being utilized -- just as the speaker mentioned, it's being utilized very widely in Europe.

I mean, that should be one of the key elements of a strategy, because it does get you the benefit, and it is a lower-cost benefit, from a consumer's perspective, that will show an increased fuel economy.

The other issue, on fuel cells -- solid oxide fuel cells were mentioned specifically that I would like to address -- that potentially can help, I think, on medium-duty, heavy-duty, also for auxiliary power. But yet, there is still work to be done.

So, that is -- even though it is a nearer-term solution, there is still, I think, some work to see the full benefits of those technologies. But again, it is things like that, that -- from not only an energy

efficiency but alternative fuel perspective, that we need to strategize our way forward to maximize their use in an overall strategy.

So, I think very good points on both of those questions.

UNDER SECRETARY KOONIN: Good. Bill?

MR. PROVINE: And just to add, I think -- and maybe -- we have not seen the report, so there is a lot of data. I hope, once we read this report that comes out in August, we will have some justification on this platform or this pathway, versus another.

For example, fuel cells, my hope is how one effectively de-selects any select technology or chooses a better -- with lack to fund it for future innovation relies on, you know, concrete analysis that says why you shouldn't do it. You know, is infrastructure too expensive? Is the technology deemed to be technically improbable?

So, I look forward to reading the DOE's report, and my hope is that some of that information will be in that report.

UNDER SECRETARY KOONIN: We will do our best.

All right.

MR. VIEAU: With respect to start-stop, I do think it is -- I call it a no-brainer. It is happening around the globe. Car companies are either adopting it readily right now, or planning to adopt it on a widespread basis. I think some of the European car companies expect in the relatively near future to have 100 percent of their vehicles -- near future, in the next 5 to 10 years -- 100 percent of the vehicles will be electrified in this way. So it makes sense.

We, as a company, have been developing start-stop batteries. We have a number of contracts with major European auto makers to deliver batteries of this type to vehicles, and it makes a lot of sense.

UNDER SECRETARY KOONIN: What is -- would be interesting, as we go through the next round of questions, is to try to focus a little on what DOE's role should be in all of this.

It sounds to me like start-stop is well out there, probably not much of a role for DOE. Solid oxide fuel cells, that sounds like a more researchy kind of thing, where the technology could be pushed,

and perhaps there is a role for the Department. And then there is the question of infrastructure deployment, which is maybe not so much about technology, but is actually getting it out there.

So, I think these three questions nicely illustrate the range of things the Department could be doing. And the real question is, given the realities of budget constraints and program priorities, et cetera, what are the things we should be doing to maximize impacts?

MR. BROWN: Steve, if I can respond to your challenge on that note, I think one of the things the Department could do is to vet a set of metrics and measures around the value delivery.

I think it would be very important for the DOE to be able to share with the American public what the value of certain technologies may be. And a lot of that are in many of the reports, but they are of such a technical nature, that the average driver couldn't interpret them.

UNDER SECRETARY KOONIN: Yes.

MR. BROWN: We can, right, because we are

technical people. But if you could translate that into a meaningful value for the consumer, I think that is something that the Department can do, number one.

And, number two, more broadly, in terms of strategy, if there were metrics and measures around the value delivery of programs towards the national objective, that is something the Department could do.

UNDER SECRETARY KOONIN: Very good, thank you. Let's take another trio of questions.

MR. FIATO: Yes, I'm Rocco Fiato, I am chief technical officer at Accelergy Corporation. And my question and suggestion for DOE -- and it's borne out of yesterday's series of meetings with Senate staffers, Energy subcommittee people, and the Department of Defense on energy-related matters -- is the most important, I think, impediment to really planning the way forward is uncertainty.

It is uncertainty on all of the issues that the folks have talked about: on what constitutes energy security, what sort of resources you should apply, what sort of peer metrics -- to reinforce Andrew's point, I think, which was very good -- on land

use, on water use. There is a need for removal of uncertainty.

And what I would submit to you is that one of the most important things DOE could do is put together the right programs. There is some recent work out of MIT that I could cite to you that has been very, very profound, I think, in understanding biofuels versus coal-derived fuels, counterintuitive results. That sort of insight, and those sort of programs, I submit, would help everyone find the right path forward, rather than what we tend to do, which is isolated individual programmatic assessments.

UNDER SECRETARY KOONIN: Okay, good. That hit -- let's take the questions, and we will respond.

MR. THOMAS: My name is Sandy Thomas. I have -- in the last three decades of my career, I have been working on hydrogen and fuel cell vehicles. So I would like to bring to everybody's attention a report put out by MacKenzie and Company in 2010 called, "A Portfolio of Power Trains for Europe: A Fact-Based Analysis, the Role of Battery Electric Vehicles, Plug-In Hybrids, and Fuel Cell Electric Vehicles."

And the reason I bring this up, they came to some very interesting conclusions, which I think everybody on the panel should know about, and should be reflected in the QTR.

Number one, they looked at -- by the way, they had inputs from 10 major automobile companies that had proprietary cost information, and MacKenzie and Company concluded that by 2030 the fuel cell electric vehicle would cost less to own and operate than a battery electric vehicle or a plug-in hybrid electric vehicle.

And remarkably, they also concluded that the infrastructure to put in charging outlets for batteries and plug-ins would cost 540 billion euros over the next 40 years. However, to put in a hydrogen infrastructure for the entire EU would cost only $100 billion (sic), 5.4 times less for a hydrogen infrastructure than for the electrical infrastructure for batteries and plug-in hybrids.

And, by the way, you know, one of their conclusions was that the -- 50 percent of all the vehicles in Europe were too big, or traveled too far to be powered by batteries, given advance to lithium ion

battery technology.

I have done some recent research, which I haven't published yet, but I will soon, and I looked at the U.S. car fleet -- which, obviously, we have bigger cars that travel even longer distances -- and I concluded that if we converted every small vehicle in the U.S. to battery electric vehicles, and all other vehicles to plug-in hybrid electric vehicles, that the best we could do, using the Argon national lab model, was to cut greenhouse gas emissions by 28 percent.

On the other hand, if we converted all cars to fuel cell electric vehicles running on hydrogen from natural gas, according to Argon we could cut greenhouse gas emissions by 53 percent.

In terms of oil consumption, the numbers are equally --

UNDER SECRETARY KOONIN: So the report is available online, I suppose?

MR. THOMAS: Absolutely.

UNDER SECRETARY KOONIN: Is that right? Okay.

MR. THOMAS: And I would like to ask you if any of you --

UNDER SECRETARY KOONIN: So is there a question? Yes, go ahead.

MR. THOMAS: My question is, how many of you have read the report?

(Laughter.)

UNDER SECRETARY KOONIN: There is at least one person. Anybody on the panel?

(No response.)

UNDER SECRETARY KOONIN: Okay.

MR. THOMAS: I would highly recommend it. I think it has --

UNDER SECRETARY KOONIN: Okay.

MR. THOMAS: -- direct implication, and I would think the QTR would be very much interested in that.

UNDER SECRETARY KOONIN: Okay, good. Thank you. Want to do another one? Yes.

MS. COX: Hi, I'm Ruth Cox, I'm with Fuel Cell and Hydrogen Energy Association. I would like to thank Dr. Koonin and his team under -- Secretary Koonin, excuse me -- and all of the folks that have opened up the discussion on this subject. I really commend you

for all the work that you've done, and we really appreciate the openness of it.

I would like to just talk about the concept of predetermining outcome in the market. And I think this use of the word "downselection," that government's role should be to downselect, and to make decisions that would preclude the market from determining which technology, what solution is going to best meet their needs, is a very -- one of great concern, not just to me, but to the industries that have invested billions of dollars in technologies that are suitable for a clean transportation portfolio.

So, I would ask that you perhaps consider the role of the Department of Energy and government to be one more of facilitating the options, developing the options, helping overcome obstacles. Because, in reality, the real issue for us, as a country, is that we need all clean energy options on the table to meet our environmental, our economic development, our energy and national security goals.

So, I would just hope that you would consider that in your process.

UNDER SECRETARY KOONIN: Okay.

MS. COX: Thank you.

UNDER SECRETARY KOONIN: Good. Want to take these two? Okay.

So, we've got two or three on the table. One was the importance of comparative analysis, a second was some data and comments about economic competitiveness of hydrogen fuel cell vehicles, and a third was, I thought, a very interesting philosophical point about what is the government's role in supporting a diversity of options versus -- and, of course, we do this all the time -- necessarily making programmatic choices.

To say it crudely, does every technology deserve support, in the spirit of keeping all options open? Or, if the government has to choose which technologies it will support R&D on, how do we make that choice, beyond simply saying everybody's got a birthright?

So, I pose any of or all of those to any of you. Bill, I think you were first, and then David.

MR. PROVINE: Yes, I just wanted to -- the

last one, to me, is a very important comment that was made, is that I do believe, from a policy perspective, there shouldn't be any downselects, the government saying, "This is the wrong way to go," unless they have very compelling evidence and factual information they want to bring to the table and say, "Here is the logic, why we believe."

So -- or, if government is willing to completely fund a particular channel themselves, which I think, at the end of the day, won't happen -- so I do think that, you know, definitely let the markets and industry bring forward the viable solutions. From a policy perspective, don't prevent things from getting to market.

Then you have to say, from the limited amount of R&D funding, is there enough? And I think that is part of the challenge here. Have we brought enough R&D funding -- you know, at the beginning of the day we saw that it was fairly insignificant versus, say, defense, the amount of funding that is being brought by the government for R&D research for energy, with energy being the fundamental building block.

So, I don't necessarily care if that feeds fuel cells or feeds biofuels or feeds clean power, as long as it gets --

UNDER SECRETARY KOONIN: I am not going to let you take that out. All right? The easy answer is to say, "More money for research."

MR. PROVINE: Yes.

UNDER SECRETARY KOONIN: And of course, that is a given. But, however much money you got, you still have to make programmatic choices. And I am looking for how we should think about that.

MR. VIEAU: I find it a unique characteristic of Washington, D.C. that we -- every time I am here someone says, "We shouldn't pick winners, we shouldn't make decisions." Now, it's a problem.

(Laughter.)

MR. VIEAU: I mean we -- actually, in the end of the day, have to pick a winner. I mean we have to decide what we think, collectively. This forum is a great forum for that purpose.

I think that -- I think the idea that we keep our options open -- and then we talked a little bit

earlier about diversity of supply, and for example, the architecture of a vehicle that allows you to have a primary means of driving a vehicle with alternate supplies that can develop over time, whether it be the fuel cell technology that's been talked about several times here, or it be biofuels that provide the best alternate -- or it be some form of energy supply that allows us the extent of range that we want to get, those are open in the future.

But using that particular crutch of not wanting to pick a winner is a quagmire, and it is a problem for us. And, frankly, China has picked a winner, and they are fast at it. And we are in a global fight for competitiveness and for the dollar.

So, I really think that we need to focus on the top few, and let -- leave the door open with a small amount of spending on things to continue to explore, and sort the data, as the original comment that came up, which is I think it's a great function for the DOE to be a clearinghouse for these ideas.

UNDER SECRETARY KOONIN: Andrew?

MR. BROWN: Yes.

UNDER SECRETARY KOONIN: I see you nodding your head.

MR. BROWN: Yes, I think his comments are right on. I mean China has decided they are going HEVEV, they put it into their most recent five-year plan, that's where they are investing.

And yet, we are still struggling, as a nation, as to what our energy policy should be. We have to make the hard choices, we have to make the hard decisions. And portfolio management, which is what this is, is hard, tough, work. And I think the DOE has to guide the rest of us through making those sets of decisions.

Unfortunately, it is a zero sum game. We only have so much money and resources to invest. And that is why I go back to the value proposition. I mean what's our strategy for the nation, and what's the value to be delivered, and how are we going to measure our performance? I think it is those sort of things that, if we could define and get behind and start to execute, I think we would make far more progress.

I know it's not easy, and there are going to

be some things that drop off. But other -- if we don't do that, we are not going to wrestle this issue to the ground, and make progress, as a nation, while the rest of the world is just zooming past us.

So, I think David's comments are right on target. And it is exactly what we need to do.

UNDER SECRETARY KOONIN: Stephen?

MR. BRAND: Yes, I agree with the previous two comments, that, you know, when you are in an R&D world or a business world, you have a portfolio out there. And when you start out, you know, you may be at the large end of the funnel, but ultimately you have to bring it down. And there has been a lot of money spent out there, and we should be somewhere down that lower end of that funnel now.

And so, you know, programs are going to have to make calls. Now, they have to be intellectually honest calls. And that is probably where DOE can fit in. I think Andrew mentioned it earlier, is, you know, you do some of these very transparent analyses of economics, you know, whether it's economics -- consumer economics to the industry, or economics to the nation,

you know, you have that economic analysis. You know, you have the value proposition out there.

And so, you know, I think DOE could probably facilitate or help in that way, and say, "Well, here are some of the options. Here is why we should make some of these calls. And, you know, not everybody is going to agree with them, but at least it is very transparent, it is out on the table.

And so, you know, you can make some -- you know, you can provide and help with some of that communication, if you want to call it that. And so I think that that's one role that the government can look at.

And then you can begin to -- if there are R&D options that, you know, the government wants to get in there, policy options or whatever, then it becomes a lot more transparent to the citizens out there, or the, you know, people involved, as to, well, okay, why are these being made. May not necessarily agree with it, but there is a rationale, a logic behind some of the calls out there.

So, I think that transparency and that

communication would help, too.

UNDER SECRETARY KOONIN: So, one observation -- and see if you all agree with it -- as we think about the future of transportation, the dialogue sometimes becomes confused about some hypothetical perfect end state, and whether it's biofuels or hydrogen or gas, or whatever, as opposed to incremental progress that we can make now to get a good start on some of these goals.

And do you sense that same confusion? Is there a duality there? Do they exist together? How should we think about that? Stephen?

MR. BRAND: Yeah, I think there is confusion. I mean we talk about -- and probably is, you know -- this nomenclature issue, you know, we talk about breakthroughs. I think a lot of the -- you know, and when I think about breakthroughs, that's almost disruptive technology. In other words, you have one technology, and another technology or another business goes out.

I think what we really have to be looking at are the incremental and -- you know, again, why are

these incremental calls being made? Why is it more important to do this? Why is it more important to do that? And, you know, have that facilitated analysis of that being done.

But I think the honest truth is there is a portfolio out there. And, you know, that doesn't mean we're going to necessarily go down to one. I think that is unrealistic, too. But there is some portfolio out there, and then why is that portfolio the one we want to follow the pathway on, and within that portfolio there is a number of options out there.

UNDER SECRETARY KOONIN: Very good. Why don't we take a couple more questions?

MR. MAKHIJANI: I am Arjun Makhijani, from the Institute for Energy and Environmental Research. I have been in the energy policy business, or energy technology business, both since 1970. And I tell people I have grown old and bald doing this.

A couple of suggestions about priorities. The -- I think there should be a framework for setting priorities. And I would suggest that, for land-based transportation, the priorities should be derived from

where transportation connects with the electricity sector. So, a focus on plug-in hybrids and electric vehicles would fall out of that.

But, more than that, I think the reason to do that is we are going to have -- we already have -- quite a lot of renewables. It's the fastest-growing electricity sector. It will make the transition to renewables much easier. We are going to have a smart grid anyway. And it will make that much easier.

I think the immediate thing to do -- I am a little dismayed by how exclusive the focus is on individual cars. I think CalCars is working on an initiative to -- and I am not a part of CalCars, I just know about it -- is to convert existing vehicles to plug-in hybrids. I really like Mr. Brown's suggestions. But we could start with school buses. I think that is a much more important market. It is much more practical. You can charge them frequently. And county budgets are under stress. And I think the numbers look pretty good, if you read the Power and Energy Journal.

The second sort of broad point I would like to make is I am very dismayed to see that aircraft haven't even been mentioned. It's a major -- it's not in the charts, it hasn't been discussed. I think hydrogen aircraft -- Pentagon is doing good job of algal fuels and biofuels in aircraft, but I think hydrogen aircraft, and maybe setting up a center for hydrogen aircraft research in Wichita, Kansas -- the President's grandparents' state --

UNDER SECRETARY KOONIN: Okay.

MR. MAKHIJANI: -- would be very, very important. We know that aircraft can run on hydrogen. It provides a great deal of flexibility. The spilled energy from renewable fuels can be transformed into hydrogen --

UNDER SECRETARY KOONIN: Okay, I --

MR. MAKHIJANI: -- at every airport.

UNDER SECRETARY KOONIN: I think they've got it. Good. Okay. Good.

MR. KEHOE: Michael Kehoe, AAAS. Thus far we have heard from seven speakers and seven questioners. And, unless I missed it, the phrase "public

transportation" has not been uttered once. And so, what I am wondering is, why has that been absent from this dialogue?

And secondly, what can and is the DOE doing, in particular with regard to infrastructure development and technology development, regarding public transportation and its place in meeting energy demands of the future? Thank you.

UNDER SECRETARY KOONIN: Okay. Want to go one more?

MS. RABEL: Veronica Rabel, independent consultant in electricity, energy, you name it.

First, I have a plea. There is no question that you have to do an analysis to be able to construct a reasonable portfolio of technologies. Please, at a very high level, make that analysis simple and transparent. Once you make the top-level decisions you can go into black box simulations. But at the top level it better be very clear to anyone what the assumptions are.

But now, my question. And just to explain the background, I will give you a background for my

question. It looks like just about everyone agrees that electrifying transportation should be part of the portfolio that allows us to diversify fuels for transportation. It also allows us to do a number of other things.

I am not sure I heard that it's -- for the first time we could actually connect renewables to transportation. And I think that is very important, as we are changing our electric grid.

Now, is there a common technology issue that crosses the problem? The first one is, of course, what's in it for the customer? And, in my view, it's the cost issue, which is related to the battery. And are there other common denominators? I think the battery is also an obstacle to addressing both current and future transportation.

UNDER SECRETARY KOONIN: Okay, good --

MS. RABEL: Anyway, so the question is, are there other -- other --

UNDER SECRETARY KOONIN: Other things. Thank you.

MS. RABEL: -- cross-cutting obstacles.

UNDER SECRETARY KOONIN: So we've got three. One is about electrification of fleets as a first step of -- school buses, as an example and hydrogen airplanes. Second is why haven't we said much about public transportation in this discussion. And then the third is what are common cross-cutting technologies.

Maybe I -- ask David -- maybe you want to start just talking a little bit about what the Department is doing in batteries, which are, as was mentioned, an enabling technology across many aspects of transportation.

MR. SANDALOW: Sure. And let me just mentioned public transport, too, to answer Michael's question.

UNDER SECRETARY KOONIN: Good.

MR. SANDALOW: On batteries, Department has an extensive research program on batteries, battery technologies. There was considerable funding under the Recovery Act, which many people here will be familiar with, for supporting battery companies in this country.

And in addition, in our base budget, have supported over the years research in really some of the

most fundamental battery chemistries, including nickel metal hydride, which -- some of the -- that work was funded originally out of the Department of Energy, and lithium chemistries, as well. This is happening in a number of our different offices, including energy efficiency, renewable energy, basic energy sciences, and ARPA-E, which has got some very interesting programs in this area.

And then, on pubic transport, DOE also does have several programs that focus on public transport. I direct you the clean cities program, in particular. And then a number of the technology investments we make may well have application in public transport vehicles.

UNDER SECRETARY KOONIN: Okay, good. Other panel members on any of those three questions?

MR. BROWN: Yes. And my comments are really directed at -- to connect a couple of the dots.

One of the elements that has not been in our conversation, and that is intermodal transportation. And the gentleman had talked about public transportation, even about buses, et cetera.

I think there are opportunities across the

entire infrastructure of transportation. I mean not -- we tend to segregate vehicles from trucks from railroad from public transportation. And I think there may be some intermodal opportunities to reduce our oil dependency by looking across the transportation sector for certain opportunities.

Give you an example that comes from the DOT world, and that is the telecommunications companies are putting in 4G LTE. And it's being driven by our use of our Blackberries. But it also turns out that that protocol could also be used for active safety kinds of applications.

And what does that mean? Well, what it means is that, potentially, we could have vehicles talking to one another that would help avoid the accident, entirely. Now, that is not something that DOT motivated, it is something that's coming from industry, coming from telecommunications. But yet it's an opportunity to achieve one of their objectives. And I would suggest that maybe DOE look to see if there are similar opportunities where things are going to happen anyway that we could leverage to achieve the DOE's

objectives. Just a thought.

UNDER SECRETARY KOONIN: Okay, good.

MR. PROVINE: And maybe I just want to add to the analysis comment, as well, that was made by one of the questioners. When you look at the portfolio question for transport, it's a system-based approach. And my hope here, since we look at this, is what we have failed to -- sort of look at it component by component.

And if you look at any one dimension of any of these problems, you might say, "Hey, this is an easy win." But then, when you look at the whole system play, from the energy origin all the way through the transport, the transport system, and the light-duty vehicles to public transport, that's a great optimization puzzle that we can do well, if we dedicate the resources for it.

So, my hope is, as we get this system information, what are the infrastructure comparisons across the platforms, you know, what is the probability of technology's success, and have a diversified conversation, just not have a government secret meeting

conversation, you know. Engage the broader community in that conversation.

I think we can get ourselves to finally a policy that is comprehensive, but has the maximized -- the probability of success. And I believe, with that low cost competitive aspect, one that adds -- that's what is going to create the jobs, in the long term. Having jobs is the forefront, that's great, and it's a mission, I want that, but you have to be sustainable for those jobs to be there, and be there 10 years from now.

UNDER SECRETARY KOONIN: Well, one of the difficulties in doing that kind of synthetic systems analysis, which I absolutely agree is important, is that, at least within the government, transportation touches on many different players, not only the Department of Energy; Interior, Ag for biofuels, Transportation, obviously.

And so, there is a convening issue there that needs to be --

MR. PROVINE: Well, there is a build-up, right, from the QTR to the QER, right? So, I think,

ultimately, it's how we build up to that QER. It's an important mission here, right? But the QTR -- so there may be the need for some recycling, right, as you go through that process, as well.

UNDER SECRETARY KOONIN: Of course, of course. Very good. David?

MR. VIEAU: Yes, well, I just -- you know, I think -- I live in Boston, and there was a decision about 30 years ago that, instead of putting in a mass transport system of some kind, that they dig big roads under the highway and we would have more access for vehicles to come in and out. That wasn't a DOE decision, as a policy decision. That was something that we make every day when we decide whether we're going to take a bus or drive a car.

I see the DOE role, really, a couple of layers below, enabling technologies that will solve the problems that can be employed in mass transport. The work they are doing in the battery area that has been significant over the last 20 years is empowering technologies that can be employed in school buses now.

And those school buses can be -- we can

execute effectively in the area of electrification of school buses with the technology we've got. And those school buses can be used during the day as reservoirs of energy to help offset shortages in energy supply during the day. And there is technology that is now being developed to do that. And I think, commercially, it's going to make an awful lot of sense.

UNDER SECRETARY KOONIN: Good. I would say one other role for the Department -- and again, I try it out on you -- is not only enabling the development of technologies, but providing sound, technical, economic assessments of various technology options.

Stephen, last comment, and then we're going to have to go.

MR. BRAND: Okay. Last comment. I agree, and I think, you know, going back to your initial comments, Steve, as you have been doing this seven years and, you know, one of the things you've found, it's very complicated. And I think that's, you know, the issue.

And, you know, we talked about regionalization. Well, there is special regionalization, you know, there is regionalization

that was -- in a sense, that, you know, you have different types of vehicles, you have intermodal, whatever. And so, you know, you have this incredibly complex matrix out there.

And, you know, from a DOE perspective, maybe that's where, you know, you can help out in this communication effort, in the analysis effort. And what goes along with David's comment is can you, you know, facilitate that type of approach and provide those types of analysis, go into the analysis, "Okay, it's a cross-government, but can you be the facilitator, can you be the enabler, to make that happen," and that's maybe a challenge to the DOE, is can you take on more of that role, and not just be a research or a provider of policy, or whatever.

UNDER SECRETARY KOONIN: Very good. Okay. We are going to take a break for 20 minutes, and pick up with the stationary panel.

I want to thank the five folks up here for getting us off to what I think is a very good start.

(Applause.)

UNDER SECRETARY KOONIN: For those of you who

have questions that we have not been able to get to, there are two opportunities to get them into the discussion. One is that on the back of your handout there is an email address for public comments. The second is -- and while I can't promise -- there maybe some opportunity at the end of the day for additional dialogue within this room.

So, thanks, and we are adjourned for 20 minutes.

(A brief recess was taken.)

UNDER SECRETARY KOONIN: Let us get started and reconvene for the second panel of the day, which is concerned with stationary energy sector, the grid and heat, or heat and power.

And let me just start by noting that, for those of you who are watching via webcast -- and I gather we are now webcasting, or have been for a while -- you can submit questions via Twitter by HASHENERGYQTR, all one word, HASHENERGYQTR. And we will put that up on the screen in a bit. And we will welcome questions from people not in the room via that channel.

Okay. So, let me introduce the panel members for the stationary panel. Ron Binz, who is the former chairman of the Colorado Public Utility Commission. And prior to that, he was the president of Public Policy Consulting and president of the Competition Policy Institute.

Mark Brownstein is deputy director of the Environmental Defense Fund's national energy program. He is the co-author of "The Carbon Principles: A Set of Enhanced Due Diligence Principles for Investment Banks Considering the Financing of Coal-Fired Power Plants."

Rich Cowart is the director of the Regulatory Assistance Project. He previously served as commissioner and chair of the Vermont Public Service Board for 13 years. And if I read his bio right, I think he is the only person I know who manages a Christmas tree farm. Is that right? Okay.

Mike McQuade is UTC senior vice president for science and technology, also a member of SEAB, Secretary's advisory board. He's had senior R&D and general management positions with technology

development oversight in previous lives at 3M and at Eastman Kodak.

And to get us kicked off is Patricia Hoffman. Pat is assistant secretary for the office of electricity delivery and energy reliability. She has had a long career in the Department as deputy assistant secretary for R&D, and chief operating officer within that office. She has been responsible for developing long-term research strategies and portfolio management in the grid area.

So, Pat?

PANEL TWO: STATIONARY

MS. HOFFMAN: Thank you, Dr. Koonin. As we go on from the discussion this morning, and we look at the goals of environmental quality, economic growth, and enhanced security, the three strategies for innovation in the stationary section of the QTR is focusing on building and industrial efficiency, clean power generation, and grid modernization.

One of the things, as we look at these three components, is it is a system. And as we recognize that, we must continue to strive to balance supply and

demand as we look at the generation aspects, how we utilize the energy, and how we manage energy.

So, on the building side of the things, we have guiding principles and technologies that we want to look at. The technologies have the greatest impact on energy productivity, technologies that increase consumer's knowledge, and technologies that are compatible with the existing infrastructure, because we have to look at the existing building base, as well as look at technologies that advance the future building designs.

Within the electricity generation side of it, of the stationary part of the QTR, we are looking at the clean generation, the clean portfolio, the time lines for introducing that to ensure global competiveness to provide some certainty as we look at investments with respect to generation.

So, technologies that can meet the 3 M's, which we call: materiality, markets, and maturity. Technologies that reduce environmental impacts, and technologies that are need for global and national security.

