3.1 EIA'S ENERGY OUTLOOK AND CLIMATE CHANGE

Ms. Phyllis Martin

First of all, I want to say that it is a pleasure to attend and participate in this symposium on energy and climate change. It is interesting how energy and the Department of Energy have evolved over the years. If we look back to the 1800s, our energy economy was really wood based. Over the course of about 40 years we moved to a coal-based economy and then we moved to electricity and now we are moving more and more toward renewables. Although things changed, change occurred relatively slowly. Each of these transactions took 40–50 years.

I remember being on the end of the coal-based era. I hate to admit it, but when I was a little girl one of my thrills was going into the basement and watching my father shovel coal into the furnace and watching the coal people come and deliver it down the chute. That shows either that I have been here for a long time or that I come from a very small town; unfortunately, it's both.

Ms. Phyllis Martin is a Senior Energy Analyst in the U.S. Department of Energy's Energy Information Administration (EIA). She has been developing energy market models since 1974 in both the corporate and government sectors. She has been an analyst in EIA's Office of Integrated Analysis and Forecasting since its inception. Her specialty is natural gas markets, both domestic and international, with a strong focus on liquefied natural gas (LNG). Ms. Martin has been a speaker at numerous national and international energy conferences and is a published author. Prior to her work with EIA, she was involved in consulting and mathematical modeling for Control Data Corporation and the Westinghouse Defense and Space Center. Ms. Martin is a magna cum laude graduate of Saint Lawrence University, with a bachelor of science degree in mathematics and a master's from the Johns Hopkins University.

I have been working with the department since it started in 1976. For those of you who are not familiar with us, the Energy Information Administration (EIA) is an independent entity within the Department of Energy. We collect and analyze data, put out forecasts, and analyze proposed legislation. Because we are independent, we do not answer to anyone else within the government or within the Department of Energy. As a result, we are known for analyses that are independent and pretty much tell it like it is. We do not propose any policy. What we do is we analyze for people on the Hill what comes out and we tell them the impacts of proposed legislation.

What is most important about our forecasts is not the actual numbers, but the incremental difference between forecasts for different years or ones based on different assumptions.

We are not going to say, "I can tell you what's going to happen in 2035." If I were to tell you the price of oil is going to be $113 a barrel, I can guarantee you one thing, and that is that the number will be wrong. But if you look at the number that comes out from our base case forecast and then you look at the number that comes out from the forecast in which we look at a proposed piece of legislation, it is that difference that is the key thing.

To get started, I will first touch briefly on the global picture. We produce an international energy outlook every year and an annual energy outlook. I will look briefly at the international picture and then focus in more on the domestic picture. Then, I will talk about an analysis we did of the proposed American Clean Energy and Security Act. [1] This bill, which has already passed the House, is a huge bill. It is over 1000 pages and includes many provisions. Because the Senate has yet to act on this legislation, there is no certainty as to whether the final law, if there is one, will include some or all of these provisions or some totally new ones.

So let's take a look at the global energy outlook. If we look at the increase in global energy use between now and 2030, 82% of that increase is expected to come from the non-OECD countries, including China, India, and other countries in the Middle East (Figure 1). The increase in global energy use in the OECD

countries is expected to remain fairly level. However, the growth in the developing nations is much more significant, their percentage of the total grows from 49% to 59%, whereas the OECD countries are expected to drop from 51% to 41%.

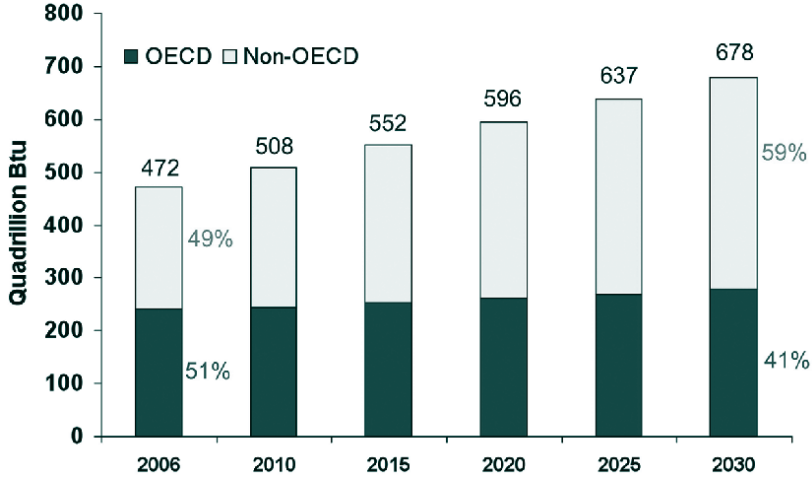

Figure 1. Expected Increase in Global Energy Use Through 2030

As far as growth, use of all forms of energy is expected to grow (Figure 2). Renewables are the fastest growing, but it is from a relatively small base that does not include biofuels. They are included in liquids right now. If they were included in renewables, use of renewables would grow to 11% and use of liquids would grow to 30% instead of 32%. Coal use continues to grow mainly in the developing countries. Natural gas use grows because it is a clean-burning fuel and there is switching from more carbon-intensive fuels to natural gas. Use of liquids continues to grow because they are the fuel of choice for the transportation sector.

