January 2007

PEAK OIL PRODUCTION -- (House of Representatives - January 17, 2007)

The SPEAKER pro tempore (Mr. Hall of New York). The gentleman from Maryland (Mr. Bartlett) is recognized for 60 minutes.

Mr. BARTLETT of Maryland. Mr. Speaker, tomorrow we vote here in the House on an energy bill. And I thought it might be appropriate to spend a bit of time this evening looking at where we and the world are relative to energy. I have here a chart with some numbers on it that inspired 30 of our prominent Americans, Jim Woolsey, Boyden Gray, McFarland and 27 others, among them retired four star admirals and generals, to write to the President a letter which said, ``Mr. President, we have only 2 percent of the world's oil reserves. We consume 25 percent of the world's oil, almost two-thirds of which we import. And that presents a totally unacceptable national security risk. We really have to do something about that to free ourselves from the necessity of buying foreign oil."

The President recognizes that this is a problem. In his recent State of the Union message he said that we are hooked on oil.

There are a couple of other interesting numbers here. We represent actually a bit less than 5 percent of the world's population. We represent about one person in 22 in the world. And with only 2 percent of the world's oil reserves, we are pumping 8 percent of the world's oil. What that means, of course, is that we are pumping our oil four times faster than the rest of the world. We have been pumping less oil each year now for several years, and with this high pumping rate that decline will accelerate.

How did we get here? To find how we got here, you have really got to go back about 6 decades. I didn't know last year on the 14th day of March, when I gave the first speech here on the floor about peak oil, that I was just 6 days beyond the 50th anniversary of what I think will come to be seen as the most important speech given in the last century. This was a speech given by M. King Hubbert, a Shell Oil company geologist, to a group of oil people in San Antonio, Texas. At that time, if you look back in your history books, you will see that we were the largest producer of oil in the world. We were the largest consumer of oil in the world, and we were the largest exporter of oil in the world.

And M. King Hubbert shocked his audience by telling them that in just about a decade and a half, roughly 1970, the United States would peak in oil production. And no matter what we did after that, our production of oil would decline.

I have here a curve which shows his prediction. His prediction is the small green symbols here, and the actual data points are the larger green symbols. And you see they reasonably followed his predicted curve. By 1980, when Ronald Reagan took office, we were already well down the other side of Hubbert's peak, and we knew very well that M. King Hubbert had been right about the United States.

Now, in 1969, M. King Hubbert predicted that the world would follow the United States in peaking in oil production about now. If he was right about the United States, why shouldn't he be right about the world?

It has now been 27 years since we knew, in 1980. We are already 10 years down the other side of what is called Hubbert's peak. And we knew that he [Page: H656]was right about the United States and he had predicted that the world would be peaking about now.

If he was right about the United States, why shouldn't he be right about the world? And shouldn't we have been doing something about anticipating this world peaking oil production?

The red symbols there, by the way, are a similar curve for the former Soviet Union, now today, Russia. And you see that when they fell apart they did not meet their expectation, so they are now having a second little peak, but they will follow the general downward trend.

How was M. King Hubbert able to predict this? We had already been producing oil for quite a while in 1956, and M. King Hubbert had watched the exploitation and exhaustion of some individual oil fields, and he found that they always followed what we call a bell curve. Small production at first, and then increasing and finally reaching a maximum, and then falling off the other side.

This bell curve is very familiar. If you weigh people, some will be very light and some will be very heavy, but most of them are somewhere in the middle and they follow a bell curve. If you measure the heights of people, they will follow a similar curve, or the number of mice in a mouse's litter. There are just a great many things that follow this kind of a curve.

So he noted two things, one, that most of the fields tended to be exploited and exhausted in a bell curve, and when they had reached a maximum, for the average field, half of the oil had been pumped. And so he rationalized that if he knew how many fields the United States had, and how many more we would discover, if he added up all the little bell curves he would have one big bell curve which would indicate when the United States would peak in oil production.

He did that. His math may be difficult to follow, but his reasoning is pretty simple. He did that, and he predicted it would be 1970. And right on schedule, we peaked in 1970.

I have been joined on the floor by my good friend, also from Maryland, Wayne Gilchrest. And before I yield to him, I would just like to introduce what he is going to talk about by quoting here from the International Energy Agency. This is a recent press release. And what they say here, ``The energy future we are facing today, based on projections of current trends, is dirty, insecure and expensive. But it also shows how new government policies can create an alternative energy future which is clean, clever and competitive."

They go on to say that ``energy demand increases by 53 percent between now and 2030.'' Well, it may. The demand may increase by 53 percent, but the use will not increase by 53 percent because, as you will see when we develop the subject this evening, the oil almost certainly will not be there to meet this demand.

Over 70 percent of this increase comes from developing countries led by China and India. World oil demand reaches 116 million barrels per day in 2030, up from 84 million barrels today in 2005 and 2006 and 2007. That number really hasn't changed. We have been on a plateau for the last 3 years of about 84, 85 million barrels of oil per day.

By the way, we use about 21 million barrels a day, about exactly one-fourth of that. Most of the increase in oil supply is met by a small number of major OPEC producers. Non-OPEC conventional crude oil output peaks, they say, by the middle of the next decade. Most observers believe that that has now peaked and, as a matter of fact, the world is about to peak. These trends would accentuate consuming nations' vulnerabilities to a severe supply disruption and resulting price shocks. They would also amplify the magnitude of global climate change.

Mr. Gilchrest, I am pleased to yield to you. They introduce the subject that I know you are very much concerned about, and that is what our increased use of fossil fuels is doing to our climate and how it is affecting global climate change and global warming.

Mr. GILCHREST. I have sort of a summary, I guess you could say, a Global Warming 101 Introductory, which will take about 10 minutes, so I am not sure how you want to proceed. Do you want me to just give this sort of a 10-minute introduction to global warming, or break it up with your dialogue?

Mr. BARTLETT of Maryland. I think that would be very instructive for our audience. Please do.

Mr. GILCHREST. Congressman Bartlett is talking about peak oil, the idea that our energy from oil is a finite resource, it is limited. And what I would like to do, in conjunction with that, is to give a perspective on one of the legacies of the age of oil, and that is global warming, heating the planet, upsetting that delicate balance between what the Earth has been used to for thousands of years, and the natural range of fluctuation in the climate, to what we have done in less than 100 years as a result of burning fossil fuel, oil in particular.

So here is how I would like to proceed. Number one, the Earth has a livable climate. The biosphere, which is the area of the planet that contains life forms that we have become familiar with is possible because of something called the greenhouse effect.

Now, in our atmosphere, we have oxygen, water vapor, methane, carbon dioxide, a number of different chemical mixes which provide us with the air we breathe and the type of atmosphere that produces, in part, the climate that we have, hence the greenhouse effect. It is warm enough and cool enough for life, as we know it, to exist.

Now, one of the most important greenhouse gases, other than water vapor, other than oxygen, other than methane--all of these contribute to the greenhouse effect--is carbon dioxide, or CO

2.

Now, even though carbon dioxide is less than 1 percent of the makeup of our atmosphere, it is critical in the heat balance of our planet. Now, that sort of gives us an idea of the importance of these greenhouse gases and the importance of carbon dioxide.

Now, is the Earth warming? There is no question, everybody would say yes, the Earth is warming, and it has been warming for the last 10,000 years. It has been warming for the last 10,000 years because that was the end of the Ice Age 10,000 years ago, and sea level has been rising, and the planet has been warming all of that time. [Time: 21:00]

It is warming, in part, because there is an increase in carbon dioxide in the atmosphere. Ten thousand years ago, and you can evaluate this by looking at ice cores and checking the bubbles out, and see what the content in our atmosphere of CO

2 was by looking at those bubbles in ice cores from Greenland or the Antarctic, and CO

2 was about 180 parts per million in the atmosphere 10,000 years ago. CO

2, a greenhouse effect, or a greenhouse gas, was at 180 parts per million 10,000 years ago.

If we move forward almost 10,000 years to the year 1890, in 1890, CO

2 in the atmosphere was 280 parts per million. It took just about 10,000 years for CO

2, a greenhouse gas, which helps the balance of Earth's climate, it took almost 10,000 years for it to increase almost 100 parts per million.

Now, let us look at the year 2000. In the year 2000, CO

2 was 380 parts per million. In effect, the natural causes before the Industrial Age were really in full swing. The natural causes gradually warmed the planet over 10,000 years very slowly.

What we have seen in the last 100 years, actually, about the last 50 years, is a dramatic increase in the amount of carbon dioxide in the atmosphere, something like we have not seen for hundreds of thousands of years and perhaps millions of years. So CO_2 in the atmosphere right now is 380 parts per million. We haven't seen that much CO_2 in the atmosphere for 800,000 years. Now, as a result of this, we are going to see some changes in our climate.

Let me make this last comment, though, about CO_2 in the atmosphere, about the heat balance, about how the greenhouse gases intermix with the atmosphere. Human activity, burning fossil fuel, has put into the atmosphere in a little more than 50 years what the natural processes took out of the atmosphere, and it took more than millions of years to effect. In less than 100 years we have changed the atmosphere more than the natural processes of the Earth have changed the atmosphere in millions of years.

Now, what are the ramifications of this? Well, warmer seas and warmer temperatures. If we want to associate [Page: H657]that with hurricanes, we have more frequent, stronger hurricanes as a result of that. Warm seas are fuels for hurricanes.

What is that doing to our economy? What is that doing to our coastal communities? What are some of the other implications?

Well, one other significant implication is sea level rise. If you went to Ocean City 10,000 years ago, and we know Ocean City in Maryland was not there 10,000 years ago, if you went to Ocean City, where Ocean City was supposed to be 10,000 years ago, you would have 75 more miles to go before you got to the ocean; 10,000 years ago you would walk from Alaska to Russia, easily, there was a land bridge, a wide land bridge.

Today we know that you can't. That is because sea level has been rising, and it has been rising because of the natural consequence of global warming, but now there is a significant change. For example, the temperature has increased, sea level temperatures have increased. In the last 20 years we have lost 40 percent of the volume of the Arctic ice. The Arctic ice cap, we have lost 40 percent of the volume of that.

Let us take a look at Greenland. In Greenland, it has 630,000 cubic miles of ice, Greenland, 630,000 cubic miles of ice. If that were all to melt, sea level around the globe would rise 23 feet.

Now, we know that Greenland's ice shelf is melting. Recently it was discovered that it is melting 10 times faster than anybody could have ever anticipated. A few years ago, it was losing about 80 cubic miles of ice a year, a few years ago. Today, just a matter of a few years later, it is losing now, and it is accelerating, 80 cubic miles of ice are melting every year.

When I say melting, it is not dripping. This is running off. In fact, the greatest contributor to fresh water to the world's oceans is not the Nile River, it is not the Amazon River, it is ice melting, pouring off the ice shelf of Greenland.

What is that going to do to our coastal communities, our coastal economies? What happened in Katrina, in Louisiana and Mississippi and Alabama? What is happening in a fairly more frequent occurrence to States like Florida or South Carolina, or even States like ours, the State of Maryland? What other changes might there be?

CO_2, carbon dioxide, is being absorbed at an increasing rate by the world's oceans. How will the oceans change as a result of this absorption of CO_2? It will become more acidic. The ocean chemistry will actually change in the ocean, and it will become more corrosive.

What is the problem with an acidic ocean that is more corrosive? Some of the best habitats in the world for the world's most abundant fisheries are coral reefs. Coral reefs cannot survive in an acidic ocean. A whole host of ocean creatures will be disrupted in their process to reproduce or in their process to exist at all. There will be warmer temperatures in the atmosphere, increased forest fires, increased infestation, increased invasive species, changing in agriculture practices, changing in weather patterns. There would be more significant rain storms, more significant snow storms.

Storm cycles would be difficult to predict, shifting in vegetation zones, habitat lost for a whole range of flora and fauna species and 40 percent of ice lost in the Arctic ice shelf right now, and accelerating, may be gone by this midcentury, a whole range, including polar bears or endangered species.

The coastal economy, the coastal economy in the United States is 50 percent of our GDP, 50 percent of our GDP. The likelihood of sea level rise as a result of all of this is going to be between 1, and more likely, at least 3 feet, that will clean out, wipe out, disturb, destroy most of the coastal cities in the United States on the Atlantic and gulf coast.

We are looking at New York City, Boston, Wilmington, Baltimore, Philadelphia, coastal areas from Maryland down to Florida, including Miami. Much of the peninsula of the State of Florida will be under water, not to mention, if you look at the State of Maryland, much of the peninsula, the Delmarva peninsula.

The natural range of fluctuation has been disrupted by the burning of fossil fuel, by oil, a limited resource, the end of the Oil Age and what are the consequences, the last 100 years of the Industrial Age, the age of fossil fuel, the natural range of fluctuation for CO_2, methane gas.

The temperature range in the last 10,000 years has been fairly close and predictable. Now, imagine a straight line, and what does a hockey stick look like? We have corresponded the increase in CO

2 with the increase in atmospheric temperature, the increase in land temperature, and the increase in sea level temperature. All of this corresponding to the increase in burning fossil fuel, and as a result, the increase of methane carbon dioxide.

I want to end with a quote from a gentleman called Norman Cousins, who had an illustrious career in journalism and in politics. Norman Cousins says, ``Knowledge is the solvent of danger." And the key to the successful understanding and opportunities for a brighter outcome with what Congressman Bartlett is talking about as ``peak oil," the end of the age of oil, and its consequences in global warming, the key to understanding and finding a solution is knowledge.

Mr. Bartlett, thank you very much for the time.

Mr. BARTLETT of Maryland. What the gentleman has been talking about is more than valid reason for pursuing the development of alternatives, if no other. Why would we want to increase CO

2 more? Why would we want to threaten more the quality of life in this world?