From the T&D side, what we were looking at is very complex interaction. And what -- we need to make sure that we look at technologies that can actively manage and control the transmission and distribution of electricity, technologies that will enable flexibility in the system, and be able to allow us to operate, whether it's at high voltages, or needs of the customers at the distribution stuff -- distribution side.

And then, finally, the technologies that will eliminate or reduce risks on the system, whether we're talking about cyber security risk or other risk.

So, with that, I am going to leave that as the introduction, and turn it over to Dr. Koonin.

UNDER SECRETARY KOONIN: Good. Thanks, Pat. Let me start out with the goals, as the top of the sheet -- we will get into many other aspects in a bit. You know, the goals, as you articulated them, Pat, are pretty broad: economic competitiveness, environmental impacts, and so on.

Can we usefully phrase narrower goals -- of course, narrower goals usually help you make faster

progress or not -- or do we really need to consider all of those aspects? And Mike, maybe I will turn to you to comment on --

MR. MCQUADE: Thank you very much. So, it's a very important question, I think, and I think it relates to not just the QTR, to the QER. I think it is simply not possible to frame the Department of Energy's goals without taking into account the environment in which those goals have to exist. So, goals around economic competitiveness, goals around national security, goals around job creation are important.

So, basic answer is I think you can't get away from those. But I do think, at the end of the day, on all of the DOE programs, whether they are stationary programs or transportation programs, they have to start with a very clear articulation of what the performance goals, from an energy delivery side, need to be -- levelized cost of energy, including cost, meaning life cycle cost, miles per gallon, all of those. And I think a clear articulation for every part of the portfolio of what the technical performance goals are needs to be done as a baseline underneath that

overarching framework.

UNDER SECRETARY KOONIN: Okay. Other folks want to weigh in on that? Rich first, and then Pat.

MR. COWART: Well, speaking about -- I don't know how frequently we are going to return to this goals question, so I might as well launch right now. I would echo the goals that have been, I think, genuinely widely agreed to. But I would prioritize them.

Two of the goals, I think, are essentially, we would have to say, non-negotiable, and have to have the highest priority. And those would be, is this endeavor accelerating the transition to a lower-carbon economy, number one? And, related to that, equally important, is, does it tend to improve reliability of electric and other energy delivery systems? We know those are, in essence, non-negotiable, and have to have the highest priority.

Energy security is important, but we have demonstrated for decades now that we can compromise energy security by importing so much of our foreign oil, and still get by. And so, even though I elevate that myself as an important public policy objective, it

is one that is somewhat less critical.

And affordability is -- or the levelized cost of energy -- is, obviously, a very important goal, particularly if we include the benefits of energy efficiency as part of the portfolio. But simply stated, the levelized cost of energy on the supply side, as an input, ought not to be elevated above those other goals.

And I say this with some humility, as a former state regulator who is -- who paid a great deal of attention to the cost of things. And I still would pay a great deal of attention to the cost of things. But it would be a false economy to elevate short-term price reductions above long-term reliability, or the necessity, frankly, to make investments now to make it possible to transition our economy to a more sustainable and low carbon economy in the future.

UNDER SECRETARY KOONIN: All right. Ron, you have been in the regulator seat for a while. Does that sound about right to you?

MR. BINZ: All right. One thing that did not make it into my introduction, because this is

relatively new, is I am now the senior policy advisor at the Center on the New Energy Economy. That is a center at Colorado State University, which is headed by former governor Bill Ritter, from Colorado.

One of the things that we start with as a proposition is that there is a coincidence of interest when you develop a low carbon or clean energy economy. You get jobs, you get independence, you get diversity and supply. That's what the State of Colorado has learned in four years. That was the largest growth sector in our state, in terms of jobs and economy.

So, the relevance to the question on the table here is I don't think we need to make these goals of energy independence or goals of economic development and job creation explicit high-level priorities. I think the priority must be decarbonization to the electric sector. And those others will travel with those. They come with.

So, my focus -- and I will make this point repeatedly, to the point where you won't remember anything else I said today -- the Administration's goal of cutting carbon will assume, or take over, the other

goals because they will simply be corollary outcomes of that chase.

UNDER SECRETARY KOONIN: Okay, Mark?

MR. BROWNSTEIN: So, if Binz is going to repeat that theme all morning, I can just sort of kick back and sip coffee and just listen.

UNDER SECRETARY KOONIN: Okay.

MR. BROWNSTEIN: Because I --

UNDER SECRETARY KOONIN: We would all appreciate that, Mark.

(Laughter.)

MR. BROWNSTEIN: -- I wholeheartedly agree. But let me just add one -- because I do think the notion of environmental quality is important, and I think it is very important to -- I mean, in setting up goals, I think it's important to be as specific as possible.

So, environmental quality is a nice sentiment. But where the rubber hits the road is really decarbonizing the economy.

But with one, perhaps, amendment to that, and I will phrase it this way. There needs to be a Pareto

principle, as it applies to low carbon, okay, which is that you want to maximize carbon values without making other environmental issues worse, at a minimum.

Ideally, you want to improve other environmental performance metrics as you go. But, at a minimum, you want to make sure you're not making things worse. A good example of this is some of the gas production debates that we've been having in the country, where you're hoping to maximize the greenhouse gas potential of natural gas, but that you have to be very attentive to the real possibility that you are making other environmental issues worse in the process.

UNDER SECRETARY KOONIN: Okay. So, good. What I would like to do is now focus a bit more down on what does DOE do. And I will start with the generation side. We will get on to grid inefficiency in a while.

The Department supports many different clean or low carbon generation technologies. And it is a renewable collection of wind, solar, geothermal, hydro, on to nuclear and on to carbon capture and storage -- I probably haven't listed them all.

But about -- if you look at the chart at the

back of our packet, about half of our R&D funds go to clean electricity R&D. We, the folks who are involved in trying to write the QTR report, are having a hard time understanding how we should prioritize or differentiate among them. And again, more money would be wonderful, but the money is always finite, and so some sense of prioritization needs to happen.

I wonder if any of you can help us try to understand how we should think about how we balance the different technologies on the generation side that we are trying to support. For example, is LCOE -- levelized cost of electricity -- the right metric? Are there other metrics that we should be thinking about?

You mentioned other environmental impacts, which is an interesting way to phrase the problem. How else should we think about segregating or categorizing our research portfolio?

Richard, I saw you nodding, so go ahead.

MR. COWART: Well, the first thing that -- I will sort of echo Mr. Binz here, in that there is something that we constantly say in our work, which is

efficiency first. That is, energy efficiency, or improvements in productivity are the engine of growth in our economy. And so, we should be constantly looking for ways to increase the -- you know, source-to-sink efficiency of energy systems.

And that is a guiding principle. That actually goes maybe to your next question, one you haven't asked yet, which is how do you balance investments in the supply side, versus investments in grid --

UNDER SECRETARY KOONIN: Good, good --

MR. COWART: -- and demand. But -- and I think, frankly, the portfolio of DOE current -- looking at the chart you just referred us to, that portfolio suggests that we are under-investing, relatively speaking, in grid, and also in end use energy efficiency. That has been the case at DOE for a long time.

But now, to come back to your question about the supply side, here are a couple of principles which I would apply.

We don't really have the luxury right now of

waiting, or investing our money in third and fourth generation technologies that aren't near term. We need to demonstrate progress pretty quickly, for a variety of reasons. And I will go through them.

For one thing, we need to avoid the lock-in of and the future costs associated with building and investing in the wrong supply-side generation now. And so, anything that helps us to avoid those wasted assets a decade from now -- and also the carbon emissions that would be associated with them between now and their retirement -- seems to me to be a really important criterion.

Second, I would look at the cost per ton of emission reduction as a factor, not just cost per whatever, but cost per ton of reduction. And that's another thing that leads me to focus on efficiency in grid, because those investments can provide, I think, very significant benefits, according to that criterion.

And finally, let me say that I think that it would be good for the Department of Energy to sort of follow what I'm gathering is sort of the advice of this panel already, that decarbonization is a good

organizing principle, for the reasons that I agree completely with what Ron Binz said, that these other public goals come right along with that.

And so, by asking ourselves, "How good a job does this portfolio do in getting us to a world in 2050 that we, as a nation, really want to be in," it's just the President's goal. And that is a pretty good organizing principle.

UNDER SECRETARY KOONIN: Okay, good.

MR. COWART: I have been doing a lot of work recently in Europe. Previously I worked for three years in China. And I can tell you that in Europe and in China, if we were having this conversation, they would have organizing principles for how to spend public monies on R&D. And it would be the principles that we have just been talking about here.

UNDER SECRETARY KOONIN: Okay, good. Ron?

MR. BINZ: I think very closely related to that is something which came up in the last panel, and this notion that DOE needs to not pick winners. I want to be very careful how I say this, but it's not true that every possible alternative is equally probable or

equally desirable. And I think it is appropriate for government to have a point of view on this.

I happen to agree with the point of view, in large part, that Richard just announced. One of the things you should be looking at is not picking winners among the contestants, but what sorts of things are likely to end up in the 2050 portfolio?

There is no doubt that efficiency will be there, just no doubt at all about it. It's the least cost, and, as was pointed out, I believe, in John's comments, not just a clean source. The cleanest source. There is no possibility of something being cleaner, I think, unless it's carbon negative, perhaps. And so, that has got to rise to the top.

The next thing I want to say -- and this will probably collide a little with what Richard just said -- I think that prioritization of these should not only look at the 2050 portfolio, but also consider the timing of decisions about technology.

And here I am going to turn to the theme of the use of fossil fuels. I don't think we know, in 2011, whether combustion of coal and natural gas is

1 going to be in the 2050 portfolio. We don't know that,
2 because we don't know if carbon can be captured and
3 sequestered. And that has got to be an early decision.
4 This is what -- this is called a capstone
5 meeting. This is a keystone issue, because the
6 challenge of putting together portfolio with and
7 without the assumption of significant amounts of fossil
8 fuels is completely different, depending upon how you
9 answer that question. All the discussions about
10 natural gas as a preferred fuel today for coal, those
11 discussions blow up if you have to assume that you
12 can't capture the carbon of natural gas.
13 If you converted today's coal fleet to natural
14 gas overnight, you would reduce U.S. carbon emissions
15 by 30 percent. A great number, but not 80 percent.
16 So we've got to get early to the fundamental
17 question, in my view, of CCS. And that will be one of
18 the reasons I support its elevation to near top of the
19 technology choices that the DOE is going to have --
20 UNDER SECRETARY KOONIN: So, you vote in the
21 question of time scale -- and maybe I'll break to
22 that -- I mean the history over the last decade or so

is that we have put in less than 20 gigawatts a year of capacity in a system that's got a terawatt of capacity. And if you actually count electrical generation, since the capacity factors -- less than, typically, for gas or other technologies -- the actual generation that we're adding is a pretty small fraction every year, one to two percent.

We are talking about massive changes in the system. Is there anything other than a carbon price that's going to drive the kind of change that you're talking about, given the historical time scales that we have been operating on? Mark?

MR. BROWNSTEIN: Well, so here is the thing. You know, my sense is that, I mean, we are dealing with a electric utility infrastructure that, by and large, is at the end of its useful life. Okay?

So, I don't look at this as a question of, you know, what do we need to do to stimulate capital stock turnover. We are going to get capital stock turnover. And the only question is, are we going to get smart capital stock turnover, or are we going to get stupid capital stock turnover? Okay?

And so, I think one of the reasons why it becomes so important, therefore, to have an organizing principle for what you want to see, decarbonization of the economy, is you can begin to condition investment expectations, you can -- that are already out there.

But let me take a step back, Steve, and just say that, you know, any conversation about energy policy tends to bring out the Soviet central planner that lurks within us all.

(Laughter.)

MR. BROWNSTEIN: Admit it. It's in there. You all are there. Okay?

I think that the value of this conversation is not to wax poetic about energy policy, but to think very -- in a disciplined way about what the Department of Energy can do. And something I haven't heard yet today, but needs to be said, what the Department of Energy can do, assuming that federal budgets will be smaller than they are today, opportunities for subsidies and tax breaks will be going away.

The organizing conversation in this town for the next 10 years is going to be about the budget and

debts and financial discipline, which is what makes this exercise so critically timely, because we are doing to be doing less -- more with less.

And in that context, therefore, I really do think -- as Ron was beginning to suggest -- you need to think about this in terms of some critical path questions that need answers. I agree with CCS, not so much around the issue of how you extract the carbon dioxide from the flue gas. But, frankly, the real question is, do we understand the geology well enough to be able to sequester? That is a critical path question.

We know that in the next 20 years we are going to retire our entire nuclear fleet, which comprises 20 percent of the nation's electricity today, and a substantial fraction of our low-carbon electricity today. We need to focus on answering that question: What is going to replace that fraction?

We talked a lot about batteries in the last panel. I think battery technology is a critical path set of technologies, as it relates to not only integrating renewables into the system, but, as we

heard, transportation.

So, I think that if you begin to think about, in practical terms, what are some of the key challenges, and then try to focus DOE resources on answering a few sort of key strategic questions, you've set yourself up well for the --

UNDER SECRETARY KOONIN: Okay, so --

MR. BROWNSTEIN: -- for the future.

UNDER SECRETARY KOONIN: So I'm hearing more short-term than long-term. Mike?

MR. MCQUADE: So yes, but maybe with an additional thought.

So, two points. One is you just a minute ago asked a brief question about is -- LCOE or a cost on carbon. I think a cost on carbon is something we will come to grips with. I think in the shorter term, over the next 25 years, the bigger issue is not going to be the cost on carbon, it's going to be cost on oil. And I think, as a driver for the investment stream that is going to go, once we get to a point where we understand that we won't live in a world of $80 a barrel oil in perpetuity, then I think that will change the

investment side.

Let me go back -- take a step back to this whole issue of organizing principles. Keep this on the generation side for a moment, we will get to grid and other things. But I think the -- for DOE, I think there are some critical conversation that needs to happen, and they range around the issue of what is the end state we desire in the 2050 time frame, into the nature of the energy supply. So the issues around what the decarbonization content is, the issues around those kinds of things.

But there are also issues around how distributed we want generation to be, how diversified we want generation to be. We have talked about the energy supply system as a complex system, and that leads to fundamental questions about how diversified we want to ensure robustness in the system. And I think having a picture of that is a necessary step to be able to say, then, "These are how I will trade the various metrics for investment."

So, I have to have an end state in mind of some kind. Once I do that, then, at the technology

level, I can then establish what the performance criteria are at the technology level.

And then, from a prioritization point of view, I bring two attributes to the table. One is forget the end state of LCOE or some other vector. One metric that I bring to the table is what is the scope and scale of the DOE investment in that technology, over time. And the second is what is the time delivery of various technologies, because in the time frame we're talking about we've got to do things both on the short term and the long term. And a balanced portfolio that takes both of those into account has to drive the prioritization decisions along the way.

CCS is -- mean we can all sort of swear and believe that if we can get there -- and I don't mean that in a negative way -- we can get there. But the time frame on which that will happen is a time frame that is long enough that forces us to have to consider solutions that may exist between now and when that time frame comes to bear.

UNDER SECRETARY KOONIN: Good. Rich?

MR. COWART: Well, I would like to answer

directly your question about a price on carbon. You asked, "Is it the only way to get there?" I mean the clear answer to that is no, it's not the only way to get there. And we have already really demonstrated that through a variety of public policy mechanisms throughout the United States.

The renewable fleet that we have today has been growing because of renewable portfolio standards. The efficiency investments we have today are because of the efficiency requirements and appliance standards.

There are plenty of things we can do while we're waiting for the day that we have an indicative carbon price that might help us accelerate progress. But waiting for the carbon price would be -- I was about to say just foolish. Maybe I can't think of a stronger word --

UNDER SECRETARY KOONIN: Okay, okay, okay.

MR. COWART: The -- at the --

UNDER SECRETARY KOONIN: So -- good.

MR. COWART: I will say that if there were a carbon price of some kind, the most important thing to think about doing with that price is to target the

revenue to strategic investments in efficiency renewables, grid enhancement, what have you, because the revenue is many times more --

UNDER SECRETARY KOONIN: Okay, good.

MR. COWART: -- powerful than the price signal, itself.

MR. BROWNSTEIN: Yes, and let me just add on that. I mean, again, what can DOE do? DOE is not unilaterally going to impose a carbon price. We may -- some of us might like it to be so, but that's not what you're mandate is. Okay, but what your mandate is is to work to facilitate the development of technologies that can deliver on a low-carbon future.

States may very well be taking the lead for the foreseeable future, and setting actual policy direction. The question is, what can DOE do to help support and facilitate? And there we go back to the questions of, you know, some of the big-ticket items that need to be worked on and resolved, and what can DOE do to facilitate both the research and development of those technologies that are enablers of that low-carbon clean energy trajectory.

UNDER SECRETARY KOONIN: We heard in the previous panel that, for transportation, at least among the LDVs, consumer choice, consumer economics, likely play a very big role. Here, for generation is it not directly the consumers, but there are boundary conditions in economics. Many people believe that the U.S. will be, for the next several decades, awash in cheap gas. And gas is, in fact, pretty low at the moment. Many people believe it will stay low.

How does that possibility change, if at all, what the DOE should be doing to foster clean energy?

MR. BINZ: Okay, here is number three time repeating this. Colorado just made a pretty interesting decision while -- the last few months that I was chairman, and that is that we decided to authorize the closure of about a gigawatt of coal capacity, and replacement of that with natural gas, for the most part.

We had some other brackets around that, namely a long-term natural gas price contract, which tends to mitigate the concerns about -- at least on the next 10 years -- the increased cost of natural gas.

We did that, I think, because we knew -- first of all, we were told by our legislature to act in a way that made sure that the electric utilities regulate. We're going to be in conformance with known and reasonably knowable EPA regulations. So that was our -- it was actually criteria pollutants, which were probably driving us, as much as anything, although we did consider carbon in this.

Where I'm going with this is that we, after looking at this, decided to make a move towards natural gas. But all through this proceeding -- and I think this was true of all my colleagues in NARUC -- we know that that will be only a bridge, unless that carbon coming out of those CCCT's is captured.

We just installed plants which probably have a 30 or 40-year life -- with retrofits, even longer than that -- so we actually were installing 2050 plants, knowingly -- knowing, doing that.

So, I think that I am a firm believer in moving as soon as possible in reasonable ways -- and this gets to efficiency, as well as fuel-switching -- to begin to lower carbon.

I mean just to tell you what that decision of ours did, it authorizes Accelergy to reduce its Colorado carbon emissions by 26 percent over the year 7 years. So we actually will be -- and we're a coal-based state, let's be clear, Colorado is the seventh largest coal-producing state in the country. So we actually made an explicit move that will cut carbon 26 percent. That's not 80 percent. We've still got all of that in our sights, as well.

UNDER SECRETARY KOONIN: Okay. I want to shift to efficiency, the other end, then grid, briefly, and then I want to open it up.

Let me just open on efficiency. As we have gone through the QTR process, one of the things that has impressed us is the lack of hard data on energy use patterns. And a symptom of it is that if you look at the Sankey diagram, the energy flow diagram that we have included in the packet somewhere, the inefficiencies of the residential, commercial, and industrial, the fraction of energy in the box that is listed as rejected energy, is exactly 0.20 for each of the 3 boxes -- to 3 digits, right?

And you know, no disrespect on the people who put that chart together, but somebody guessed, all right?

And you know, I come away from that, as a scientist, saying we need more data. And is that an appropriate thing we should be doing in the Department? Do we need programs for that? What kind of data do we need, et cetera?

Mike, since that is part of your day job, I will turn to you, first, for that.

MR. MCQUADE: Thank you very much. So, yes. I think this -- there are several key roles on the efficiency side DOE, I would say, certainly can and should play.

So, we all work the numbers, and they have a set of assumptions in them on buildings. And to the dialogue we have had up until now, if those numbers have any voracity, this is, I would argue, one of the most important places that we need to be investing, in delivering the solutions.

But we also need voracity on the numbers coming in. And that is a very clear role for DOE, both

in the technology development, to report those numbers, in the accumulation of national databases.

I would argue it, then, triggers over into the second role DOE can play, which is related to standards and regulatory policy, and the delivery of that information in a transactional nature.

So, the deployment of that information during a sale of a piece of property, the ability to go in and look at energy performance in a building. I think that is a very large role that DOE needs to play.

UNDER SECRETARY KOONIN: Okay.

MR. BROWNSTEIN: So, this is a critical issue, from my perspective. You not only need better information to inform better policy-making, but what we find, based on our experience through the Eastern Interconnection Planning Collaborative, is that we need better information so that utilities and grid operators can make more intelligent decisions about how to operate the system, number one, and how to plan better for the system.

Because right now, I would argue that some of the more interesting and exciting innovations in energy

technologies are happening on the distribution side of the system: demand response, various forms of DG, various forms of energy storage, electric vehicles.

And yet, our current analytical tools for planning and operating the grid sort of treat that whole universe as terra incognita, you know? There be dragons over there, right? But we don't really know much about them.

UNDER SECRETARY KOONIN: So, Pat, do you want to comment on that, since that is part of your responsibility?

MS. HOFFMAN: Yeah, actually, I want to try to pull some of the pieces together. I mean we talked about time line, but what we're talking about is keystone decisions and information that we can build upon.

And the criticality of this is the information requirements that, as we build upon a better understanding, we can decide where the next generation of decisions, you know, and the logic structure, should come from. We can look at the prioritization. And some of that has been learning of -- the biggest

opportunity, at least from the grid side, is looking at the investments on the distribution side. That was built by some of the data that came about from the planning studies, from the installation of sensors and meters on the system.

And so, we started saying, "Okay, now that we have this information, we can really target, near term, what do we want to go after, but also what do we want to build upon, as we go towards the 2050 target." And so, two things. Near term, but also a set of decisions that we can go after for the long term.

UNDER SECRETARY KOONIN: Mike?

MR. MCQUADE: I think this is sort of a classic place for DOE, because at the core there is a set of technologies that DOE can help enable. There is a market that will grow with that set of technologies for delivering information solutions.

But there are two aspects of this same problem that grow off of that base. One is the information that is available for policy, for consumer decisions, for what I would say -- non-real-time purchase and planning decisions. But how do we link that same

underlying technology base to the real-time information flow that allows us to manage the grid in an intelligent fashion?

And the DOE role, in my opinion, is, at the base, underneath both of those, what is the enabling technology in sensing measurement analysis that could allow both of those sides of the market to grow?

UNDER SECRETARY KOONIN: I would agree. But we also heard during the QTR discussions that DOE's informational role on the grid for utilities, for grid operators, and our convening role, the ability to pull the great diversity of grid stakeholders, authorities together, is also very valuable, quite apart from the technology development itself.

What I would like to do is -- perhaps a little bit earlier than scheduled -- just start to engage you all now, and begin to take questions from the people in the room, as well as the people out there in cyber space.

I remind you again, Twitter HASHENERGYQTR is a way to get your comments in. So I am happy to have people come up to the microphone and ask questions or

make comments.

MR. MEYER: Hi, Alden Meyer, Union of Concerned Scientists. This is a great panel. Rich mentioned China and Europe. There is a whole universe of countries out there -- Japan, India, others -- that are doing a lot of work in this space.

There is the technology initiatives under the major economies forum, road maps for international technology. There is also portfolio states -- California, New York, a whole host of others -- with the system benefits charges of the 1990s. They are spending roughly, I think, the equivalent of what DOE is in some of these areas, certainly on renewables and efficiency.

The question is, how much are we thinking about DOE's work in the context both of the international R&D portfolio and collaboration -- obviously, there is some competitiveness and national security issues there -- and the state portfolio, and what is DOE's sort of role as an integrator and leverager of these different geographic levels?

Are we doing as much as we should in that area? Is there more we should -- can be doing? So --

UNDER SECRETARY KOONIN: Let me -- go ahead.

MR. BROWNSTEIN: Let me -- so let me give you an example of a place where I have seen DOE's role be very profound, okay?

I had a chance to spend some time out at the wind testing facility. And what impressed me about that facility was -- is that it was an opportunity for any vendor, any technology, to come and use the facility to test out the latest in wind turbine design. And what was most impressive about that was it was not just limited to American companies, it was limited to any company that wanted to come, okay?

That's a great example of the kind of role that DOE can be playing, because I think, Alden, as you point out, good ideas are sprouting up all over the world. And we get maximum economic value out of being the place that everyone wants to come to test out their idea, to develop their idea. We learn from that, it helps us innovate our own products. So that's a great example of the kind of thing that DOE can be doing that

I think has multiple benefits.

UNDER SECRETARY KOONIN: I think we will have an opportunity to dig into the notion of test beds and test facilities over the lunch time conversation.

Well, I have violated my rule of wanting to take three questions at a time. So let's take a trio, and then get the --

MR. PATEL: Pinakin Patel from FuelCell Energy. I would like to thank Dr. Koonin. This is the second time I am attending the meeting, and it has been a very good experience about how different opportunities can be identified for the future of energy.

And one thing I see here is cross-cutting technology opportunity is very important, multi-purpose solutions. What I heard is that you want to have reliable grid. You want to have clean energy. Green. Something that provides solution.

I would like to give one example and maybe -- if there is other ideas. Two weeks ago, Smart Grid California had a conference, and Sacramento made a comment to limit insulation of PV because of the

requirement of back-up power, 250 megahertz TV, the utility said you need 125 megahertz of back-up power.

Now, DOE has the solution. If stationary fuel cells can provide that, you don't have to limit 250 megahertz in certain area if you use stationary fuel cells. Now, you can make that extra by operating fuel cell on --

UNDER SECRETARY KOONIN: Okay.

MR. PATEL: So, the the cross-cutting technologies that go for liquid biofuel and those things -- so my question is, how would you handle the cross-cutting multiple solutions?

UNDER SECRETARY KOONIN: Okay, good. Rocco?

MR. FIATO: Yes. Rocco Fiato of Accelergy again. CCS, carbon capture and geologic sequestration, to my hearing of what you all are describing, seems to be the primary mitigation path that is being considered.

In our work currently with Chinese Academy of Sciences and NDRC. They are now focusing more on carbon capture and utilization, what we call carbon capture and recycle. It's a radically different

approach.

So, I was wondering if any of the panel members are familiar with it, and what their thoughts are on it.

UNDER SECRETARY KOONIN: All right. And one more from cyber space, or --

PARTICIPANT: I am going to take liberty of paraphrasing a question from Dan Witat over the Twitter. It came in in the middle of the discussion. Subsequent discussion may have elucidated more for him.

But the -- he had asked how would we determine what will be the right generation technologies. And I might sort of generalize that to say how would we distinguish between what the right generation technologies are on the grid in the private sector versus what the right generation technologies are for DOE's investment.

UNDER SECRETARY KOONIN: Okay, good. So we have got three: one about cross-cutting technologies as typified by fuel cells, but batteries, obviously, as well, and combustion, more generally; the importance of carbon recycle versus carbon capture in geologic

storage; and then again, more or less portfolio balance question. How do we determine the right generation technologies, both for deployment, as well as DOE investment?

And Ron, I saw you react to the recycle question most immediately.

MR. BINZ: Yeah, I don't want the impression left that I am advocating for geologic sequestration. I don't know the answer to that, and none of us does. There is a company, Kolera, who is a commenter in this proceeding, who is turning it into sort of a cement fill substitute.