The transportation sector depends heavily on liquid fuels. Because goods and people have to move from place to place in order to reach markets or employers, this sector tends to be less responsive to changes in prices than is the case with some of the other energy sectors. Another complicating factor is that we cannot easily substitute other fuels for gasoline or diesel when their costs

go up, although we are trying to make that more feasible. Use of nuclear is projected to remain about the same as at present. Overall growth in energy use depends, of course, on economic activity, and we can see where the GDP growth is the strongest in the developing nations, namely China and India (Figure 3). There is

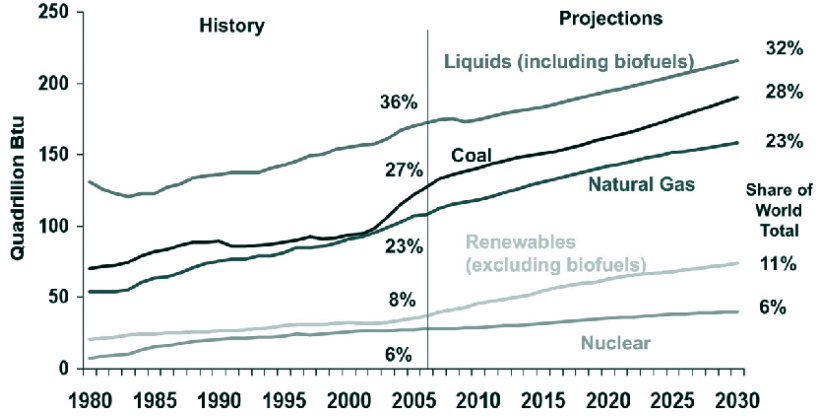

Figure 2. Expected Growth of Various Forms of Energy Through 2030

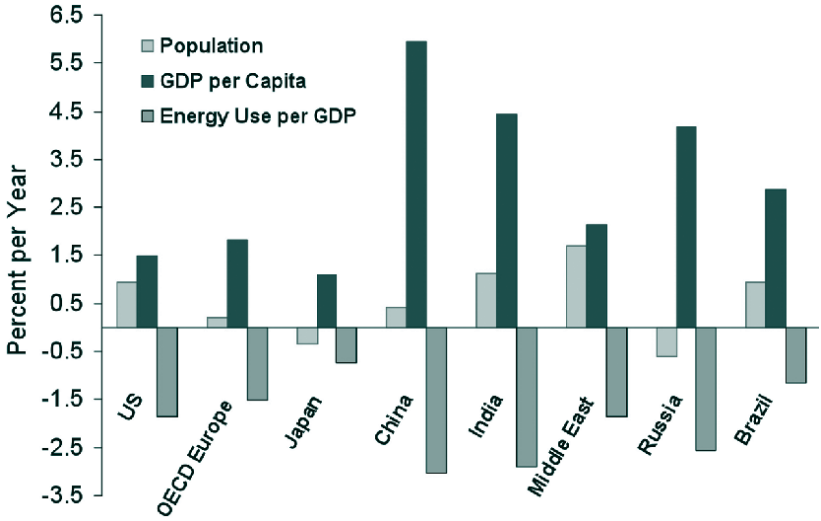

Figure 3. Expected Growth of Energy Use in Relation to GDP

also a lot of growth in Russia and Brazil. In these countries we see strong growth in energy use per GDP.

Without new energy policies for carbon emissions, we will see quite a growth between now and 2030 for the international and between now and 2035 for the domestic outlook (Figure 4). We are projecting that growth in both consumption and carbon dioxide output. Without emission control policies, we expect to see strong emissions growth.

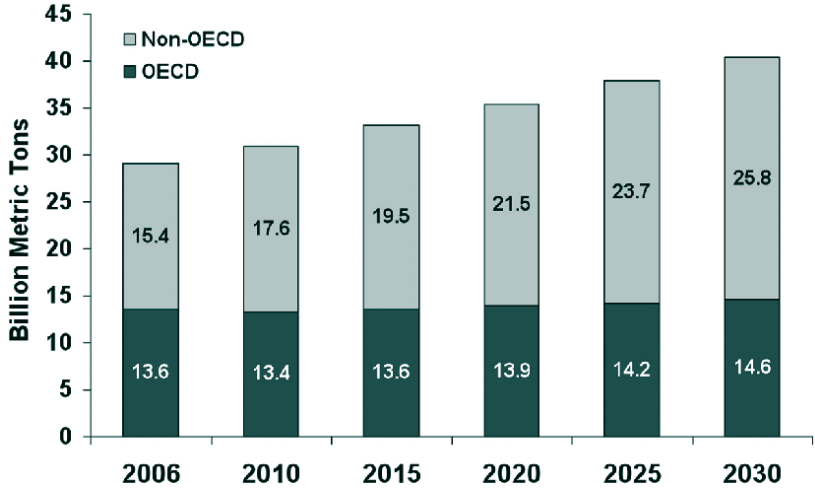

Figure 4. Expected Growth of Energy-Related CO_2 Emissions

Turning to the U.S. energy outlook, this is our annual energy outlook. We published our base case assessment at the end of last year, along with about forty side cases that show the range of uncertainty about the forecasts. I really encourage people to look at all of our side cases. The full report will be out shortly. [2] The assumptions are key in that they really rule the forecasts. We look at high and low technology growth, high and low world oil prices, high and low GDP growth, and higher and lower resource bases. So there are a number of combinations, and you cannot just take it out of context.

One of the key things coming into the U.S. energy outlook right now is that the global recession is really affecting things and we are not expecting GDP to return to the 2008 level until 2011 and consumption to reach the 2008 level until 2012.