The Congressman and I have been to Antarctica twice; one of those trips we went together. Down in Antarctica, 90 percent of all the fresh water in the world is locked up in the ice there. It is nearly 2 miles high, and 70 percent of all the world's ice is locked up in Antarctica. Now that hasn't really started to melt yet, although it has threatened. I am told that calculations indicate that if the polarized caps in the Greenland ice shelf, if they were all to melt, the ocean levels would rise 200 feet.

Now, if you look around the world you will note that a big percent of the world's population lives within 200 feet of sea level. This would be a monstrous, monstrous change.

There are three very good reasons for pursuing alternatives, which is what the bill tomorrow is going to be talking about. One of those is certainly a climate change, because what we are doing now is releasing CO

2 that was bound up in these plants and organisms that grew aeons ago, and it took many, many years to tie up the CO

2. Now we are releasing it very quickly as we burn these fossil fuels.

A second reason, of course, is I just don't think that the oil is going to be there, which is what we are talking about tonight as ``peak oil."

The third really good reason for doing it is the reason the President advanced, and that is, it really is a big national security risk to be so dependent on foreign oil.

What I have here on this chart is another depiction of Hubbert's peak, and this is by the Cambridge Energy Research Associates, commonly referred to as CERA, and they are trying to indicate that one should not have confidence in the predictions of Hubbert because his curve didn't exactly actually follow his prediction.

Well, by golly, it is pretty close to actually following his prediction. Here is the U.S. actual production in red. You will see there is a little second peak here, and the next chart will show that is because of Prudhoe Bay. We found a lot of oil there, but that was not in M. King Hubbert's prediction. He hadn't imagined that we would be going to the North Slope of Alaska to drill.

So the little yellow ones here are his prediction. Notice that the actual Lower 48 has followed very closely, very closely, his prediction. We are now down to, even with Prudhoe Bay, we are now down to about half, about 5 million barrels a day. That is the red one over there, as compared to roughly 10 million barrels a day at our peak.

The next chart shows better where their oil comes from. Hubbert's prediction covered the Lower 48, and that is this gray area here. Now we need to add to that gas liquids. The big find in Alaska here, and that is what causes this little blip here in the downward slope. I remember a number of years ago, these fabulous discoveries of oil in the Gulf of Mexico, which is supposed [Page: H658]to solve our problem for the foreseeable future, that is the yellow there. Notice it hardly makes a shadow on the downward slope of Hubbert's peak.

The next chart is really a chart that we could spend a long while talking about because it has a great deal of information on it. The bars there represent the discoveries, and you notice that we were discovering oil way back in the 1930s, big discoveries in the 1940s, and then lots of discoveries which peaked about 1970, and since then it has been going down, down, down.

The solid black line here indicates the amount of oil that we have been using. Notice that for a long while we were accumulating big reserves of oil; everything about this solid black curve is reserves that we have in store that we can use later. [Time: 21:15]

But then in about 1980 there, you can see these two curves cross. I say two curves, because obviously you could draw a smooth curve through the peaks here, and these two curves crossed about 1980. Ever since 1980 we have been burning more oil than we found. Today we burn two or three barrels of oil for every barrel of oil that we find. So for this period, between 1980 to the present, we have been using up some of the reserves that we have back here, but still a lot of those reserves remain.

Now, what will the future look like? Well, there is a big difference of opinion in what the future will look like. The persons that put this chart together believe that by about 2010, about 3 years or so, the world will peak in oil consumption. Some believe that it has already peaked, others believe it may peak a little after 2010, and then it will go down.

Now, they have made some guesses as to how much oil we are going to find. I am not sure I would have drawn that curve exactly that high, because a smooth curve might bring you down about here. I think they have been very generous in the amount of oil that is yet to be discovered.

By the way, the world's experts on oil believe that we have, most of them, we have probably found about 95 percent of all the oil that we will ever find. You notice that when we find oil now, we find it in very difficult places to get to. The last big find was in the Gulf of Mexico, through 7,000 feet of water, and then about 30,000 feet of rock and dirt until you get down to the oil. We aren't now developing that field, and I am told, you can be told a lot of things that aren't true and I don't know the veracity of this, but I am told we will be developing that field when oil reaches $211 a barrel, because that is what it will cost to get the oil out of that field.

I just want to spend a moment looking at this before we go to the next one. If you draw a smooth curve through these bars, the area under that curve represents the total amount of oil that we have found, and the area under the consumption curve will represent the total amount of oil that we have consumed.

Now, it is very obvious that you can't consume oil that you haven't found, and you can make the future, within reason, look anyway you like. But what you can't do is pump oil that you haven't found. Unless you believe that we are going to find a whole lot more oil than indicated by their projection, then you have some choices as to what that downslope is going to look like.

You can be very aggressive and use enhanced recovery techniques, you can pump steam down there, you can pump CO

2 down there, you can flood it with sea water as the Saudis do to get their oil out. You get it more quickly. But if you get it more quickly, you have less to get later on.

So we have choices facing us as to what that downslope will look like. But, remember, you can't pump oil you haven't found, and the area under the consumption curve cannot be larger than the area under the discovery curve. They have to be the same area ultimately, the same volume.

Here is a prediction by our Energy Information Agency, and it is a very interesting one, and they use some unusual statistical approaches. But this is a curve through the discovery peaks. Let me put the other one up just quickly so you can see the similarities here.

Notice the big peak here in the late 1940s and 1950s and another peak here. They have kind of smoothed that out here. You can see this is the early peak here and then the later peak and then down, down, down.

We get to the point we are at now, and they make some very unusual predictions. The yellow line there, they say, is the 95 percent probability, and the green line is the 50 percent probability, and the blue line is the 5 percent probability. And they say that the 50 percent probability is the average, the mean, and, of course, probabilities and means don't mean the same thing, so therefore, that is what our production is more likely to be.

Surprisingly, this curve that has been going down for a number of years they thought was going to turn around and go up. But notice for the roughly 5 to 10 years after they drew this first curve, notice the red symbols there. They have been following what you would expect they would follow, and that is the 95 percent probability. Ninety-five percent probably is a whole lot more probable than 50 percent probable, and that is what it has been following.

Here is another chart from CERA, and it shows something very interesting. First, I want to look at the left here. This is the low, they say, is the 95 percent probability. Now, the 95 percent probability is the most probable, so it is not the low, it is the most likely.

Then they say the high probability is almost 4,000 gigabarrels. The mean is right in the middle. Most of the experts in the world believe that we have found about a little over 2,000 gigabarrels of oil. I use the term ``giga,'' because a billion in England is a million million, and in our country a billion is a thousand million. So everybody understands giga. A giga is a thousand million. We have consumed about half of that and about 1,000 gigabarrels, maybe a little bit more, but roughly a thousand gigabarrels remains.

Several Congresses ago I was privileged to share the Energy Subcommittee on Science, and I wanted to get some idea of the dimensions of the problem we face, so we had the world's experts come in for a hearing. And I was surprised at the unanimity. It was like from 970 to 1,040 gigabarrels of oil remaining in the world, not a big spread.

Now, what they are showing here is that if in fact we find as much more oil as all the oil that now remains discovered, if we find as much more as all the oil that remains discovered, we will still peak at 2016, 9 years from now, if we find as much more oil as all the oil that now exists, that we know exists in the world. If you don't find that, then we peaked about now and it is going to start down this way.

Another thing they have shown here is if you

aggressively develop these fields and pump life steam down there or put CO

2 down there or pump sea water down there, you can get it more quickly. But then look what happens. It falls off more quickly too.

Again, the area under this curve has to be the same thing as the area under this curve. You can't pump more because you are pumping it faster. Now, with enhanced oil discovery, you might get a little more, because you might get some oil that you wouldn't have gotten with conventional techniques.

Here is another more recent chart from the Oil Information Agency. They have been pooh-poohing the idea of peak oil. They said it was going to be an undulating plateau. I agree, it is going to be an undulating plateau. So they show here with what I think are wildly optimistic estimates of how much oil we are going to find, they believe that we are going to find twice as much more oil as all the oil we now know exists. That just isn't very probable.

But even if we find that much oil, they have a peak. Notice it. They say it is an undulating plateau. I agree. With the world's economies and demands and warmer temperatures, which is why oil is down a bit now, because we have warmer temperatures in our country, I agree it is going to be undulating plateau. They are pooh-poohing the idea of peak oil, and they show in this curve peak oil. They show it I think a good many years beyond when it will actually occur.

This little curve down here is closer what I think is reality. They have 1.92 trillion, and it is just a bit over 2 trillion, I think, so maybe it would extend [Page: H659]a little beyond this. But notice they are showing this peak about now, aren't they? So if we don't find this enormous amount of additional oil, it will be peaking about now. What they are saying is if we have only 2.93 trillion, we will be peaking at this point.

I have a quote here from one of the world's experts on oil, Dr. Laherrere, and this is what he says, and I think that it is kind of difficult to argue with his logic. Jean Laherrere made an assessment of the USGS report.

Now, it is the USGS report that provides the data that permits CERA to make their prognostications. He concludes that the USGS estimate implies a five-fold increase in discovery rate and reserve addition for which no evidence is presented. Such an improvement in performance is in fact utterly implausible, he says, given the great technological achievements of the industry over the past 20 years, the worldwide search and the deliberate effort to find the largest remaining prospects. Today we have 3-D modeling and seismic use, and so we know pretty much what the world's geology looks like.

I might take just a moment to talk a little bit about this geology, because it is very important in understanding how much more oil we are likely to find.

How did the gas and oil get there? Well, nobody was there when it got there, so we really don't know, but one of the best guess its is that a very long time ago the Earth was very much warmer than it is now. As a matter of fact, there were subtropical seas at the North Shore of Alaska. In the North Sea, there were subtropical seas. And every cycle the vegetation grew, and then when it matured or if there was a fall, and it may have been warm enough there was no true fall, but still there was a cycle of life, and it grew and sank to the bottom as algae does now in the ponds and so forth. And then waters washed erosive materials off the surrounding hills and it mixed with the organic material. This continued for an a large number of years until there was a lot of mixture of organic material and inorganic material there.

Then the tectonic plates of the world moved, and we know that happened, and it opened up and sank and went down to a depth where the temperature was appropriate, closer to the molten core of the Earth, and where the pressure was appropriate, and then cooked there under this pressure for who knows how long, and this organic material, mostly plants, maybe a few small animals, gradually became what we know as oil.

Now, the oil is made up of molecules of varying lengths. Some are very short and they are in fact gasses, if you let them escape from the oil. Some of them are very long, and that makes the waxes and so forth that we find in oil.

Now, if there happened to be a rock dome over top of this deposit way down there that is now being cooked and pressurized for a long while, if there is a rock dome over that, the gas that escapes will be trapped under that rock dome. So when you come along and drill a well through that, and you get down to the oil, the oil is going to be under pressure because of that gas above it. So you have what you call a gusher. The gas pressure above pushes the oil down and up the drill pipe and it continues to gush until that gas pressure has been relieved.

Now, this may not be the way that oil and gas were formed, but there isn't any better guess as to how it was formed. And if that is in fact the way it was formed, then we can make some guesses as to how much more oil and gas we are likely to find, because we have done a pretty good job of matching the geology of the Earth.

What you need to find is some of this organic material buried deeply for a long while with a rock dome over it so it captures the gas. By the way, if it doesn't capture that gas, you end up with something like the tar pits of California, and you end up with the tar sands, they call them oil sands, they are tar sands, thank you. They flow about as readily as the blacktop driveway out here, unless you heat them up, which is what they do, and combine them with some shorter chain molecules so that when they cool they will still flow.

The loss of these gasses has produced what we call our oil shales in the west. By the way, there are huge, huge deposits of these tar sands and oil shales.

As a matter of fact, the deposits of each of those represents way more than all the fossil fuels that we now know exist in the world, and the Canadians are making some heroic efforts because their big fields are up in Alberta, Canada, and they have a shovel up there that lifts 100 tons and they dump it into a truck that carries 400 tons and then they carry it and cook it. When it is cooked, why, the oil flows and then they mix it, as I said, with something with shorter molecules, a solvent, so when it cools it will flow and they move it out through pipes. With this heroic effort, they are getting about 1 million barrels a day. That sounds like a lot, 1 million barrels a day, but we use 21 million barrels a day. That is about 5 percent of what we use, and just a bit over 1 percent of what the world uses, because the world uses about 84-85 million barrels a day.

And what they are doing is not sustainable, because they are cooking this with natural gas that is what we call stranded. By ``stranded'' we mean there are not very many people there to use it, and natural gas is hard to transport unless you liquefy it and are near a port, so it is cheap. So I understand they may be using more energy from natural gas to produce the oil than they are getting out of the oil. But from a dollar and cents perspective, it makes sense, because the gas is really cheap and they are producing that oily understand for $12 to $25 a barrel, again, you get various estimates of this, and they are getting $50 to $60 barrel for it. So dollars and cents-wise, that makes good sense. [Time: 21:30]

From an energy profit ratio, it does not make any sense at all. Natural gas is a high quality feed stock for an enormous petrochemical industry.

One of the things that we use it for, by the way, is making nitrogen fertilizer, and without our ability to make nitrogen fertilizer, we could not begin to feed the world. It is not just the plant breeder, and he has done marvelous with developing new plants. It is all of the fossil fuel energy we use in agriculture, and a great deal of that is used in making nitrogen fertilizer from natural gas.

I have next a little schematic here, and this kind of smoothes out these curves. By the way, the world has been increasing its use of oil about 2 percent. That does not sound like much, does it, 2 percent? But 2 percent exponential growth doubles in about 35 years. It is four times bigger in 70 years, and it is eight times bigger in 140 years.

Albert Einstein was asked after the discovery of nuclear energy and the detonation of the nuclear bomb, Dr. Einstein, what will be the next great energy force in the world? And he said the most powerful force in the universe is the power of compound interest. Exponential growth.