So, I agree with the gentleman, that reuse of carbon is another possibility. There is lots of ways. The point is that we are having a debate, a very fundamental debate, about how this would go. Is it physical sequestration? Is it geologic sequestration? We need an answer to that in an early stage. That is really my point.

And I do not -- I used to make a joke in Colorado about the carbon -- about the baking soda economy to come, because of all the CO2 you would be

capturing in physical form. But I think we need an early answer to that, and I agree with the gentleman's sentiment, that it may not be simply pumping it into salt caverns.

UNDER SECRETARY KOONIN: Rich?

MR. COWART: Yes. Our comment on -- actually, it turns out to be number one and number three of the three questions asked. And that is when we think about the grid of the future, and the decarbonized energy systems of the future, two things have to be happening at once.

The first is that generation mix has to be decarbonized quite significantly, almost entirely. And that would include, most likely, a pretty high fraction of renewables on the grid, along with some nuclear or CCS or something else that is low-carbon coming out of something that looks more like a base load unit.

It also requires that we decarbonize -- and this is a link to the earlier panel -- that we decarbonize light-duty transport. I mean we can't continue to burn oil in automobiles and make the progress that we need to make.

And so, that creates this wonderful connection between the two panels that we have here, where we just have to organize the grid, so that we can electrify light-duty transport at least, and also significantly decarbonize the heating of buildings.

That means that the comment about storage, really, which -- I will take the fuel cell comment to be one about storage -- leads us to the requirement to develop the end uses, or the end use management techniques, that allow the smart charging of vehicles as a way of storing energy of when you've got excess renewables on the grid, for example. And the same thing for thermal storage, hot water or heat storage or ice storage in buildings.

And so, there is a future there, in which these highly desirable goals on both ends of the grid can be married. And I would say -- my message to DOE is -- help us, as a nation, to articulate and find that marriage.

UNDER SECRETARY KOONIN: So this requires a much greater degree of systems thinking than --

MR. COWART: Yes, absolutely.

UNDER SECRETARY KOONIN: -- we have done in the past. Mike?

MR. MCQUADE: Yes, I think the sort of -- two sides of the grid is exactly the right analogy. And I think, particularly as it relates for DOE, I -- my view is DOE has three critical roles to play, relative to the grid.

One is -- Steve, to your words -- the great convener. This is a system, and it is going to require new protocols, new understanding of how you operate and manage that system. So there is -- that is one role.

The second role is the sort of at-the-point-of-use side, and that is conceptualizing and executing a grid that allows us to use input and output at the demand side. And, to the point someone made before, allows decision-making to be made, particularly on, I would say, building and industrial scale for how you want to use the resources that are available to you.

So, in a world where all of your power comes from a distant power plant, and you have no choice, as a home consumer, you don't think about that. As an

industrial business, we think a lot about, "Do I want to put my own co-gen facility in? Do I want to put in my own fuel cell with CHP, so that I can manage both my local utilization and decision-making and, in a good world, know, when I have excess capacity, put that back on the grid? So that's the second part, which is the demand side.

And to me, then, the biggest other role DOE can play on the grid is purely driving the technology around grid scale storage, because there is the control and management of the grid, but the grid scale storage, whether that is fuel cells or large battery systems, or whatever, I think that is a big technology component that is necessary for the enablement of the grid that we are talking about.

UNDER SECRETARY KOONIN: Okay, let's take another trio of questions.

MR. SMITHERMAN: Great. I am Barry Smitherman. I am the newest Texas railroad commissioner. I am also the former chairman of the Public Utility Commission of Texas. And I am somewhat troubled by the singular focus on carbon, because it

may be, as someone said, all we're going to talk about in Washington in the next 10 years or so is reducing spending, it may be that the American public is unprepared to support carbon-related issues.

So, let me ask you all to do this. Perhaps you could set that issues to the side, for the moment, and talk about other worthy initiatives: national security, grid reliability, empowering customers, for example.

You know, in Texas we have retail customer choice in the electricity market. We also run, at the wholesale level, a security-constrained economic dispatch model. And, as a result, wind and nuclear dispatch first on the grid. We have dramatically cleaned up our environment from where it was 10 years ago, including the reduction of CO2.

But that was not our organizing principle. Our organizing principle was empowering customers to make choice. So, perhaps if you suspend for a moment an objective of carbon reduction, could you focus on the other issues?

UNDER SECRETARY KOONIN: Okay, thank you.

MR. MAKHIJANI: Arjun Makhijani. Appreciate being able to come up a second time. I wanted to address this technical question of how you make the efficiency calculations between useful and not useful energy. I think the report says that it's not possible to do it, but I think it is.

Second law of thermodynamics, readily available, most of the energy in the house -- heating, water heating -- is thermal. You can apply principles, and easily determine that most of the energy in the residential and commercial sectors is wasted.

And I think the similar principle can be applied on the supply side, so we are not adding solar thermal water heaters to solar PB as being equivalent amounts of energy generated. I think second-law principles should be applied uniformly after the first investment: what kind of quality of energy do you get --

UNDER SECRETARY KOONIN: Okay.

MR. MAKHIJANI: -- and what kind of quality of use do you get? And, by that standard, I would say 80, 70 percent of the residential and commercial energy is

wasted. Quite a bit, anyway.

UNDER SECRETARY KOONIN: Okay, good. Terry?

MR. BOSTON: Terry Boston, PJM Interconnection. Electricity is not a source of energy, it is a common currency of all sources of energy.

And I was a little surprised that good old American ingenuity in a group of people in Zurich 2 weeks ago that owned 70 percent of the generation capacity in the world said that shale gas and non-conventional gas was the paradigm shift, the most favorable thing that happened in energy.

I guess, as I look at that -- and we tend to be monogamous, we bill all one fuel-type at a time, like the 1970s was about nuclear, the 1960s was about coal -- given that gas this morning was $4.30, and that gives you a 3-penny fuel cost, what is the Department of Energy doing to take advantage of this new fuel that hits the energy independence to get combined heat and power, carbon -- even carbon sequestering is easier, with gas. How have we realigned the priorities, given this new technology of horizontal drilling and boring?

UNDER SECRETARY KOONIN: Okay, good. So, if I could summarize the three questions -- let's put carbon aside for a moment and acknowledge that that's important, but in some ways perhaps a more difficult political hurdle to overcome. What, beyond carbon, should be an organizing principle? We have already heard other environmental impacts as being important. Consumer choice was suggested as something that is also important.

Second, efficiency calculations in the second law and all of that. And then, the third is, again, the gas question, if the U.S. is -- or the world, perhaps more generally -- is awash at less than $5 shale gas, what should the Department be doing about that situation?

So, Ron, I am maybe going to say for you now the fourth time, rather than the third, at least if you're worried about carbon, gas is only a bridge, and you need to go beyond that.

MR. BINZ: I absolutely agree with that. I want to address the point that Barry Smitherman raised. He is correct, of course, that the carbon well has been

poisoned by the politics of Washington. All you need to look at is the current spectacle about the deficit -- the debt cap, to know that we shouldn't be looking to our political leaders. You know the old political leader chant, right? "There go the people, I need to get out in front, so I may be their leader." I think that's where we are going to be in this area for a long time.

The lingo has changed to "clean energy." It means low carbon. That is the conceit that everybody is using right now. So, while I would agree with Barry that it is probably politically infeasible or undesirable to trumpet this as a carbon issue or a greenhouse gas issue, that is still the organizing factor, as far as I am concerned, about what our challenge is.

UNDER SECRETARY KOONIN: Okay, Pat?

MS. HOFFMAN: I just want to add to this conversation, and remind everybody that the electric infrastructure is a solid foundation in which we -- you know, the consumers, the residents, the industrial manufacturing -- and what we need to do as we look at

this is go after how can we be the most flexible, most adaptable, as we look at the electric infrastructure, and building the near-term technologies, but also building a platform for the future generation technologies, which goes after consumer engagement, consumer choice, as well as how can gas be utilized today, but also be a balancing tool for, say, wind technologies or solar technologies? It goes back to the local distribution question.

As we are looking at putting PB in the system, are we building in the flexibility for what will we need 10 years or 5 years from now, as we -- depending on what the questions -- the questions may change. But the system itself must be built that we are flexible enough to introduce new technologies, handle security issues -- if you're going to bring that up -- and that is what we need to make sure, that we don't miss the point, as we go after one metric --

UNDER SECRETARY KOONIN: Okay. I know Mark and Rich -- keep it brief, because I want to keep the questions moving and --

MR. COWART: Yes, I -- let me just respond. I

have been working in this area for, I don't know, 30 years now. And energy efficiency has always been the under-utilized resource in America. And I would say to Barry, as I have said to his predecessors -- and I know he agrees -- that energy efficiency is a huge potential resource in Texas, and everywhere else.

And that, along with the fact that the public actually likes the jobs and the economic development associated with renewable development, to me, gives us plenty to work with over the next -- over the coming decade.

MR. BROWNSTEIN: But again, the question is what can the U.S. Department of Energy --

UNDER SECRETARY KOONIN: Thank you.

MR. BROWNSTEIN: -- do, okay? And on that score, I think what is often missing is information. And the U.S. Department of Energy can be a powerful source of information in those jurisdictions that still exist in the IRP world, and where regulators need objective understanding as to various technology choices, so that they have some way of gut-checking what utilities are telling them.

In de-regulated states, like Texas or where I am, in New Jersey, where customers are empowered to make choices, customers need information. My neighbor across the street is trying to retrofit his house right now with efficient technologies and the like. And I am watching him, and this is a several-month process that he is going through. And it is only because he is obsessive compulsive that he is continuing to follow through with it. But most of us would have thrown in the towel a long time ago.

And DOE has incredible opportunity to use what it knows, and to marry that with technology to make information available to consumers so that they, in fact, can make smarter choices.

UNDER SECRETARY KOONIN: Very good.

MR. BINZ: Steve, I want to make one quick response to Terry. I think that -- I don't think that DOE has a large part to do with natural gas in this respect. I think it is up to state regulators -- state air quality and water quality regulators -- to get that industry to show that fracking can be accomplished safely.

Now, I am not saying that it isn't now. There is a huge debate. But it's got to get over that debate. The energy -- the sector has to clean up its act and produce natural gas. If that is done, I think we are seeing natural gas, as far as --

UNDER SECRETARY KOONIN: So I remind you that, as we speak, John Deutch's task force concerned with those matters is meeting and working hard on trying to make some statement about that.

Let's take another trio of questions.

MR. HEYECK: My name is Mike Heyeck. I am from American Electric Power. And, yes, Pat, you are right. The grid -- we do -- we have supplied written comments, and I won't duplicate those.

National security is, to me, the most fundamental. And as we replace the grid over the next 20 or 30 years, I think DOE is in a great position to help us come up with standards for grid planning, asset hardening, and sparing of critical components -- not only the components, but also incenting manufacturing returning to the United States for these critical components.

I have a tangential comment that -- actually, Warren Buffet stated this, and it's a cross-over between the two panels. If we electrify the entirety of the railroads with structures, and used those structures to put transmission lines on top, would that help the infrastructure of our nation? I think the DOE would be great in sponsoring that kind of convergence of right-of-way, not only infrastructure of railroads, but also think about the -- I think it's 20 billion gallons of diesel used by the railroads. So it is an opportunity. Thank you.

UNDER SECRETARY KOONIN: Okay, good. So, that was one. All right.

MS. RABEL: Veronica Rabel. My question has to do with organizing principles. And one question is, how would the portfolio change, if we added water or maybe go all the way to sustainability as one of the organizing principles?

What if we added risk management, and look at adaptability? How would it affect our T&D infrastructure?

UNDER SECRETARY KOONIN: Thank you. Good

question. Yes? We're going to do one from cyber space, or -- no? Okay.

MR. MIKHAIL: Amir Mikhail, Clipperwind Power. You know, mentioning the emphasis on what DOE can do -- we are a manufacturer of wind turbines. And one of the most effective things, in terms of information dissemination, was the report that was issued 6 or 7 years ago about meeting 20 percent of our energy from renewables. That report was completed vetted by the Department of Energy and outside reviewers, and that gave the path and the credibility to the wind energy to actually meet a sizeable portion of our demand.

I happen to be a reviewer on a study right now in the Department of Energy that is called "Renewable Energy Futures". I don't know if you're aware of that study that says that we can meet 80 or 85 or 90 percent of our energy from a combination of natural gas and renewables. Issuing that report would be very helpful towards showing a path, because this is a scientific study that is based on actual segmentation of all our electric demand.

And the other part is wind competes directly

with natural gas, and the price of natural gas, which you mentioned, is a pretty big impediment right now. When the price of natural gas was in the $10, $12, you know, wind put in at 40 or 50 percent of the new electric demand. When the price of natural gas is now at $4, the installed capacity went to to 50 percent.

So, what can the Department of Energy do in terms of RPS, introducing all these requirements to make renewables a very viable option --

UNDER SECRETARY KOONIN: Okay, good. So we've got a good trio again: a suggestion that we exploit railroad right-of-ways for electrical transmission; a second, how would the portfolio that DOE pursues change if we worried seriously about other matters like water, like risk management, and so on.

And just with respect to water, some of you may be surprised, as I was, to see how much water is actually used in generation. If you look at chart five of the handout, in the lower right corner, essentially half of our water withdrawals in the country go to thermal electric power, by far the largest of the various uses there. So, water is, and likely will be

in the future, a big issue, as we think about the generating mix.

And then, the third issue was stated pretty clearly. We could -- there are studies that show we could generate 80 percent from electricity. How do we think about that? Why aren't we pursuing that? And what can the DOE do about renewable portfolio standards?

So, Pat, let me ask you about that last question, perhaps. We don't control renewable portfolio standards, do we?

MS. HOFFMAN: No.

UNDER SECRETARY KOONIN: Okay. So, sounds to me like a QER topic, rather than a QTR topic. Okay. All right.

Anybody want to take a crack at the other two?

MR. BROWNSTEIN: Well, the only thing I will say there, Steve, is that you look at studies like that not because -- I think studies like that are interesting because they help suggest to you the kinds of enabling technologies that might be necessary to achieve that kind of --

UNDER SECRETARY KOONIN: Good.

MR. BROWNSTEIN: -- that kind of outcome. So, to think about the grid integration issues, and therefore, what needs to happen on the grid, and where are we in terms of technological maturity to make that happen, and so on and so forth.

I completely agree with the commenter about looking at other environmental and social attributes. I think probably another area where DOE could make a valuable contribution is in this whole question of life cycle analysis, even as it applies to natural gas production. I think what we find when we do life cycle analysis is the greenhouse gas benefits that people ascribe to it are perhaps not as great as people might want to believe.

So, I think it is very valuable to have some way of doing an apples-to-apples comparison with some kind of, you know, disciplined analytical approach.

UNDER SECRETARY KOONIN: Good. Mike?

MR. MCQUADE: Mainly on point number two, which was about the issues of risk management, et cetera, I will go back to the comment we've made a

number of times about DOE's role in information providing. I think it leads to this whole topic, which is DOE's analytic role in understanding how systems perform.

And, at the end of the day, this is about creating the models and capability to look at the energy system we will have in place in the decades to come. LCOE is a fine number to look at, but it is not the only number in town. And DOE's ability to project, predict, and become the credible source for analysis, I think, is crucial.

And I think, on the question of RPS standards, I would say, as a -- and maybe it's related to the ability to analyze and model -- I would argue that DOE's role, at least in determining its proper position, has to be about predicting what the landscape might be.

So, for DOE to say, "We're going to determine a portfolio in a world for which there isn't an RPS standard," I think, is very, very short-sighted. For DOE to say, "We are going to analyze our portfolio in a world for which, because there isn't now, there never

will be a cost on carbon," I think, is a mistake.

Whether the actual decisions that get implemented are time-based, DOE's ability to say, "Here are scenarios that may evolve over the decades to come, and here is how we would balance the portfolio according to those scenarios," has to lever on the ability to do the sort of modeling and simulation of the energy structure that we need in place.

UNDER SECRETARY KOONIN: That kind of analysis you're talking about is very interesting, but very difficult, and involves fusing not only what you think about technology evolution, systems operation, the economics, business context, the regulatory environment, and so on.

I think we need to do a much better job in the Department and the government as a whole of pulling those various disciplines together to some kind of synthetic --

MR. MCQUADE: I agree, and it's a QER issue.

UNDER SECRETARY KOONIN: Right.

MR. MCQUADE: But at the end of the day I'd go back to -- I don't know if it was one of the three M's

or the three somethings or other -- if it's hard enough to do, we ought to be doing it.

UNDER SECRETARY KOONIN: Yeah.

MR. MCQUADE: And I think that should be an organizing principle for the DOE research investment.

UNDER SECRETARY KOONIN: Yes, yes.

MR. COWART: I have a comment about all three of the questions, actually.

On the first question about the grid, it's just -- generally speaking, I think that this is -- it's appropriate for us to think -- to realize that there is very little private-sector R&D in the transmission grid, and the architecture of the grid that serves the nation, and that there is definitely a significant role for DOE to play.

And that is an area that I -- as we look forward, the importance of the grid as the element that ties together the things we were talking about earlier that get us to the sustainable energy mix of the future, the importance of the grid is growing, and the technology that enables that grid to be a lot more flexible is developing. And DOE's role needs to grow.

That is part of the grid answer.

With respect to risk management, the portfolio mix is really decided elsewhere. DOE isn't going to be deciding the portfolio anywhere in the country.

UNDER SECRETARY KOONIN: The deployed portfolio, not DOE's research portfolio.

MR. COWART: Correct, right.

UNDER SECRETARY KOONIN: Yes, sorry.

MR. COWART: That's right, the generation portfolio.

UNDER SECRETARY KOONIN: Right.

MR. COWART: And -- but DOE can help -- and I am echoing the comments earlier made, that -- can help by identifying and articulating in some, you know, well-designed research what the pros and cons are, what the risks might be of different scenarios.

And a third, I would like to make a comment about the renewables versus gas question. You know, the President -- I guess -- I don't know exactly his words, but I think he said we have a tradition of going from crisis to trance on energy policy, something like that. I have been through, I think, three of those

cycles in my professional life, and it is true. If we allow gas, shale gas, to be the trance-inducing fuel of this decade, we are really going to regret it. And I think DOE has a role in reminding everybody of that fact.

And here is an example. If we really -- if we understand that gas is a bridge to something, as opposed to the answer for all time, then we know we need to build the domestic industry infrastructure that will deploy a lot of other resources -- that is, the resources to refurbish buildings, the resources to build wind farms, the resources to build a smart grid. All of those industries need to be developed. And they are not going to -- in 2030, when we decide, oh my lord, we really need much more of these other things, we can't just call them into being instantly.

So, it's important to examine some of these for DOE, to remind us all how long it takes to build the infrastructure to build an industry that can deploy resources.

UNDER SECRETARY KOONIN: Good. There is another side of the bridge, and we have to worry about

that. Okay. Good.

Let's take a few more.

MR. LAGRANDE: Yes, I'm John LaGrande here, from Amerigon. My question, I think, is directed to Patricia, perhaps Michael.

In the previous panel, Delphi's Dr. Brown made reference to newer-term gains that could be realized by addressing what he called the existing car park. In looking at the Lawrence Livermore energy utilization chart, chose 34 quads of energy rejected as waste heat from the non-transportation sector -- this is presumably stationary stuff. What portion of the DOE spend is or should be directed towards the recovery of waste heat?

UNDER SECRETARY KOONIN: So let me step in and perhaps excuse Pat from answering that question.

If you want to know what fraction -- I mean there is a budget chart at the back, which is, of course, a budget that, in the end, is approved by Congress. I think we're much more interested in hearing from you all about what the opportunities are to do better in that, and whether we've got that

properly balanced with what we're investing in generation or the grid itself.

So, anybody on the panel want to take a crack at that balance question of efficiency versus generation versus grid?

MR. BINZ: I will make one point here on this -- the gentleman's -- the issue behind the gentleman's question, and that is how do you, if you look at this chart and you see all the gray bars there, which are rejected energy eventually, you can do one of two things. You can fix the problem at the point of generation, you can improve generation efficiency from 33 to 34 percent, or something like that. Or, you can save kilowatt hours being used at all, in which case you pick up not only the efficiencies, but the inefficiencies.

UNDER SECRETARY KOONIN: Right, okay.

MR. BINZ: And so I think that is, really, the key connection to efficiency in that --

UNDER SECRETARY KOONIN: Okay. Again, I am violating my trio rule for questions. So go ahead.

MR. HINKEL: Yes, Jerry Hinkel from the

American Clean Skies Foundation. Great panel, lots of critical stuff here. Flexibility of the grid to be able to evolve itself is very important. And, in terms of performance criteria for evaluating grid movement and change, we think that the entire emissions footprint is a much better way to look at it than just -- than exclusively carbon.

And for planning purposes, in the AEO 2011 and predecessors and future configurations of that, the most interest things with regard to transportation and the grid are all buried somewhere. It's very difficult to find the actual -- all the tables that go. And so, I would -- that go together that match up, say, with the reference case that we are all used to looking at. So, there is some very interesting cases in the AEO 2011. I would hope that the DOE would use that as a mechanism for extending your planning, thinking.

And another thing I want to mention is that, with regard to CCS for gas-fired power plants, we have a forum that we are planning at the Monaco Hotel on November 4th of this year. So we -- come to our website, cleanskies.org. And as Dan Quayle once

remarked, "The future will be better tomorrow."

(Laughter.)

UNDER SECRETARY KOONIN: Good.

MR. SINGH: Vranveer Singh from Genesis Semiconductor. We are a developer of advanced semiconductors for electricity delivery. And my question is regarding creating a policy environment for encouraging investment into RD&D.

It seems -- my impression is, it could be wrong -- that utilities have relatively little incentive to invest in RD&D, because of the way they have monopolistic situation.

For example, in our case, we are -- technology is almost equally applicable towards energy, as well as defense, and we have a much easier time being able to market ourselves to, let's say, prime contractors who can adopt these technologies, whereas the prime contractors for DOE -- excuse me, for energy delivery don't quite have that same attitude or incentive, it seems to me, for adoption.

So, my question is really how can we improve our policy to encourage investments into RD&D?

UNDER SECRETARY KOONIN: Good.

MS. CHUNG: Elena Chung from the National Renewable Energy Laboratory in Golden, Colorado. I am a fellow there. And I would like to bring one point to the information of this group, and thank Under Secretary Koonin for organizing this very, very important area in the QER. It's extremely important, as is the QTR.

I had the opportunity to participate in the past three years in the inter-governmental panel on climate change, special report on renewable energy sources, and climate change mitigation. DOE, ERE, the laboratories, had a major impact in that particular study. And I will highlight two points, because they are very germane to questions that were asked.

One of the things that the report did was to not only bring all renewables to the same level -- i.e. doing levelized cost of electricity, heat, commercial fuels, all of them at the same time on a comparative basis, for as many countries in the world as we could. And DOE had a major role in that, through the laboratories, as well.

1 That was point one. And so, this second point
2 we also brought because we have done a lot of life
3 cycle analysis on a comparative basis -- bring all of
4 those life cycle analysis comparisons for all renewable
5 technologies compared to natural gas, to coal, to coal
6 carbon sequestration, and storage.
7 Final point: 168 models were studied for this
8 question, future 2050. The starting point of the
9 effort was 2050, all those technologies, what role can
10 renewables make. The answer can vary from 17 percent
11 to 77 percent, depending on the study's premises, and
12 so forth. But major role. Carbon capture
13 sequestration was --
14 UNDER SECRETARY KOONIN: Okay.
15 MS. CHUNG: -- part of it. So it is
16 available, it's on the web in the IPCC web chart, it's
17 SRREN --
18 UNDER SECRETARY KOONIN: Okay, good.
19 MS. CHUNG: Thank --
20 UNDER SECRETARY KOONIN: Thank you. All
21 right. So we've got three, and this may be the last
22 round. One is the importance of the AEO documenting

DOE planning, and perhaps a plea for greater transparency or accessibility in that document.

A second is what incentives do utilities have to do RD&D, or how do we increase the incentives for them to do that.

And then, the third is a comment on the value of good inter-comparisons of various technologies going forward. And I will -- Mike, you are first out of the gate.

MR. MCQUADE: Well, this is Ronald Reagan's statement about I have -- "I paid for the microphone." So those were mostly statements, I'm not sure there was a big question in there. So I will just sort of, as we're coming up on the end, make my plea for energy efficiency. I think it's been said a number of times here it is the under-funded portion of the portfolio, it has the most visible set of returns on the short scale.

And, as I've said over the last hour-and-a-half, DOE needs to be thinking on multiple time scales, and balancing its portfolio, its investment portfolio, across multiple time scales. And

the role that DOE can play in information aggregation and distribution to make the case for energy efficiency more visible, and the role that DOE's technology investment should make on the energy efficiency side. So, just one more plug before we turn the microphone over to somebody else.

UNDER SECRETARY KOONIN: Okay. Anybody else want to weigh in?

MR. BINZ: I think it's important at each stage of these discussions to remember why it's important that DOE gets involved in these discussions. We have been talking about the shape of it. But what is the "it", and why is there an "it"?

We have a so-called "tragedy of the commons". We have an atmosphere which is being treaded upon by lots of uses. And without an intervention of someone who can look at those externalities, you don't have the incentive at the utility actually to spend money on that. State regulators don't typically think of themselves as the point at which basic R&D should be done by utility companies.

EPRI does a fine job, I rely on them for a lot

of the information that I use in forming my positions on these issues. But it's a shadow of its former self, given the change in the industry structure, and I think needs to be supplemented greatly by an intervention by government. In this case, it's DOE.

UNDER SECRETARY KOONIN: Good.

MS. HOFFMAN: And I guess I am going to follow up on that, because the thing that we go after as regulations is not necessarily the greatest framework for innovation. And what we really need to do is recognize that this industry is ripe for innovation and ripe for new technology, and ripe for information for better decisions and better investments, as we look at the investment cycle.

And so, how do we accelerate that is really some of the flexibility that needs to be put in the infrastructure --

UNDER SECRETARY KOONIN: I think what I have heard often is we need to get the regulation aligned with the technology, or vice versa. And we have not done too well with that.

MR. BROWNSTEIN: One of the things that you

really need to be paying attention to is the fact that this is now a global enterprise. And so, part of what DOE needs to think about doing is how do we capture the best research and ideas that are going on around the world, okay, and continue to make the case that wherever you're piloting or developing a technology, you want to bring it here to the United States to further refine it, to deploy it, to develop it, that we should be thinking about this not only in terms of what can we do to do home-grown, but how can we encourage the best of the world's ideas to come to us.

UNDER SECRETARY KOONIN: Okay. Good. Rich, I will give you the last word.

MR. COWART: Well, I am just going to echo my co-panelists' statements here, I think.

First, I will repeat the observation that efficiency is key, and it has been the under-funded part of the Department's portfolio for a long time, and that really needs to be addressed.

Second, I agree completely with what Mark just said, that this -- there are ideas out there across the globe that the United States could be taking advantage

of. And DOE could play a greater role in bringing those -- it goes both ways. But there really is a lot more going on than most of us are aware of.

UNDER SECRETARY KOONIN: Very good.

MR. COWART: And I think my third point is about policy. This is called a QTR, it's about technology. And -- but it's essential, as I think this conversation has unfolded, to recognize that technology without policy is like, you know, a tool in the box in the warehouse that isn't on the job site.