As far as the carbon output that we had in 2008, we do not reach that level again until 2019 (Figure 5). Energy intensity, which is energy use per increment of GDP, is continuing to fall. A lot of this is a direct result of efficiency improvements. Energy per capita is falling slightly. This trend is expected to continue through the end of our forecast.

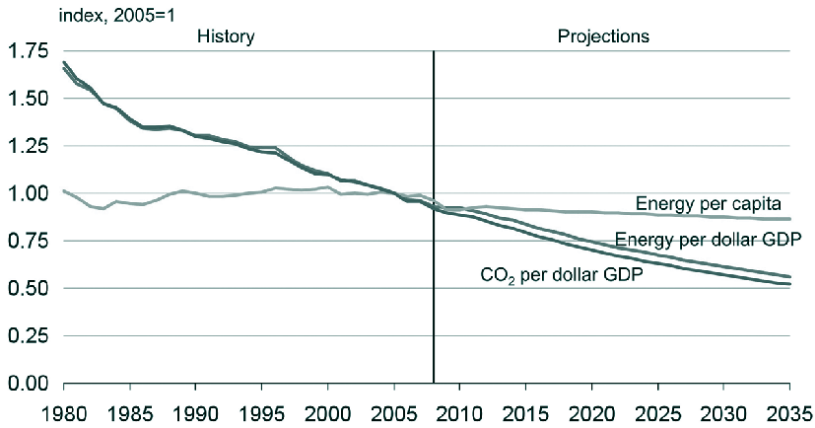

Figure 5. Decline of Energy and CO_2 per Dollar GDP

As far as energy consumption in the United States, again we see, as we did internationally, a strong growth in renewables (Figure 6). In particular, we see a strong growth in biofuels. There is an overall growth in natural gas. We see quite a decline initially and that decline is attributed mainly to coal plants and renewables that are already in the construction phase and coming online. So we see a decrease in natural gas use and then it picks up again. As you may recall, just a few years ago natural gas prices were really high. As a result, coal became the fuel of choice for many installations. That is now changing. Nuclear is growing and the

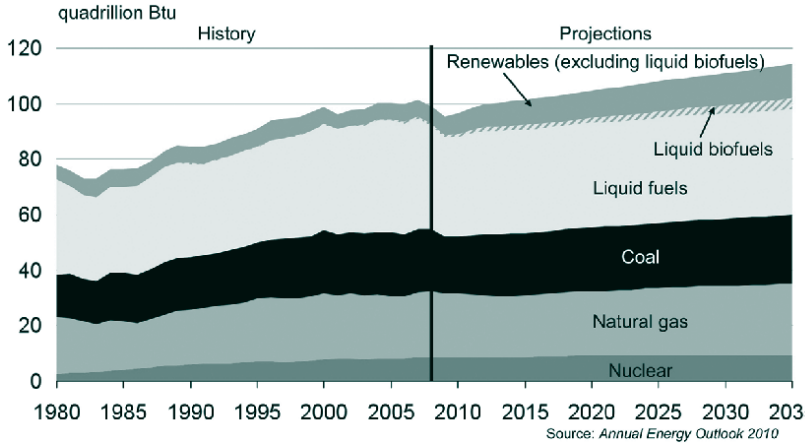

Figure 6. Energy Consumption in the United States

growth is mainly because of capacity—new capacity that is being added.

One place where we are making a little progress is in our dependence on foreign oil (Figure 7). We reached a peak of 60%, and that has declined in 2008 to 57% and we expect it to decline further to about 45% in our reference case. The decline is due to several things—one, more use of biofuels and more domestic

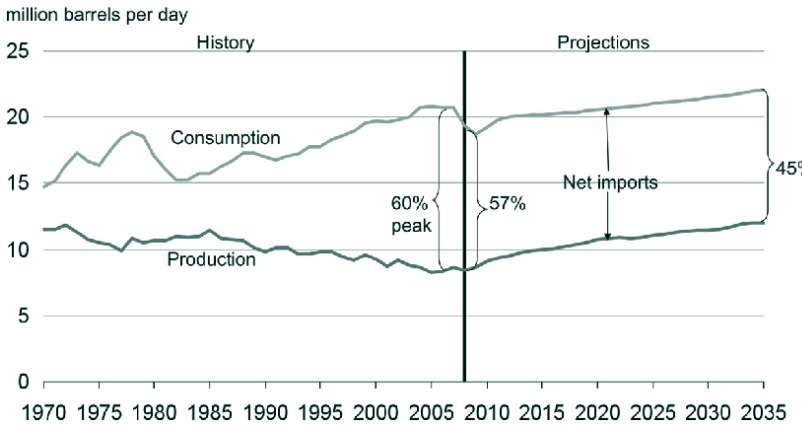

Figure 7. U.S. Dependence on Foreign Oil

production. That domestic production is coming from both offshore and from onshore with enhanced oil recovery.

Most of the growth in liquid fuel supply is coming from biofuels, and that includes biofuel imports. Now biofuels are expected to grow, but they are going to fall short of the 36 billion gallon renewable fuel target for 2022 (Figure 8). A lot of this is because of slow downs or cancellations of projects for cellulosic ethanol. We still see a lot of corn ethanol; however, this is going to pick up again, and by 2035 we expect to exceed the target. But, in the interim, we do not expect that the 2022 target will be met.