I have a namesake, no relative. I wish I had some of his genes. He is really very brilliant. Dr. Albert Bartlett, professor emeritus at the University of Colorado, he gives the most interesting 1-hour lecture I have ever heard on the failure of our industrialized society to understand exponential growth. Just do a Google search for Albert Bartlett and energy, and it will come up and you will be fascinated with this 1-hour lecture.

Here we show this little schematic curve. It is a 1 percent growth rate. Remember, that doubles in 35-years. This point is twice as high as this point, and that represents 35 years. Notice that the shortage occurs before we reach the peak.

The shape of the bell curve and the exponential growth curve indicate that you are going to have shortfalls in supply, price is going to go up before you might reach the peak, and maybe, just maybe, we are in this time right here. A lot of the evidence indicates that is true.

The next chart is one that really gives you some pause when you look at it. Let us just look at the upper one because the bottom one is an expansion of the upper one, separating the gas from the oil here in the red curve. But this shows only what 400 years, a little less than 400 years of more than 5,000 years of recorded history. The use of energy in our world was so small back in 1750 that that brown there which is [Page: H660]wood is just about the baseline, is it not?

The industrial revolution started with wood. The hills of England were denuded to make charcoal to make steel. Catoctin Furnace, a little historic site up in Frederick County, they denuded the Catoctin Mountains where Camp David now is, thankfully the trees grew back, they denuded that making charcoal for that furnace.

The industrial revolution really took off when they discovered coal, and it was stuttering when they finally discovered gas and oil. Then look what happened.

The hockey stick, that is the hockey stick that Congressman Gilchrest was talking about, look what it did. It just goes straight up. Notice here what happened in 1970. There was a real oil price shock there, and the world used somewhat less oil. We are now very efficient in the way we use oil in this country. Air conditioners probably are twice as efficient at least as the ones you used in 1970. If it were not for our increased efficiency we would be in even more trouble with energy today.

But what I want to point out is that we are about 100, 150 years into the age of oil. That is this. If Hubbert was right, and he was exactly right about the United States, why should he not be right about the world, this is going to be a bell curve. By the way, you can make this thing look steeper or shallower depending upon the dimensions and the ordinates, the absinthe ordinate and abscissa. Here, of course, we have 400 years on the abscissa so it is very compressed so it makes the curve look higher, but that is exactly the same kind of curve we have here. We just spread out the abscissa here so that we spread it out. If you really push these two things, that is going to peak up high in the middle.

Out of 5,000 years of recorded history, the age of oil will represent about 200 to 300 years, remaining about 100, 150 years. What will our world look like post age of oil?

The next chart shows us something that is alarming a number of people, and this is a little drawing of the world. It has a number of symbols on it, and one of those symbols shows where China is securing rights to buy oil, and they are all over the world. This symbol here was Unocal. They almost bought Unocal, one of our oil companies. They are buying oil all over the world. They are scouring the world for oil.

I just came back from a trip to China, and we went there to talk about energy by the way. I was pleasantly surprised when they began their discussion of energy by saying post-oil. They get it. I wish we did. They talk about post-oil. They recognize that they are big polluters. As a matter of fact, I have a reference here that says by 2010, just 3 years from now, they will be a bigger CO

2 producer than we are, in just 3 years. Their economy is growing, the last 2 quarters, at more than 10 percent a year. That doubles in 7 years. It is four times bigger in 14 years. It is eight times bigger in 21 years, 1.3 billion people. I saw essentially no bicycles on the street and traffic jams like we have at rush hour here in Washington.

Well, the fact that they are scouring the world for oil indicates their understanding that this is going to be a resource in short supply for the future. We can spend a long time talking about China and what they are doing. They are aggressively building a blue water navy.

A blue water navy is different than the brown water navy, brown from the silt that comes out the rivers near shore, little navies that protect you from somebody coming from afar. They are rapidly developing a blue water navy. Last year, for instance, we launched one submarine. They launched 14. Now, their submarines are not ours but 14 submarines is 14 submarines.

I have here a very interesting statement from our Secretary of State Condoleeza Rice: ``We do have to do something about the energy problem.'' I am thankful you recognize that. ``I can tell you that nothing has really taken me aback more as Secretary of State than the way the politics of energy is I will use the word `warping' diplomacy around the world. We have simply got to do something now about the warping now of diplomatic efforts by the all-out rush for energy supply.''

It would be nice if everybody in the administration understood that and we were doing something meaningful about it.

So what do we do? Well, I think that any rational person would understand that you need to get busy developing some alternatives if you are going to run out of these fossil fuels. By the way, these fossil fuel are just incredible. The energy in these fossil fuels is just unreal.

I have an article, really not an article. It was a

speech given by Hyman Rickover in 1957, 50 years ago this year, and I want to read something that he says here which is really interesting. He understood 50 years ago, ``With high energy consumption goes a high standard of living. Thus the enormous fossil fuel energy which we in this country control feeds machines which make each of us master of an army of mechanical slaves. Man's muscle power is rated at 35 watts continuously,'' little more than you are working, but you have got to sleep, ``or one-twentieth horsepower. Machines therefore furnish every American industrial worker with energy equivalent to that of 244 men, while at least 2,000 men push his automobile along the road, and his family is supplied with 33 faithful household helpers. Each locomotive engineer controls energy equivalent to that of 100,000 men; each jet pilot of 700,000 men. Truly, the humblest American enjoys the services of more slaves than were once owned by the richest nobles, and lives better than most ancient kings. In retrospect, and despite wars, revolutions, and disasters, the hundred years just gone by may well seem like a Golden Age."

And it has gotten even more golden in these last 50 years, has it not?

Hyman Rickover understood very well our dependence on fossil fuels. One barrel of oil controls the energy of 12 men working all year for you. If you figure out what that costs, it is less than $10 to purchase the equivalent work of a person all year long.

Now, if you have some trouble getting your minds around that, imagine how far that gallon of gasoline or diesel fuel carries your car. And by the way, it is considerably cheaper, a little over $2 a gallon, than water in the grocery store.

Now, how long would it take you to pull your SUV or your car or push it as far as that little gallon of gasoline or diesel fuel take it? I own a Prius. We get under normal road driving conditions 51 miles a gallon. It would take me a long time to pull my Prius 51 miles.

Another indication of the incredible energy benefit from fossil fuels, if you work really hard all day long, I will get more work out of an electric motor for less than 25 cents worth of electricity. It may be humbling to recognize in terms of fossil fuel that we are worth less than 25 cents a day, but that is the reality, and that is why we live so well.

As Hyman Rickover understood 50 years ago, if that was true what he said 50 years ago, it is true in spades today, is it not, because we have even more helpers to make our life quality higher as a result of our use of energy.

Well, what do we do if we are going to run short of fossil fuels? Obviously, we have no surplus oil to invest in the development of renewables. If we did, oil would not be $50, $60 a barrel, but we can free up some oil and buy some time with a very aggressive conservation program.

Matt Simmons, who has written a really good book on Saudi Arabia called ``Twilight in the Desert,'' and he makes the case that Saudi Arabia has probably peaked in oil production. They will not tell you that, but you notice they cannot make good on any promise to increase oil production so he may very well be right. Then after having freed up this energy and bought some time, we must use it very wisely. We would get a lot of benefits from that.

Life is just so easy in this country that we are bored. We are watching awful movies. We are doing drugs because we are bored. There is no exhilaration like facing a big challenge and besting that challenge. There is nothing that puts flavor in pie so much as work, and I can imagine Americans, when they understand the problem we face, going to bed at night saying, gee, today, I used less energy than I did yesterday and I lived just fine, and tomorrow I am going to do better. [Page: H661]

But we need leadership that is not here yet so that we will do that. By the way, big benefits. We could once again become a major exporter. We are the most creative, innovative society in the world. Properly challenged, we will figure ways to get this alternative energy. We could again be a major exporter. Today, we are a big, big importer, as you know, $800 billion trade deficit this year.

We are a role model whether we like it or not. When you use 25 percent of the world's energy, you are a role model. Not a very good one today. We profligately use energy, way more energy than the average person in the world. It really is possible to be much more efficient.

This is a fascinating chart, such a simple one, but what it shows is the heat that you get out of an incandescent bulb and the light you get out of it. Ninety percent of it is heat which is why I use an electric bulb for brooding little chickens. I am not so much interested in the light as I am the heat from it. Now fluorescents are much better, and I saw there was a Time magazine cover page that had a pile of coal there. I think it was on the cover page, and they have one of these screw-in fluorescent bulbs beside it. Five hundred pounds of coal, that is the amount of coal you save in the life of that one fluorescent bulb, that is here.

But notice what you get out of light omitting diodes. I have a little light omitting diode flashlight that I carry. I put two little batteries in it, and I have forgotten when I put them in. [Time: 21:45]

It just lasts so long. We have the same amount of light out of each one of these, but notice the enormous amount of heat you are getting out of the incandescent bulb and the tiny amount of heat that you are getting out of the light emitting diode.

There are lots of opportunities in our society to live well and comfortably using a lot less energy. I don't have the chart here, but the average Californian uses only about 65 percent as much electricity as the rest of America, and it would be hard to argue that Californians don't live well.

This next chart is a really interesting one, and what it shows here on the abscissa is the amount of energy that we are using per person and what it shows on the ordinate here is how good you feel about life. You couldn't feel any better than 100 percent, and notice where we are. We are the biggest users of energy in the whole world and we feel pretty good about it; but notice how many countries that use less energy than we feel even better than their quality of life. Let's go way back here to Colombia. They use a fifth as much energy as we; they feel almost as good about their quality of life as we feel.

If you drew a curve through this, you need some minimum energy to feel good about life, but once you go up that steep part of the curve, the minimum energy is pretty flat. We can move way back here on the curve and feel just as good as we do now about life. You don't have to use the amount of energy that we use to feel as good about life as we do.

The average European, the countries are scattered through there, but the average European uses half the energy we use and, by the way, pays more than twice as much per gallon of gasoline and they have been doing that for a very long time.

We are shortly going to run out of our 60 minutes this evening and we will need to come back to finish this, but obviously we have got some finite resources here that we can use. When we come back, we are going to talk about the resources available to us to meet the challenge of transitioning from fossil fuels to renewables. And, by the way, we will transition either on a time scale that we have chosen or on a time scale chosen by geology.

As we run down the other side of Hubbard's Peak and the world has less and less supply of fossil fuels, we will transition. It can be a bumpy ride, or it can be a really bumpy ride. But Americans are up to it. We need leadership and knowledge. And we will be back again to talk about the finite resources available to us and all those fascinating opportunities in renewables.

END

CLEAN ENERGY -- (House of Representatives - January 17, 2007)

The SPEAKER pro tempore. The gentleman from Washington (Mr. Inslee) is recognized for 60 minutes.

Mr. INSLEE. Mr. Speaker, we come here to the well tonight to continue this discussion about energy. I have enjoyed listening to my colleagues Mr. Bartlett and Mr. Gilchrest, who have been talking about the need for changes in our energy policy to effectuate an energy efficiency policy for this country, to use our innovative talents to come up with new technologies to deal with our energy challenges, and to really bring our energy policy from the 19st century into the 21st century. And the good news is tomorrow, Thursday of this week, in just the third week of the 110th Congress, this new Congress is going to start with a big step out of the 19th century, which has been represented by the last Congress, and into the 21st century, which is represented by this Congress, and I am pleased to report to the House tonight and to the country, tomorrow the Democratic majority with some help from some of our friends across the aisle will pass a bill which will cause a major shift in the energy policy of this country.

In the last Congress there was a clear direction of the energy policy of this country, and under the last management of the U.S. Congress the basic operative rule was to give billions of dollars of taxpayer money to the oil and gas industry, the most profitable industry in the history of the solar system, over $10 billion in tax breaks to the oil and gas industry. Tomorrow, that money will be returned to the citizens of the United States for the use in developing a truly 21st century energy plan.

Tomorrow, the Democratic majority held Congress or House of Representatives will pass a bill which will reel back in $14 billion of taxpayer money that was sent to the silk-lined pockets of the oil and gas industry, and that is a good thing for Republicans and Democrats and Independents and for our grandchildren for reasons we will talk about tonight. It is a good reason because when we reel that $14 billion in giveaways to the oil and gas industry that happened in the last Congress, what we will do tomorrow is take that $14 billion and create a fund of money belonging to the American people that will be used for the development of new technologies, creative new sources of energy, energy efficiencies, more efficient vehicles, more efficient appliances, and a way to beat global warming.

So we are going to convert the giveaways from the oil and gas industry that happened in the last Congress to an investment in the future of our country to have a new energy technology, technologically based future for the energy source of this country. We are going to do it for three reasons. And perhaps those three reasons are obvious, but I want to state them.

Tomorrow when we pass this bill, we will create a fund called the Strategic Renewable Energy Reserve. Not really much of an acronym; I didn't get to name it. But the Strategic Renewable Energy Reserve will be a fund with $14 billion that will be taken back from the oil and gas industry and be used for our inventors, our businessmen, our academicians, our people who are doing great work to develop new sources of energy, and we will do this for three reasons. I will go through them quickly.

Number one, we will use this fund to develop a domestic source of energy for this country. We will use this money to develop the new advanced biofuels, the second generation ethanol, the cellulosic ethanol, the advanced biodiesel systems so that we can start buying our fuel from Midwestern farmers rather than Middle Eastern sheiks. We know the trouble we are in in the Middle East due to our dependence on Middle Eastern oil, and we are going to break that oil addiction, not rhetorically, but in reality.

Second, we are going to use these funds to develop new clean energy sources that can stop global warming. We are going to have energy efficiency which can have efficient appliances rather than dirty appliances that waste energy. We are going to have energy efficient cars, plug-in hybrids, flex fuel vehicles that can use biofuels developed in the Midwest; energy created by wind turbine, solar energy and perhaps clean coal, wave power. You name it. [Page: H662]We have a thousand flowers that are going to bloom in energy if we use this money in a smart way to stop global warming.