And we need to get the tools on the job site, which means that DOE has a role in helping states, stakeholders, utilities, and others to examine which tools are best fitted for which technologies to bring them to ground.

UNDER SECRETARY KOONIN: Good. Thank you. I want to thank all five people up here for living up to the standards of the first panel.

(Applause.)

UNDER SECRETARY KOONIN: And so, what's going to happen now is that lunch will be available to be picked up outside this room, where breakfast was.

And then you're supposed to walk down the left side -- the President's Walk, is it that way? Yes. So your left side, where you will find a place where we can all sit down and eat lunch.

The Secretary will begin his remarks at 12:45, and lead immediately into the third panel, which will take place in that room. Thanks much.

(Whereupon, at 12:18 p.m., a luncheon recess was taken.)

A F T E R N O O N S E S S I O N

UNDER SECRETARY KOONIN: It is my great pleasure and privilege to introduce Dr. Steven Chu, the Secretary of Energy, my boss.

Dr. Chu has brought a remarkable degree of energy to the Department, has really been instrumental in helping to focus the Department's activities on the challenges that we face, and has brought a level of rigor, both in the science, but in the planning and departmental activities that are really helping us make, I think, wonderful progress in what the Department is supposed to be doing.

And it is a particular pleasure to ask him to say a few remarks on the QTR process. I will then introduce the panel, and the Secretary will also set the frame for the third panel. So, Mr. Secretary?

(Applause.)

KEYNOTE ADDRESS

SECRETARY CHU: Thank you. So I have two microphones. And, just out of curiosity, I think this one is okay.

Well, you probably heard from John Holdren and

Steve and others what was the idea behind this QTR. I wanted to revisit that in my own words, what we are trying to do here.

In many respects, a lot of the technology -- the research, the innovation, a lot of the things that will be needed, going into the future in our country, will be very closely related to energy.

So, it's -- the things we are investing in, and anything having to do with energy, is something that is a multi-multi-trillion-dollar-a-year business. Just the primary energy is over $1 trillion. And so there is a lot of work at play.

The other thing is the natural time scales for changing energy infrastructure are in decades, they are not in years. And they are not in yearly budget playing cycle years, they are not in every-other-year congressional cycle years, but they actually are a much longer time horizon.

And so, when we asked PCAST to give us a report on what the Department of Energy could be doing better, they came up with a number of recommendations. And one of the most important recommendations was a

quadrennial energy review. But, as a subset, why not do a technology review first? The technology review first is, thus, the first step. We have to pull this one off well. But if this is done well, and this is technology review 1.0, after about 2.0 we can maybe think of going to an energy review, which will be necessarily multi-agency.

So, that is the idea of what this thing is about. We need to talk about things that we would need to do, and we have to think about now, rather than let them creep up on us. So, let me give you a few example.

First, we -- if you look at transmission distribution systems, it takes 5, 10 years, at a minimum, to begin to decide how to plan and site line that could take between 5 and 15 years to get the permission to site these lines.

And yet, some technologies -- for example, photovoltaics -- we see a very rapid decrease in price over the last 5 years, it dropped by 50 percent. Over the next 6 or so years it's anticipated to drop by at least another 50 percent. And with this additional

drop, you can see more and more deployment. In the Department of Energy we are trying to do what we can do in the whole innovation value chain to drop that further, so that, perhaps within the end of this decade, it can drop by 70, 75 percent.

At that point, photovoltaics becomes -- the levelized cost of electricity for photovoltaics, including a little offset for its variability, actually becomes competitive with any other form of energy. Let's say new combined cycle gas, or -- certainly will be competitive with what we are -- now have with coal.

But without a transmission distribution system that automatically toggles between fossil energy and renewables, that has some energy storage in it, this won't actually happen. It will be bottlenecked at the 5, 10, 20 -- possibly you can get lucky and go a little higher, but it would be bottlenecked at the 23 percent level without an integrated system.

And so, the Department of Energy has said, "Okay, we recognize this, and it's going to take decades to get these systems and the players in place." And I just noticed Terry Boston is sitting over there,

nodding, and he is one of the players that we have to get incorporated in this, so that as we -- as the price of renewables -- wind and solar -- are dramatically decreased -- certainly solar we anticipate to be dramatically decreased in the next decade -- we have to think about the systems, going forward.

With batteries, we have a similar situation. We think that batteries can -- there are going to be great innovations in batteries. There has been great innovation over the last 5, 10 years, but we see continued innovation. And there is maybe a 50/50 chance within 5 or 6 years batteries that have double the capacity, possibly up to triple the energy density, and one-half to one-third the cost would become testable for automobiles.

So, that means all the sudden you leapfrog from what we -- where we are today, a 100 or 75-mile battery, to -- for an all-electric vehicle, to a 300, 350-mile battery at a lower cost. And at that point it becomes widely mass-marketable, without any subsidy, because we anticipate the cost of the battery will also go down.

While we push on the technology side of this -- and there are some very encouraging things on that side -- the Department of Energy is -- also has to begin to look at how this is going to interface with a lot of other things. And so, for that reason, we have begun to say we also need a better understanding of what drives a lot of investments in these technologies.

The most important one is, of course, energy efficiency, where many of the technologies are -- do exist today -- you know, ceiling duct works, windows installation, things of that nature -- and yet, there are very few -- and many of us believe that investments in energy efficiency will more than pay for themselves, even if the cost of money is five, six, seven percent. They will still pay for themselves.

And yet, we still seem to be stuck where people are thinking energy efficiency costs money. And we can't afford to retrofit, either a commercial building or a home. And again, is it a lack of a good business model? Is it a lack of information? Is it a lack of mass production of retrofitting technologies? And it's really all of these things.

So, the Department of Energy has begun to think very differently to help the private sector design business models that can actually get this retrofitting off the ground.

So, I can go on and on and on, but I think, although much of what we do is technology, I think the little bit of this interfacing of how this technology will interact with the right business models to spur private investment -- because going forward we -- this is what will be needed, certainly in the next half-a-dozen years.

So, finally, what we are doing -- and again, this is something that Steve Koonin hinted at -- we are looking at what do we invest in, whether it's solar or batteries or next-generation biofuels, or building systems, we are beginning to look across the parts of the Department of Energy, from the office of science to the energy technologies area to RPE, and now most of the times we are thinking of programs, insisting that all those three parts, all those people -- and not the under secretary level, I mean at the technical and the program level -- are in the room together.

And even to say we're going to design a new building -- let's say a new hub on batteries that would be integrating all the battery research we're doing across the country that would also include the packaging, the commercial -- not only of automobile batteries, but also for utility-scale batteries, which is a very, very big deal.

Because if we can get 100 kilowatt -- $100 per kilowatt hour up to 10 megawatt utility-scale battery, we will start off automatically saving 1 or 2 percent of our electricity, which is billions of dollars, just because we overfill our lines now, and we spill them out, because electricity has this terrible property, you use it or lose it. And so we overfill, and just let it drip off. And with modest improvements that will happen probably in the next five years in utility-scale batteries, you no longer -- you don't have to do this any more.

And then, how do you actually get that deployed as quickly as possible?

So we have a very different attitude about the way we do business, because all of these things -- many

of the things I have just talked about are very interconnected.

So it's a -- it's thrilling, actually, to be able to be able to begin to engage the various parts of the Department of Energy to think about these things and how they are interconnected with each other. The quadrennial technology review is an instrument, a very powerful instrument, starting with the strategic review, in order to get us to think about these things in a much more interconnected way.

And then it's in forums like this that we want outside input. Are we barking up the wrong tree? Are we doing something that is quite silly? Or is it -- and -- or are we doing what we should be doing, namely, trying to stimulate the innovation chain so that the United States, in the future, becomes -- is the technology and manufacturing leader and deployment leader in all the new technologies that we will need, going forward, to make us both competitive economically, and also to decrease our emissions on carbon. So, there are -- and decrease our dependency on oil, particularly foreign oil, and all of these

other things that we are trying to do.

So, with that, I will let you bring up some speakers, Steve, and --

UNDER SECRETARY KOONIN: So let me introduce the panel, and then we will ask the Secretary to set the frame.

Let me just ask you all to come up, and I will say a few words as you are coming up. First, Dr. Bill Brinkman, who is the director of the office of science in the Department of Energy. Bill brings long experience and, maybe more importantly, wisdom from a lot of time managing scientific research in academia, in the private sector, in the national laboratories, and in the government.

Kathleen McGinty is a founding partner of Peregrine Technology Partners, and a director of energy. She was previously secretary of the Pennsylvania Department of Environmental Protection. That's a pretty hot seat right now, I expect, in Pennsylvania.

"Can you say shale gas?" Right. Katie is a member of John Deutch's task force on shale gas, and

was chair of the Pennsylvania Energy Development Authority, and was Bill Clinton's chair of the White House Council on Environmental Quality.

Daniel Schrag is a professor of earth and planetary sciences at Harvard, where he studies climate and climate change over the broadest range of earth history. But Dan has also got a lively interest and expertise in technology approaches to mitigate future climate change, and it working with a number of economists and practical people like that -- engineers -- to get some of those technologies off the ground.

David Terry is executive director of both the National Association of State Energy Officials and the Association of State Energy Research and Technology Transfer Institutions. He has 22 years of experience working on a range of energy issues for organizations like the Governors' Wind Energy Coalition, the Energy Services Coalition, the Governors' Biofuels Coalition, the National Academy of Sciences, and the Department of Energy.

And then, finally, Sue Tierney, who is a

managing principal at Analysis Group, and an expert on energy economics regulation and policy, particularly in the electric and gas industries.

Before she joined the Analysis Group she was senior VP at Lexicon, was also the assistant secretary for policy in the Department of Energy. And before that, was secretary of environmental affairs in Massachusetts and commissioner of the Massachusetts Department of Public Utilities, and is someone who knows the Department extraordinarily well. Also another of John Deutch's minions on the fracking panel.

(Laughter.)

DR. KOONIN: Mr. Secretary?

SECRETARY CHU: Yes, I did something a little out of order. I was supposed to take question and answers from you all before I give this committee the charge.

MS. MCGINTY: So now we get to ask the questions. Now, Mr. Secretary --

SECRETARY CHU: And so, let me open for any questions you have directly of me before I pose some questions to the panel that they can then deal with.

So, just any -- if you have questions for me, please raise your hand. Otherwise --

(No response.)

SECRETARY CHU: What a tame audience.

(Laughter.)

MR. PROVINE: Hi, Bill Provine from DuPont. I think as we go through our public process like this, I am going to ask you an open-ended question. How much does the DOE have an open mind of what the solutions are, versus doing your own analysis, I guess, behind the closed doors and coming up with your own conclusions? How do you wrestle with that?

I mean we all have that same phenomenon, right? So how do you wrestle that openness to input here, the process?

SECRETARY CHU: We -- yes, it's true, we do our own analysis. But, quite frankly, we could be -- in a lot of things -- so we -- this is one forum, but there is also informal forums, which people come and see me and say, "No, it's -- Chu, you're not -- you're barking up the wrong tree," or, "You're" -- we actually -- let me just say just

straight off, in terms of research and development, we feel pretty strongly that there is no way that -- research and development is such a small fraction of the total cost in developing something, piloting it and deploying it, that even if it doesn't look like it will yield fruit in 10 or 20 years, we say, "Okay, it still needs some research and development."

So there is very few -- because, you know, the greatest example in my physics background is the research levels of superconductivity went down, down, down, down until high-Tc materials were discovered. But if was never really turned off.

And so, there are -- and so you -- in the research area, you do not want to turn a lot of this stuff off, because dramatic things can happen. It's -- but as you go to demo-ing, piloting, demo-ing, and finally deployment, then we -- actually, it's the voice of the private sector that is the strongest voice there. Because what are they willing to invest in, what are the people willing to adopt also, as customers?

So -- but then this middle ground, you know, we certainly -- well, why don't you be more specific and say, "What are the things you think we don't want to do that you think are worthwhile doing?"

MR. PROVINE: I will just -- I guess you have a reputation -- and say the only solution to energy is the electric car.

SECRETARY CHU: No.

MR. PROVINE: So --

SECRETARY CHU: That's -- no.

MR. PROVINE: Okay, so --

SECRETARY CHU: That's -- no, actually, this is something where it's very much we need a diversified portfolio. The -- we think it's -- first, vehicle efficiency will get the fastest immediate gains, for sure, in the next coming 10, 20 years.

Secondly, electric vehicles do have a role in this. But you may not get that 350-mile battery at $3,000, which is this size, not the size of the current batteries. And so you can't put all of your eggs in that basket.

I think -- we think -- biofuels, next

generation biofuels, has a shot, a real shot, because there is very dramatic things that are happening in system synthetic biology that could transform the way we make this, so that you can generate not only biobutanol, but a drop in substitutes that we think have a chance of being -- production costs of being $50, $60 a barrel, equivalent, of oil. And so, we think there is a shot at that. If that's true, I don't think you will need a subsidy, going forward.

So there are many other things. Natural gas, we're still looking in that -- natural gas happens to be a more mature technology. So we will invest in research on the most innovative parts of natural gas, okay? We don't see us -- you know, the Honda Civic natural gas seems to work just quite well, and we don't see us making large investments in that.

So, in terms of the light vehicle transportation sector, no. We think that we have to have a diversified portfolio. But efficiency, electric vehicles, biofuels are certainly up there. But we still want to support research and development and hydrogen vehicles on the R&D side. I think it's still

premature for deployment support, but on the R&D side, yes, and for those areas of natural gas where we think we can pre-IPE things.

So, it -- I don't know where you got the impression, but that has not been our thinking.

MR. PROVINE: Thank you.

SECRETARY CHU: Yes?

MR. BLADEN: Good afternoon, Secretary Chu. My name is Jeff Bladen, and I am with Mark Group. We are sort of the poster child for your desire to see a company that can scale on energy efficiency. We are based in the UK, and we do a little more than 6,000 home retrofits every week, globally, and we have just entered the U.S. marketplace.

But I am concerned that the policy in the U.S. doesn't seem to sort of match the desire to see energy efficiency. There really isn't any significant incentive given to folks to do home energy efficiency things like insulation and draft ceiling, relative to other choices they might have that are incentivizing, things like the production of renewables -- not to say we shouldn't be doing those, but does the policy match

the desire?

SECRETARY CHU: Well, we hope so. The Department of Energy is taking very, very seriously the energy efficiency things.

And, as I said, we are, right now -- given where we are, and the budget realities, we can't do Recovery Act spending, going forward. And so, for things like efficiency -- I mean let's stick with building efficiency, home retrofits, what you were talking about -- we have -- we do have incentives. We would like small incentives. But the major thing is actually not the incentives, it's really how do you tell the home owners what are the most efficient things they can do. I think people in the business know this. It's cellular air spaces. You know, the housing envelope and the duct work.

Insulation, number two. So, stop the big drafts, insulation. Number two. Then you can look at a higher value items, higher cost items, like windows and things like that. And there is -- and so, we are developing methods which there are tools where either contractors or homeowners themselves can then say,

"These are the things you need to do," then you need reliable contractors who -- you know, when they really say they put in insulation, they are putting in all the insulation, they are doing all this stuff.

So, we are working in all these mechanisms in order to have that occur. There has been -- unfortunately it got cut in the last legislation, the last congress, about home-start-type programs. That was truly unfortunate. But still looking at mild incentives.

But, in actual fact, we think that you may not need incentives -- that's not to say we might not want to -- in order to start, but you may not need incentives in the long run, because in many instances the saving energy is really saving money, even with the cost of money at five, six, seven percent.

MR. BLADEN: If I might ask just a very quick follow-up, one of the great challenges we have found as we have entered the U.S. marketplace -- and we are obviously happy to offer any benefit of our experience outside the U.S. to you all -- the greatest challenge has been having a way for people to finance the energy

efficiency upgrades.

So, even -- you know, the cost of money isn't five or six percent for folks.

SECRETARY CHU: Right.

MR. BLADEN: It is 18 percent, because most banks look at this as an unsecured loan. So I guess I would offer that up as a way to think about --

SECRETARY CHU: I agree with you completely. That's why I'm saying five or six or seven percent, because we are trying to work -- we have some programs with FHA, but this is very high on my list. If you get the ability to borrow money for efficiency retrofits, both commercial and residential at the moderate single-digit -- up to eight or nine percent, a lot of things will happen.

And so, we are very focused, actually, on stuff like that, because I agree with you. If you have to borrow at 15, 18 percent interest, it is not going to work.

UNDER SECRETARY KOONIN: I know your time is short, you have another engagement. You may want to say a few words about the panel.

SECRETARY CHU: Okay. So, anyway, thank you for the question. That's the gentle hint from Steve. Okay.

(Laughter.)

SECRETARY CHU: I will stay more to the script.

So, this is an introduction. I am here to introduce the technology panel. And there is a few things. First, let me say what we think the Department of Energy does, and how it impacts technology development and deployment.

First, we do gather and analyze and disseminate information that is useful to policy makers in the private sector. We also convene participants in several ways. In things like transmission distribution, there are many, you know, utilities, and RTOs and everything else, so we convene them to try to get them to work together.

But there is a more important role in our convening, because we also, through our grants and funding -- things, for example, like the energy hubs that we've started, but in other instances -- where we

say, as a requirement, "Let's get either university researchers or national lab researchers starting to work with the commercial side, the private sector, more at the beginning than at the very end, when you've got the IP and see who wants to bid for it."

And so, what we're doing is we are trying to establish, pretty aggressively, programs where you get the private sector actually engaged before. Because the last thing we want to do is have a bunch of really smart people, whether they are in university or in national lab, going off in this direction, and the private sector is not really interested in that direction.

But if they could have changed the course a little bit, it could have been deployed a heck of a lot sooner, because the private sector knows more about manufacturability, what might actually take in the marketplace, all these things.

And so we are working very hard, first, to change the culture within our national labs and universities to actually say, no, this is not only allowed, this is encouraged, because there -- you know,

in the past, there were -- people have said, "Oh, my gosh, you are starting to work at the private sector. Aren't you showing favoritism, or are you unclean in some other way?"

(Laughter.)

SECRETARY CHU: And the answer is these things can be worked at. But it's very important that we do this. But we can do it in an open, fair, and transparent way. And so the charges of favoritism can be managed and dealt with.

So, the other final thing, of course, is we do support a lot of pre-competitive research and development and engineering. That is our central core strength. It will continue to be. We want to know, actually, are we supporting the right things. Again, the right things are the things -- eventually, the success is not so much the great scientific papers we do. Our success is really -- is the private sector going to pick it up? Is this going to help the United States be economically competitive, and satisfy many of our other national goals? So, those are other things that we do.

Another question for the panel is, how should we prioritize our technology development activities to get the most of whatever funds we do have? You know, people say, yes, the QTR was necessary, because we have the great time of fiscal restraint.

But, you know what? It was necessary no matter what. Even if there was a lot of money we would have done this. You may not believe us, but it is true. But whether times of plenty or times of restraint, we need to do this. And -- but which -- how should we do this?

Concerning targeted technology development initiatives, should we give priority to technologies that simultaneously satisfy the following conditions? So this is a question to the panel. This is, again let me say, targeted technology development.

So, instead of just even-handedness, if you are going to start to have emphasis -- in particular the technology issue -- we give -- consider the maturity of the technology, whether there is significant technical headroom yet to be demonstrated on a commercial scale -- and perhaps within a decade,

that's the time scale.

The materiality. Sometimes you can invest in very innovative things that could be economically viable, but it won't have any materiality, because the market, or the business model, would saturate, you know, the total available market -- the TAM, if you will -- and the business lexicon is so small it wouldn't have actually done anything material to our country's energy portfolio.

And finally, the markets. Technologies could be expected to be adopted by relevant markets. What would be needed to by -- and how are these markets driven by economics? How do we understand how these markets are driven by the economics that shape public policy?

So, those are some of the things. I think, even though this is a technology review, we have to understand what drives the private sector, what drives the markets, what drives deployment. That's another thing we are trying to come to grips with. Because if it was just in a vacuum, and we were just techy geeks, that's not going to actually help get this thing

deployed and change our energy mix and our -- all the things that the people in the room want to do, in terms of our energy independence, our -- the fact that we want to develop clean energy, the fact that we want to do it in a viable way, and the fact that we want to be leaders in this technology around the world.

So, those are a few of the questions that are posed. And with that, you're off.

UNDER SECRETARY KOONIN: Thanks.

(Applause.)

PANEL THREE:

ROLE OF DOE: TECHNOLOGY POLICY

UNDER SECRETARY KOONIN: Okay. Good. So thank you, Mr. Secretary, for setting that stage. What I'd like the discussion to focus on for this third panel is, how does the Department really do its business? We have a set of capabilities. How do we build the portfolio? When and how do we do initiatives, demonstrations, the importance of road maps, and so on.

And let me start out by focusing in on something the Secretary mentioned already, the criteria

by which we would make a push on technology. And what we're thinking is something like the ability to make a one-quad-a-year difference by 2030, the ability to be commercialized by 2020, as things for which we might use as criteria in which to make a push.

Are criteria like that even useful in thinking about what we do, or are there more subtle and nuanced matters or judgement that should be applied for when we decide to put a really big push behind something? Katie?

MS. MCGINTY: Sure, I'll kick us off a little bit, Steve. Thanks.

It seems to me that a goal like that, it's just completely deductive. Pull it out of the air, sounds like a great number, great bumper sticker, great phrase, let's go for it. You might get away with that once.

UNDER SECRETARY KOONIN: Yes.

MS. MCGINTY: But then after everybody tries it and it goes nowhere, you wouldn't get away with it the second time. For those programs, though, that I think -- where there is a dialectic between that

deductive and an inductive approach -- and I'm thinking of the sun shop program, for example -- you know, the dollar a watt, you didn't just pull out of the air. You are capturing an effort in a way that I think helps concentrate effort and will be effective.

But I believe it was after some consideration and studied analysis, working with private sector and others to say "What's in reach at what time frame and at what price point," and then you pushed it a little bit from there. That combination, to me, feels like an effective approach.

UNDER SECRETARY KOONIN: So more capability price point of --

MS. MCGINTY: Really, I guess, in simple terms you can't just pull it out of the air.

UNDER SECRETARY KOONIN: Right.

MS. MCGINTY: But I think, if you can concentrate effort and concentrate the mind with a goal like that that is informed by some market and technical realities, it is an effective way to go.

UNDER SECRETARY KOONIN: Okay. Somebody else want to weigh in on that? Sue?

MS. TIERNEY: One of the things I heard the Secretary say was that there were these three criteria or planks that you all are considering: materiality, maturity, and markets. That combination, I think, is very powerful. But I want to suggest that there are maybe some other ones to put on the table. So I am going to give you three more M's, to see if I can get you there.

One of them is that there are a number of things in our system of government where we operate in silos and we look at only the energy issues, and to the extent that there are collateral benefits. And, of course, when we look at energy we look at energy security, environmental things. But we have a number of competing programs and purposes through which we spend public money. And to the extent that there are collateral benefits for health with a public health agenda, or something else, I think that that is an important one to put in there. So I will call that the "multiples" in the four M's.

Here comes number five. There are some things that meet your test, but they're really stretches, but

they could be game-changers, and it is really important to keep an option value going, in terms of keeping the technology option available over the long term. So I will call that a "maybe". That was stupid.

And then, the number six is that there are some technologies that are just fantastic. They might meet all the tests. They are potentially game-changers, but we find these really pernicious, sticky, non-technical systems barriers to getting them in. So that would be your "muck" criteria. Figure out how to get through the muck.

UNDER SECRETARY KOONIN: I like that.

MS. TIERNEY: And I think that that's actually important for thinking about what's on the Department's portfolio, because those things that get you stuck in the quicksand make it so that you have no pathway to market.

UNDER SECRETARY KOONIN: So let me pick up on the muck for a second. I know you were off doing other things today, this morning.

MS. TIERNEY: Oh --

(Laughter.)

UNDER SECRETARY KOONIN: But -- no, that's not what I meant about muck.

MS. TIERNEY: -- the shale gas.

UNDER SECRETARY KOONIN: Yes. But one of the things that came through this morning was a need to consider the broader systems or societal context in which the technologies get deployed. And certainly the muck is a big piece of that.

MS. TIERNEY: That was a loveable phrase for our loveable country, when I said "muck."

UNDER SECRETARY KOONIN: Okay. I'm never going to do crosswords with you, Sue. I -- Dan, you look like you were going to say something.

MR. SCHRAG: So, I think I like the idea of muck, Sue. At the same time, I think a lot of people call --

MS. TIERNEY: Your muck is my mud? Yeah.

MR. SCHRAG: Well, what I mean is, you know, if you talk to people who are sort of out in Silicon Valley, and more on the technology push end of energy technology, they will bemoan the Valley of Death, and they'll say, "All we have to do is figure a bridge

across the Valley of Death."

But the Valley of Death is there for a reason. There are a lot of things that just don't make any economic sense. And before you build a $4 billion power plant using technology that isn't competitive, you know, there is a reason sometimes some of that doesn't happen.

And, you know, we are talking a lot of money at real commercial scale. And so, some people will say, "Oh, it's just because there is too much muck." And the decision -- and I think there is no one size fits all here. Ultimately, it is technology by technology, market by market. Ultimately, the decision of what is muck and what is real, long-lasting barriers to commercialization is a very difficult, very challenging decision.

MS. TIERNEY: I agree.

MR. SCHRAG: And has to be made in the context of the broader energy policies of this country, of which DOE represents a relatively small fraction, in terms of tax policy, in terms of permits, in terms of leases on federal lands. All of those things matter

probably a lot more than the kind of technology investments that the QTR is talking about.

That being said, this QTR is a very important step towards a comprehensive U.S. energy policy. It's not the last step, but it's a very important first step. And I think one has to ask the question, as far as the audience of this QTR, one might think about one audience being the cross-section of the U.S. Government that will ultimately do the QER, the ultimate, more comprehensive view, and what does the DOE have to tell them about the readiness and obstacles of these various technologies?

UNDER SECRETARY KOONIN: Good. So, let me focus particularly -- since six dimensions is even harder than the three we had, let me focus on one, and that is the maturity aspects, and pose the following question. There is no sharp answer, of course, but it would be good to hear your views.

Some people say that the Department should be concentrating a lot of effort on pre-competitive research, or things that industry is just not doing, but should be done. Other people say, "No, our

problems are really urgent, and we should be focusing on things" -- how can you get things either over the commercialization hump, or facilitating already commercial technologies into broader deployment?

So, I would like to get -- you know, the easy answer is, of course, you should do both. But I would like to get a little bit more nuanced answer from some of you. And, David, you look like you're about to say something.

MR. TERRY: Well, I will try not to give an easy answer, an easy perspective. But working at the state level, of course we're more interested in near-term items. So we have a great interest in seeing balance in applied research demonstration deployment. A lot of the state's resources, whether they are from the state research institutions, or from the state energy offices, do go into that space.

But I think there is a need to have that balance at the Department, as well. I think, in terms of figuring -- I think it depends a little bit on the technology, it depends a little bit on the time frame. And when I think about maturity, and the kind of

political and economic environment we have right now, I think the question of bringing some focus to nearer-term items is really crucial.

I think we have to make some more emphasis on nearer-term items. I know there is not a big appetite for that in Congress, but I do think that is important. It is certainly what the states are hearing from their constituents, and the people they are working with. So both -- I think we need -- I think we have a long way to go to step up to the nearer term.