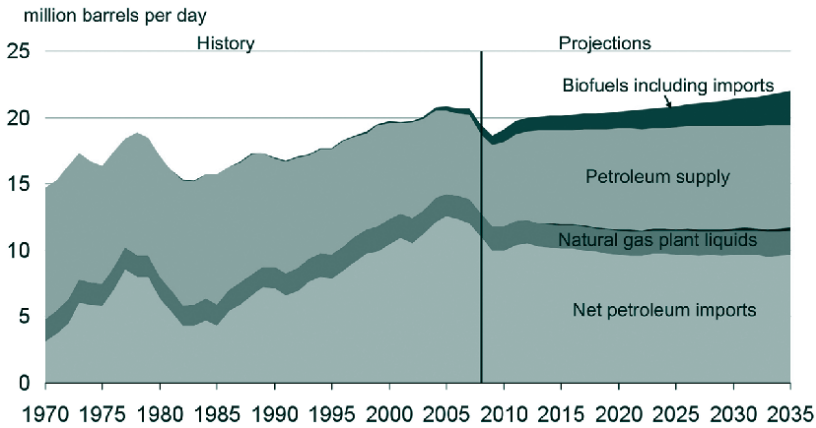

Figure 8. Growth of Fuel Supplies

Turning to natural gas, we are, again, lessening our dependence on foreign sources (Figure 9). Most of our foreign gas currently comes from Canada, but, with increased domestic production and domestic production growing faster than domestic consumption, we are less dependent on imports. Key in this is the increase in our resource base due to shale gas discoveries. Shale gas has really been a game changer here.

If you look at the increases in natural gas, you can see that production from our domestic onshore resources is declining significantly; however, shale gas is growing considerably and we also see a big contribution from an Alaska pipeline. The economic

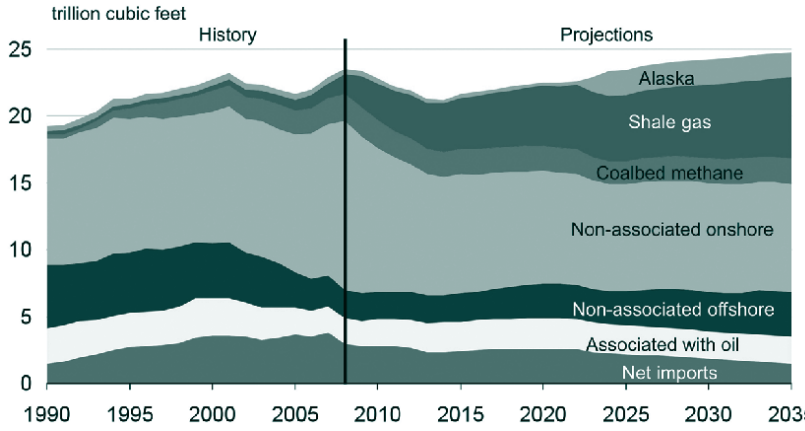

Figure 9. Sources of Natural Gas

conditions are such in this forecast that a pipeline comes on in 2023. Now over the years our forecast, the timing with the pipeline, keeps getting pushed out. This is mainly because the economic conditions have been changing. Costs for the pipeline have been going up. But we do expect an Alaska pipeline to come online and we do expect a significant increase in shale gas.

As a result, we have moved from about 1300 trillion cubic feet to more than 2000 trillion cubic feet—a significant increase in our own domestic resources. That increase is a lot stronger than the growth in the production, so we have significant shale gas resources and significant natural gas in our own country.

In the case of electricity, we show a decrease in electricity growth (Figure 10). It is still growing, but look at how quickly it has dropped over the years: In the 1950s the annual growth was 9.8%; the 1960s dropped to around 7.3; 1980s, 4.7%; and on and on. In our forecast we are expecting it to grow about 1% per year. Now a lot of this is due to efficiency improvements and also to a lessening of demand because of higher prices.

As far electricity market shares, renewables show strong growth—from about 9% to about 17% (Figure 11). There are a number of reasons for this and a lot of legislation involved. There

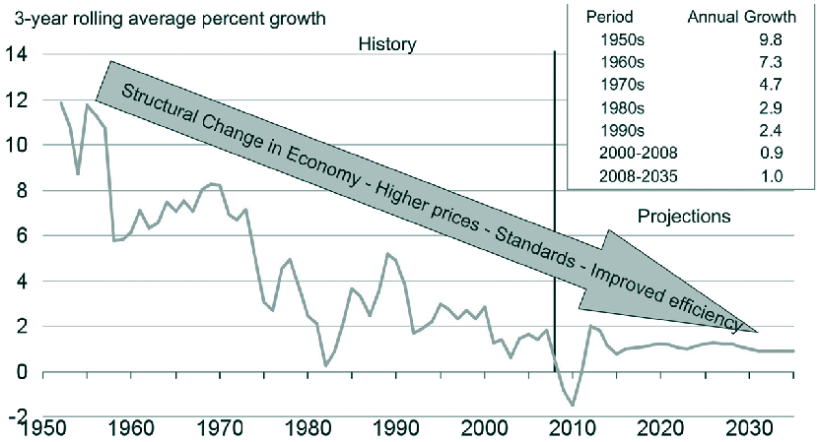

Figure 10. Growth in Electricity Use

are tax credits for renewables. The stimulus plan has subsidies for renewables and there are state renewable fuel standards, so that has helped; plus the concern over the environment has helped. Although we model current laws and regulations—there is no carbon legislation out there right now—we do assume that there is a penalty for using carbon. We do that by increasing the cost of carbon-intensive utilities. So there is a cost associated with building coal-fired plants, and that is to reflect the industry anticipation of some kind of legislation.