And, third, we will use this money to create a new energy source of jobs in this country. It is about time to start building fuel efficient cars in this country, new technologies here. It is time to reel those jobs back in.

So I am very excited what will happen tomorrow. It is the first step in a long road of what we will talk about tonight, the new Apollo Energy Project. And we have a new Member of the U.S. House who has brought a new vision of energy, Mr. John Hall of New York. And I will yield to Mr. Hall.

Mr. HALL of New York. I thank the gentleman for yielding, and I am excited to be here at this time, at this point in history when our country will finally, beginning in this House of Representatives, begin to act on renewable energy and conservation in a meaningful way. And I also want to say that I hope Northeast farmers will also be able to contribute to the biofuels that will be developing.

I have a friend in New York State who is driving around in a stock diesel Jeep Liberty 4-by-4 that he is running on biodiesel made from wood waste at a renewable tree farm that makes furniture in New York, just north of my district in Representative Gillibrand's district, but it is minutes from where I live in Dover Plains, New York. There is no modification needed to the vehicle. The company that is making this fuel runs all their farm vehicles on it, they run their road vehicles on it. Every scrap of leaves and sawdust and little twigs and things that are parts of the tree that are too small to go into the furniture they make goes into making biodiesel fuel, and it is very successful.

The only thing that is lacking is the knowledge on the public's part that they can ask for it, and the law of supply and demand will work for renewables the same way it does for any other form of energy or any other commodity.

I called up my own local oil company in my hometown of Dover and asked if they had biodiesel to sell for me to burn in my home heating oil system, my furnace that heats our home, and they said yes. And I said, ``What is it?'' And they said, ``20 percent soybean derivative.'' And I said, ``Sign me up.'' And I asked the gentleman on the phone, ``How is it?'' And he said, ``I am the owner of the company and I burn it in our house, and it burns cleaner than regular home heating oil.''

So it is similar to the situation I ran into when I served in county government and we were dealing with markets constantly fluctuating in recyclables, for instance, where one month you might make money on recycling paper and the next month you might lose it. It depends on how many plants are built to recycle it and how many new communities start to do so in earnest.

If our country and our citizens know to ask for wind power, which we get in my home the first 1,500 kilowatt hours per month from a wind farm in Atlantic City. And that is only one of many wind installations that are being put up around the northeast. There is a big wind farm in the Tug Hill Plateau in the Adirondacks that is going to figure majorly in New York's energy supply, and in the Finger Lakes region also. Farmers are finding out that they can lease space on their property for wind turbines, make royalties on it or lease payments from the utilities on it that will pay their property taxes and enable them to stay in farming. The cows don't care. They graze under the wind turbines, and meanwhile they are turning overhead and cranking out the energy.

The Jersey Atlantic Wind Farm in Atlantic City that my wife and I are buying power from will be amortized in 5 years. It consists of five 380-foot-tall wind turbines. Each turbine is a greater surface area than a football field and taller than the Statue of Liberty and generates 7 1/2 million watts of power when it is running at peak operation.

So if it is free in 5 years, the investment is paid off. After that, you have free energy, you have no pollution, zero emissions, and as you were saying it helps our balance of trade deficit, it cuts back on the money that we are sending to the Middle East oil potentates that are funding the madrasas that are training people that we then have to send our military to go fight. It cuts back on oil spills. It cuts back on asthma and emphysema in the inner cities, the particulate emissions. So it is a win-win-win situation with jobs being created here, with the dollars that we are spending on energy being kept here.

And I would just like to say once again that I am proud to be a part of this action of repealing and closing loopholes. It is not a raise of taxes as our colleagues on the other side of the aisle were saying before, but it is actually closing tax loopholes, subsidies, and giveaways that they created in the last Congress and transferring those funds to these renewable energies.

Mr. INSLEE. If the gentleman will yield. Very much so, it is claiming what should be rightfully ours. We essentially gave away oil that belongs to the citizens of the United States, and gave it away with no royalties. It was a giant, giant giveaway program. And subsidies in certain circumstances are appropriate for nascent growing industries, but this is a mature industry. There was no reason to give a company that made $20 billion profit last year more of our taxpayers. You are paying twice when that happens. You are paying at the pump, and then you are paying on April 15 when you are paying taxes that are given to these oil and gas companies.

I want to just touch on your wind sample. Today I had the Director of the Bonneville Power Administration that runs the electrical grid in the Northwest today, and he was telling me that wind power today is cheaper, cheaper than essentially any other system that we have to generate electricity, at least in the Pacific Northwest, cheaper than coal even. [Time: 22:00]

For those that say wind cannot be an integral part of the system, a study came down from a Minnesota group last week which evaluated how one can integrate wind because the wind does not always blow. It is not a totally reliable system, so you have to integrate it into your system.

They concluded it is so cheap you can integrate it by having backup gas turbines sometimes to kick in if the wind doesn't blow with minimal to no increases in prices.

This revolution that is happening in energy that we will start tomorrow, sort of the Concord Bridge moment for the energy revolution here, is all over the country. You mentioned in your neck of the woods, it is not just the Midwest, in Washington State we are going to have the biggest biodiesel plant in the Western hemisphere. It is going to be up and running next year.

Minnesota has huge growth in wind power. Wisconsin has a company that is building wind turbines so fast they cannot fulfill the orders. Missouri has just started three huge wind farms. This is something all over the country.

When I talk to businesses, what I find is there is not a State in the country that does not have some business that is going to benefit from what we will start tomorrow, which is new energy revolution. California in Silicon Valley is developing these new solar cells that could be 30-40 percent less expensive. A company called Fiber Forge in Colorado is starting to make composite bodies for cars that could be 40 percent stronger and half the weight. This is a national effort. All of us will get to brag about it some day.

I would like to yield to the gentleman from Florida (Mr. Klein), a new Member of Congress. Thanks for joining us.

Mr. KLEIN of Florida. Thank you, Mr. Speaker. It is a pleasure to be here with Mr. Hall, my good freshman friend from New York, and my good friend from the State of Washington. I know you have been leading the fight for a number of years and trying to get our focus, not only in your State, but throughout the country on the idea of renewable energy sources.

Many of us in the freshman class came to this year's campaign and this Congress with a view that this is an opportunity of historic proportion. This is an opportunity for us to recognize that this is a once-in-a-generation calling, no different than our predecessors had with the Manhattan Project. I know that many seniors in my district in south Florida have talked about that, the calling of their generation to make sure that World War II would end [Page: H663]with an atomic weapon. Of course we all know that when Sputnik went up in the early 1960s, a little before my time, but at a time when this country saw this little tin can up in space and thought this could be a threat of possibly bombs coming from outer space into our country, and John F. Kennedy saw this as a time and place for us to engage our private sector, our universities, our public, to create a new generation of scientists and mathematicians who would put a man on the Moon by the end of the 1960s. By 1969, they did that. And now the science and technology that came out of the space program has broad applications to our daily lives.

I view this, as do many Democrats and Republicans, as a time in our country's history when we need to make ourselves energy independent. I believe it. There is nobody in this room or in this country who doesn't believe that Americans, when they put their nose to the grindstone, can't accomplish anything. We can. We can and we will.

This has the unbelievable capacity of recognizing three great elements in this day. One is national security. We should never, ever have to make another foreign policy decision based on where the next drop of oil is coming from. That is a strategic mistake of unbelievable proportions. To have to import 60 percent of our oil from unstable countries around the world that in many cases are taking some of the dollars that we send over, the millions and billions of dollars, and financing both sides of the war on terror is wrong.

Recognizing that is something we need to do for our own national security, inside the United States, is crucial.

Secondly, we all understand the environmental impacts. I know my colleagues that are speaking tonight have led the fight on this, and many others. And recognizing whether it is global warming or any of the other environmental impacts of some of the technologies that are used today with oil and other things, these are issues that we need to take up.

I live in Florida. We have had a battle in Congress, and I was not in Congress last year, but many of us fought the fight back home: We don't want drilling off the coast of Florida, or in Alaska in the refuge. Those are false choices made by the administration.

The right choice is we don't have to have more oil drilling. Oil drilling will be a part of our energy solution, but we don't need drilling in places which will have a potential of having a tremendous long-term environmental impact. Off the coast of Florida, we have a very large tourist industry. We have wonderful reefs. We have a beautiful environment in our oceans and bays and the Gulf Coast. We can't afford to do that. It is not good for anybody in this country. There are choices that allow us to have alternative energy.

And of course the last thing is the new economy. Many have talked about the fact that in this economy today we have lost jobs overseas. We don't have steel manufacturing like we used to. We don't produce a lot of the products. The science of alternative energy sources and the commercialization of that technology and those products can once again be our big technology boom like we had in the 1990s in this decade, and for decades to come. It will make us energy independent, and it will be exportable science to the rest of the world.

Mr. INSLEE. I was talking to a businessman the other day who wants to develop the Chinese market to sell China thin solar film technology to become the distributor in China of a technology developed in America. Talk about a great thing for our balance of payments.

You talked about the original Apollo project. We have named our bill, the first step we will talk about tomorrow, the New Apollo Energy Project because we believe, as John F. Kennedy did, that we have unlimited innovative capacity. But what we don't have at the moment are policies to put that innovative genius to work.

For instance, we are spending less than 16 percent on energy research in total in this country. We are only spending 16 percent of what we spent on the Apollo project. That is just abysmal. We had at least as much of a challenge as trying to get to the Moon.

I had a utility executive in my office today. He told me this factoid: We spend more on research about dog food than the utility industry does on new energy in this country. I don't want to belittle dog food, it is important, but we need to boost our research. Tomorrow we will put $14 billion back into the pockets of Americans to use in part for research, the tremendous things that are going on. Every time I pick up the phone, I learn about a new technology being developed.

I yield to Mr. Hall.

Mr. HALL of New York. I am just looking at the uses

of the Strategic Energy Efficiency and Renewables Reserve, and I will get that out in one sentence, to accelerate the use of clean domestic renewable energy resources and alternative fuels, to promote the utilization of energy efficient products and practices and conservation, and to increase research development and deployment of clean, renewable energy and energy efficiencies and technologies.

The word ``conservation'' is in there, and it is one that has been sadly neglected. In fact, it was unfortunate a few years ago when our Vice President said conservation may be a personal virtue, but it is no way to build a national energy policy. I completely disagree. I think it is one of the most important ways to start building a national energy policy, and I was happy Mr. Bartlett earlier was talking about energy efficiency. It is time all of us on both sides of the aisle did that and put our money where those words are.

I see these pet peeves of mine as I go through every day life. For instance, walking down the aisle of the supermarket, in the Northeast, I can walk through Hanford's A&P or Stop & Shop, and there are aisle after aisle of cold cases with yogurt or beer or cheese that is being kept cold by a refrigerator and a compressor running all of the time, and an open top so it is convenient. I can just reach in. But there is no door or plastic sheet to keep the cold air in and the warm air out. Meanwhile, because we live in the northern part of the country, half of the year there is a furnace going to keep the shoppers warm and the furnace and the compressor are working at cross purposes. That is the kind of blindness we have gotten used to, that energy is something we can throw away.

Mr. INSLEE. There is so much good work going in to stop those things that you are talking about. To mention two instances of success on energy efficiency, I was talking to the Vice President of Dow Chemical yesterday. Dow Chemical historically has not been looked at as a company on the forefront on environmental issues, but they got a star last year for their energy efficiency program.

They have saved 42 percent of their energy since 1990. They have reduced their energy since 2000 by 22 percent by just adopting commonsense measures, some of which you might have talked about, by having energy efficient appliances and lighting, by looking at how they monitor the energy in their building. So a 42 percent reduction of their energy usage, and they did that because it is good business, not because it is some granola-crunching idea. They did it because it is good business. And we will create a fund tomorrow to help businesses and individuals go down that road.

Second accomplishment, California. California has essentially, while the average American uses 50 percent more electricity than they did 10 years ago, 50 percent, California has been stable for the last 10 years. They have not gone up one kilowatt hour. And the way they did that was to help people invest in energy efficient light bulbs, energy efficient windows and appliances. As a result, they use 8,000 kilowatt hours per person per year, and the average person uses 14,000 kilowatts.

Does that mean people in California are living in the stone age? They are still taking hot tubs in Marin County and still putting out movies in Hollywood. They are living a good life there, and their economy is booming. But they are doing some commonsense things with energy. That is what we are going to start tomorrow.

Mr. HALL of New York. I wanted to mention something that should be another part of our energy mix and that is low head hydroelectric power. There are dams and waterfalls throughout this country where in some instances they used to generate power and no [Page: H664]longer do. But our own Idaho National Laboratory from the Department of Energy did a study a couple of years ago that showed, and it is on their Website, it shows how much State By State latent hydroelectric power is waiting to be harvested.

In New York State, there are some 4,000 dams and waterfalls that could, just by having turbines placed where the water is already falling, yield greater than 1,200 megawatts of power, which is about 60 percent of the peak output of the Indian Point Nuclear Plant in my district.

It is that kind of using everything. We have to leave no stone unturned and to try every opportunity for clean, renewable domestic sources of power for national security purposes, as Mr. Klein mentioned, for environmental purposes, as we all know, and for global warming. Anybody in my part of the country knows that the weather is not normal this year. And, indeed, the records for last year showed that it is the warmest year on record and there has been a string of years getting warmer.

We had a seminar at one of our freshman orientation sessions on global warming that shows as the carbon dioxide levels in the atmosphere are rising, the temperature average is rising with it. It has risen out of what they call the background noise, where it is no longer something that can be written off to the normal ups and downs of climate. We are experiencing a change, a man-made change in our climate here on earth, and it is our duty to our children and grandchildren not to leave them that problem or to leave them mountains of debt because we refused to deal with this problem and keep borrowing money from one country so we can import oil from another country and lose our own sovereignty in the process.