UNDER SECRETARY KOONIN: Bill, you are the steward of long-term science in the Department. I wonder if you can comment, both on this balance, but also how we're connecting the more basic work to the applications.

MR. BRINKMAN: Yes, well, we -- the sunshine program aside, that's not the only program we're doing right now. We've tried to reach across from science to the energy -- applied things, and form these groups within the DOE so that we have goals and have an understanding.

And one of the things, from my point of view,

as running a research organization, is it's often the case that researchers, in their nice little labs at universities or their national laboratories, don't really know where industry is. And so, one of the objectives of this, of these cross-functional things, is to put out there what -- where industry is today, and what is needed in industry.

You know, one of the problems, you know, one of the things you deal with when you deal with real development, is most real development is going to get done by industry. Government -- it's very difficult for us to go in and take -- redo a factory, reduce the cost of manufacturing. But there are always fundamental -- there are always problems that can be addressed outside that factory that will make a difference. I can give you examples, if you like. And those kinds of things we can address.

And so, you -- so -- but this requires a pretty detailed knowledge of the development side of the picture, and that is what we are trying to achieve in doing these cross-functional things, to get a clear -- much clearer picture of where the fundamental

problems are, and if they were solved, would make a big difference in some particular -- might already be in a factory.

And so it's that kind of thing that I think is very -- really, very important to get started. We -- in the battery world, you know, we now have a goal of a cent a mile. Sort of if you think about it for a while, it has a nice thing to it, that it's --

MS. MCGINTY: It's not pulled out of the air.

MR. SCHRAG: I mean computation is a nice example of that.

MR. BRINKMAN: No, no, it's not pulled out of the air. I'm sorry, it's very much not pulled out of the air. But it incorporates the length of -- the life of the battery, it incorporates the fact that you have to be able to go a long way, and it also incorporates the fact -- the reliability and weight of the battery. So, it does a nice set of things, and so --

MR. SCHRAG: Bill, you might mention the computation program, and all that DOE's doing in terms of simulation --

MR. BRINKMAN: Well, you know --

MR. SCHRAG: -- to bring down costs across many technologies.

MR. BRINKMAN: Oh, we have done many technologies of many cases. And our famous one that we've been publicizing a lot in the last six months is a smart truck, which turns out, if you think about long haul trucks, when they're going 70 miles an hour down a road, almost all the resistance to motion is wind resistance. And it turns out that you can do a very simple thing, and that is to kind of mount some plastic boxes under the main trailer. And it will reduce the wind resistance by 12 percent, and increase the gas mileage by 6.

And so, this kind of simulation is extremely important. In fact, I often think that it would really be an interesting thing to think about a industrial computing user facility, which would essentially be maybe funded by industry, but would be actually a large facility in which -- a computer facility which would have the kind of high-end computers that we have, and we would run them for industry.

And I think there is a lot of problems we

could solve that have a bit impact on industrial -- they are doing a lot of basic research with our machines, but we could --

UNDER SECRETARY KOONIN: Okay.

MR. BRINKMAN: -- we could do a lot more of the things --

UNDER SECRETARY KOONIN: Katie? Yes, good. Thanks, Bill.

MS. MCGINTY: Thanks, Steve. It just strikes me that, as you're reaching for do we only do those things where there is some demonstrated market appetite and we have some confidence there will be uptake, or do we do the things that are very substantially pre-competitive and pre-commercial, it strikes me that -- in the ARPA-E program, that you are pulling some of the best from both worlds.

I mean those are clearly research initiatives at an earlier stage. But, as I understand how you've structured that, and how you're working it, those priorities are informed by some significant collaboration across sectors with private sector joining with you.

And so, to me, that begins to resemble a sweet spot between what is basic and may or may not contribute ultimately to commercial, and what is almost fully commercial, and maybe not an appropriate role for you.

UNDER SECRETARY KOONIN: Very good. Sue?

MS. TIERNEY: Thanks, Steve. I have a couple thoughts on it. Some of them are maybe more lofty than other.

One of them is that I do think you need to have a portfolio that is balanced. So somebody's balance is somebody else's bias, I know, and so that doesn't really mean anything.

(Laughter.)

MS. TIERNEY: When I think about technology, often we think about wind, fuel cells, CCS, whatever it is. But I actually think that the Department is focused on pieces of things, materials, that could have lots of applications. And so, sometimes I'm not sure whether it is really pre-commercial technologies, or solving a particular widget problem. And so I don't want you to lose that piece of it when you are thinking

about where you stay along the R&D curve.

Here is maybe my less lofty ones. Maybe that one wasn't very lofty. But one of them is -- the number two is if the Department doesn't stay in the relatively close to commercialization phase -- is that --

UNDER SECRETARY KOONIN: Something is making noise --

MS. TIERNEY: Is that my voice crackling? Then I worry that we would -- "we," the United States, Congress, constituencies -- would begin to see the Department of Energy as the next NSF. And not that I am pleading the case for keeping the Department of Energy open, but I do think that there are -- there is not so much a constituency for this concept of R&D here that is focused on solving major societal energy problems if it isn't balanced.

Now, the third issue is that I think that pathways to technology solutions are informed by things along the supply chain. And so, having an organization really just doing things 10 years out leaves aside the indications that you get through industry partnerships

and a variety of other things about where things need to be driven.

UNDER SECRETARY KOONIN: David?

MR. TERRY: If I could just add to that, I think the continuum -- I mean part of it is balance, but I think you're exactly correct, the other part is the continuum.

We had a pilot program with the state energy office of state research institutions in the Department about 10 years ago. And every project and program goal we set out had to address the entire continuum. And I think you see a lot of those elements, for example, in the solar sun shop program, which I think is exceptional, but I think that continuum is important, and the feedback loop that happens, as a result of that. So --

UNDER SECRETARY KOONIN: Good. I want to turn to a different topic entirely, because we're going to open it up to the floor in about five minutes. But it's the social science question, or human behavior, as was pointed out this morning. People are, in the end, the purpose of the energy system, in many ways. And we

need to worry about the human factors as we develop technologies, whether it is for consumers or acceptance of large-scale technologies, or whatever it is.

And I will just tell you two anecdotes, one from this morning. There was a lovely story about the design of the charging head for the Chevy Volt, and how it purposely looks like a gasoline pump, because that is what people are used to in refueling their vehicles.

Another, from my own point of view, is a consumer -- there is a lot of discussion this morning about engaging the consumer in energy efficiency. Well, I don't know about the rest of you, but I am deluged with information these days. And the last thing I want to worry about is fine-tuning all the time the efficiency settings in my house. I am happy if it does it by itself, or I do it once and don't need to worry about it for a year.

So, you know, these human factors are very important. The Department has not had a strong effort in that. There are other parts of the government that might. Should we have something like that in the Department, should we marry up with someone else? Is

it important at all? Maybe it's business's role to do all that.

Your thoughts about the social science dimensions of what we're trying to do? Sue?

MS. TIERNEY: Yes, yes, and yes.

UNDER SECRETARY KOONIN: Okay.

MS. TIERNEY: When I think about the scale-up requirements for a robust energy system which is low carbon and enables our economy to be -- continue to be a global leader -- that was a hopeful statement -- it's enormous scale-up challenges.

And, of course, there are technology breakthroughs that have to happen. But you can't scale up either -- think of any of them at random. You can't scale up wind without transmission, and you can't get transmission without thinking about siting, and you can't XYZ -- or investment, if you think about biomass, you know. The land area, what that means about crowding out other land uses -- so pick your technology at huge scale, and it's a systems issue about human, economic, institutional, behavioral, social stuff. It must be part of it, I think.

UNDER SECRETARY KOONIN: Dan?

MR. SCHRAG: I think there might be a lesson that the DOE could take from other government agencies in this one.

For example, the USDA, which, you know, invests in agricultural economics, in a variety of other behavioral sciences, thinking about, in terms of the -- its function of advising farmers, they think a lot about how to get technology out to the farmers in a way that it will be taken up well. That certainly resonates in the energy efficiency space. And I think there might be some lessons there.

The other thing to say is I think it ranges, in terms of the social science, from more theoretical questions -- for example, the energy efficiency paradox -- the Sloan Foundation is just starting up a study on that --

UNDER SECRETARY KOONIN: The Jevins and all of that. Jevins rebound, that paradigm?

MR. SCHRAG: Yes, exactly.

UNDER SECRETARY KOONIN: Right.

MR. SCHRAG: On the other hand, very applied

things, as Sue mentions, real political science, on-the-ground politics of, you know, what do you do in the Pacific Northwest with all that cheap hydro, and they don't want to build power lines to connect it anywhere else, because their prices would go up? You know, how do you deal with the politics of that?

I think you could see a full range of that. It's all very important. But I do think agencies like the USDA have some interesting models to follow.

UNDER SECRETARY KOONIN: Okay. Bill?

MR. BRINKMAN: I am only going to make one comment. It -- I agree that there are a lot of things that could use a study by economics. I mean every major corporation that introduces a product has a market analysis group that involves those kind of folks.

The thing that I would be cautious about is -- I remember when nanoscience became the big thing a number of years ago. It was forced to have social analysis of the impact of nanoscience. The problem was that nanoscience didn't have any products or anything else that was going to come on the field at any time

soon. And so, the three to five percent was being funded on all kinds of things that -- I personally didn't find it very useful.

And so, I think you have to be careful about that kind of -- asking people to study problems that don't yet exist is basically what it was about. And that --

UNDER SECRETARY KOONIN: On the other hand, in the energy system we've got more than enough problems to study already.

(Laughter.)

UNDER SECRETARY KOONIN: Yeah, right. Katie?

MS. MCGINTY: Well, I just -- I think it's a important point. Forever, folks like Avery Levins have been talking about all the energy efficiency that's there, and it's available to us, it's the $20 bills that are all over the floor, and nobody stops to pick them up, and why don't they.

I guess -- so a valuable question, a valid question. But I do think you can study those things to the distraction of the tools and insights that are available to you today. And it just seems to me that

we do know some things, right? So, people respond to things that are cheap, convenient, and accessible. And I think you've got stuff to start aiming in those directions already.

On the accessibility piece, make it the easiest thing in the world to buy a really efficient name-your-widget, and that's your standard-setting capability. That is an extremely valuable tool. Now, it takes us out of the science and technology part of DOE, but recognizing DOE as a whole has some other extremely valuable tools.

And I would say, if you could, just take, as an article of faith, the things that are convenient and easy are going to be more attractive than not.

It seems to me that in the design of your research programs you are already looking at markets. You know, what will -- where -- what and where will there be uptake by markets, and that some of these things may be subsumed there.

So, I guess I would say yes, but I wouldn't want to see you distracted, diverted, wrapped around the axle, when some things are kind of plain, and we

know them, and we can go after them today.

UNDER SECRETARY KOONIN: Good. David?

MR. TERRY: I would add a yes as well, and I think it is in two flavors. I think it's in the bigger picture items that Sue mentioned that I think really matter, from an end use perspective, but also in some of the smaller areas.

We have a tremendous experiment going on around the country with all the residential retrofit and ramp-up program, and so forth, better buildings that the Department is operating, states are investing in. Some of those programs have a fair amount of market research and analysis going on real time.

But, in general, I don't think we had good analytical information about how easy we needed to make it for consumers. And I think we see slower uptake in those programs, in many cases, as a result. And I think if we'd have had some of that analysis up front on the social science side, we'd have been further along.

UNDER SECRETARY KOONIN: Very good. But I've got a couple of other topics I do want to

explore -- but I think if we open it up to the floor, and we'll hit them -- and if not, I will make sure that we do, eventually.

So, your engagement with the panel is solicited. Questions? Comments? We will adopt the same format as this morning. We will gang the questions in three, if we can. And, Mike, I see you --

MR. MCQUADE: Yes, it's actually very timely, just because it's tagging on the last comment.

I want to only make one comment. I think the investment that DOE can make in understanding social and psychological phenomenon -- why people make the choices they do, why people don't pick the $20 up -- I think that is well within bounds, and sequestering a portion of the funding to be able to do that, I think, is a really good thing.

I think, in the atmosphere we're in right now, I think DOE needs to be very careful about anything that hints of trying to change people's minds in a social engineering points of view. And I think that is a line that is very dangerous to get up against. And preserving the investment and the need to invest in

understanding why people -- what they want to do is very different than convincing people to do something that someone else thinks they shouldn't want to do. So, full stop.

UNDER SECRETARY KOONIN: That's -- Bill.

MR. PROVINE: Yes. A question, just in terms of maximizing the impact from whatever technology is being funded, how the panel might be thinking about intellectual property and intellectual property rights. And my concern is how they get too bucketed in different domains, and then minimizes the value from that technology investment, and how you might be thinking about that differently.

UNDER SECRETARY KOONIN: Good. And we're going to do three at once --

MS. MCGINTY: Oh, okay.

UNDER SECRETARY KOONIN: -- and then you can get a chance to -- Mason?

PARTICIPANT: A question from T.J. Mitchell, via Twitter, who asks, "What is a reasonable time frame for renewable energies to cost less than all other forms of energy?"

I might put that more generally in our context of, when we're thinking about maturity by some time frame, materiality by some time frame, what should the department's target time frames be in those criteria?

UNDER SECRETARY KOONIN: Okay. So we've got three -- and you're welcome to address any or all of them -- one on staying clear of social engineering, yet still doing meaningful social science discussions; another about the buckets of intellectual property, and how do we make sure that we don't run afoul of that; and then finally, this time frame of renewable energy.

And Katie, you were first, and then Dan after that.

MS. MCGINTY: Thanks. I wanted to address the intellectual property question. And I have, I guess, two thoughts that I want to share.

I don't think they are fully in conflict, but I will admit that there is some tension between them. I do think, as DOE invests public dollars, especially as we get into the larger scale public dollars around demonstration projects, et cetera, that it ought to be a condition to those dollars that the research would

1 produce fully disclosed results, and there would be
2 complete transparency there.
3 But the other thought is with respect
4 to -- and here, having a hat on as a clean technology
5 investor -- greater encouragement to the Department in
6 considering and allowing exclusive licenses to
7 technology. It's pretty darn hard to get that growth
8 capital when there could be a challenge or a
9 requirement to share a technology that you are seeking
10 a couple hundred million dollars of private capital
11 for.
12 UNDER SECRETARY KOONIN: Okay, good. Dan?
13 MR. SCHRAG: Well, I was just going to respond
14 to the last question from Twitter about when renewables
15 are actually going to be economical. And I think the
16 answer is we have a very complex landscape of energy
17 prices.
18 Just take electricity, for example, because
19 we're talking about renewables -- we won't talk about
20 transportation fuels -- but there is almost a fivefold
21 difference between the states in residential
22 electricity price across the U.S. And there are some

states where renewables are very competitive today, and there are some places where renewables make no sense at all. And they don't necessarily match up with where it's sunny or where it's windy.

But, for example, Iowa, which is now 20 percent wind generation, was building windmills for almost $1 a watt, installed. That's pretty competitive with anything, until you get to the threshold they're at now, where they have to think about storage. And that's a different question.

So, that's a -- it's a more complicated answer, but it's -- the answer is, "Today, in certain places."

UNDER SECRETARY KOONIN: Sure. Sue?

MS. TIERNEY: I don't know about you guys, but I was hoping he was going to give us a date. That would have been great, and when they're going to be ready.

But you didn't give us a date, and I don't have one, either. And for a different reason. I like to think about the question in terms of how long is it that we need to keep policies in place that are either

market conditioning or creating financial incentives to overcome some investment hurdle, or the -- you know, the learning curve problem.

So, I think that it is a function of watching the relationship between subsidies, the deployment quantity, and then the continued market barrier that still exists. And at some point, if you've got a lot of injection of financial incentive, and a lot of deployment, and it's just not getting to market, I think that that begins to be a huge sign.

That's -- there is a problem.

UNDER SECRETARY KOONIN: Right. Okay. There is one in the back. It's a little bit hard for me to see everyone. So just step up.

AUDIENCE PARTICIPANT: So I'm Haresh Kamath from Electric Power Research Institute. And I just wanted the panel's opinion on something that Dr. Chu had talked about, which was the involvement of industry, and understanding some of the priorities of the research agenda.

I was going to ask whether such public-private partnerships are an important part of the agenda and

should be considered right up front, and also make the observation that, by working with research consortia like EPRI or with U.S. Car, for instance, that a lot of the issues with picking or choosing or being -- favoritism can be eliminated. Thank you.

UNDER SECRETARY KOONIN: Okay, good. Thank you. Yes?

MS. ULRICH: So, I'd like to state that I believe that the Department of Energy has been a very strong science agency. And it is clear that, you know, in recent years they have had a lot of support from the President, the Secretary. They are doing amazingly great work as a science agency.

But nevertheless, with all of that science, we still are not meeting our energy goals, in terms of security, in terms of competitiveness, and in terms of CO2 reductions.

And so, I am just wondering -- and, you know, we're talking about the role of the Department. How does the QTR -- how does the QER, in general, move the Department and the Agency? How does it inform taking the Agency to a place where it can better meet those

needs?

And, you know, I think -- particularly when I think about the role that states have in a lot of these energy issues that -- many of these energy decisions are very distributed, and especially all the discussion about electrifying the transportation sector and things like this, it is going to be moving more and more towards being a distributed system of decisions.

You know, what role does DOE have in working with FERC, NARUC, NASEO, all of these folks, and how can it be better at bringing tools -- whether it's like USDA, or when Dr. Brinkman was talking about computing tools and things like that -- to the fore for those various constituents?

UNDER SECRETARY KOONIN: Okay, good.

MS. ULRICH: My name is Elaine. I'm an energy analyst.

UNDER SECRETARY KOONIN: Thank you. Good. One more?

AUDIENCE PARTICIPANT: I have one question.

UNDER SECRETARY KOONIN: Go ahead.

AUDIENCE PARTICIPANT: It's a follow-up of

this question from EPRI.

In the past, when we were not deregulated, electric power research institute and gas research institute worked very closely with Department of Energy. And I have seen many, many technology development and the projects and demonstrations. There was a very good streamlined public-private partnership.

Now, with the de-regulation, one of the side effects was EPRI's role, in my opinion, was minimized because there was no funding. GRI role was minimized. Now, to develop the new technologies that demonstrate, what will be the new model that would replace this?

UNDER SECRETARY KOONIN: Okay, good. So, if I could summarize, we've really got two questions on the efficacy, importance of public-private partnerships for moving technologies forward, and then one on how can the QTR/QER make the Department more effective, particularly as decisions become more and more distributed.

So, either of those. Bill?

MR. BRINKMAN: I could try to answer the second question.

UNDER SECRETARY KOONIN: Good.

MR. BRINKMAN: It seems to me that -- you know, that there is this famous statement, right? "Planning is essential; plans are worthless." And I think that that's really what it comes down to, when you think about it. It's this kind of conversation that you have with people that you learn from the interaction, and it will educate the people who are making decisions, and that's how it works. And I think that's a very simple thing.

UNDER SECRETARY KOONIN: Yeah, good. Anybody else on either of those two points?

MR. TERRY: Sure. I guess with regard to public-private partnerships in particular, I -- obviously, that is an essential area to focus on. I think one of the things that we used to do that we've gotten a lot better at -- both the Department, the states, and the private sector -- I think we used to see those partnerships as sort of the Department puts out an RFP and people respond. And I think we've certainly moved beyond that. But I still think there is a lot of work to be done, from a communications

perspective on joint planning, setting joint priorities.

The states spend roughly $3.5 billion to $4 billion a year in deployment and demonstration, some applied research. And I think, to the degree that we can better -- not synchronize those things, but at least do a more formal systematic partnership and planning with the private sector, and with the federal government, we will get a lot further.

I think that also goes to -- somewhat -- to a point of the decisions that are made at the state level that are impacting energy. Obviously, a huge amount of activity in that area.

And with regard to, say for example, the cooperation between NARUC, the National Association of Regulatory Utility Commissions, and NASEO, the state energy officials that I represent, and the air regulators, we have been working on how to better implement efficiency, and integrate efficiency as a way to mitigate air requirements associated with power plants.

I think that's the kind of federal/state

1 involvement and integration that can be replicated in
2 other technology areas. That's a broad area, but I
3 think that's something we might want to try and
4 replicate.
5 UNDER SECRETARY KOONIN: Sue?
6 MS. TIERNEY: I would like to address your
7 extremely thoughtful question and really pernicious
8 question. You -- I think you described the fact that
9 we are not really meeting our energy goals. And you
10 mentioned security, competitiveness, and CO2 reduction.
11 And, for sure, we are nowhere near the aspirations that
12 we talk about, if you were bundling all those things
13 together, of somehow having a transportation sector
14 that we're not dependent on Middle East oil, or
15 something.
16 But, you know, I think that one of the things
17 that PCAST did was say that our energy policy is
18 derivative. I have never personally yet seen the
19 energy policy that is sustained, comprehensive,
20 articulates every one of those -- it doesn't exist,
21 right? It doesn't exist. It's all those things that
22 Dan described in tax law, environmental laws, land use

laws, transportation laws, everything else.

So, there is a huge gap between what we think we want when we talk about what we need, and what we decide every single day in the micro-decisions we make as energy consumers, where we basically are happy enough, as long as we can plug it in, and get it there, and put our gas, you know, thing in the gas tank.

So, one of the challenges, I think, for the quadrennial technology review is providing things that are descriptive of where we are, the state of play, the challenges that we pose, and why it's important to think about these things at a more macro level, and to identify places where the common national interest is really just not embedded in our little micro-decisions. Carbon pricing would be a perfect example of that.

So, there is two -- I know you're not going to probably say that in the quadrennial --

UNDER SECRETARY KOONIN: Well, we can say that a price on carbon, in one way or another, would move low-carbon technologies along.

MS. TIERNEY: Excellent, excellent.

UNDER SECRETARY KOONIN: That we could say.

MS. TIERNEY: Excellent.

UNDER SECRETARY KOONIN: And we will --

MS. TIERNEY: Saying those kinds of things would be very helpful for doing these national things better into the micro-decisions.

UNDER SECRETARY KOONIN: Okay, good. Anybody else on any of those?

(No response.)

UNDER SECRETARY KOONIN: Okay. Let's go back to Kelly.

AUDIENCE PARTICIPANT: I wanted to make a --

UNDER SECRETARY KOONIN: Down here first. Go ahead, Kelly.

MS. GALLAGHER: Yeah. Okay, thank you. Kelly Sims Gallagher. I'm at the Fletcher School at Tufts University.

MS. MCGINTY: You should be up here, Kelly.

MS. GALLAGHER: No. And I was on a PCAST working group.

I wanted to ask Steve, you, and Dr. Brinkman to reflect a little bit on how DOE is assessing what the private sector is doing when making decisions about

what DOE's role should be, or comparative advantage should be.

What are your mechanisms for doing that? How do you understand what is happening in the private sector? Of course, how there might be opportunities for partnership, but then also, really, what DOE can do that the private sector is not going to do.

UNDER SECRETARY KOONIN: Okay --

MS. GALLAGHER: And just a quick follow-on. The same thing with respect to international public investments. Both of those seem to be important: understanding the competition, finding potential areas for cooperation.

UNDER SECRETARY KOONIN: Good.

MS. GALLAGHER: Thanks.

UNDER SECRETARY KOONIN: Thank you. I will take two more, and then we will -- yes? I'm sorry.

AUDIENCE PARTICIPANT: Regarding the earlier conversation, whether we want to confine the research very closely to the relatively near term goals, I think it is very important to recognize the unpredictable nature of research.

Much of what -- the technology we are using today and we take for granted are coming from unexpected or unplanned discoveries. Whatever you do, if you confine the goal too narrowly, you suppress creativity. I think it's very important, whatever you do, you don't suppress that.

And I would say that, for DOE, it's okay to have goals, broadly defined, objective goals. But at the micro level, I think you need to be very careful not to suppress the individual creativity. And I think a case can be made -- we can look back -- that much of the technology of the future may not be thought about today. And that aspect should not be forgotten.

UNDER SECRETARY KOONIN: Good.

AUDIENCE PARTICIPANT: -- yes, from Stanford University.

UNDER SECRETARY KOONIN: Yeah, good. Anybody else? Avi?

MR. GOPSTEIN: Third question. My name is Avi Gopstein, I actually work for you. So --

(Laughter.)

UNDER SECRETARY KOONIN: Yes. Very hard,

actually.

MS. MCGINTY: You have a good one.

UNDER SECRETARY KOONIN: He knows all the skeletons.

MR. GOPSTEIN: One thing that the Department does is we operate facilities around the country. And I was hoping the members of the panel could discuss or opine on the best management practice, or the best type of applications for these facilities, as they relate to our energy technology challenges and opportunities.

UNDER SECRETARY KOONIN: So -- okay. If I could summarize the three again: how do we assess the private sector, and how do we assess the international public investments, because these are obviously important, as we decide where to put our resources; the second is being sure to preserve the unplanned discoveries, there are always surprises, the common quip is that we tend to over-estimate technology in the short term, and under-estimate it in the long term, and how do we preserve that space for our true creativity; and then Avi's question about the role of technology user facilities, and the Department.

We do a good job in operating science facilities. What about technology user facilities? Is there enough space there for us to do something more than we are doing now?

So, I don't know -- Bill, it seems two of those questions are more or less in your bailiwick, and I will --

MR. BRINKMAN: Well, let me start with the first one. The question is, how do we know what's going on in industry? Well, we know that the same way industrial folks know it. They -- you get around to conferences, you get around to your friends who work in the industry, you talk to people, you find out what industry is doing, you pay attention to the market.

We have people in the -- who do many of these things. I think the easiest one to talk about is the sun shop one, where we clearly had a very clear picture of where the market was going, where -- what people like Sun Power and First Solar and SunTech and all these guys were doing.

I think we do that pretty well. I think we pretty much do that well in the nuclear world, we do

that well in the battery world. Maybe we don't do it quite as well in something like CCS, but I think we do, I believe we do. And so, I do believe we pay fairly decent attention to industry.

As far as national user facilities for technology, well, we have all these things like that, and they often are used a lot for technology. In fact, the upgrade that we're doing to the advanced photon source at Argon is almost entirely devoted to the idea of being able to do imaging of devices, because -- and so it -- building shorter wave-length x-rays that penetrate deeper and can look more closely.

But, you know, there could be others. I mentioned earlier this idea of a user facility for applied research using computers, and it seems to me that's the kind of thing that we could contemplate, and it is certainly a thing that has been found to be useful by a lot of different folks. And so, you know, I think that's a very real possibility, to do something.

As far as a long range thing that CX was worried about, I regard as part of my job to see to it

that we don't drop that.

UNDER SECRETARY KOONIN: Yes, yes, right. Very effective. Dan?

MR. SCHRAG: So, yeah, let me start with that. I agree, Bill, and to my colleague from Stanford. So, as -- I think I'm the only person up here with a laboratory and graduate student's -- basic science with a lot of creativity is really important, and I hope DOE will never drop that.

On the other hand, it's really cheap, compared to everything else we're talking about.

(Laughter.)

UNDER SECRETARY KOONIN: I don't know, Bill.

MS. MCGINTY: Nice move.