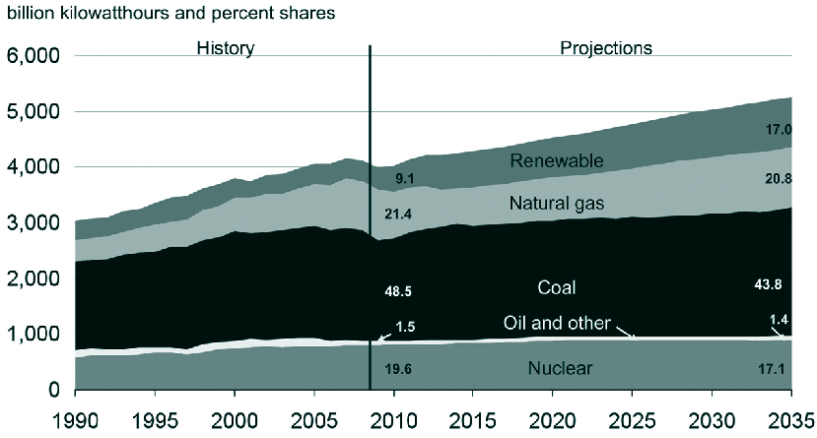

Figure 11. Projected Market Share

Most of the added coal is already under construction. We see very little new coal capacity coming on that is not already in the works. As a result, the coal share drops from 48.5% to 43.8%. The non-hydro-power renewable sources—mainly wind and biomass—make up about 41% of the renewables. Solar has a strong percentage growth but still is a very small portion of our entire generation. Geothermal and waste are also quite small.

Assuming that there are no new policies, growth in energy-related carbon dioxide emissions is really driven by electricity and transportation fuel use (Figure 12). Over the forecast period, there is an 8.7% growth in our carbon emissions. Most of this is due to the electric power and transportation sectors. When we look at the proposed legislation, you will see that most of the results are achieved in the electric-generation sector and not in the transportation sector. That is mainly because in the electricity generation sector we do have choices and you can switch to natural gas or go into renewables.

In the transportation sector, without some big technological breakthroughs, we are pretty much dependent on liquids, to include biofuels. There has to be some major breakthrough and

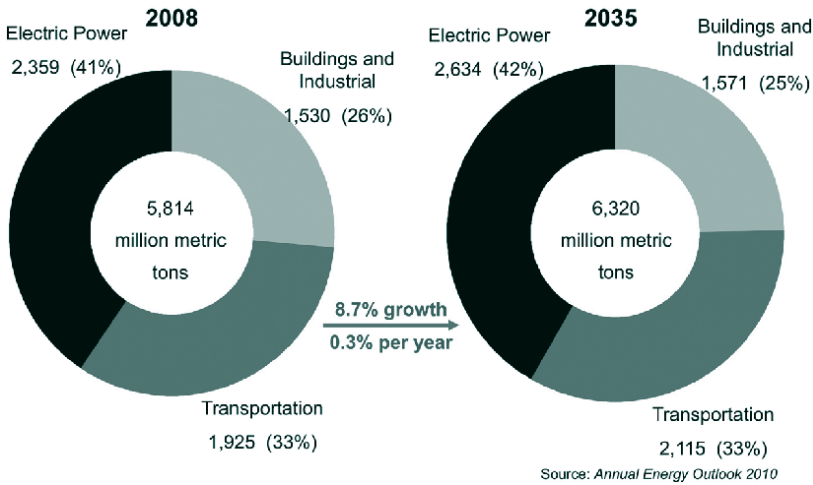

Figure 12. Drivers of Growth in Energy-Related CO_2 Emissions

there has to be change in infrastructure to increase benefits in the transportation sector.

I will now discuss the EIA analysis of the American Clean Energy and Security Act. [3] As of now, our forecasts assume current laws and regulations. What if policies change? As you know, there is a lot of policy that could change. In the past, we have had investment tax credits, renewable portfolio standards, production tax credits, renewable fuel standards, CAFE standards, and all of these have made a difference. There is a lot of talk about carbon legislation; nothing has made it all the way through, however. There is talk about a cap and trade program. EIA did an analysis of the implications of the American Clean Energy and Security Act, also known as the Waxman/Markey Bill after the representatives who were the chief supporters.

There are many provisions in this bill. In particular, it calls for a reduction in covered greenhouse gas emissions of 24.6 billion metric tons over the 2012 to 2030 period. In our analysis, we examined six basic scenarios (Figure 13). Detailed results for those scenarios are available on the EIA website. That website also provides a link to the testimony of our Administrator, Richard Newell, regarding the bill.

Case Name	Assumptions
Basic	Integrated analysis of all of the modeled provisions of ACESA.
Zero Bank	Same as Basic but no carryover of allowances beyond 2030. Proxy for major low-/no-carbon energy technology breakthroughs with significant market impacts after 2030.
High Offsets	Same as Basic but assumes increased use of international offsets.
High Cost	Same as Basic but assumes that nuclear, fossil with CCS and biomass gasification costs are 50% higher.
No International	Same as Basic but assumes international offsets are too expensive or unable to meet the requirements for use.
No International/Limited	Same as Basic but limits additions of nuclear, fossil with CCS and biomass to reference case levels. Also no international offsets.

* Additional report cases examine impacts of high technology assumptions, limited supply technology availability, the recent proposal to modify CAFE standards, a lower banking discount rate, and more aggressive banking through 2030.