Mr. KLEIN of Florida. One of the beauties of what we are talking about, and what Americans are talking about, is there is a lot of technology and a lot of science and businesses that are already out there doing these things. That is a very exciting thing. If you listen to the national picture that 60 percent of our oil is imported, and that is a major source. And we obviously have lots of other fossil fuels being burned at this point, but there is solar power.

I am from Florida, and we call ourselves the Sunshine State. And we constantly hear in Florida you can't use solar effectively because the panels are too big and they can't store the energy.

My personal feeling, and I think you believe this, if we put our mind and science to this, we could probably have a solar panel the size of this 8 1/2 by 11 piece of paper on every house that powers that house. Individual power plants, and it will happen. It is going to happen. There is wave power. There is wind power and corn-based ethanol and sugar-based ethanol like they use in Brazil.

Again, they may not be perfect in their present form. That is the point. Let's further them and use our innovation agenda that we are pushing in this Congress to get all of the economic incentives in place to encourage the businesses, to encourage our science and university academics as well as business leaders to come together. [Time: 22:15]

Mr. INSLEE. We had a meeting with Hank Paulson today, Secretary of the Treasury in the Bush administration, and he had made an interesting comment. I am very impressed with him, though I have been pretty critical of the Bush administration, because he has been a pretty outspoken advocate that we need to do something about global warning.

He said everything he has learned since taking the job as Secretary of the Treasury, he comes from a very successful Wall Street career, has been worse than he thought. The deficit, the situation in Iraq, everything he has learned has been worse than he thought, except energy, because he has learned about the new innovations going on around the country.

What we want to do is help businesses, like the Iogen Corporation, which is ready to build the first commercial cellulosic plant in America in Idaho. They are ready to go, as long as they can get their loan guaranty. They have 300 farmers that are going to give them their straw left over after wheat. They are going to chop it up, put an enzyme in it, and then free the carbohydrates and distill that into ethanol, and, boom, you have a product that is three to four times more productive per acre than the current type of ethanol we get from our farms.

Ocean Wave Technologies has the first permit for wave power in the United States off the coast of Oregon, a 50 megawatt plant. They are using a technology now that is in the water in Hawaii, generating technology with this buoy that is anchored below the water. It goes up and down and creates a force thoromatically that runs a generator. They are generating electricity today for the Navy. They are ready to make this a commercial operation. They need a little help to get started.

The Nanosolar Company, a company that was started, and the fellows who wrote the first two checks were the two guys who started Google. They have done pretty well for themselves, and they wrote a check to a couple of entrepreneurs in California, and now they are ready to do 450 megawatts of thin cell solar, where you use a solar panel that has one-fiftieth the width, using a selenium, iridium, gallium and caesium type of technology that they think can be 30 or 40 percent cheaper.

Another company trying something like this is called Miasole.

These are the companies that need help, not the big oil companies. And what we are doing tomorrow is shifting the subsidies that have been given away to the oil industry, an 18th century technology, and helping these new-generation technologies come on.

By the way, in this debate we are the optimists. We should identify who is on what side of this. We are the optimists who believe global warming can be dealt with. The pessimists say we can't.

Now, they are giving up. The debate about global warming is over. And I know it is over because yesterday the Exxon Corporation, which has fought tooth and nail the science on global warming, basically withdrew their support from the political organization that has tried to create doubt about global warming.

So when the Exxon Corporation agrees it is time to start getting serious about global warming, I think the debate is over. And now the question is, how can we join on a bipartisan basis to find solutions, and we are starting this tomorrow. I hope we draw some votes from some of our colleagues across the aisle.

I yield to Mr. Hall.

Mr. HALL of New York. Thank you, Mr. Inslee. I am pretty confident there will be votes from both sides of the aisle tomorrow. And it is interesting thinking about the history of ExxonMobil in terms of their corporate advertising, going back to the days of Herbert Schmertz and the op-ed in The New York Times, and how they have spent probably more money, and other oil companies as well have spent more money. Or I should say they have spent good money on advertising to try to stop people from changing the approach that they could have spent instead on research and development on these new forms of energy.

I wanted to mention one you had not mentioned yet, and that is tidal power. Wave power, of course, is obvious. My dad taught me to sail when I was a kid, and many is the time I have sailed by a buoy that had one of those wave-driven generators in it and keeping the light powered, and/or a solar panel on it keeping the light powered and a battery storing the energy.

But tidal power in my neck of the woods, in the Hudson River, which splits my district in half, is tidal all the way to Troy, all the way past Albany, and navigable all the way that far north. The current runs a couple knots and a half south on the ebb and about two knots north on the flood in New York Harbor. And in the East River and in Hellgate, what they call the juncture of the East River and the Harlem River, where it opens into Long Island Sound to the east, the tidal current there runs five to six knots, depending on the phase of the moon.

We have inlets, rivers, harbors, coastline all throughout this country where tide comes and goes, millions of tons, millions of tons of pressure of water moving in and out of these bodies of water twice a day every day. And that is, well, it is solar and lunar, because it is driven by, I guess primarily by the [Page: H665]moon, but nonetheless it is natural, free energy that can be harvested and should be explored. And, indeed, there have been experiments going on in the East River with tidal generators within the last year that I am looking forward to seeing the results of. But that is one more available source.

Mr. INSLEE. I want to comment that some people have argued this is sort of peripheral or tangential sources of energy, niche types of energy. I think it is important to realize the scale of energy that we have available domestically. It is enormous.

When you talk to the scientists about this, the wave power in a 10-mile-by-10-mile stretch of the California coastline, that is 100 square miles, if you can imagine 10-by-10, there is enough wave power using this existing technology to generate all of the electricity used in the State of California. That is not hypothetical. That is actual wave power that is available. That is not a niche technology.

In Montana, if we can a find way to burn coal cleanly, and I say if because we are a long ways from being able to do that, to segregate and store the carbon dioxide below ground, but there is enough coal in Montana, just Montana, if we can find a way to do that, to power the electricity needs of the entire Nation for decades.

Just to give people a sense of the scale of this, with solar energy, in a few hundred square miles, there is enough to light the entire Nation, if we get solar power down to a market-based price. It is more expensive than electricity right now from a coal plant or a gas-powered plant.

But what we are learning is that for all the technologies we have talked about today, solar, wind, wave, efficiencies, where some day plug-in hybrids, plug our cars in and run on clean electricity, every single one of those technologies has come down in price dramatically as the technologies have improved and as we have scales of economy.

Wind power has come down in price 80 percent in the

last decade. Solar is coming down. There is a factor basically every time, if I get this right, every time it goes up, and I am going to have to check to make sure. In fact, I will not use it because I can't remember what it was, but there is a ratio that has been clear with solar power that has come down. Every time you ramp up production by a factor of X, you get a Y percentage decrease in price, and that has been a constant.

What we have learned is that we know there are two curves. Fossil fuels are going up because China is coming on gangbusters and demand is going to go up. We might reach peak oil. We don't know. But we know fossil fuels are going up long term, and these are coming down, and we want to be on the downward sloping path.

So one of the things we want to do eventually, in our new Apollo project, is to have a renewable portfolio standard to say that a percentage of our electricity will be generated by clean energy sources by the year 2020. We just did this in Washington by popular vote.

I yield to Mr. Kline.

Mr. KLEIN of Florida. I thank the gentleman, and I think that is exactly the point. The point is, there is not necessarily one source of energy alternative that is going to be for everyone. We have a big country, with lots of existing resources that have been mentioned by the gentlemen on the floor this evening, and the choices and the competitive ways that we as a country can competitively grant resources to companies, to scientists to come together and say, listen, we think there is enough coal in this country to power the country for 300 years, but we have a high sulfur and carbon dioxide problem. Is there a solution? If there is a solution, that can be a wonderful thing. So there is coal in certain parts of the country and maybe that works there.

Wave power, wind power, all the things we are talking about, it is this competitive way of approaching this. Not one solution necessarily to fit all. There is still going to be oil out there to some extent, but the point of all this is, it is there. And the most exciting part about this is that there is a solution, and Americans need to engage this.

The Congress is way behind the American public, and the administration is even further behind. And the part where we, I think, are coming together tonight and tomorrow, as you and many others are going to be leading this fight for energy independence in the first step we are taking now, which will continue with additional steps, is, we want to ask the American public to come forward to their Members of Congress, to their business leaders, and to their Chambers of Commerce and start talking about the technologies that they have. What can we do to collaborate with each other to take some of these ideas and make them commercially viable? The more competition out there, the more resources in, the lower the price will be.

It is almost like the discussion we have had for so many years, public transportation versus road building. People have said, well, you have to subsidize public transportation. Well, absolutely you do. But guess what road building is? Who pays for the roads? It is your gas taxes in every State of the country and the Federal Government that pays for that. So it is a question of reordering our priorities.

In this case, it is the reordering of priorities from more oil drilling and giving those types of resources and support to putting that into places and with people that can create the new generation of energy alternatives, and it is very exciting.

Mr. INSLEE. I want to comment on two really exciting transportation alternatives. One is public transportation.

The city of Portland, Oregon, has demonstrated the ability of America to reduce our CO

2 emissions to deal with global warming. They are the first city in the Nation to reduce their carbon dioxide emissions to 1990 levels, which would be consistent with the Kyoto Treaty, which may be a treaty we do or do not eventually adopt, but they have been the first city in the Nation to reach these 1990 levels, to roll back their carbon dioxide emissions.

One of the principal ways they did it was they embraced an incredibly popular light rail system to move people. Rather than sitting on freeways for hours at a time, you go down to Portland on a convenient, much-loved system that has now been voted on five times successfully in Portland because people love this system. It is convenient, it is safe, it is cheap, and it saves us from global warming.

So if we have a transportation policy in this country that helps communities work in that regard, we will make some strides.

The second thing I want to bring up is a technology called plug-in hybrids, which I think could be maybe the ultimate vision for us in the next decade, and that is to develop our cars so we go home at night and we plug them in. You take power off the grid, electricity generated by clean wind, clean solar, clean wave, clean coal, or a variety of technologies. These are cars that today are running, that can run 20 or 30 miles just on electricity. And then when you run out of juice, you start running on your motor.

If we have a flex-fuel hybrid plug-in car, we are going to be in really great shape in this country, because we can plug it in and get clean electricity. We have the pipes to deliver it, which is the electricity grid. You plug it in at night, you run your first 20 or 30 miles, then you use ethanol that you bought from our local farmer in the Northeast, or in Iowa, or eastern Washington. And if you don't like that, you can burn gasoline as well.

General Motors just announced their first sort of proposed car, called the Volt. They ran it out at their show just 2 weeks ago in Detroit at the auto show. Now, we have to improve the batteries to really make them commercialized, but that is where our money should be going, to improving the batteries so we can have plug-in vehicles, rather than going to the oil and gas industry.

So tomorrow we are going to make a decision to take money we gave to the oil and gas industry and give it to these companies, to the extent we can, to help develop these new technologies for batteries and a whole host of other things. These are lithium iod batteries, and they are close to being commercialized. There are a few security issues they have to work with to make sure they are stable and workable, but that is a good shift for the country. [Page: H666]

Mr. KLEIN of Florida. If the gentleman will yield for a second, the next level of this, just like any start-up business in this country and the success of the capitalistic system that we have is, business entrepreneurs realize value. What we are talking about here is start-up capital for many of these businesses. We are not talking necessarily the United States taxpayer funding these things indefinitely.

The great part about this is that many of them are already in place. They just need a little additional push or a little additional resource, and then you will see venture capital and lots of business entrepreneurs, and probably even oil companies who will see a good opportunity, who will even invest. But whoever it is, we want to see the direction of this jump-started, and that is what the gentleman is talking about.

Mr. INSLEE. Sure. And we can do things essentially at no cost to the Federal Government. For instance, loan guarantees. If we guarantee a company that wants to start a plant, like this Iogen cellulosic ethanol plant, if we do a loan guarantee for them, there is a high level of confidence it is going to work, and it never costs us a dime, assuming that it works. But it helps them get the capital to give security for the investors to do that.

That is a good investment for the country, if we choose wisely. But these companies will tell you they have to cross the valley of death, to get from development, where they have their prototype, until they can really commercialize it. And that is where Uncle Sam can happen.

And we will get a lot more bang for our buck helping a battery company that will help us drive plug-in hybrids a few years from now than we will just giving it to a company that made $22 billion last year in the oil and gas markets. [Time: 22:30]

That is a better deal for America. Mr. Hall.

Mr. HALL of New York. Yes, if the gentleman would yield for another minute. I wanted to mention a couple of other ways we can help, that the government can help jump start these industries. One of them is indemnification of risk. We have unbeknownst to most Americans been the underwriters for the nuclear industry since its beginning via the Price-Anderson Act. In fact, there would never have been a nuclear plant, electrical generating plant built in this country if the taxpayer didn't underwrite the possible cost of a catastrophic accident.

Now, if we took that same approach where we were willing to subsidize or underwrite alternative fuels or low head hydro plants, many of which are being held up, by the way, because of liability issues, that would be one way that we could help.

Another way would be preferential purchasing, because the government, at all levels, buys a lot of vehicles. And if we put out a request for proposals saying that we want American companies to build vehicles that will either be plug-in hybrids or plug-in biodiesel hybrids, or just high efficiency vehicles that can be used in our fleets that the different departments of our government used, that would start the economy of scale working. The same way the wrist watches, digital wrist watches that used to cost $200 when they first came out came down to the point where they are $2 now, and computer chips that were bought in quantity by the Defense Department, or by the aerospace industry and NASA, drove down the cost to the point where now anybody can afford a laptop. It is that economy of scale that we can help get started.