MR. SCHRAG: As far as Kelly's question, the integration of what's going on in industry, what's going on internationally -- and I would add, really, what's going on across the U.S. Government, as well -- it really comes back to policy inputs into DOE decisions, policy writ large, not just U.S. policy, but international policy, competitiveness issues, and industrial policy.

And one of the things, as you know, that our PCAST report called for was to take away half of David Sandalow's job and create a director of energy policy that would report to the Secretary of Energy, and have a much higher, broader role for energy policy -- an energy policy office, that would actually help make sure that there was uniform analysis of energy policy in all the ways you're talking about integrated into decision-making at DOE.

And I think that's a very important concept. Whether that's the best structural way to do it, I have no idea. But I think certainly not having it done division by division, program by program, but actually having some DOE-wide energy policy analysis capability is very important.

UNDER SECRETARY KOONIN: Sue?

MS. TIERNEY: So, the question on user facilities and best practices, was that kind of at a -- best management practices -- I actually think that is one of those social science issues where the economist in me wants to say, "Actually, it's a cost allocation and pricing issue."

If you are at a weapons lab, maybe your overhead is paid for by some other things, and you're able to price and make those accessible. If you are a renewable energy lab, where everything you have to do has to be at least partially paid for by the users, you have a pricing decision. Are you trying to price for maximizing use? Are you trying to price so that you actually get overhead picked up in every single application, and thereby inhibit use, and then you're stuck with a lot of overhead?

So, I actually think that figuring -- and both of those issues are not easily solved at the Department of Energy, because those are program by program. The OMB might have a point of view about those things, they're going to be through appropriations issues. But I actually think that is a really critical issue: how do we want to price getting people to use this national asset that we have made investments in?

That was just, you know, a social science plea.

UNDER SECRETARY KOONIN: Okay. Katie, did you want to --

MS. MCGINTY: Well, I will go from the social science plea to political science suicide here.

So I have three quick things to, I guess, share on the user facilities. And the first is the political science, which is that there are instances in which some of those facilities are an answer in search of a question. But they happen to have a sponsorship.

And so, it might be that it is hard fully and maximally, to use those facilities because those facilities may have been designed from something other than end user need at the outset.

MS. TIERNEY: Katie.

MS. MCGINTY: Moving right along --

(Laughter.)

MS. MCGINTY: For those facilities that do have very strong user needs, I will just share two personal experiences that -- you know, or anecdotes, but hopefully they are illustrative of something that would be useful here.

One is that we did have a wonderful such facility, it was a Department of Defense facility in Pennsylvania, and it was funded to the tune of several

hundreds of millions of dollars a year. And the operators of that facility tried their best to attract -- to fully occupy it. And it was a matter of publicity.

It just was in a small town in Western Pennsylvania, no one knew it was there, but it had truly exceptional facilities for things like testing equipment in every kind of wind regime that you could imagine, big enough to build entire homes inside of it, and be able to test different combinations of technologies, et cetera. So, one best practice is finding ways to publicize the availability and the location of some of these facilities.

The other example, though, is one that -- bait and switch isn't good. And maybe those words are a little too harsh, but I am on the advisory board of a company that was very warmly received in one of the user facility labs, and it was hugely important in the development of the technology.

What happened, though, is the department's priorities changed midway into the full testing of this technology, and it was very, very disruptive to the

further development path of the technology that it essentially got unwelcomed. And it wasn't that particular company, it was a sector, a segment of technology that was decided no longer to be of interest. So, the Department has to make those decisions.

But I would wonder, for example, if there would be some middle ground where the Department would not put its own money, then, into the further testing of that technology at that facility, but not throw it out if the private sector investors would pay for it, but enable the technology to continue to avail itself of the facility.

UNDER SECRETARY KOONIN: Sounds eminently sensible.

(Laughter.)

UNDER SECRETARY KOONIN: Yeah, Bill?

MR. BRINKMAN: I would just like to say the office of science has a lot of facilities, national laboratories, and we have 26,000 users at these facilities. So it's a very large number of people. And, frankly, we are very hard-nosed about whether

there is -- a specific facility has enough users.

And if -- so, we, in some sense, use a marketing test. If there is no market out there for the user facility, it's too bad, right, and we'll close it down. So we have that attitude. And so I don't know what else to say. It seems to me that running user facilities is a bit like running a business. And you've got to show that you're useful, and -- otherwise, it doesn't make sense.

UNDER SECRETARY KOONIN: Good. Okay, let's take another round of questions. Yeah?

MR. MCBRANCH: Yes, Duncan McBranch, from the Los Alamos national lab. I wanted to offer a national lab perspective on a couple of things, and encourage the QTR to consider how we can leverage more effectively with some of the assets that DOE does control in a couple of areas.

First of all, in -- there has been a lot of discussion on how DOE sets priorities for basic research, and then how do they bridge across to technologies that scale meaningfully in U.S. markets. And I would suggest that there is bridging

opportunities at the 17 DOE national labs in each of those.

For one, following up on the Secretary's remarks to create more and better public-private partnerships that create niche markets -- and so, for example, in biofuels we have a lot of emphasis on creating fuels that are competitive in the marketplace at today's prices. But there is a lot of other chemical intermediates that come out of biofuels, and lots of opportunities for partnering with industries where we can create niche markets along the way to make those more viable.

And the second aspect is there is another side to Avi's question, other than user facilities, and that is there is a lot of operational muscle within the DOE at the national labs themselves, in terms of implementing energy efficiency, and maybe disruptive technologies that aren't quite ready for market. But the DOE facilities are a pretty big footprint. They are much smaller than the DOE.

But maybe the -- working from the national laboratories to DOD facilities gives one an opportunity

to test out technologies on an operational scale, where you've got the in-house scientific and engineering capacity in order to implement those.

UNDER SECRETARY KOONIN: Good. Thanks. Another question? Yeah.

MR. GRAMBER: Hi, my name is Jack Gramber. I am a student at Harvard University. Just to follow up on the social sciences aspect, I wanted to ask the panelists in what way do you think that DOE could reach out to end users in trying to point them to new technologies?

And would that be something like Energy Star, or lead certifications? Could the Department use its voice to push consumers to new, more efficient technologies? Or what do you think?

UNDER SECRETARY KOONIN: All right. One more? Yeah.

AUDIENCE PARTICIPANT: Eric -- University of Maryland. I wanted to follow on the previous comment about EPRI and GRI in the context of additional funding for energy research in the United States, setting a price on carbon, public-private partnerships, and

industrial relevance.

When those organizations existed as a funding agency, they collected cents per BTU from the gas pipelines, cents per kilowatt hour on electronic transmission grid, et cetera. And then the industry made decisions on funding of research that was industry-relevant, and industry oversight, to make sure that that was the types of things they want.

One could easily extend that and modify the electric power one, where -- that the price per kilowatt hour was based on the carbon intensity of the electricity that was going through the line. And one could extend it to the petroleum industry, in addition, to address the transportation sector, and fund from that industry-relevant research that addressed DOE goals, but that was in line with what industry wanted, and simultaneously put a price on carbon, and simultaneously get industry buy-in.

UNDER SECRETARY KOONIN: Okay, good. So we've got three. Again, one is being able to leverage capabilities in the national labs, both for niche markets, as well as the laboratories as demonstration

sites for new technologies; one on how can the DOE help promote new technologies to end users; and then finally, the public-private partnerships industry relevance, and can one take some gallon charge or wires charge, or whatever, and use that to help fund desirable research.

So, Dan, you move first, and then Sue.

MR. SCHRAG: Very quick on the last one. That's exactly, actually -- this PCAST report recommended, basically -- we took from the corporate leaders the recommendation of a $16 billion-a-year R&D investment in energy.

But it was very clear, from our discussions with Congress, that that money was not going to come through new budget appropriations. There was just no chance of that. And so, explicitly, we talked about off-budget mechanisms exactly like what you are talking about, and that was the whole idea. And so, I think that's very, very important.

As far as the how to reach out to people more broadly, specifically on energy efficiency -- Bill and I were just talking about this over lunch, and the

agricultural services at the state level is a nice example. Bill, do you want to maybe take it on that?

MR. BRINKMAN: Well, I was just going to say that one of the things I would have said in energy efficiency, since it's -- you know, in this country, the -- a home building regulation is done by local cities, not by the county, not by the state, and not by the federal government. So, you know one possible way of addressing this is through what I -- the way it was done in agriculture 100 years ago, namely to have an extension service.

And, in fact, if you go to Penn State today, Penn State is actually -- has actually taken the agricultural extension offices throughout the state of Pennsylvania, and converted them into energy extension offices. And I think that's a really interesting thing to do, and it's a means of propagating these household efficiencies down to the level where you need them to be, right? And I think it's a really good idea.

UNDER SECRETARY KOONIN: Sue, and then David. Yes.

MS. TIERNEY: I wanted to comment on this last

point about what we call in the electric business "system benefit charges," which are charges, of course, that are collected in elect -- in a number of states, where the state legislature or regulators have approved that. New York, California fund R&D with that, as many of you know. And a number of other states collect these money for funds for market conditioning and also for rating for the public treasury in the states.

This was an idea that was a Boucher amendment, if you recall, in the last bill, the climate bill, as part of the package. And the money would have gone to EPRI. And then we saw what Congress thought about that idea.

UNDER SECRETARY KOONIN: David?

MR. TERRY: On the energy extension idea with the ag extension service, there used to be an energy extension program, of course, years ago, run out of DOE with the states. We actually, through the state energy advisory board to the Secretary of Energy, we made a recommendation that we return to a joint partnership between the state energy offices, the governors' offices, and the extension offices.

We have a pilot, actually, launching later this year with DOE in that area, so I think that's a great idea. We see that actively being used already in Kentucky, North Carolina, Florida, and New York, as well as Pennsylvania. So I think that's a good way.

The other way, I think, is the Energy Star program, and I believe it's going to be rolled out later this summer or early fall, their sort of emerging tech Energy Star element. I think that that's an important way to provide the best of the best, newest technology that is commercial available, give it a stamp of approval, if you will, for the consumer. I think that's a really critical role, I think it's one that gets leveraged greatly by retailers, by states, and something that we probably need to do a bit more of. And I think some of the changes ERE is making in that regard at the Department are very positive.

UNDER SECRETARY KOONIN: Okay. Katie?

MS. MCGINTY: So, I guess I wanted to toss a question back out to our friend from Harvard, which is, you know, I know we all know that energy technology is cool. But maybe everybody else hasn't gotten there.

But I actually think maybe they would, or they could.

And I guess my thought, or my question is, I mean, first of all, in terms of pushing those technologies out, I am going to say what I said before: standard setting, standard setting, let's make it easy, accessible, and cheap.

But I wonder if social media and technology -- that we could capture the public's imagination, especially young people's imagination about these technologies, such that it would be something that would really draw their interest, and it would be fun to participate in.

And I am thinking of things like the company Plextronics. You know, inherently, you know, you're walking down the street, your tee shirt is literally charging your iPod in your pocket. Is there sort of an American Idol or some throw-them-off-the-island or vote-them-on-the-island kind of show, or kind of use of social media that could draw people in to what this technology is about?

You know, inductive recharging. You're sitting in a room and you're not plugged in to

anything, but all your gadgets are all recharging. It just -- I toss it back to the student from Harvard to bring back to us an idea that students would find fun, to draw them in and engage them, and use social media to have people as interested in energy-related technology as they are fully drawn to other types of technology.

UNDER SECRETARY KOONIN: Good.

MS. TIERNEY: Katie's Kooky Kinetics program.

MS. MCGINTY: Hold on now, Miss Alliteration.

UNDER SECRETARY KOONIN: Okay. We are very close to the appointed hour. And so I would like to do something for this panel we haven't done before. In one minute or so, what would you like to say that you haven't had the opportunity to say yet this afternoon?

MS. TIERNEY: I think you have done a terrific job on this QTR.

UNDER SECRETARY KOONIN: Thank you. Okay.

(Laughter.)

MR. TERRY: I guess I would second that, just with the kind of input that the Department is providing, and the Secretary is providing, you are

providing in these forums, I think, is critical and I think is the kind of buy-in that we need to get to move the issue forward, politically, as well as to get good answers, good solutions.

UNDER SECRETARY KOONIN: Okay, good.

MR. SCHRAG: Somebody asked the Secretary if he was really open minded and listening. And I can just say my experience is you guys are listening, and that is appreciated.

UNDER SECRETARY KOONIN: Of course, of course. Katie?

MS. MCGINTY: Yes, I've referenced some of these things previously, Steve, but I think that the Department is really to be congratulated in the innovation that you have shown, and I do think things like the hubs, the sun shop program, and ARPA-E are really creative, dynamic, and game-changing models.

And I would like to thank you and the -- your team for your innovation, and also your courage in trying those kinds of models, because you have opened your, you know, hands, and allowed other people to be part of the creative force. And I think it's making a

big difference.

UNDER SECRETARY KOONIN: Thank you. Bill, anything?

MR. BRINKMAN: Let's see. I would hope you would include the FRC's on your list.

(Laughter.)

MR. BRINKMAN: I think I want to thank the panel for the interesting conversation. And the many questions that were asked were very worthwhile.

UNDER SECRETARY KOONIN: Yeah.

MR. BRINKMAN: Thank you.

UNDER SECRETARY KOONIN: Good. So thank you all for -- even despite the post-lunch -- we will adjourn until -- let us give ourselves another 5 minutes -- 10 to 3:00 in the other room, back where we were this morning, and we will pick up with the final panel.

(A brief recess was taken.)

UNDER SECRETARY KOONIN: Okay, thank you. We are heading into the home stretch here, saving the best for last, of course.

We would like to focus this final conversation

around balance of the DOE's activities, or portfolios. As Sue Tierney said very quotably in the last session, "One person's balance is another person's bias."

There are many different dimensions in which we in the Department, and more broadly in the government, and all of us in the community, need to balance things. And so, how do we really do that? And I would like to get beyond just the statement that we need a balanced portfolio. What does that really mean, and what rules should we use, if there are any, in order to strike the right balance?

Let me introduce the panel, and knowing some of them, it's particularly ironic we're talking about balance; I expect the discussion will become unbalanced pretty quickly.

(Laughter.)

UNDER SECRETARY KOONIN: But our first panelist is Eileen Claussen, who is the president of the Pew Center on Global Climate Change, and Strategies for the Global Environment. She is the former assistant secretary of state for oceans and international, environmental, and scientific affairs,

special assistant to the president, and senior director for global environmental affairs at the National Security Council, as well. She has also served as chair of the United Nations' multilateral Montreal protocol fund.

Dr. Ernie Moniz is the Cecil and Ida Green professor of physics and engineering systems, the director/founder of the Energy Initiative at MIT, and director of the Laboratory for Energy Environment at MIT. He was under secretary of Department of Energy, back in the days when there was a single under secretary, from 1997 until January of 2001, and was also the associate director for science in OSTP in the White House. And, as you heard this morning from John and me, he was one of the co-chairs of the most recent report that begat this exercise.

We will have a discussion later, Ernie.

(Laughter.)

UNDER SECRETARY KOONIN: Our third panelist is retired Vice Admiral Dennis McGinn. He is chairman and CEO of Remote Realty. He is previously with Patel Memorial Institute, which he was an officer, and led

the energy and transportation environmental division. And he was with the Navy as deputy CNO for warfare requirements and programs at the Pentagon, where he oversaw the development of future Navy capabilities. And most relevant now is the head of ACORE.

And then last, but certainly not least, Dr. Phil Sharp, who is president of Resources for the Future. He did 10 terms as a Member of the House of Representatives from Indiana, had a long tenure on the faculty at the Kennedy School and the Institute for Politics at Harvard University, and again, brings, I think, a very different and useful perspective on energy matters.

To get us kicked off, I have asked one of my DOE leadership colleagues, Dr. Arun Majumdar, to make some remarks. Arun is senior advisor to the secretary and director of ARPA-E. In his previous life, he was associate lab director for energy and environment at the Berkeley National Lab in professional mechanical engineering and material science engineering at UC Berkeley.

So, Arun, the floor is yours.

PANEL FOUR: BALANCING THE PORTFOLIO

MR. MAJUMDAR: Well, thank you, Steve. This is -- I should say, before we start, this is my fourth public event of the day.

(Laughter.)

MR. MAJUMDAR: Luckily, they have all been in energy, so -- wonder why. So if I confuse meetings, please wake me up, Steve.

(Laughter.)

MR. MAJUMDAR: The purpose of this -- first of all, let me, along with all my DOE colleagues, just use this option (sic) to welcome you for this QTR meeting. Our job, from the DOE's point of view, is to listen and get feedback from the stakeholders. So I will be very brief, and then I will just shut up and listen.

You know, this -- the QTR has also been triggered by a PCAST report which required or suggested, recommended, that we have a quadrennial energy review. And this is the technology part of it. And I am hoping that Ernie is going to give sort of a broad overview of why that was the reason, and what were the -- you know, rationale behind it, to give

a -- before we get into the specific, sort of the broad breadth of things. I think that is -- it would be really nice to hear from Ernie about that.

But balance of the portfolio, you know, it's -- I think we all would agree that energy is not a -- there is no silver bullet. We need to have a portfolio, both in the transportation side and in the stationary power side. But the question is, given our national security issues, the economic growth issues, our environmental issues, how do we balance that, and how do we -- what do we emphasize? Are we doing the right thing?

For example, between the transportation sector and the stationary power sector, do we have the right mix? Do we have the right emphasis? Or should we be emphasizing something more?

Within the transportation sector there is the electrification side of it. There is also -- you know, one of the options is hydrogen. And on the -- and then you have alternative fuels. So, given that, what are the things that we should be doing? And we want to listen to your -- about that.

Within the stationary power sector, there is power generation, there is the grid, as well as energy efficiency. And you know, what is the right mix up there?

There is a short-term thing, and there is a longer-term thing. What is the right mix up there? What is the balance of portfolio within that about short-term achievements versus long term?

And finally, you know, there is an assured path of doing something, a certain learning curve. Lithium ion batteries -- we can go down the learning curve. How much of that versus, you know, breakthrough technologies that can be disruptive? So, what is the mix of that?

And so, these are the issues that we have to deal with. I know we talk about it internally, all about this balance that we should strike. And, you know, frankly, this is our turn, as I said, to listen to you, as to what do you all think. And I would love to get the panel's opinion on this.

So, that is sort of my version, very briefly, on the framing of the discussion.

UNDER SECRETARY KOONIN: Very good. Thank you. Let me start with a question, really, to the panel. But I expect Phil might want to lead off on answering this one.

You know, debates about energy R&D have a strong flavor, in my experience, of both technology and economics, but also ideology, and perhaps even distributional politics. This is Washington, after all, and that's where such things get sorted out.

Should all technologies have equal access to the treasury? How do we account for differences in maturity, in differences in regional applicability, in differences in market construction, as we think about the DOE portfolio?

MR. SHARP: Well, very simply, the answer is no. More significantly, I would suggest that one of the criterion for these projects should not be balance. That is, at the end of the day you want to know you have done the right things. But I would not make balance the highest order of the goal of judging the portfolio, because balance, in and of itself, is not the goal. The goal is are we doing things that we

1 think can really pay off and have value. And, of
2 course, often times that is quite speculative.
3 If you go with the idea of every technology
4 having access -- I am on the Nuclear Waste Commission
5 now. We are going to make a recommendation -- no
6 surprise, anybody -- that you ought to do some
7 investment in nuclear research kind of proposition.
8 And one individual suggested -- I don't know whether it
9 was staff or member -- that, well, 20 percent of our
10 energy comes from nuclear, so 20 percent of our budget
11 ought to go to research here.
12 Well, I think, pretty quickly, people can see,
13 okay, so now how much do we get from oil, so we give it
14 that proportion. You can do that, if you want to, but
15 I think that is a -- just stupid, okay?
16 (Laughter.)
17 MR. SHARP: So -- and I don't think that will
18 make it into the report, and -- because I kind of
19 expressed it that way.
20 If I could say something, though, about the
21 process, just one quick thing about the QTR, I think
22 this is a very important process you are going through.

I'm sure it's a learning process for everybody involved. The question is, is it going to be useful to the government, beyond this immediate process? And I think it has great potential to do that.

But you are setting a precedent -- and this goes back to your ideological question -- I would be very careful in this document not to make it a wish list, not to make it an ideological, "Here is where we really wish we could take the country" kind of thing, but rather, do serious technological assessments -- which, as I understand it, are a cornerstone of this document -- which then, four years from now, when the document is done again -- or maybe you do iterations in between -- you actually are able to go back and say, "Well, it had been suggested we could get to X, we didn't make it to X," or Y, or "What is the status of things that -- where we could have some way of evaluating and measuring whether we're actually making progress," and we can have an honest discussion about this.

If this becomes an ideological, or just a "Let's make this in addition to testimony of what the

Administration wants on Capitol Hill," then I think I wouldn't expect this process to last. It may in the next four years, because I think the President will be re-elected, but that will be the end of it.

UNDER SECRETARY KOONIN: Okay, very good.

MR. SHARP: And so, I think I would focus heavily --

UNDER SECRETARY KOONIN: Thank you.

MR. SHARP: -- on that technology assessment work.

UNDER SECRETARY KOONIN: Anybody else want to weigh in on that particular question? Ernie? Yeah.

MR. MONIZ: Yeah, I agree with everything that Phil said, but let me add to it. And, in doing so, perhaps I will take Arun's invitation to say a few things about --

UNDER SECRETARY KOONIN: Good.

MR. MONIZ: -- the overall construct, because I think it does flow from what Phil said.

I think it is important, in the context of whether this has life beyond this QTR, to repeat that we envision this as a first step in kind of an

inside-out process to a full Administration-wide quadrennial energy review.

And the motivation for that is that, fundamentally, we don't think we will ever have an energy policy that is coherent and sustainable, unless it recognizes that what we call energy policy is generally kind of derivative of lots of other policies: environmental, industrial, security, land resources, water, you name it, with equities that are spread all over the government in a way that DOE has no chance of convening for a serious discussion.

The political power is just not there to do that without a strong push from the executive office of the President. So we feel the convening has to be there. But being someone who once served in the EOP, the last thing I would want is to wrest implementation capacity in there. That rightfully belongs in a department. And, therefore, we suggest DOE is the appropriate, if you like, executive secretariat for this entire enterprise.

But that is a huge lift to establish that kind of a process. So we recommended a four-year process to

get to the first one, and starting at the DOE, positioning for the role of executive secretariat, starting with something that really is DOE's lead responsibility, which is technology.

Now, having said that, there were two other conditions that we believe need to be met if this is, in fact, going to amount to something. One is -- and this goes to the ideology -- it has to have an analytical capacity based upon sound engineering economic analytics, a capacity that does not exist in the Department -- I mean anything like the scale that's needed.

And so -- and I suspect that we will see that that has not been fully assembled magically in two months in this exercise, but must be viewed as that is the key next step, in my view, is to build that analytical capacity that gets us away from the political or even sometimes -- even worse -- non-political technology du jour.

A second little minor point on it relevant to what Phil said is we targeted 2015, not only because we felt 4 years would be required, but also because it is

in the middle of a Presidential Administration. If 4 years came out to be 2013, we would have it takes 6 years to do it.

(Laughter.)

MR. MONIZ: Because, frankly, a document produced in the first month of an administration is going to be a political document. And so, the hope is that one can build something that will, in some sense, constrain the argument, but constrain it in a way that has a chance of building a political consensus. It might not work, but I don't know what else can.

UNDER SECRETARY KOONIN: Good, good.

MR. MONIZ: So that's kind of the way we thought about it, and I think it just -- it fits in completely with Phil's characterization.

UNDER SECRETARY KOONIN: Very good. Eileen, you have sat in several parts of the executive branch. Does that sound right to you? What advice would you offer?

MS. CLAUSSEN: Yeah, it does, although I am probably even less optimistic than Ernie about this actually sort of coming through and amounting to

something. And I also have been in the executive office, and you can coordinate some things. You can't do it, I agree, Ernie, in the first year. And you can't do it when you are running for re-election in the last two years. So you really have a very small window to hit it. I agree with that.

I am not sure there are administrations that are brave enough to take this on, because that is really what it requires. I mean you want to step away from the politics, you want to actually do something substantive and meaningful with the right analysis, and you're right on, there, I think. I don't know DOE as well, but I'm not sure you have that capability. It's really important. Even in a world where the facts don't count, I actually think the facts should count, and the analysis should count.

But, you know, I think it is worth a try. I mean let's give this a real try, and see if we can make it happen --

UNDER SECRETARY KOONIN: Good, good. Denny, you want to weigh in on this one, or I can go to a more --

MR. MCGINN: Yeah.

UNDER SECRETARY KOONIN: Okay, good.

MR. MCGINN: I'd just like to say that a balanced portfolio of energy technology may or may not be a good one. I like to apply the out in the future looking back, how do we feel about the decisions 20 years from now, the way things turn out.

So, a portfolio, a good portfolio, could be balanced, but it might not be. It has to be resilient, it has to meet some prioritization criteria. I will throw out a couple.

Is this form of energy secure? Are we not independent, but less dependent than we are now, for example? Is it relatively affordable? Or shall -- let me take the relatively -- is it affordable? Is it clean, in every sense of the word: locally, regionally, and globally? Is it available? And that availability speaks to reliability.

I think that the portfolio must be developed and continue to be tweaked every year. And it has to be strictly applying to rules of cost benefit and risk, as objectively as you can, assembling the best set of

facts, as Eileen indicated. You need to get honest costs, direct and indirect costs, taking into consideration the economic externalities. You have to define exactly what the benefits are, and to whom, and what the risks are, whether they are technological risks, financial risks, or what have you.

And finally, I think you have to think of the portfolio in a context of a system. I will use an example. We could really put a lot of money in this country into getting the world's most efficient vehicles -- name your size: small passenger vehicles to big freight haulers. And we could get up there in the hundreds of miles per unit of energy. Let's use gallon for discussion purposes.

But if all of those wonderfully efficient vehicles are sitting gridlocked in a highway system, or a surface infrastructure that is absolutely miserable, why do we do it? It doesn't have any value. So -- because the investment in that vehicle efficiency technology wasn't done with the infrastructure context in mind.

And I will just stop there, Steve.

UNDER SECRETARY KOONIN: Okay, very good. Thank you.

Let me pursue the balance question now, and get down to some specifics. If you look at our budget distribution, which is in the -- as I mentioned this morning -- in the next-to-the-last chart, two-thirds of our R&D budget now are spent on the stationary side, and two-thirds of that is focused on clean energy, with smaller fractions going to efficiency or the grid in the stationary sector.

Does that adequately address the issue of energy security and petroleum dependence, which is one of the other great problems we are wrestling with?

Where do our transportation investments have the greatest impact? Or should we just leave all of that to the Department of Transportation, EPA, and the private sector, who have a lot of resources invested in trying to improve efficiency and look for alternative fuels, and so on?

MR. MCGINN: No, I think the Department of Energy has a key role to play. Perhaps not a lead role, in terms of transportation infrastructure, but

one that, in partnership with EPA and DOT, demonstrates the technological trends, the types of systems that may be out there. It could have something to do with a smart grid, if you will. It could have something to do with a biofuel infrastructure delivery system. It could have something to do with the vehicle -- very highly efficient vehicles. And I think that DOE has an absolutely essential role to play in that. But it has to be a partnership role in the right proportion.

I think that we need to think about our security, energy security, in terms of our current portfolio of transportation energy, and our stationary electrical portfolio in different terms.