Figure 13. Six Main Cases in EIA's Analysis

The baseline for this forecast was the Annual Energy Outlook 2009, updated to include the stimulus bill. This was done before the Annual Energy Outlook 2010 came out. As I mentioned earlier, we want to look at the relative impacts, not just the numbers. The change could be higher or lower than the actual reduction based on how much use is made of offsets. Accordingly, our results show bands in which we could get more or less.

The basic case is an integrated analysis of all of the provisions that we modeled. The "zero bank" case is the same as the basic except that we do not allow any carryover of allowances beyond 2030. This is a proxy for major carbon energy technology breakthroughs in which industries would not be as prone to banking credits. The "high offsets" case assumes an increased use of international offsets. Now you can get credit for domestic or international carbon reduction. The "high cost" case is the same as the basic in that it assumes that costs for nuclear and fossil with carbon capture and sequestration by mass gasification are higher. The "no international" case assumes that the international offsets are not available. Either they are too expensive or they cannot meet the requirements. The most restrictive case is the "no international offsets and the limited editions of some of the better choices for carbon." If we look at the energy sector reductions, those are the two bottom sections and they vary considerably with the availability of the offsets and the availability of the low-emitting generation options such as nuclear and coal with sequestration (Figure 14).

As you can see, when we have no international and no international or the limited cases, most of the compliance comes from actual reductions, whereas in some of the other cases a lot of these international offsets are used.

As I mentioned earlier, the electricity sector really dominates the projected reductions in the energy-related CO_2 emissions (Figure 15). If we look at that, the electricity sector is the green on the top. You see a strong variation there. In the transportation sector it is very little. If you look at the percentages for the numbers, the electricity sector is responsible for roughly 80% of the reductions, whereas the transportation sector only accounts for 5% to 8% of the reductions that can be achieved with this particular legislation.

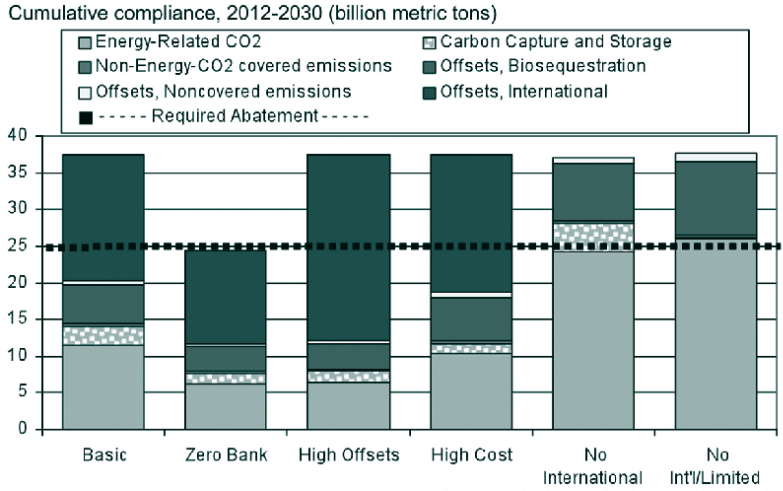

Figure 14. Projected Energy Sector Reductions

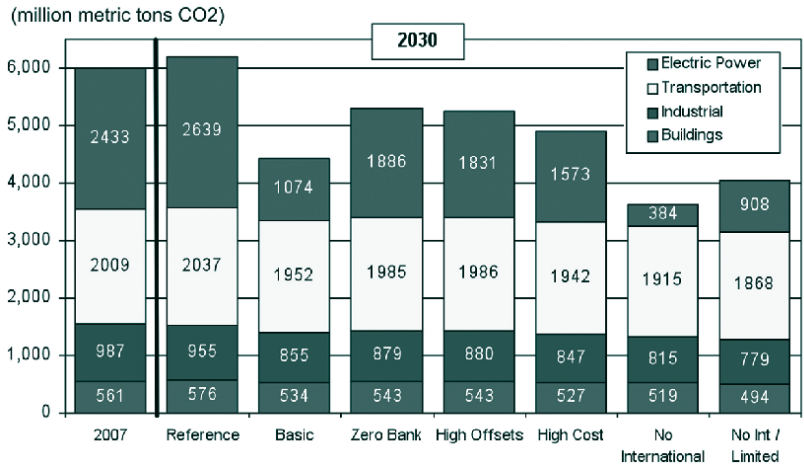

Figure 15. Projected Reductions in CO_2 Emissions Dominated by Electricity Sector

This is because the transportation sector is 90% dependent on petroleum. By 2030 we see a shift in generation in these cases from the conventional coal to the nuclear renewables and fossil, plus carbon capture and sequestration (Figure 16). Natural gas use does grow dramatically if these other options are limited.