And as you said, it is not going to be something that we will have to underwrite or subsidize forever. But when you look at the number of years that we have been subsidizing the old technologies that may be 19th or 20th century technology, we certainly now, in the 21st century can look at these renewables, domestic clean safe renewables and think about the same helping hand to get them off the ground.

Mr. INSLEE. And I think it is important to point out the tremendous payback to our economy of relatively small Federal investments. Look at the computer industry. It grew by leaps and bounds because of the Apollo project. There is more computing power now on a wrist watch than there was in the original Apollo space vehicle because we developed computer based software systems as part of the Apollo project.

Our medical device industry with these exotic materials largely came from the American space program, and these were relatively small investments.

By the way, we spend less today on research and energy than we do in a month in Iraq by a factor of about 10, just to put this in perspective. We are talking about for a family's budget a lot of money, but for the Federal budget fairly small amounts of money that can have absolutely tremendous payoffs.

I want to talk about one other thing that we think we need to help these companies too, though. If you want to start a company that will generate clean electricity with no carbon dioxide emissions today, you don't have a huge advantage because of a loophole in the law that a coal company has right now that is putting their carbon dioxide up the stack. That coal company that has what we call dirty coal, where you just burn it and you put your carbon dioxide, you dump it into the atmosphere, they have a huge loophole in the law because they can put as much CO

2 into the air as they want the tape. They can't put as much sulfur dioxide, they can't put as much nitrogen oxide, they can't put as much particulate matter, but they can put as much CO

2 into our atmosphere that you and I own jointly, with no charge. And the company that is going to make a clean industry, they don't get any benefit like that. We have to close that loophole. There has to be a way that there is some charge imposed on polluters who

use our atmosphere to dump their carbon dioxide. And that is a loophole that needs to be closed to help these innovators as well to level the playing field.

Now it is really interesting. We are getting some support for this idea from some unusual sources. Duke Energy, I think, the third or fourth largest electrical utility in the United States, they burn massive amounts of coal, I think 40 or 50 percent or more of their electricity is produced by coal. But they recognize the need to have what they call a cap and trade system that caps the amount of carbon dioxide going into the atmosphere. And in part they realize that, I think, because when you impose some cost on this pollution it inspires these new companies to be able to create new technologies that are clean. So we hope ultimately the U.S. Congress will adopt a measure that will level the playing field and not allow these dirty plants to continue to pollute our atmosphere for nothing. You know, when you and I go to the dump it costs us 25 bucks to dump our pickup load of junk at the dump. But a company that burns coal can put their carbon dioxide and just dump it into our atmosphere, gigatons for nothing. That needs to change

Mr. KLEIN of Florida. Well, exactly. And the incentive that is being used to encourage a company to make the investment in some type of scrubber or some type of way of reducing the amount of carbon dioxide should be just that. It should be an incentive to do that and make that capital investment in that technology, versus not having to pay for it. There is no economic incentive to change. Obviously there is a huge environmental impact for all of us who are breathing the air and the entire impact on the climate and the environment. But those companies that continue to burn coal don't have an incentive. So if we flip it around and say, all right, there is going to be a charge, in order for you to do this there is going to be an expense associated with it, whereas if you invest, if you are going to have to pay something in, if you are going to invest in something that is good, good for the environment, good for you. You get some type of benefit out of it then it is a good swap for the company, and it is a particularly, it is exactly what we need in terms of our encouraging private investment in technology that will clean our air.

Mr. INSLEE. And what we are finding is that more and more companies are actually accepting this idea, thinking it is a good idea because one, it will drive innovation. It will help us invent new technologies. But second, they realize this works. What we are talking about is a thing called a cap and trade [Page: H667]system. We cap the amount of carbon dioxide that can go into the air and we allow polluting companies to bid and trade for the right to put that pollution in. It is the most economically efficient way to do it. And what the companies have discovered is that when we do this, it works. When we did with sulfur dioxide in the 1980s it cleaned up the air and it actually ended up helping the economy.

Mr. HALL of New York. It created jobs.

Mr. INSLEE. It created jobs in creating these scrubbers. It helped our health and it actually, if anything, increased the gross domestic product. So what we are seeing is that some of these visionary companies are embracing this idea and it makes sense.

Today when I was talking to the Treasury Secretary, Mr. Paulson, I said, you know if we don't do this we are

going to be wasting a lot of money. The Bush administration has supported a program, basically, it is a combined cycle way of using coal that you can make into hydrogen and sequester the carbon dioxide. It is called ``future gen.'' We are going to have a future way of generating coal based electricity. And I think it is a good idea to invest in that type of research to see if we can burn coal, take the carbon dioxide, stick it in the ground forever and we will have clean electricity. But the Bush administration is spending $750 million of taxpayer money to do that. But the plant will never, ever, ever be used or built if the Bush administration's policies succeed because they don't want to have any charge for carbon dioxide, any regulation on the amount of carbon dioxide going into the air. Well, if you are a coal company and you have got to invest money in this future gen program but you can put your carbon dioxide in the air for free, are you ever going to build this kind of machine that President Bush wants to build? It doesn't make any sense. So if we are going to do research in this new technology, it only makes sense also to have some regulation in the amount of carbon dioxide that goes into the atmosphere. Otherwise these technologies will be developed and never used. And that is not our goal, Mr. Hall.

Mr. HALL of New York. I wanted to say that you prompted this thought. I am not against big corporations. I am not against corporations making a profit. In fact, a couple of the companies that are making the most innovation and putting the most investment into wind energy in our country right now are GE and Siemens. General Electric built the wind turbines that are in the Atlantic City wind farm that I mentioned earlier. Whether it is small start up companies working on alternative energy or whether it is existing oil companies or other utilities or big energy companies, the important thing to say, and this is the important thing, I think, to say to individuals also, and it is what I believe leadership should be doing, whether it is our President, whether it is Senators or whether it is us here on the floor of the House of Representatives, we need to tell our corporations and our citizens that it is patriotic to save energy, that it is patriotic, when you have a choice, to use the most domestic, clean, renewable form of energy that you can. It is patriotic to try to support, if you have a choice on the back of your utility bill, as I do in New York State, to check off that I want wind power, or to check off that I want hydro electric. You could choose the source of where your power comes from if you can afford to do it. And not everybody can, but those of us who are able to spend a couple of cents more per gallon for home heating fuel can get biodiesel. Well, right now it is no difference where I live. It is the same price for bio as it is for oil. But we need to think of this in terms of patriotism and national security and our national interest, and that you can't separate it from our foreign policy. You can't separate it from our economic well-being. You certainly can't separate it from our health. And I don't think you can separate it from our job future either. We need to have these industries start up and be developed here so we can compete. We can't afford to be in a situation we are in right now with hybrids, where I, who want to support, I got elected with union support, I am proud to say. Now I want to buy an American hybrid car that gets top mileage, and right now, the best mileage cars being sold in the United States are made in Japan. I don't believe, for a minute, that we can't compete and make a car that will get as good mileage or better as any other country in the world as their companies can. I think it is the choices that have been made, and the incentives that have been offered or the direction that has been given by government has been lacking. And I am proud to be a part of this 110th Congress, when we, tomorrow, will start down that road where we transfer the emphasis from the old to the new in terms of energy.

Mr. INSLEE. I really appreciate your comment. A couple of comments, first off, about the value of business, big, little, medium, small, all sizes. There are so many companies today that are leading this revolution that we want to assist them. DuPont has done tremendous work on energy efficiency. 3M has done tremendous work on energy efficiency. British Petroleum, an oil and gas company, internally, because of their great leadership, reduced their own carbon dioxide emissions down to 1990 levels. They thought it was going to take them 5 years. It took them 3 years. And they saved $300 million in energy because of doing just exactly what Mr. Hall is talking about of energy conservation. This is a green policy in two ways. Green environmentally and green for profit, and red, white and blue for America. So we have a lot of colors working for this policy.

I want to mention one other thing about our auto industry. We need our auto industry to give consumers cars that we can drive to use multiple fuels. Right now we are all kind of slaves to gasoline. We don't really have a choice. We need cars that will burn gasoline or ethanol, like they have in Brazil. The cars in Brazil drive, almost all of them burn either gasoline or ethanol. And because of that Brazil is energy independent today because they are growing their own ethanol, which we can do in this country. But we need the auto industry to give us this choice, to give us cars that can burn gasoline or ethanol. Now you can make a car for about $85 that does that. That is all it costs. Almost nothing. That is what is costs to put tint in your glass. But we need the industry to do that. And you know, Congress may need to act, and I think it does need to act to get the industry to agree to do that rapidly. The second thing we need is these oil and gas companies to agree to put pumps in that will be ethanol pumps or biodiesel pumps. [Time: 22:45]

That is not happening, because, unfortunately, those companies kind of only are selling gas right now, not biofuels. So we need to act to give consumers that ability to have at least a small percentage in the number of service stations that are going to give us that choice.

Mr. KLEIN of Florida. To follow up, if, the whole idea of gas, miles per gallon, which people have a tendency to look at cars today and look at the miles per gallon, there have been a lot of games that have been played with that over the years, sport utility vehicles being viewed as trucks, therefore, not having the same limitations that most automobiles in the United States have.

As the gentleman from New York mentioned, there are many cars made in other places around the world that have figured out how to make 40, 50 miles per gallon, base car and some hybrids as well. I don't believe there is any inhibiting factor in the United States for our car companies to do the same.

Now, do we need to give a little incentive? Maybe. I think we have all seen the statistics. For every couple of miles per gallon you increase in efficiency, we are dropping some amount of oils per barrel, gas that has to be imported from the Middle East or wherever every day. So there is a trade-off here.

There is also this issue of importing, which is a current issue which we need to reduce. The technology is going to take a little bit of time. We need to do exactly what we are doing tomorrow and over the next number of weeks and months. But there are some immediate things we can do.

I certainly would suggest to Americans on a patriotism basis, on a smart basis on the thinking of your children [Page: H668]and your grandchildren and what's right, we will sacrifice. We are all in this together here. Let's make the right decisions, do what you can. It's not the right thing for everybody. But to the extent that you can buy a car that gets better gas mileage and focus on that cars that maybe use regular instead of premium. Those are all choices that people make. Everybody is in this together. Let us make some smart decisions.

Mr. INSLEE. We know this can be done because in the 1970s and early 1980s we increased our gas mileage by 60 percent in 8 years. If we had simply continued on that path with the same rate of improvement, we would be free of Saudi Arabian oil today. We need to get back on that path of energy efficiency. We can do that. We can start tomorrow. It will be a good day for energy revolution tomorrow. I am looking forward to it.

Mr. Hall do you have any closing comments here? We are about ready to wrap it up.

Mr. HALL of New York. I think you have said it all, Congressman. I am happy to be here and proud to be here as part of this 110th. This is part of our taking our own future back, we as a country, I am talking about all the citizens of this country.

I think the same way Congressman Klein mentioned the moon shot, I do remember that, I am a couple years older than you are, and there was a huge lift in the psyche of this country, because even though President Kennedy didn't live to see the day that we landed a man on the moon, it was done in 9 years when he said we could do it in 10.

So our ingenuity and our industry and our creativity took hold, and we accomplished the goal. You could just sense this palpable lifting of the weight off the shoulders of Americans on the street. I mean, people you knew, that we had done this.

The day that we harness all these alternatives, and harness the power of conservation and efficiency so that we can say no thanks, turn that tanker around, send it back to the Middle East, we don't need that oil, that day, when that day arrives, you will see the same feeling of weight lifting off the shoulders of the American people and a feeling of self-sufficiency and of pride and of being in control of our own destiny again. That is really something to look forward to.

Mr. INSLEE. When that day arrives they will write a sequel to Tom Wolfe's book about the Mercury 7 program, and he called it ``The Right Stuff.'' Tomorrow Congress is going to have the right stuff. We are going to do a good energy policy.

PEAK OIL -- (House of Representatives - January 18, 2007)

The SPEAKER pro tempore (Mr. Murphy of Connecticut). Under the Speaker's announced policy of today, the gentleman from Maryland (Mr. Bartlett) is recognized for 60 minutes.

Mr. BARTLETT of Maryland. Mr. Speaker, last evening we were here just about this time talking about this same subject, the subject we have been talking about for the last hour. We had been discussing the phenomenon known as peak oil. That is the term given to a prediction that a geologist made, M. King Hubbert, working for the Shell Oil Company in 1956. He gave a speech in San Antonio, Texas, which I believe within a decade will be recognized as the most significant, most important speech given in the last century.

What he predicted was that the United States, which at that time was king of oil, we were producing more oil than any other country. We were using more oil than any other country, and we were exporting more oil than any other country. M. King Hubbert had the audacity in San Antonio, Texas, in 1956 to predict that in just a bit less than a decade-and-a-half, by about 1970, he said that the United States would reach its maximum oil production, and after that, inevitably, no matter what we did, oil production would tail off.

That prediction came true. Surprisingly, in 1970, some may say 1971, we peaked in oil production. In 1969, using this same analysis technique, he predicted that the world would be peaking in oil production about now. So last night we had come in our discussion to the point that we were looking at the potential for the alternatives that we and the world would need to turn to as we slide down the other side of what is referred to as Hubbert's peak. We noted that there were some finite resources, some nuclear resources and then the true renewables.

There are three justifications one might use for moving to alternatives. One is peak oil, and we will transition from fossil fuels to alternatives. Oil, gas and coal obviously will not last forever, and as the earth at some point runs down the other side of what we call Hubbert's peak and there is not enough oil, gas and coal to meet our [Page: H752]energy needs in the world, we will transition to alternatives. The only question is whether we do that on a time scale that we control so that it is a pretty easy ride, or whether we do it as dictated by geology, where it may be a very difficult ride.