The former does have traditional national and economic security dimensions, you know, the price of oil. We are not in charge of our energy future in any way, shape, or form. Mother Nature is in some cases, as she was in 2005 with Katrina, driving prices above $3 a gallon -- can you imagine that -- for the first time. And they are not -- we are not in charge if the Iranian Republican Guards decide to slam the door on the Straits of Hormuz, sending tremendous

reverberations through the economic system of the world. We would be looking back on $100-a-barrel oil as the good old days very, very quickly in that, and we would really be hurting in something that would be beyond the deep recession for a long time.

So, there is that. And so, making our prioritization of DOE portfolio there has to place security and availability pretty high on the criteria list of benefits.

On the stationary power side, it's more of an environmental and an affordability issue. And I think that we need to think of it certainly in terms of climate change and greenhouse gas production. That is a big one, and it is one that is coming sooner than we think, in my view. But it is also thinking about the local and the regional environmental -- and public health aspects of why it is we should move to a much cleaner portfolio of electricity production.

And then, finally, we need to think about -- if you think of simply how you get energy, how you use it, and how you get it between those two activities, we need to really think carefully about how

much we want to stick with Edison's form of electrification of America versus some sort of a distributed grid in the right form.

UNDER SECRETARY KOONIN: All right. Good. I think, had you been here this morning, I don't think -- you would have heard echos of much of that in the separate transportation and stationary panels.

So, anybody else want to weigh in on this stationary transport balance?

MR. SHARP: I -- yes, not between stationary and transport, but within stationary.

I think one of the more general criterion that you are looking at, which came out in the last panel and has been articulated a couple times today, is what has either multiple -- as Sue said -- values, or, as I would say, as an enabling technology of other innovation and other technologies.

And so, this I would put a heavy emphasis on what we call smart grid. Now, by smart grid, I don't mean you just smarten up the existing lines. We are talking about a whole suite of ways in which we will use electricity, transport it differently, that enables

a whole host of unknown technologies, as well.

And I think we would be smart -- and I know EPRI is on top of this -- but I think we would be smart to put in -- you articulated one of the issues of this as, well, I don't want to have to mess with everything in my home. I'm with you. I am a bad consumer on that.

But the notion of prices to devices --

UNDER SECRETARY KOONIN: Right.

MR. SHARP: -- is a technique you could use. That is not the point here, though.

The point here is that -- look at some of these questions and say, "What could they bloom? What could they -- how do they empower other innovation or other kinds of things, and enable?" And I don't know what those research projects would be. But I sure as heck am more interested in not what is happening at the power plant, but what is happening -- and this even gets to what Dennis is saying.

We are talking about a grid that is all split up and does multiple things. It's not like it's the old grid, and you're either on or you're off kind of

proposition. You will be on, you'll be off, you'll be in micro grid, you'll be in a whole host of ways. We ought to be taking the lead. We had the lead on these technologies in the past. And we sure as heck shouldn't concede this.

UNDER SECRETARY KOONIN: Okay, good. Ernie?

MR. MONIZ: Yes. Let me make three comments. One is, first of all, to your question about is it the right balance in the macro portfolio.

UNDER SECRETARY KOONIN: Yeah.

MR. MONIZ: Well, you have to tell me what the question is. And if you have a one-parameter, you know, criterion, then I can answer the question.

So -- and for example, if the one criterion is carbon, then I could easily conclude, without looking under the covers, that is a very good balance.

UNDER SECRETARY KOONIN: Right.

MR. MONIZ: Because you know, in building efficiency, it is probably less R&D than it is a whole bunch of policies. On the supply side, electricity is where you can get the lowest price for the marginal ton of CO2, et cetera, et cetera. On the other hand, if

you are talking to me about security, that is almost certainly not the right balance.

But then comes the next question. What do you mean by "security?" If security means reducing oil imports, I don't know. Does it mean reducing oil use, or does it mean what I view as the most sensible response -- that is, long before you can impact oil use at a large level, can you impact elasticity of the fuels market? And that goes to something that is not on your list, things like flex-fuel vehicles.

So, you know, I think we need to have a question definition before we can answer --

UNDER SECRETARY KOONIN: Right, right.

MR. MONIZ: -- on the balance. And, in reality, there are going to be multiple objectives, which is going to require a multi-dimensional portfolio.

Second point I would like just to make is I would like to be as much of a one-trick pony today as I can, in terms of, you know, analysis, et cetera.

And in the issue of transportation infrastructure that Dennis raised, I would go back to

say that one component of the analytical capability that one needs is developing much more sophisticated kind of modeling simulation systems dynamics approaches, which can lead to a rather more sensible potential, potentially building up of an infrastructure, than, say, "Why don't we build a million charging stations?" No customers, just mindless policy.

So, analytical capabilities could actually be helpful.

(Laughter.)

MR. MONIZ: And, third --

MR. MCGINN: The same that were used during the construction of the interstate system, or the same that were used in the construction of the trans-continental railroad?

MR. MONIZ: I allow you to answer the question as you wish.

(Laughter.)

MR. MONIZ: The trans-continental railroad has just had some -- actually, interesting book written about it, which is not quite so cheery. But,

anyway -- yeah.

So, it is a question of you may build something, for example, in a shotgun way that may, in a very, very long time, find the market. It may be an extraordinarily inefficient way to have done it. And so what I'm talking about: is there a better way to do it?

UNDER SECRETARY KOONIN: Yeah, right, good.

MR. MONIZ: And then, third, is -- and I will just leave it with a question, since Phil raised this -- I would like to hear the articulation of the value proposition of all of this smart stuff out there.

(Laughter.)

UNDER SECRETARY KOONIN: Okay --

MR. MONIZ: Personally, I like dumb.

(Laughter.)

UNDER SECRETARY KOONIN: I want smart, but I don't have to think about it.

So, Dennis, you weighed in with interjections on the interstate highway system and the railroad. I would be interested --

MR. MCGINN: I was simply making the point

that sometimes -- and I am not necessarily defending a million electric vehicle charging stations without much better analysis -- but I would make the point that sometimes build-it-and-they-will-come works. You do have to create an infrastructure. And it gets you to the overused metaphor of the chicken and the egg.

Flex-fuel vehicles you mentioned very appropriately. If we say to our car manufacturers, "You've got to build flex-fuel vehicles," and then people will say, "Well, okay, great, I've got a flex-fuel vehicle. Where is the ethanol" --

UNDER SECRETARY KOONIN: Yes.

MR. MCGINN: -- or, "Where is the biofuel," or whatever.

If the biofuel manufacturers, from feed stock producers to refiners, to those who would wish to have a distribution infrastructure, say, "I've got this great, really cheap -- gosh, it's down to $60 a barrel for this wonderful transportation fuel, it's drop-in" -- how do you drop it in without a vehicle fleet out there that can, in fact, accommodate --

UNDER SECRETARY KOONIN: And, if it's $60 a

barrel, you're not going to sell it to me for $60 a barrel --

MR. MCGINN: Right, exactly.

UNDER SECRETARY KOONIN: -- you're going to sell it at $100, or whatever the price is.

MR. MCGINN: Exactly.

UNDER SECRETARY KOONIN: So you haven't helped the price problem.

Arun? And then I want to turn to a completely different question.

MR. MAJUMDAR: So this is actually a follow-up to Ernie's question on the smart grid. I think smart grid means a lot of things to a lot of people. I think we should define it, what that is. It is modernizing the grid.

But MIT is coming up with a report -- has come up with a report on smart grids. What do you think is the value proposition?

(No response.)

(Laughter.)

MR. MONIZ: First of all, I am not a member of that study group.

(Laughter.)

MR. MONIZ: And, second of all, the release date is the middle of October.

(Laughter.)

UNDER SECRETARY KOONIN: And Arun --

MS. MCGINN: And I want to emphasize, though, it is not the future of the smart grid; it's the future of the grid.

UNDER SECRETARY KOONIN: Oh, yes, right.

MR. MAJUMDAR: Right.

MR. MCGINN: Big difference.

UNDER SECRETARY KOONIN: And, Arun, as you know, university administrators have no control over what the faculty say.

(Laughter.)

UNDER SECRETARY KOONIN: Eileen, let me ask you about balance in a different dimension, and that is short-term relevance versus long-term impact. And you know, the Department is the repository for a lot of basic pre-competitive research. At the same time, there are urgent problems we are trying to address. And the political system would clearly like to see

short-term impact in the things we are doing.

You know, are we at risk of becoming the NSF of energy, in some ways, on a -- you know, a track that is sort of interesting, but not with much immediate impact? How do you think about that?

MS. CLAUSSEN: I hope not. Although, I think there is a value to that. I mean I, myself, like to think about what you might call the medium term, you know, 10 to 20 years, I mean that kind of a range. I think if you do things looking at it as a system -- because I actually really like that point there -- that is something you can affect.

That is the reason why, in addition to R&D, I like demonstration and deployment, because I actually like to see things make a difference in my lifetime. You know, I am a grandmother already, I have to be cognizant of all of this.

UNDER SECRETARY KOONIN: Yes.

MS. CLAUSSEN: So, to me, that is important. So -- and let me just sort of go back for a second to some of the things that were said before, if I may.

I think Denny actually did a nice job of

saying secure, reliable, affordable, and clean. I would look for systems that accomplish most or all of those. In other words, why would you only fixate on one of them, when actually we really do care about all of them?

UNDER SECRETARY KOONIN: Okay.

MS. CLAUSSEN: So, if I was setting priorities, I would look for things that cut across them.

Now, the secure stuff is more transportation than electricity, but the others? Why not sort of look across at not just -- look at one criteria, or one really important more than the others, much less? They are all actually important.

UNDER SECRETARY KOONIN: Other people on this short-term versus long-term balance, or challenge -- Dennis?

MR. MCGINN: Just that I think that, throughout the DOE infrastructure of labs, plus all of the wonderful universities that collaborate with DOE in some fashion on a daily basis, there has to be some sense of connectedness from research to development to

demonstration to deployment.

I don't want to get into a big, long, agonizing discussion about the Valley of Death or valleys of death, but you really need to, in creating a portfolio, think about reducing the transactional costs or friction, if you will, between going from one stage of a technology to the next stage.

You should, you know, use Covey's old adage, "Begin with the end in mind," at least to a certain degree. And then you can think about it in that systematic way, in a systems context that I mentioned before.

UNDER SECRETARY KOONIN: So I will raise for your attention, I think -- it's been a bit of a theme during the day -- several people have said begin with the end in mind, envision an energy future, and then work toward it. Other people have said, as you may have heard in the last session, technology is unpredictable. And I think we have to strike the right balance, you know, defining goals that are, in some ways, technology agnostic, and moving toward them.

On the other hand, we have finite budgets in

the department, finite resources, and we do have to make some prioritization, even if it's only everybody gets an equal share. It's a balance.

MR. MCGINN: One of the things that -- one way you could address that -- everybody has limited budgets, but we ask ourselves, "Are we getting the most out of the individual budgets of departments and agencies?" Clearly, the answer is no, not because we're not trying, but maybe we're not taking a broad-enough view.

So, the Department of Defense does a tremendous amount of research, as well as the Department of Energy. And NASA has their research budget as well, everything from basic research, up through operational types of research.

So, I think that if we can -- and this is a cultural comment -- get over, to the extent we can, the not-invented-here syndrome, or "I need to control everything, or as much as I possibly can," and start taking that broad view about is there a possibility for partnership with others, public, private, within the public sector, different agencies and departments, that

could really, really produce a much better outcome than if you are viewing it as limited to your five-year plan, and a budget that will support it.

UNDER SECRETARY KOONIN: Okay, good. Ernie, you were going to say something?

MR. MONIZ: Yeah, I just wanted to react to this business about imagining a future, and managing to that. I mean that, I think, Would be a horrible approach.

I think the key word -- which is, unfortunately, not always in the forefront about -- as one thinks about putting together a program -- is "options." I believe the role of the government is to provide options for a credible range of futures.

So, for example -- and particularly to support activities for which we have not prepared for that future, as in, for example, let's say, carbon. So I think any sensible manager, independent of one's views about climate risk, has to, I think, have a plan around the possibility that there could be a serious restriction of carbon initiatives. That is something that is not internalized in the market place, and

certainly, I think, defines a very critical public role.

There are other issues -- like in the security domain, et cetera -- but I think that any time we start to base public policy -- "any time," meaning as we have for decades -- around things like market share of a technology, we are just making a terrible mistake. And we make it over and over and over again.

UNDER SECRETARY KOONIN: So what do we do -- and all that -- I understand that. What do we do when there are barriers to the adoption of better options?

To just give a few examples, the interdependence of vehicles, fuels, and infrastructure makes it particularly difficult to affect revolutionary changes. The fragmentation of the grid oversight regulation operation makes it particularly difficult there to take up options.

There has been a lot of discussion about consumers, or businesses, leaving efficiency dollars on the table, even when the options make perfect sense. Beyond just doing the technology, how do we -- what

role does the government have in trying to promote the adoption of particular options?

MR. MAJUMDAR: If I could just add to that, I mean, is there -- yes, I totally agree with you, that we should be providing options, keeping in the mind the liability and everything that you said.

But if you are to provide incentives for adoption, do we have the technology agnostically, of doing it, or do we have to pick a few things?

UNDER SECRETARY KOONIN: No.

MR. MAJUMDAR: Given all the reliability access, security, et cetera. So that is, I think, a --

MR. SHARP: Well, first of all --

UNDER SECRETARY KOONIN: Phil?

MR. SHARP: Obviously, we have gone beyond what the QTR is, in my judgement, here. The QTR is about where to -- I think -- is about where to -- what are the technology possibilities, and where to invest. But maybe I'm wrong.

UNDER SECRETARY KOONIN: Well --

MR. SHARP: Maybe your view is what policies will cause adoption in the marketplace.

UNDER SECRETARY KOONIN: I think that is an explicit part of the PCAST recommendation, is to talk about policies that promote the demonstration -- Ernie should say -- he wrote the words, probably.

MR. SHARP: No, no, no, no. I am raising the question about what is the purpose of the QTR, partly because I think its success will be enhanced by keeping it limited, okay?

So I start with this view that the most likely way this will have value on a continuing basis is if you do solid work on the technology assessments, which then can be judged by others, it can be judged by yourselves, four years from now, and other -- that point.

The minute you veer that whole thing into all the political disputes about which technique of government intervention into the economy, that is a separate range of problems. Now, those are important, and they can be done, but by and large the Department has very little control over those choices, at all.

UNDER SECRETARY KOONIN: So --

MR. SHARP: That's got to be in the law, even

the tax code, or in the regulatory codes, or what not.

UNDER SECRETARY KOONIN: Yes.

MR. SHARP: So, I guess what I am saying is I would strongly urge you to keep this highly focused, and that is an endeavor worthy in itself. If there is anything you hear on Capitol Hill or in any conversation in Washington or anywhere else, it is everybody's view of what is the status of this particular technology, why don't we just do that, buy that technology, and there is very little -- maybe -- I'm sure it's out there -- but where one can go for any kind of disciplined discussion that simply gives you a perspective --

UNDER SECRETARY KOONIN: Right.

MR. SHARP: -- on what is happening and what is available, and what is the potential of it. And then, what did we think 10 years ago was the potential of it?

MR. MONIZ: Excuse me.

UNDER SECRETARY KOONIN: So -- no, that's fine. So, Ernie, how far do you think we should be moving in this policy direction, or focus -- as Phil

has just suggested -- on these are just the facts.

MR. MONIZ: Well, the first thing I want to say -- this is along the lines of the question -- but emphasize that, Phil, your answer was very much around what the DOE does.

MR. SHARP: Yes.

MR. MONIZ: The question was framed, "What does the government do" --

MR. SHARP: I know. I was trying to say are we talking about the QTR, or are we talking about government policy --

UNDER SECRETARY KOONIN: Right, right, right, right.

MR. SHARP: -- which is --

UNDER SECRETARY KOONIN: Right.

MR. SHARP: And maybe both.

MR. MONIZ: And, ultimately, I think it's both. But clearly, the latter is not a strictly DOE role, although that was the construct, our hope. And it's a big stretch. And I agree with Eileen. I mean we're not saying this is an easy road. But the idea would be that one would perform, one would have this

very firm technically-grounded base. And, as you say, that will be valuable in any event.

PARTICIPANT: Everywhere.

MR. MONIZ: And then see how far you can get to start building up more far-reaching policies, based upon that.

You know, you're always -- you're going to have a lot of rough spots, obviously, a lot of arguments. But that is -- the hope is to do that. I mean -- I guess, because again, the view is that if we go beyond the DOE with its specifically technology responsibilities, and very limited policy options, we have got to go beyond the DOE for that very reason, because the energy marketplace is not going to be conditioned reasonably unless we address those policy issues.

UNDER SECRETARY KOONIN: Good.

MR. MONIZ: So, let's get as much technical grounding and analysis as we can, which we have not done well in the past.

UNDER SECRETARY KOONIN: Right, right.

MR. MONIZ: And then see how far we can go.

UNDER SECRETARY KOONIN: Good. We are making as good an effort as we can in the six or seven months we've got to do this.

I want to open this discussion up now to the broader audience. We have got a bit more than half-an-hour. It has been really rich and interesting. Ernie, you want to --

MR. MONIZ: One more --

UNDER SECRETARY KOONIN: Sure.

MR. MONIZ: -- which is that you want to emphasize that -- particularly in the climate context, I just want to clarify that, although I think getting this kind of policy construct in place is very important for guiding things, in the climate context I'm going to be very clear. I believe that, as far as a global response goes, it is going to be technology-led, not policy-led.

UNDER SECRETARY KOONIN: Right.

MR. MONIZ: It is going to be the technology that lowers the cost increment that will eventually, in some sudden phase transition, give policy-makers courage.

UNDER SECRETARY KOONIN: Good.

(Laughter.)

UNDER SECRETARY KOONIN: Good. All right. We will take a couple from the audience. Yeah?

MR. DOUGHERTY: Thank you. Good afternoon. My name is Doug Dougherty, I am president and CEO of the Geothermal Exchange Organization, representing the geothermal heat pump industry. And I first want to thank Dr. Majumdar for attending his fourth public event, because he is the first and only person with a degree in mechanical engineering, and our industry loves that. So thank you for coming, Doctor.

I want to talk about bias and imbalance, and it stems from my thought that 40 percent of all the energy consumed in the Unite States is for thermal loads or buildings. And reviewing the 30-page document, the technical framework, I found it a little incongruent that there were two paragraphs devoted to thermal loads of the 30 pages.

And when I was talking to a DOE staffer -- to remain unnamed -- earlier, he said, "Be lucky you got that."

(Laughter.)

MR. DOUGHERTY: So, I would hope, going forward, there would be a greater emphasis on building technologies and efficiencies on that side of the demand equation.

And I guess my question is, what role does the DOE play, or should play, in being an advisor to other federal agencies that are contemplating retrofitting existing buildings, or looking for technologies on new buildings? And that includes GSA, DOD, the Department of Education.

What role would DOE play in assisting those federal agencies in making sure they're picking -- or at least bidding out in a proper way -- namely, life cycle costs would be great -- that they get the biggest bang for their buck?

UNDER SECRETARY KOONIN: Okay, good. Take a second one.

MR. MAYBURY: Hi, Dr. Mark Maybury, the chief scientist at the Air Force, and also head of the energy horizons and our science and technology strategy for energy.

I want to pick up on the themes of collaboration, and also independent assessment. We have found in the Air Force -- in fact, broadly in DOD -- the need for independent expert technical advice to advise our public investments. So, for example, mechanisms like the Defense Science Board, the Air Force Scientific Advisory Board, also other federal-created institutions. Interested to what extent Energy intends to use similar mechanisms. We found those instrumental over the past 50-plus years.

Second question is really a question of collaboration. And it was mentioned -- I appreciate the comment -- about reaching out to other parts of the government. We actually have, both at the institutional level, the Secretary level, and then further down, detailed partnerships with NASA -- for example, in the production of engines, new structures, new biofuels, et cetera -- and, of course, we're beginning to partner with Energy on this, as well.

My question is, what mechanisms can you use -- for example, in DOD we use joint concept technology demonstrations, lots of discussion of that.

Why don't we have those kinds of things, federal-wide? Maybe there are other mechanisms.

So, interested, again, in your mechanisms for better collaboration and also better objective technical assessment.

UNDER SECRETARY KOONIN: Thank you.

MS. DERIMAS: Good afternoon. I am Frederica DeRimas, I am from the Air Force office of scientific research. And I was -- my question is prompted by some of the comments that were made in terms of coordination across agencies and across sort of various energy efforts and sectors.

In the 1980s and the 1990s, the -- when the dawn of information technology or modern sort of era of information technology started emerging, we created the National Coordination Office, a coordinating body across the agencies. And then, with the advent of nanotechnologies, we have the National Nanotechnologies Coordination Office.

So, I was wondering if there is times that there is some kind of national coordination office for energy to bridge across agencies, across the various

sectors -- industry, academia -- in a tripartheid kind of partnership with government. Or, if you want to consider also the labs that tripartheid --

UNDER SECRETARY KOONIN: Okay, good. So we've got three questions, and I will turn to the panel to answer any or all of them. I may weigh in a bit, myself.

One is the emphasis, or seeming lack of emphasis, on thermal loads in buildings, and how do we, the DOE -- or should we -- provide advice to other folks, as they go about retrofitting or building new buildings.

A second is to what extent does the DOE use independent expert advice. And what better mechanisms might we have for collaboration with other agencies?

And then, the third, if I could paraphrase, is where is the national energy coordination within the executive branch coming from?

And I will turn to any one of the panelists. But, Arun, I know you spent a lot of time with buildings in your former life, and some fraction of your time now. Maybe you want to talk a little bit

about what the Department is doing with respect to thermal loads in buildings.

MR. MAJUMDAR: Well, I think -- you know, the thermal loads are of various kinds. There is, of course, the cooling load, as well as, you know, the losses through insulation, et cetera. There is a buildings program in the Department of Energy in the office of energy efficiency and renewable energy, which looks at both emerging technologies for insulation, as well as new HVSE.

In ARPA-E we have a very aggressive program on cooling technology, because we found that we are a factor of 10 away from theoretical limit, in terms of cooling. And so, if you could make it a factor of five, that's a big deal. It's 50 percent reduction in energy at the same cost. So, I think there is a lot of head room, there is opportunities out there.

But in addition to that, someone asked the question about, you know, helping other federal agencies. There is something called FEMP, federal energy management program, something like -- yeah. So, FEMP is really to help other federal agencies, GSA,

Department of Defense, et cetera. And that enables that.

And there is also -- the program is an actual deployment of the technology -- or I should say catalyzing deployment of the technology in real buildings, measurement systems, et cetera.

So, that's what is going on. I think the question would be to ask the panelists out here and others as to, hey, do you think that is -- we are doing enough? Should we be doing something differently?

UNDER SECRETARY KOONIN: Yes.

MR. MAJUMDAR: And what else should we be doing?

UNDER SECRETARY KOONIN: Dennis?

MR. MCGINN: I think that one of the roles -- perhaps additionally -- that DOE could play was more business-oriented analysis about paybacks, what the ROI is for various classes of buildings for both heating and cooling over a set period of time, and different -- a big matrix from a lot of investment, little investment, short return and long return.

But whatever role DOE has played, is playing

-- and I think they are positive -- it really comes down, in many ways, to a policy issue.

If we were to just say, "If we only use the existing technologies" -- and you mentioned -- the questioner mentioned heat pumps or geothermal heating and cooling and building materials -- if we just confined ourself (sic) to a discussion of existing technology that is out there in the marketplace, and we just used that somehow through building associations, through local codes, through national associations of builders and building suppliers, we would make a tremendous dent in that -- literally -- waste of energy that happens in simply trying to create workable and liveable environments in our homes and businesses.

UNDER SECRETARY KOONIN: Ernie?

MR. MONIZ: On that first question, on buildings, let me just make a couple of comments.

And we -- about three weeks ago or something -- no, a month ago -- at MIT we published a future of natural gas report. It's on our website. There is two things of relevance to that question mentioned.

One is we completely concur on this issue of,

essentially, life cycle analysis being important in looking at efficiency standards. Right now, we tend to have sight efficiency standards, which can be very, very misleading.

So, we do advocate moving towards that life cycle analysis, but point out that it is not quite so simple. There are regional differences, there are climate differences. So we actually suggest that would be a great thing for the Department or the EPA or somebody, to start trying to figure out how do you do appropriate regionally-adjusted kinds of metrics for various kinds of appliances.

The second thing is, although you mentioned buildings, I think we should not forget the enormous fuel uses for heat in industry. For example, when you say, let's say, natural gas and industry, one often thinks of feed stock. Now, that's important. But 85 percent of the natural gas use, like 6TCF, is for boilers and process heat. And this is a big number, and there is a lot of opportunities for technology advancements on industrial process heat reductions, for example.

And, in fact, the third thing I will then throw in, as well, is -- again, now going to the boilers in industry, you know, EPA put out a rule, which was since withdrawn, on control technologies for coal boilers in industry. Two-thirds of the large boilers in industry are coal, one-third natural gas. And it talked about, you know, maximum control technology on the coal boiler.

Well, if you look in the report, it turns out that we did analysis looking at modern, really high-efficiency, commercially available 94, 95 percent efficient gas boilers, and you have a lower -- I mean an improved net present value in switching to that, at least with current gas prices. And with current gas prices, it is minus $5 per ton of CO2.

So, you know, there is a lot of stuff that we really have to take a system view of, and we will really --

UNDER SECRETARY KOONIN: Eileen and then Phil, and then we will move on. Yeah.

MS. CLAUSSEN: I mean this raises a question. I mean when EPA was doing the boiler rules, or any

other rules that deal with energy systems, what role does DOE play in this? Because you should, actually, be able to provide a lot of information and analysis. I don't know how good your capability is. But some of it -- is there a way to provide that, so that they actually propose something that makes sense?

UNDER SECRETARY KOONIN: Well, so one would think. I have not been directly involved with such things, myself. There are some DOE folks here. The answer is yes?

PARTICIPANT: Yes.

UNDER SECRETARY KOONIN: We do weigh in. Okay. Good.

MR. SHARP: Steve, if I could pull us back to what I think the purpose of the QTR is -- because I have some hope that it can make a major contribution to how we make decisions in this country -- and, by the way, this isn't the first imagination of this to come about.

When the Department was created in -- I guess 1978, was it? I can't remember how often. They had to report with an energy plan to the Congress, but it was,

I think, every two years. Maybe somebody is old enough here to remember. And then that turned into plans, didn't seem appropriate in a non-totalitarian society, and so it was changed into strategies, and what not.

But it was an effort. It was an effort to try to say how can we have a consistent conversation? How can people look at this? They didn't have to agree, but how can we ever get us focus? Because, just as what is happening right here, right now, is not lacking in value, it's just that we have trouble focusing.

So, my strong recommendation is -- and without knowing the details, maybe I'm totally all wet about this -- that doing this, what you call a technological assessment of getting a baseload of knowledge that the other departments input with, and they know about, that other places know about, and MIT can say, "You've got it all wrong," and you actually include in there multiple points of view about where the technology will go, that could be an ongoing, useful thing. It is not going to transform the U.S. Congress, but I can assure you it will be harder to not have a disciplined conversation if multiple people have looked at this

document and said, "That technology is so far off the line, why would you spend $12 hundred million on it?"