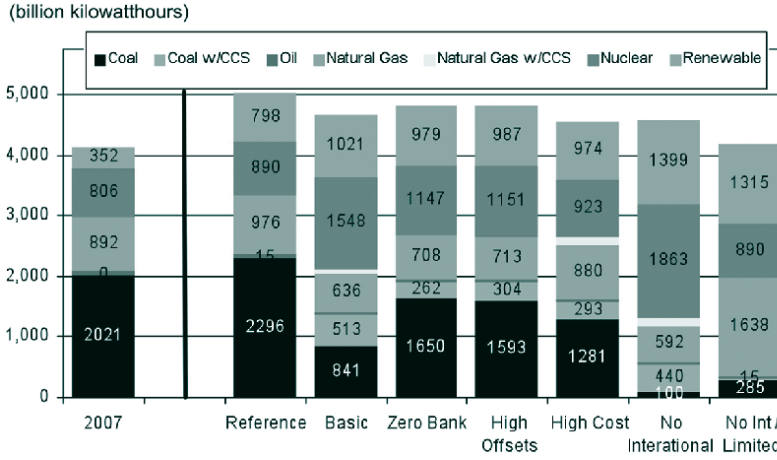

Figure 16. Projected Shift from Conventional Coal to Other Sources

If you look at the no international and the limited cases, you see the strong growth in natural gas. You also see growth in nuclear and in renewables. So basically what this shows is that there really is a wide variety of alternative futures.

Capacity additions are generally dominated by a mix of nuclear renewables and the fossil fuel with carbon capture and sequestration (Figure 17). Natural gas is more important if these options are limited. Thus, we see a lot of renewables, especially in the no international and the no international unlimited option cases. Efficiency programs and high electricity prices also reduce the electricity demand growth, and this is another key point in reducing our carbon footprint.

If you look at the growth over these different cases, the growth in electricity demand is less in all of these cases and you see the variation from 0.2% to 0.9% (Figure 18). Electricity prices, with the exception of the no international and the limited case, are pretty much around what they are for the base case, and these prices are a little bit under what the prices have been recently. The principal factor underlying the large increase that occurs after 2025 is the assumed phase out of the free offsets to carbon-emitting facilities.

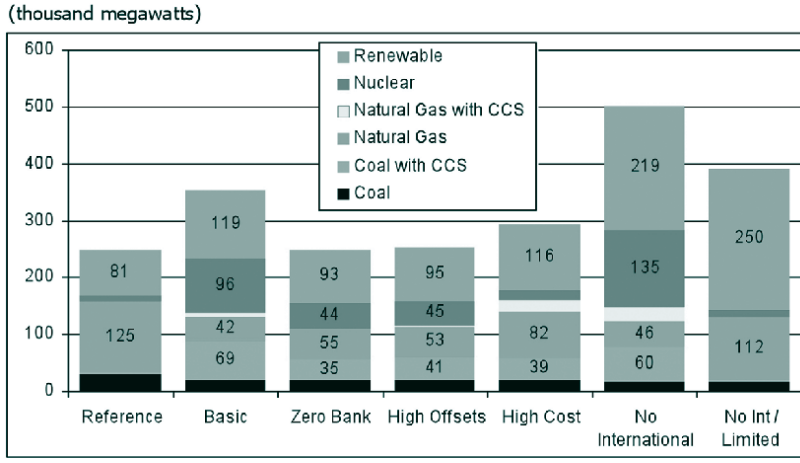

Figure 17. Capacity Additions, 2008–2030

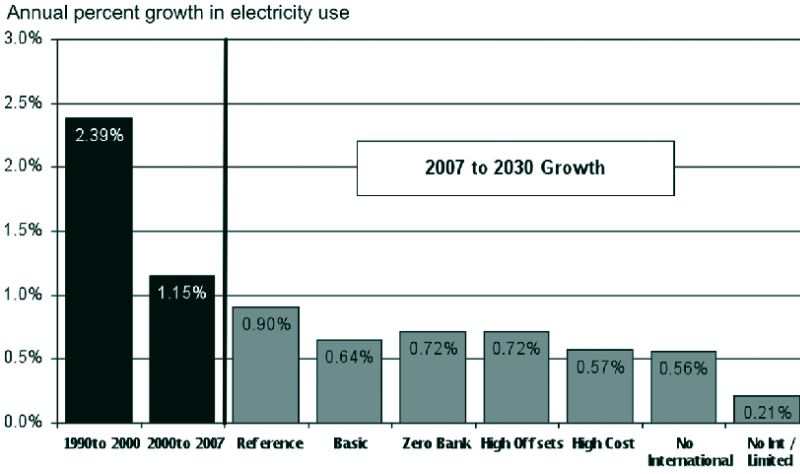

Figure 18. Projected Growth in Electricity Use

We have assumed that the free offsets to carbon-emitting facilities will be phased out after 2025 (Figure 19). When you put in any type of legislation like this that is going to cost money, we are going to see a change in GDP and a change in consumption. On the left of Figure 19 you can see the cumulative change in real GDP, and that is from actually less energy use, and the cumulative change in real consumption. So there is a more significant

drop obviously in the most limited case. If you look on the right of Figure 19, we show the absolute numbers. Now the economy is huge, so if you are looking at the absolute numbers, it looks like there are small differences.

If you are looking at the cumulative change, the numbers look a lot larger. So you can portray numbers however you want and it can either look like a huge change or a small change. EIA tries to remain neutral and present things both ways. With regard to carbon legislation, our focus is mainly on the cost because we cannot model the intangible benefits of emissions reductions. Those can be inferred. So this is basically the impact of provisions of the legislation that is up on the Hill right now.