Two other reasons for moving to alternatives. One is our dependence on foreign oil. Today, we have only about 2 percent of the known reserves of the oil in our country. We use about one-fourth of all the oil in the world, and we import about two-thirds of what we use. Obviously, if M. King Hubbert was right about the world, and there is every reason to believe he will be right about the world, we will need to transition to alternatives.

From a national security perspective, we ought to have been doing this a long while ago. A couple of years ago, 30 prominent Americans, Jim Woolsey, Boyden Gray, McFarland and 27 others, wrote a letter to the President saying, Mr. President, and they used the statistics I just used, the fact that the United States has only 2 percent of the known reserves and uses 25 percent of the world's oil and imports almost two-thirds of what we use is a totally unacceptable national security risk. Mr. President, we really need to do something about that. So even if you think that there is a whole lot of oil and gas out there, you still may be very incentivized to look for alternatives if you are concerned about our national security.

There is another reason to look for alternatives, and that is, if you believe that we have global warming, and I think there is an increasing body of evidence that suggests that that is probably true, and that we are probably contributing to that, although in the past the earth has been very much warmer, this is in a very distant past. Ordinarily, the past that we are talking about is from the last ice age, which is like some 10,000 years back. It is now the warmest we have ever been since that last ice age, but sometime way in the past the earth has been very much warmer because there were apparently subtropical seas in what is now the north slope of Alaska and the North Sea because we are finding oil and gas there.

The general belief is that this oil and gas was produced by organic material that grew in these subtropical seas, that every season it matured and fell to the bottom and was covered and mixed with sediment that was washed off of the adjacent hills, and then that built up for a very long time. Finally, with moving, the tectonic plates was submersed down with enough pressure and enough heat from the molten core of the earth and enough time that this finally was processed into gas and oil, and then if there was a rock dome over it which would hold the gas, now you have a very fertile place in which to drill. It took a very long time to grow all of that organic material and to turn it into gas and oil.

We are now in a relatively few years releasing all of the carbon dioxide that was sequestered in this organic material over quite a long time, until we are driving up the CO_2 of the world, which in the last century or so is nearly twice now what it was a century or so ago. This is what we call a greenhouse gas.

You can get some idea as to the greenhouse effect. If tomorrow is a sunny day and a cold day, and if your car is parked outside with the sun shining on the windshield, you may find quite a warm car when you go out there. That is because of what we call the greenhouse effect. The light that comes in from the sun, call it white light, it comes in over a long spectrum of wave lengths, and it goes through the glass of your car. Then it warms up the material of your car and it reradiates only in the infrared. Well, the glass of your car is pretty much opaque to the infrared. It keeps the heat inside. It reflects it back, and that is why your car gets so warm.

The greenhouse gases out there, you may remember being in an airplane, you are 44,000 feet, and the pilot tells you it is 70 degrees below zero, when down just below you may be flying over south Florida where it is very warm, and this is because of the greenhouse effect. The energy coming in from the sun heats up things in the earth, and when that heat is reflected back out, emanated back out, it is reflected by what we call the greenhouse gases and CO2 as one of those.

So there is increasing evidence that we have global warming, and there may be a need to move to the alternatives because many of these alternatives, although they will produce CO2 when you burn them like ethanol, that CO2 was taken out of the atmosphere by the corn plant when it grew. So you are not contributing any more CO2 to the atmosphere if you are using a product that just last year or so took the CO2 out of the atmosphere.

Now, what you would want to do in these last 2 cases is a little different in moving to alternatives. We have a essentially run out of time and run out of energy to invest in alternatives. We absolutely knew by 1980 that M. King Hubbert was right about the United States. We had peaked in 1970. We have done nothing in the ensuing years. If M. King Hubbert is right about the world, we have no excess energy to invest or oil would not be $50, $60 barrel, which means we have essentially run out of time and have no energy to invest.

Now, we could buy some time and free up some energy with a very aggressive conservation program.

Now, if your concern is foreign oil, then you could also get some additional energy from such things as tar sands and oil shales and coal. But if your concern is global warming, this will be a very bad place to get energy to invest in the alternatives that we will ultimately have to transition to because it take a lot of energy to get energy out of tar sands, and that energy is fossil fuel energy and that releases CO2 into the atmosphere.

So you are making a bad situation worse if your concern is global warming and you think CO2 is the cause of that and you want to transition to renewables, and you are going to get the energy to transition to renewables from tar sands and oil shales and particularly in coal somewhat. You will simply be releasing more carbon dioxide into the atmosphere. But let's look at these, because if the other two incentives are your incentives, then these are good bets.

If you are simply concerned that we have got to transition to renewables, then you will use whatever energy is available, and there is potentially enormous amounts of energy available in these tar sands and oil shales. And if you are concerned about dependence on foreign oil, then this is a good place to begin.

The tar sands. Some may call them oil sands; they are tar, thank you. It doesn't flow; it is really very much like tar. It is, I guess, a bit better than the asphalt parking lot out here, but not much better. If you put a blow torch on the parking lot, that will flow, too, which is pretty much what we have to do with the tar sands. They exist in Canada around

Alberta, Canada. There is an incredible amount of potential energy there. There is more energy in these tar sands than in all the known reserves of oil in the world.

But why aren't we resting easy, then, that we have got an easy transition, a big source of energy? Because this energy is not all that easy to get out of the tar sands. The Canadians are now getting about a million barrels of oil a day. That sounds like a lot of oil, and it is a lot. It is a little less than 5 percent of what we use in our country and just a bit more than 1 percent of the 84 million, 85 million barrels a day that the world uses; but they are using an incredible amount of energy to get this.

They are mining this, if you will. They have a shovel there that lifts 100 tons at a time, they dump it into a truck that hauls 400 tons, and then they take it and they cook it, and they are cooking it at the present with natural gas. They have what is called stranded natural gas there. There are not very many people in Alberta, Canada, that use it and gas is very difficult to move long distances; and so they are using this gas to produce oil from the tar sands.

I am told, and you can be told a lot of things that aren't true, but I am told that they may be using more energy from the natural gas than they are getting out of the oil that they produce. But from an economy perspective, that is okay, because the gas is very cheap and the oil is very expensive. And I understand it costs them $18 to $25 a barrel to produce the oil; and if it is selling for $50, $60 a barrel, obviously there [Page: H753]is a big profit there. But this natural gas will not last forever.

And where will the next energy come from? They are talking about building a nuclear power plant there so they will have additional energy for cooking this oil.

And they have another problem. The vein I understand, if you think of this as a vein, it now ducks under a big overlay of rock and soil, so that they will not be able to continue to develop this by mining it which is what they are doing now. They will have to develop it in situ, and I don't know that they have any economically feasible way of developing it in situ.

So although there is an incredibly large amount of potential energy available there, it will take a lot of energy to get it out, so what you really need to be thinking about is the net energy or the energy-profit ratio that you get out of this.

Who knows what new technologies we may come up with, what the engineers may be able to do, but one should not be too sanguine that this will be a savior, that we will get enormous amounts of energy from this, because of the difficulty of getting the oil out.

The oil shales. The name might better be called tar shales, but we refer to oil shales, and they are found in our western United States, in Utah and Colorado and so forth. And, again, there is absolutely an incredible potential amount of oil that could be extracted from these oil shales, or tar shales. Probably more than all of the known reserves of oil in the world, if we could get it all out. There have been a couple of attempts to do that. The most recent one was by the Shell Oil Company, and there was some glowing reports in the papers about what they did there. But there are aquifers associated with this shale that they need to protect, and so what they do to develop this is to go in and drill a bunch of holes around the perimeter and then freeze it.

So they in effect have a frozen vessel, and the oil will not move through that frozen vessel. And then they drill wells in the middle of it and they cook it, and they cook it for a year. And then they drill a third set of wells, and then when they get to the bottom, they go horizontally. They are very good at doing that now. So the oil that they cooked, loosened up by the second set of wells they drilled, now flows down through the shale, into the well that they drilled that finally went horizontal, and then they pump it out of those wells, and then they pump it for several years and they get a really meaningful amount of oil out.

A couple of years ago I was out in Denver, Colorado, speaking to a peak oil conference there, and the engineer, the scientist who did this little experiment cautioned that it would be several years before Shell Oil Company decided whether it was even economically feasible to get any oil out of the oil shales using that technique. Now, there may be other techniques, but at present to my knowledge nobody has any big exploitation

of the oil shales. The one that got the most publicity was this experiment by the Shell Oil Company, and they have indicated it would be several years before they can determine whether $60 a barrel is even feasible to get that oil.

The next one here is coal, and we will put another chart up in front of this one, because we hear a lot about coal. And you may hear it said that we have 250 years, 500 years of coal. We don't have 500 years, but we do have 250 years of coal at current use rates. Be very careful when people are telling you how much we have of some resource. If it is at current use rates, you have to factor in how long it will last you if you have an increased use rate.

After the development of atomic energy, and the world was amazed by that, Dr. Albert Einstein was asked: What will be the next great energy source in the world? And he said the most powerful force in the world was the power of compound interest.

And when you look at exponential growth, if you increase the use of coal just 2 percent, and I submit that we will have to dig into coal much more than just 2 percent increase per year over what we now use, but if it is only 2 percent, that 250 years immediately shrinks to about 85 years; and then you can't fill your trunk with coal and go down the roads. You have to convert it to a gas or liquid. And, by the way, we have been doing this for decades. Hitler ran his whole military and his whole country on oil from coal. When I was a little kid, the lamps that you now call a kerosene lamp we called coal oil lamp because it was coal oil that replaced whale oil in the lamps, and long after we were using kerosene I still called it coal oil.

But if you use some of the energy from the coal to convert the rest of the coal into a gas or a liquid, now you are down to 50 years with just 2 percent growth rate. And there is something else to look at. Because oil is fungible and moves on a world market, and it really doesn't matter in today's world who owns the oil, the guy who bids the highest gets the oil. It all moves on a global marketplace. And since we use one-fourth of the world's oil, our 50-year supply at only 2 percent growth rate will last the world just one-fourth of 50, or 12 1/2 years.

So the coal is there. It is the most readily developed, unconventional fossil fuel energy source, and we need to husband it. But it is dirty. You will pay an environmental penalty if you use it without cleaning it up, or you will pay a big economic penalty if you clean it up.

Let's go back to the original chart we were looking at. And the previous speakers talked about nuclear, and indeed today we produce about 20 percent of our electricity, 8 percent of our total energy from nuclear. We could and maybe should do more. There is no energy source that is without its drawbacks. When you burn any fossil fuel, you release CO_2 into the atmosphere and that produces greenhouse effects, which might very well produce global warming. There are potential drawbacks to nuclear, but so are there drawbacks to not having enough energy for your civilization.

There are three ways in which we can get energy from nuclear materials. One of them is the lightwater reactor, which is the only kind of reactor that we have in our country that uses fissionable uranium, and there is not an inexhaustible amount of fissionable uranium in the world.

And one of the big problems in this whole dialogue is agreement on what the facts are. When I ask how much fissionable uranium remains in the world, and I guess you have to say at current use rates, I get numbers that range from 15 years to 100 years. We desperately need an honest broker to help us agree as to what the facts are so that we can have a meaningful dialogue.

I have thought a lot about this, and perhaps the National Academy of Sciences, which is highly respected and very knowledgeable, would be this honest broker. Because when we sit at the table discussing where we are and where we need to go, you can't have a rational discussion without agreeing on the facts. But nobody disagrees that there is an inexhaustible supply of fissionable uranium. So obviously at some point in a few years, or a few more years with building more nuclear power plants, and China wants to build a lot more nuclear power plants, we will run out of fissionable uranium.

And then we will have to move to the second type of energy released with nuclear fission, and that is the breeder reactor. The only breeder reactors we ever had were those that were used for producing nuclear weapons. France produces about 80 percent, 85 percent of its electricity from nuclears, and they have some breeder reactors. The breeder reactor does what its name implies, it breeds fuel, so you now will have essentially a replaceable and therefore inexhaustible amount of fuel.

But there are problems that go with the breeder reactor. It has waste products that you have to somehow store away for maybe one-quarter of a million years. Now, we have only 5,000 years of recorded history. It is hard for us to imagine one-quarter of a million years. Something that is so hot that I have to store it away somewhere for one-quarter of a million years I think ought to have enough energy in it that we ought to be able to do something productive with that energy. As a matter of fact, the usual nuclear power plant gets only a tiny percentage of all the potential energy out of the nucleus.

So I would like to challenge our engineers to look at a way to make something good out of what is now a big problem when you have breeder reactors, and that is a byproduct that you [Page: H754]need to store away for very long time periods.

The second type of nuclear energy release is what is called fusion. And we have a great fusion reactor; it is called our Sun, which is a mediocre star over near one end of the Milky Way. By the way, if you go someplace where the air is not so polluted and you look up at night, you can see across the sky that great Milky Way. It looks like you have taken a brush across the sky. There are just billions and billions of stars out there. [Time: 22:00]

All of the stars are the equivalent of our sun, by the way. Nuclear fusion, power plants, if you will, and we are kind of a mediocre one near one end of the Milky Way.

We invest about $250 million a year in nuclear fusion. I happily support that. I wish there was a technology out there to and a technologist to use more money. I would happily vote for that. But if you think that we are going to solve our energy problems with nuclear fusion, you probably have some confidence you are going to solve your personal economic problems by winning the lottery. The gamble is about the same.

I think there are huge, huge engineering challenges with nuclear fusion. We have been working for many years, and we are always about 20-30 years away from a solution. We have been 20-30 years away from a solution for the last 20-30 years. We may get there. But it is not the kind of thing that you would want to bet the ranch on. By the way, we are home free if we get that. That would be an inexhaustible source of energy, essentially pollution free except for thermal pollution.

I would like to talk about thermal pollution in our power plants. We have had the luxury in this rich country we live in to put our nuclear power plants away from where we live, and the heat energy that comes out of them, we dissipate. If you drive, you see the big cooling towers for the nuclear power plants. What we are doing is we are evaporating drinking water to cool these power plants.