UNDER SECRETARY KOONIN: Yeah.

MR. SHARP: And you don't --

UNDER SECRETARY KOONIN: Okay.

MR. SHARP: -- have to come to that conclusion. But do that well, or set up a process so it can be done well, and it will be a contribution made to the entire government.

UNDER SECRETARY KOONIN: Thank you. I want to move on to other questions. But four sentences in response to the four points we have been talking about.

There is, of course, America's Energy Future study that the Academy did. Many of us were involved in that, one way or another. That was an exercise, much more extensive than what we are doing now, to try to lay those benchmarks for the various technologies.

A wonderful study -- I don't know if Peter is still in the audience, but what I told him when it came out is, "This is great, Peter, but you haven't told me how to balance, prioritize our portfolio among these various possibilities," and that is what I would like

the QTR to try to get at.

On the three questions that were raised, one sentence each. On building thermal loads, we, of course, have not forgotten about that. There is a whole hub that is devoted to building efficiency, and you will find, when the technology assessments come out, an extensive discussion of building thermal loads.

Second, on independent advice, the Department has a whole gaggle of federal advisory committees, ranging from SEAB, the Secretary's advisory board at the highest level, down to the National Petroleum Council, the Energy Electricity Advisory Committee, which met yesterday, nuclear, et cetera, in the technology areas, as well as many in the science area.

And finally, national coordination of energy activities across the government. I would say the fact that a distinguished body recommended a quadrennial energy review suggests that we could do better in that than we are doing right now.

All right, let's go on another trio of questions. Yeah?

AUDIENCE PARTICIPANT: Oh, okay. So, in the

area of balanced portfolio, I wanted to address the technology aspect of that. And what happens many times is the Department of Energy makes an investment in sort of one area, and it grows, and it addresses others. And now you sort of have these six strategies.

So, an example of that would be batteries. They were developed over many years, specifically for the transportation sector. But then, all of a sudden, it opened up possibilities in grid scale, et cetera, and now that's a big new area, in terms of storage. So, it addresses more than one of the strategies.

Another example that I do want to get -- and I will go back to the solid oxide fuel cells -- through the SECA program was focused on deploying clean electricity, large-scale power generation. But it also can be used in modernizing the grid for natural gas-type distributed generation. And, of course, throughout Europe and Asia it is being used for increasing building efficiency through combined heat and power systems.

And, as I mentioned earlier this morning, if we separate from -- fuel cells from hydrogen, and we

bring the temperature down, then we can have range extenders and APUs that electrify -- help electrify the fleet, addressing range concerns, increasing vehicle efficiency. And, of course, they are fuel flexible.

So, in many respects, you could argue that that is a unique technology, solid oxide fuel cells, that actually addresses all six of the strategies. It also is a unique technology, in that the primary program that funds solid oxide fuel cells, SECA, was zeroed out in the budget. And I'm just wondering if maybe that should be re-looked at.

UNDER SECRETARY KOONIN: Okay, thank you.

MR. MERIT: I'm Gary Merit, population and health specialist, USAID retiree. I want to just pose a brief question to the panel regarding what lessons were acquired, if any, in consequence of the 2009 Recovery Act, and the massive, if short-term, infusion of resources thereby?

UNDER SECRETARY KOONIN: Okay, good.

MR. PATEL: Pinakin Patel from FuelCell Energy. I like the way one of the panels described 20 percent nuclear should not mean 20 percent of funding.

It should be based on value proposition.

And also, I will use that in light of the Secretary's comment on going more for liquid biofuel. If you go for liquid biofuel for 30-billion gallon, probably you are going to end up with more than 30 billion pounds of biomass waste.

I have a question for Dr. Majumdar. He has done lot of good innovating things. Are you looking at creating uses of that biomass waste to solve the stationary problem? And how would that policy balancing portfolio help?

UNDER SECRETARY KOONIN: Okay, good. So, again, to summarize, three questions. What weight should we give to technologies that have broad applicability? And solid oxide fuel cells was mentioned as one example, although there are others. A second is, lessons learned from the Recovery Act. And the third is fuel cells and gas, biogas, and if we're going to have so much biofuels, what do we do with the biowaste? And of course, one person's waste is another person's feed stock -- for cattle, for example, or other things.

So, I don't know. Three questions on the table. I will put them, any and all, to everybody on the panel. Phil?

MR. SHARP: Without knowing all the details of what we did in the stimulus package, let me just say a couple of things. First of all, obviously, it was an extraordinary time. I don't remember a time in 30 years in which we were willing to put that much money on the table so quickly for doing a lot of things.

But the one thing that I think was very positive was the fact that we actually chose to invest -- and, by the way, so did the Chinese, and a number of other governments; we had some limited international coordination on clean energy propositions. This would not have even come up 10 years or 20 years ago in stimulus packages that went through Congress.

Now, partly, I think it was probably beneficial because it substituted for losses in the general economy of dollars and access to capital, and what not, which may have kept alive a few things. Obviously, the practical problem is you fall off a

cliff when it stops in certain areas kind of proposition. And that is a practical problem of where we are, and our economy and budget, and that is unfortunate.

One hopes that we will be able to identify out of it -- and maybe something the Department might be able to usefully do, maybe it's better done by some outside force, is to identify where successful things that we learn something that actually shows us, boy, we really ought to go forward with this, we experimented with some things. Hard to find a lot of shovel-ready projects, of course.

UNDER SECRETARY KOONIN: So, let me weigh in with a couple of inside-the-Department lessons.

One, I think we learned that it is hard work, but not impossible, to spend a lot of money well and rapidly. The second is that I think it taught us new models about processes inside the Department, efficiencies, new ways of doing things, some of which have been adapted throughout the Department.

ARPA-E is another example of trying to do things differently and better that was stimulated by

the stimulus. And let's not forget that the first tranche of ARPA-E money was stimulus money.

And then, finally, I think, in terms of the practical imports -- or impacts, let's wait and see. I mean we have catalyzed the transportation battery industry, as we have talked about, a number of other investments. It will take a few years to see what the real impacts are. Dennis?

MR. MCGINN: I just wanted to mention it wasn't exactly Recovery Act, but a lot of the executive orders that have been issued related to reduction of greenhouse gases, increase in energy efficiency, increased use of a broader portfolio of energy sources, have made a difference. I am fairly familiar with what is going on in the Department of Defense, and -- but other agencies, as well. And I think that is creating a market demand.

In my network and the American Council on Renewable Energy, the financiers, project coordinators, companies, have -- are definitely benefitting, not just from Recovery Act spending, but also, if you will, that mandate of executive orders that affect a very large

part of our government.

UNDER SECRETARY KOONIN: Yeah. Dennis, maybe you want to turn to the biomass waste question. Somebody said 30 billion tons. That is much too big. You know, we're talking about a billion tons of biomass, in total. So -- but it's still a lot of material. What are we going to do with it, besides burn it?

MR. MCGINN: I think that some of it we will burn and convert into other forms of energy.

In talking with people who are in the bioenergy field, they really are great analysts for their entire value chain. They want to squeeze everything they possibly can out of every part of the process, by making it more efficient, combining it with cleaner forms of energy, cheaper forms of energy, renewables at various stages. And the waste certainly is a part of that.

I have been asked to speak in September to this forum that is called Manure to Energy. And I was thinking, maybe I could start by thinking of a way that we could make our U.S. Capital net zero if we applied

the right kind of technology --

UNDER SECRETARY KOONIN: Recycling, right?

(Laughter.)

UNDER SECRETARY KOONIN: That's good, okay. Well, we can do energy content times mass -- never mind.

Okay, let's take another three questions.

MR. KAMATH: Hi, I'm Haresh Kamath from EPRI, the Electric Power Research Institute. I wanted to, first, say a thank you to the people who spoke of us fondly earlier, as something of the distant past. But thank you, we're still here. And we are still active.

So, and in that vein -- I think I am speaking for the other consortia here, research consortia here, who represent industry. And, for us, you know, we are 90 percent -- our members represent 90 percent of the electricity generated, transmitted, and distributed here in the U.S., and we also have a substantial number of members overseas.

And this is really a question with respect to what was said earlier about technology transfer, technology transition, moving technology from early

stage to later stage. You know, we are very interested in assisting with that process, especially if the technologies are the ones that we need for our industries.

You know, we have already got an agreement with ARPA-E. I know some of our others -- similar organizations like U.S. Car and GTI have done the same thing. But that really depends on a certain understanding, or a certain amount of feedback going back and forth between DOE and our organizations. And I am just curious. I am really very interested in understanding what's the long-term commitment to that, coming from DOE?

UNDER SECRETARY KOONIN: Okay, thank you. Let's gang them up first, so -- but I will turn to you, then, after that. Go ahead.

MS. MANDEL: Hi, Jenny Mandel, a reporter with Green Wire. It seems like future political appointees are a significant audience for this document. The timing and the content are sort of geared that way. And I imagine that future political appointees might look a lot like the people on the panel here, people

who know a lot about energy, and a lot about what's out there, and what's been done.

So, I would like to ask what this document could say that would be worth the time for these future political appointees to read, or to look at? Thank you.

UNDER SECRETARY KOONIN: Okay, good. Thank you. And then the third?

MR. ROSENBERG: Hi. My name is Adam Rosenberg, I work for the assistant secretary of defense for operational energy plans and programs. Here we have a sitting under secretary for science, and a recent acting under secretary for energy. But my question is more targeted toward the former under secretary, Dr. Moniz.

One of the points in the PCAST report recommended having a single under secretary essentially for energy and science to better coordinate all of the energy activities across the board within the Department, and a single individual with budgetary authority. And I am curious is that is still something you are pushing towards, and where the Department sits

on this.

UNDER SECRETARY KOONIN: Yes. So, again, to summarize the three questions, does the Department have a long-term commitment to engagement with consortia like EPRI, the gas institute, and so on?

The second is, what could the QTR say that would be useful to future political appointees? And then, finally, Ernie, was it really better back in your time when there was a single under secretary, or not?

(Laughter.)

UNDER SECRETARY KOONIN: Yeah, the good old days. So, you know, again, any and all questions open to the panel.

MR. MAJUMDAR: With regards to the EPRI and the partnership -- this is just a reference point -- ARPA-E had a partnership with EPRI, Duke Energy, and other utilities. EPRI actually addressed some of the common problems, that utilities are quite diverse, so the problems -- the other utilities are also part of this consortium that you are trying to put together. I think it's extremely important.

It comes back to this idea of what the future

grid is, and what is the modernization of the grid.

Today, so far, the so-called smart grid is, you know, smart meters, synchophase measurement units that we can measure what's going on. There is a huge need -- we are hitting the asset wall, in many of the cases, of components that are more than 40 years old -- being able to replace them with devices -- electronics, for example, which are absolutely relevant, and there is a huge opportunity to make a quantum leap into technology, as opposed to buying transformers which look very much like what Tesla built.

So, that is the opportunity. And, of course, the feedback, controlled communication, et cetera, I mean that is the balancing the renewable versus with natural gas and storage. I mean all that -- there is a huge opportunity out there, and there is a market opportunity out there, as well.

I think the role that we can play to partner with EPRI and other utilities is that we can look at the R&D side of it. But, frankly, if you -- you know, if you ask, "Do we have the budget to be able to do all

the way to deployment," the answer is no. And I think that is the opportunity that we can see, in being able to partner for test bedding some of this technology -- the risk, and thereby utilities and other ISOs and RTOs can take a look at that and say, "Hey, this is something that has been de-risked, and we can take a look at it."

So, I think there is a huge opportunity out there. That's all.

UNDER SECRETARY KOONIN: Okay, good.

MR. MONIZ: Let me say a couple things about, okay, all three questions.

On the first one, with EPRI, I mean, I didn't make the comment about the EPRI of the past, but I would argue in this context -- it may not be totally irrelevant -- I would argue it's the EPRI of the past funding arrangements pre-deregulation, which is more parallel than, I would say, with GRI and other kinds of funding issues.

So, on that, let me just note Dan Schrag on the last panel mentioned something in the PCAST report. I am going to extend it. He noted that we did

recommend -- or did a note with back of the envelop numbers that the order of $10 million a year is kind of missing, in terms of public support for energy R&D.

What he did not say is that we go on to note that, for all or at least a substantial part of that funding, we prefer a mechanism of that sort, which is -- was raised in the last question of the last panel, specifically that, in our view, I mean, DOE's real strength is in the earlier stage in translational research. The history of demonstration and deployment is a more checkered one, shall we say.

And we believe that the overall research investment would be better with DOE -- certainly maybe getting some additional funds, but you know, the $5 billion scale, more weighted to the beginning, with more applied and demonstration projects in one of these quasi new revenue stream approaches, with industry playing a very central -- in some sense, statutory -- role in how the portfolio is put together would be best.

And those are not disjoint. In fact, first of all, the DOE -- or certainly some government agency; I

1 would think DOE -- would have to have an oversight role
2 directly in that process, as has always been the case
3 -- with GRI it was FERC, for example.
4 And secondly, historically, I know the example
5 of GRI pre-deregulation. There was a -- so, again,
6 their funding -- it was $225 million a year, something
7 like that -- came from a tariff on interstate gas
8 transmission. And they did -- it was sort of
9 official -- very close coordination with the office of
10 fossil energy, in terms of how things went together.
11 So, it was actually a very, very symbiotic
12 relationship. And yet, having the tariff structure
13 giving an assured funding stream, encouraged much more
14 forward-leaning industry commitment to cost-sharing on
15 long-term projects, because they felt it wasn't going
16 to get jerked around by annual appropriations, or
17 changes of administration.
18 So that's the structure that we actually
19 advocated -- details to be worked out -- but I
20 think -- I remain at least -- I feel that is the right
21 way to go.
22 On the second question, I just note -- why

should they pay attention? It's what Phil said earlier. If there is real good hard-nosed basis of assessment, that should be of interest to everybody. And then, the analytics leading to the program choices may be disagreed with, but they have to be transparent.

UNDER SECRETARY KOONIN: Yes.

MR. MONIZ: And based upon analysis.

Third, the good old days -- Steve mentioned that I am a fossil, apparently, the last unitary under secretary -- I will be very clear. I always favored going to two under secretaries, one for the military side and one for the civilian side. I found the additional fissioning to be unhelpful.

I do support the idea of an under secretary that combines energy and science, as we go forward. And if one has a third, then I would have that under secretary focus on operations, essentially a COO role, probably including environmental management, which is largely a COO role, and that would then free up the deputy secretary to be a real deputy secretary, and not a COO.

UNDER SECRETARY KOONIN: Okay.

MR. SHARP: Could I just add in one thing that triggers by what Ernie said about EPRI and the broader PCAST recommendations, and that is we need to be very focused in this country on our intellectual infrastructure, and recognize that this has been -- we have been on the cutting edge, and among the leading places -- and we were never exclusive producers of innovation and new technologies, but we have been central to that in the last 50 to 60 years.

We are not likely to play that continuing role. So we've got to do two things. One is we have got to be more focused on what is our comparative advantage. The Chinese and others are going to be innovators. What can we learn and seize from them, and not have to duplicate expenditures? Where can we cooperate? I don't think cooperation works so hot, usually. But the point is, we have got to be, in this QTR, much more attentive to not just a -- two American-centric a focus.

But the second part of that is -- and I would urge you to judge some of your projects -- this is not the first order of judgement of the value of a project,

but does it contribute to our great university laboratory, independent research organizations? Because it may well be worth choosing a project which -- two projects have roughly equal value, but one will sustain the scientific wherewithal that we have in this country, and the other might not. And, boy, I would make that choice these days.

UNDER SECRETARY KOONIN: Okay, very good. Eileen, you are one of the four of us who are or have been sitting in political seats. What would you think would be useful for the QTR to leave for future political appointees?

MS. CLAUSSEN: I mean information and analysis, because actually, an informed political appointee is a much better political appointee.

(Laughter.)

UNDER SECRETARY KOONIN: Usually. Good. Very good.

Arun, I know you have to go just about now off to a budget meeting, I know.

MR. MAJUMDAR: This input has been very helpful.

UNDER SECRETARY KOONIN: I am happy to -- first of all, I am happy to let the panel continue --

MR. MONIZ: I want to add PCAST also recommended $1 billion a year for RPE.

UNDER SECRETARY KOONIN: Yeah, yeah, yeah, right. Yeah, yeah. He is even happier.

I am happy to let the panel continue, if you all are there, and take more questions. But, Arun, you may want to say a few words before you depart.

MR. MAJUMDAR: Thank you. That's all I will say.

(Laughter.)

MR. MAJUMDAR: But this has been an engaging -- I am sorry I missed the first part of the day. As I said, this is the fourth public event that I am doing today. But I would love to get the feedback from this whole day. And what was said before, I couldn't agree more -- most of the things that was said. So I greatly appreciate it.

UNDER SECRETARY KOONIN: Okay, good. Thank you.

And if the panel is willing, we can continue on. I don't know -- there seem to be more people with questions. So thanks for your time.

Let's go to another question or two.

MR. TARKA: Tom Tarka, from the National Energy Technology Laboratory.

One of the things that's come up throughout the QTR process has been the -- how the nation is going to address the divergent energy goals of energy supply or -- supply security, economic sustainability, and environmental quality. And I would really like to see, as part of the QTR process, making some bold recommendations to tease out what the minimum requirements are in those areas, or at least sketching out what the criteria should be in those areas that we should evaluate on.

Because for all the talk we've done, we haven't actually addressed what those metrics might be. And it might just be a do-no-harm in two out of the three, and the other -- the third should be a dramatic increase. But I think that would be very useful, as part of a QTR document.

And one quick comment. One thing NETL has done is we have been working towards putting together quality guidelines for energy systems analysis, or energy systems studies, and I think that could be also useful in a department-wide, and even from a university and industry, to use a similar set of guidelines for whether it's just we use the same financial assumptions for comparing our levelized cost of electricity makes a big difference.

UNDER SECRETARY KOONIN: Okay. Good.

MR. ZIMMER: Steve Zimmer, with U.S. Car. It's a collaborative organization made up of Chrysler, Ford, and General Motors, and we are part of the DOE, U.S. -- former Freedom Car program.

I mention that because, first of all, this whole public-private partnership, I think, is extremely important. I think it is a very appropriate role for DOE to use in this program. We have been involved in collaboration with the DOE for 20 years, and made a lot of progress. And we look at the next 20 years as exponentially greater than that.

The recent thing that has happened in our

public-private partnership is bringing in these industries that historically haven't talked with each other, in the case of the fuel industry, the automobile industry, and now the utilities.

I think that is a very, very important role for DOE, under this whole context, is to create those public-private exchanges, not with individual industry, but as a forum between industries. Because you find the spaces between the industry is where some of the gaps have to be closed, some of the greatest gaps.

And the other thing, I think that forum does identify new areas for a portfolio and priorities that have to be addressed in your balanced, or meaningful, portfolio.

UNDER SECRETARY KOONIN: Thank you. We will take one more, we'll turn to the panel, and then we need to wrap up.

MR. BOGISH: My name is Ed Bogish, I am from Syracuse University. I lead a university industry collaborative organization focused on innovations.

So, I wanted to give recognition to Dr. Majumdar's second event today, which was at the

Brookings Institution, which today released a report, an analysis of the clean economy across the country, counting clean jobs by region.

And these questions, or the discussion that is evolving now, the question I wanted to raise is the -- in selecting the balance of the portfolio, building capacity in the country, so that the country has competitive advantage in global competition, and where we can draw insight into the role of regional innovation clusters, such as the E-RIC, which was awarded last year. Curious whether DOE has intentions to foster regional innovation clusters in that model.

UNDER SECRETARY KOONIN: Okay. So, I'm not going to try to summarize those last three questions, but they are on the table, and I would just ask the panelists, perhaps individually, to either address those questions and/or make some concluding remarks, as we try to wrap up.

So, in either order, anyone who feels inspired to go first. Dennis?

MR. MCGINN: I would like to comment on the last question. For those of you not familiar with it,

Brookings report -- I think in collaboration with Patel Memorial Institute -- put out a report on clean energy economy, the progress made since about -- I think it's 2003 to 2010. And we -- my organization, ACORE, also puts out a report called "The 50-State Report," where it gives you a one-stop shopping -- this type of metric, as well as some of the technology aspects of it.

This is really, really good analysis, in that if we are going to, in an environment, a political environment, a politically-charged environment that -- the big axes are coming out to cut, in some cases indiscriminately -- making the economic case, the job creation case, the -- and not just writ large across the country, but granularly, by congressional district, for example, by city, by state, that this business of clean energy technology, both efficiency, as well as renewable energy, is really, really a good thing.

It is inevitable. It will happen. Maybe because we are forced, but I would like to think that maybe it can happen because it is the right thing, and

we recognize we can change challenge into opportunity.

UNDER SECRETARY KOONIN: Good. Anybody else? Eileen? No? All right.

MR. SHARP: Just so summarize, which I maybe don't mean to beat a dead horse, but I think this QTR process has the potential for doing a very good thing here. And I think the PCAST people had that in mind, the President has that in mind, and I know you're trying hard to do that. It is hard to do. So let's understand that, and it needs to be developed.

But -- so I would hope you and your team would stay focused on the precedent you are setting, as to whether it has value to be done again. Its only value, ultimately, is its iterative process that we have got to understand. We don't get it right the first time ever. We are always evolving. And the most important thing we have to do is learn how to adapt and change and get options in our energy system.

Now, the part that I happen to think is important is not the goals. We should articulate them. We will, and they will be fine. But don't spend, you know -- that, frankly, is the easy part. The harder

part is the criteria by which you make judgements. But I, frankly, am doubtful you will come to any more brilliant insight into how to do that than we have for 50 years in this country. But more power to you.

But where you can make a real difference, in my view, is in how -- in the -- and part of it is just descriptive, analytical work about what is the status, what people are saying are the potentials for different technology paths as a base. Then we got a good policy, and all that other kind of stuff. But we don't have that common base that people can argue about, to my knowledge -- and maybe I've missed it -- and that is across the government, and you folks can take the lead. And good luck.

UNDER SECRETARY KOONIN: Thank you. Eileen? Anything else?

MS. CLAUSSEN: Just good luck.

(Laughter.)

UNDER SECRETARY KOONIN: All right. Let me thank the panel, and excuse them, and then take a few minutes of the podium to summarize. Dennis?

MR. MCGINN: Just a real quick one. In your

packets, slide 32, it looks like little spheres --

UNDER SECRETARY KOONIN: All right, yes.

MR. MCGINN: -- sectors, pie charts. I would recommend that those charged with doing this QTR and deciding where the changes need to be made start with something like this.

Now, this applies to DOE, but you could, with a little bit of research, expand it to include other public sector investments in energy -- DOE comes to mind, NASA, et cetera, Agriculture, to an extent, and private sector, especially universities -- and then say, "That is where we're starting, that is where we are putting our money right now."

Now, let's apply these criteria. Is it more secure? Is it cheap? Is it cleaner? Is it available? Does it fit in an infrastructure context in a systematic way? And you could probably get it -- the QTR about 80 percent right, just by simply doing a drill like that.

UNDER SECRETARY KOONIN: Yeah, that's the right approach, and what we are trying to do.

MR. MCGINN: Thanks.

UNDER SECRETARY KOONIN: Thank you all.

(Applause.)

UNDER SECRETARY KOONIN: Okay. So, I thought I would take a few minutes to sum up and outline next steps. But before I do that, one very important practical announcement. There was a set of keys that was found, and they can be claimed at the front desk if you find you are missing your keys.

CLOSING REMARKS

UNDER SECRETARY KOONIN: So, let me tell you some of the things I have taken away from the day.

First of all, this is the first time -- at least in memory -- that we're -- we, collectively -- are trying to do this. We won't get it right. And, as Phil said, it is the beginning of, hopefully, an iterative process. Nevertheless, there were some things I heard today -- and we have heard in the five previous workshops that are worth at least getting out in front of you.

First of all, a good neutral documented assessment of technologies is really important. America's Energy Future study did some of that. It is

now a year or two out of date. And you will see, ultimately, the set of 19 technology assessments that we have done, using departmental lab resources.

Second, decisions are useful by the Department, a clear statement of priorities. This is more -- something, we want to emphasize, more than that would be useful. But those need to be informed by the technology assessments, transparent, documented, logical, et cetera, et cetera. Pretty clear statement, rather than simply technological opportunism, or driven by ideology or personal preference.

I heard tension -- and still not resolved, in my mind -- we heard this morning someone say it's really important to envision the end state and then figure out how to get there. Other people emphasized you can't predict technology. So how do we square that, together with the urgency of actually doing something about the problems?

What has become important, evident today, and actually was already there, is the importance of the Department connecting with and respecting, taking input from, and understanding the private sector. I like to

say most of the energy infrastructure in this country is in the hands of the private sector, and they must be the executive agent for any changes that the country is going to make in the energy sector.

I heard a lot of discussion about balance, but still come away a little bit uncertain about what exactly are the criteria by which we should balance. And I suspect that anything we come up with in the end will refract this balance versus bias, and this don't forget me sense that one often gets in talking to people pursuing different technologies.

We heard again today -- and again, emphasizing what we heard in the workshops -- the importance of the roles beyond just technology R&D that the Department can have in its information capabilities, certification of technologies, advising other folks in the government who have regulatory responsibilities, the convening capability that the Department has.

Simply by saying, as it has done in the past, "biofuels," it instantly brings together a set of players into an agenda that didn't exist before. And there are numerous other examples of that.

So, you know, we need to exploit that. That doesn't cost a lot of money. But we need to exercise that capability with thought and discretion.

And then, other modes in which the Department works by maintaining base research capabilities and underlying science and technology, whether it's materials, computing, biology -- understanding the ins and outs of combustion, for example -- those are important things the Department needs to do.

And then, selectively making big technology pushes, of which sun shop is probably the best known recent example. But we have seen others that have been successful, and some that have not been successful.

So, the Department has all of these modes in which it can work, and we need to understand how to deploy them across the spectrum of technologies.

We had a lot of discussion about non-technical barriers to adoption and deployment, and the roles in which the Department can or cannot play, and the importance of other players in trying to make those non-technical barriers disappear.

I heard again today system-system-system, and

perhaps the need to improve the Department's analysis of various systems. Who owns some of these systems? Who owns the energy system within the government, responsibility for overall -- certainly there is regulation, but there is the technology development, which does not seem as well coupled with the regulation as one would like.

And then, finally, I heard a good deal of enthusiasm for the QER. We're not ready to execute that yet, but clearly, the degree to which we are successful in doing the QTR will lay the ground work for that, should the government decide to undertake that in a year or two.

Follow-on, first of all, email address was up there. It's on my screen -- I guess we can put it up there -- there is a place for public comments and, in particular, if there is something that you wish you had said today, but didn't have the opportunity to do so, send us an email. We will listen, as we have listened to input from the previous workshops.

And then, finally, watch for the public release of a draft. Hopefully that will happen in

September. You all have now been exposed to some of the thinking, debates that are going on, and your own weigh-in with comments during a public comment on that draft -- again, ideally, in September -- will be much appreciated.

With that, I thank you all for your participation in this exercise. It is an ongoing adventure for those of us who are doing it. And I look forward to further interaction with all of you, as we try to get it right. Thank you.

(Whereupon, at 4:33 p.m., the meeting was adjourned.)

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