Of course, many other options could be proposed. EIA will most likely be called on to analyze anything that comes out, and the analysis will be published on our website. In case you are looking for more information, we have a short-term energy outlook that comes out every month, an annual energy outlook yearly, an international energy outlook yearly, the latter two of which I have

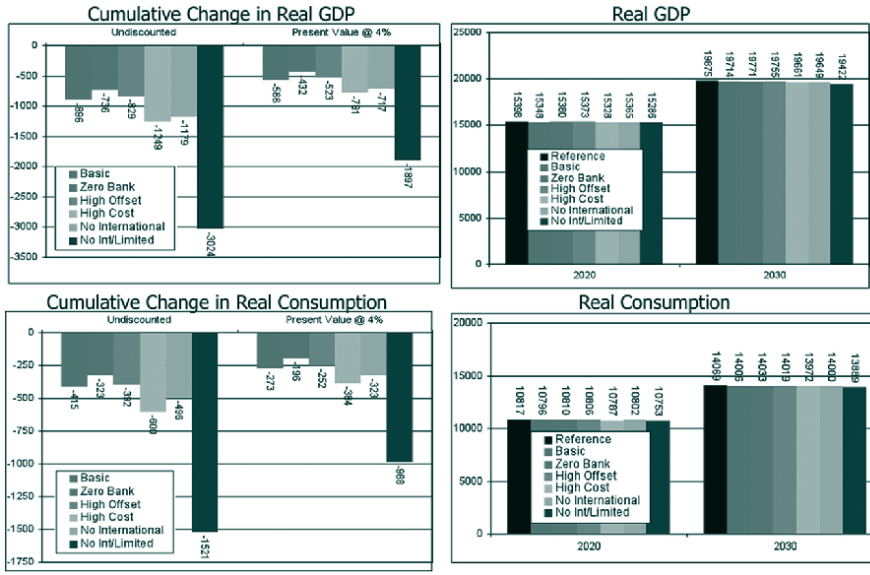

Figure 19. Projected GDP and Consumption Losses

touched upon, and a monthly energy review. With that, I will open it up for any questions.

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Q&A SESSION WITH MS. PHYLLIS MARTIN

Q: *One of the questions as you're predicting future energies, your natural gases, first question is does that include methane hydrates and if it does not, is there any look at international efforts going on with Japan, their exploration, as they're starting to consider that in their economy? Shell, Chevron, Texaco, BP, and Amoco are also doing heavy exploration.*

Ms. Phyllis Martin: At the present, methane hydrates are not included in our forecast. The technology is not there right now to bring them on economically. As far as looking at other countries, yes, we have a whole international team that focuses on the different regions of the world and they are looking into that. We are also looking into methane hydrates; it is just that right now it is not incorporated in our forecast. Our forecast does not go out far enough, really.

Q: How sensitive are your estimated GDP losses and costs in general to assumptions about technological change and do you have a sense for how those costs would compare to the benefits of the policy changes?

Ms. Phyllis Martin: We cannot look at the intangible benefits, as I mentioned. Those can be inferred by the fact that we are reducing greenhouse gas emissions, for example. As far as technological development, our estimates are very sensitive to that because if we have stronger technological development, that is what has allowed us to do things such as bring the shale gas on. For a long time, shale gas was not economical. Advances in hydraulic fracturing now allow us to get the gas out of the ground economically. So technology makes a big difference. As for the transportation sector, if we had the technology there, for instance, for electrification of vehicles, that could make a huge difference and the transportation sector could be a larger contributor to reducing emissions. But we do not have the technology there now; we do not have the infrastructure to change from a petroleum-, or a liquids-based, economy for transportation. So, yes we do look at different technological scenarios and if you look at our full report coming out shortly, there will be high and low technology cases for oil and gas development and for a number of things in a number of areas. That is what you should look at to see the incremental impacts, and then you could shift that over to the incremental impacts in the legislation.

Q: First, I want to ask a question for clarification. I assume you use the same modeling techniques in the global analysis? You look to the effects of the economic downturn and things like that?

Ms. Phyllis Martin: Yes, we do and, in fact, what we see is that the initial growth slowed and then picked up and then picked up again. So the economic crisis did have strong repercussions worldwide and that is represented in the international forecast.

Q: Do you also look at the implications of these forecasts against the IPCC scenarios? The IPCC based their temperature projections on the specific scenarios that include a certain level of emissions, and it seems that there are differences between what they expected and your forecast, which has implications for temperature.

Ms. Phyllis Martin: We do look at alternate scenarios in all of the forecasts. There are many more alternate scenarios that we look at for the domestic than for the international. When we are doing the international forecast, we look at maybe six or seven, and in the domestic we have probably forty to fifty alternate scenarios.

Q: *I am going to ask a question that I think is a little bit beyond the scope of what you are doing, but I am trying to understand how it would be addressed. You are reflecting the loss in GDP because of the change in the allowable energy uses, but what you are not accounting for is the cost not incurred from things such as sea-level rise. And I am just wondering where does this all get brought together to determine the net economic impact of a mitigation strategy?*

Ms. Phyllis Martin: Well, you are looking at things that we cannot quantitatively include in the forecast. And one thing I want to make clear about the GDP, it is not a loss of GDP or a reduction in GDP; it is a difference in GDP relative to our reference case. GDP still grows and consumption still grows in all of these cases. So it is relative to the reference case and it is the relative impact of putting in some of these forecasts.

Q: *We have seen models of likely sea-level rise and large uncertainty, but associated with that would be loss of developed territory in the United States. Is that not a quantifiable cost?*

Ms. Phyllis Martin: That definitely is a cost, but it is not a cost that we would be identifying in the forecast. You are getting into details that would require too detailed a model to take all of that into account. Now that is the type of thing if we wanted to somehow try to quantify that we could develop a scenario that would take that into account. That would just be basically a different assumption and we would associate some type of a cost with it. So it is something that could be done, but it is something that we have not done.