Almost everywhere else in the world, whether it is nuclear or coal, no matter what it is, unless it is hydro, then it is where the water is, but every other power plant is pretty much in the city right where people live, and they use the heat from that for what they call district heating. They pipe it to homes and businesses, and they use it in the wintertime to heat. In the summertime, you can use the heat to cool by the ammonia refrigeration, ammonia cycle refrigeration system, which used to be very popular in this country. But now you have to buy one from Argentina if you want one, for some reason. They have no moving parts and last a very long time. You can get cooling out of heat. So you can both heat and air conditioning with the excess heat from these power plants if you simply sited them nearer where people live.

Once you have used these finite resources, and they are finite, except for the nuclear that we have discussed. The others are finite. They will not last forever, then we will have only the true renewables left. They are such things as solar and wind and geothermal. This is true geothermal.

You may have people talk to you about geothermal and they are talking about connecting your heat pump to the earth or a well. What you are doing with your heat pump in the summertime, your air conditioner is really trying to heat up the outside air, that is how it cools the inside. And in the wintertime, your heat pump is keeping you warm by trying to cool down the outside air.

If you are working against groundwater, and here it is about 56 degrees, groundwater looks very cool in the summertime, and it looks very warm in the wintertime. I remember as a little boy we had a springhouse on our farm, and that is where our food was kept cool. I used to wonder how does that happen.

In the summertime I went into the springhouse and it was so cool. And in the wintertime, it felt so warm. Of course it was essentially the same temperature. But in contrast with the hot summer air it felt cool, and in contrast with the cold winter air it felt warm.

True geothermal is where we are connected to the heat from the molten core of the Earth. If you have been to Iceland, there is not a chimney in all of Iceland because they have geothermal and they get all of their heat sources from that.

Several places in our country we can tap that, and wherever we can we should. It is not really inexhaustible. The molten core of the Earth will not be there forever, but it will be there for millions and millions of years, so from our perspective that is an inexhaustible source of heat so we include it under renewables.

Then we have a number of sources of energy from the oceans. There is huge potential from the oceans. The tides, and by the way, the tides are one of the few energy sources that are not either the direct or indirect result of the sun. All of the fossil fuels that we are burning, gas and oil, and all of these tar, sands and oil shale were all produced by organic material that grew because the sun was shining a very long time ago.

I knew that when I was a little boy for coal because we lived on a farm in western Pennsylvania, and there was a coal mine on our farm. There had been a cave-in and they simply took the mules and the people out an air shaft that had a walkout slope, and so there was still some coal left. There was not enough to open the mine, but we partnered with a miner from the local town but he opened the mine and they drug coal with a pick and a shovel and a wheelbarrow. So we had what was called run-a-mine coal. We had a coal furnace, as did everybody in western Pennsylvania. Some of the lumps were too big to get in the furnace. Leaning against the cellar wall was a sledge hammer. If the lump was too big, you would break it. I remember breaking those lumps of coal and they would break open and there would be the imprint of a fern leaf. I still get a chill when I think about that.

Here I am looking at something that grew who knew how many eons ago. So I knew very well where coal came from, it came from vegetation that had fallen and was overlaid with Earth.

You can see coal in the process of production, by the way, in the bogs of England. It is not yet coal but it is on the way to coal. And if you take it out, it will burn.

The sun produces most of the energy that you can get from the oceans. It produces thermal gradients. It produces the waves. How does it do that, by producing wind. The wind is the result of the differential heating of the Earth, and that therefore is sun driven.

There is one big potential source of energy in the ocean that is not sun generated, and that is the tides. They are generated by the gravitational pull of the Moon, which lifts the whole ocean 2 to 3 feet.

Can you imagine the incredible amount of energy it takes to lift three-fourths of the earth's surface 2 or 3 feet a day. We have tried to get meaningful energy from the tides without a whole lot of success, and it is simply because they are so disperse. There is an old axiom, energy or power to be effective must be concentrated, and the tides are anything but concentrated. They are spread over huge, huge expanses.

We get some meaningful energy from the tides in the fjords where because of funneling effects you may have a 60-foot tide. You let it come in and then you wall it off and let it flow out through a generator when the tide goes out.

There is another potential source of energy from the oceans, it is not really oceans but you find most of it there, and that is gas hydrites. There is more potential energy in the gas hydrites I understand than in all of the fossil fuels in all of the Earth, but we have been singularly unsuccessful in trying to collect those little nodules of gas hydrites and get the energy from them because they are dispersed largely on the ocean bottom over enormous expanses of the ocean. Well, these are all challenges. And one day when energy becomes less and less available from fossil fuels and more and more expensive, some of these other sources will be more exploitable.

And then the agricultural resource, and let me put the next chart up here.

I would like to start on the left-hand side of this because it really shows us where we are and the challenges we face. We are very much like the young couple whose grandparents have died and left them a pretty big inheritance, and so they have established a life-style, pretty lavish life-style where 85 [Page: H755]percent of the money they spend comes from their grandparents' inheritance and only 15 percent, some people will say 14, 15 percent comes from their income. They look at how old they are and how much they are spending, gee, it is going to run out before they die, before they retire, as a matter of fact. So they obviously have to do one of two things, or both: They have to make more money or spend less money. That is pretty much where we are with energy.

Three-fourths of all of the energy that we use comes from fossil fuels: Petroleum, natural gas, and coal.

Only 15 percent of it comes from something other than fossil fuels. Eight percent comes from nuclear power, and that is 8 percent of our total energy. Nuclear power represents 20 percent of our electricity. If you don't like nuclear power, imagine when you go home tonight that every fifth business and every fifth home doesn't have any electricity because that's what the picture would be if we didn't have nuclear power. So 8 percent. And this is data from 2000. It is a little different because we have been trying to do something since then.

Seven percent of the energy represents the true renewables, like solar and wood and waste and wind, conventional hydro. Agriculture, here we have alcohol fuel and then the geothermal that we talked about where you are truly tapping into the heat from the molten core of the Earth.

These numbers would have to be a little bigger now, but they would have to be a lot bigger to be relevant because in 2000, solar was 0.07 percent. That is trifling. It has been growing at 30 percent a year so it is several times larger than it was in 2000. But still, it is minuscule compared to the 21 million barrels of oil that we use per day.

And 38 percent of this comes from wood and that's largely the paper and timber industry burning waste product.

Then a very interesting one, waste to energy. A lot of people look at the incredible amount of waste we have and say if we could just burn that waste, we could get a lot of energy from that. That's true.

As you go up into Montgomery County, they have a very nice one, I would be proud to have it beside my church. You don't even know it is a waste to energy power plant. It is a nice looking building and the train or the truck comes in and the waste is all in containers and you don't even see it.

But let me remind you that almost all of this waste is the result of profligate use of fossil fuel energy. What you are really doing when you burn that waste to produce electricity is you are kind of burning secondhand fossil fuels because that's what was used to produce this waste. In an energy deficient world, there will be far, far less waste because waste is a by-product of large energy use, and in an energy-deficient world we would be using nowhere near as much energy.

Wind. Wind is really growing. Our previous hour talked about wind. The wind machines today are huge. You may see the blades for them go down the highway. They may be 60 feet long, as big as an airplane wing. They are huge, and produce megawatts of electricity. They are producing them at about 2.5 cents a kilowatt hour.

By the way, because we did not have the proper incentives in our country, we have now forfeited the manufacture of this product. Almost all I understand of the new big what I think are handsome wind machines are made overseas. Most are made in Denmark.

The cheapest electricity costs several times the 2.5 cents a kilowatt hour, so wind machines are now really competitive with other ways of producing electricity.

There are a lot of siting problems, a lot of nimby kinds of reactions. That is, not in my backyard. My wife says these are really bananas, build absolutely nothing anywhere near anybody, she says is the attitude of many of these people.

You know, pretty is as pretty does, and if your alternative is shivering in the dark in an energy deficient fossil fuel world, that may be what we are coming to, and wind machines may start to look a whole lot better. I know some people who live along the coast would mind wind machines if they couldn't see them, so they are trying to site them out in the ocean beyond the horizon so they won't see the wind machines. [Time: 22:15]

Conventional hydroelectric. You see, that is the biggest sector of these renewables. We have about maxed out on that. We have dammed every river we should have dammed and maybe some we shouldn't. The migratory path of fishes, and I saw a big article the other day about eels, we are now building some ladders so that eels, which are snake-like fish, can get back to their spawning grounds, but there is a huge potential, I understand, maybe as big as that, from something called microhydro. And that is using the water flow and drop in small streams. And there you can use it without the big impacts on the environment that you have when you dam up a big river.

By the way, if you have dammed that river up for water for a downstream city, that will become less and less effective as it gradually fills in with silt, and it will. And by and by, who knows how many years later, there will be little water there because it will be mostly filled with silt that came down from further up in the watershed.

If you are just interested in electricity, it still, when it comes over the dam, falls the same distance. So that silting in won't really effect how much electricity you can produce, but it will affect how much you can vary the height of the reservoir so as to always maintain some reserve for producing the electricity.

I would like to spend a few moments talking about energy from agriculture. There is an awful lot of hype about energy from agriculture. I read the other day, and I don't know why it took us so long to find this, but in 1957, 50 years ago this year, Hyman Rickover, the father of the nuclear submarine, gave a talk to a group of physicians. It is an incredible speech. He was so prophetic. He understood that gas and oil were not forever. That, I think, is obvious.

Maybe it is because I am a scientist, but probably 40 years ago I started asking myself the question, you know, since gas and oil obviously are finite, they are not infinite, they will not last forever, at what point do we need to start being concerned about what is left? Is it a year, 10 years, 100 years, 1,000 years? I didn't know when I first started asking this question. But I knew that at some point in time the world would have to start thinking about, gee, what do we do when gas and oil and coal are gone? Because one day gas and oil and coal will be gone.

So there is a lot of hype about energy from agriculture. But Hyman Rickover, very, very astutely observed that as our population increased, the ground would be more used for producing food than it would be something you burned or fermented. And he also noted, talking about biomass, that biomass might be more valuable returning it to the soil so that you still had soil rather than taking it off to either burn or ferment.

We will get some energy from agriculture, but every bit of corn you use to make ethanol is corn that is not used as a food. We are well fed in this country, many of us more than well fed, but tonight, about 20 percent of the world will go to bed hungry. But as our population continues to increase, there will be less and less opportunity to use agriculture products for energy rather than food.

By the way, there is one way we could free up a lot of agricultural products for energy. If you will eat the corn and the soybeans rather than the pig and the cow that ate the corn and the soybeans, then you could free up a lot of corn for ethanol and soybeans for biodiesel. The animal breeder may brag he has a pig or a chicken that is so efficient that three pounds of corn will make one pound of pig. That is true. But that is three pounds of dry corn and one pound of wet pig; maybe 90 percent dry matter in the corn and for sure 70 percent water in the pig. And you can't eat his bones.

And so on a dry matter to dry matter basis, it takes at least 10 pounds of dry matter in corn to make one pound of dry matter in the pig or the chicken, and probably 20 in the steer. You get very much more efficient conversion of these grains and beans into good food if you use milk.

A cow will today produce 20,000 pounds of milk in a year with a ton of dry matter. She doesn't weigh a ton, but you have a ton of dry matter in her [Page: H756]milk for the year, which has very high food value. There is no protein that is as good as milk protein. We determine the quality of protein by feeding young rats. It may not be complimentary that the animal has dietary requirements nearer us than any other, rats, but they do. And they are also omnivorous. And we determine how good their protein is by how fast young rats grow.

If you assign a value of 100 to milk protein, eggs come in at about 96, and the meats on down. And that shouldn't surprise you. God or nature, or whoever you think did it, obviously designed milk to grow young animals. A 100-pound sheep will put a pound each on twin lambs just from her milk. Enormously efficient. And eggs are very efficiently produced compared to producing the chicken that you eat.

So we can free up a lot of these food crops for energy if we will simply eat the food crops rather than processing them through animals.

The next chart shows one of the challenges in producing ethanol. Indeed, there are some scientists who believe that we use more energy in producing ethanol, more fossil fuel energy in producing ethanol than we get out of it. I hope they are wrong. I believe that it can be possible. But even after you have made the ethanol, you still have all of the protein and all of the fat left in the corn, and that is pretty good feed.

Just an observation about what we eat and give to our animals. If you go to the Orient, the main protein source there for people is what is called tofu, and that is soybean protein. In this country, we take the soybean and we express the oil, which is the least valuable nutritionally, and we use the oil and we feed what is left of it to our pigs and chickens. No wonder that they are healthier than many of us.

Here is a little comparison of the energy inputs in producing ethanol and in producing gasoline. Obviously, you expend some energy. You don't get all the energy from the oil in your gas tank. You expend some of that in drilling it, in pumping it, transporting it, refining it and hauling it to the service station, and so forth. So you use 1.23 million Btu's to get 1 million Btu's.

Well, what is the story with corn? Now, you have a lot of free energy with corn. You have the solar energy, the photosynthesis that makes the corn grow. And this is about as good as it is going to get. To get 1 million Btu's of energy out of corn, you are going to have to spend about three-fourths of a million Btus in growing the corn, harvesting it, processing the ethanol, and so forth.

Down at the bottom here is a very interesting pie chart, and it shows something that very few people know, and that is that almost half the energy that goes into producing corn comes from nitrogen fertilizer, which is now made from natural gas. So this is a fossil fuel input. This is all fossil fuel input, by the way.

You just go around this little pie here and you are talking about mining the potash, and mining the phosphate, and mining the lime that makes the soil sweeter so that the nutrients can be absorbed. The diesel fuel in the tractor, the gasoline, the liquid propane gas, the electricity you use is produced by fossil fuels. The natural gas you use for drying your crops, for instance, the custom work, the guy you hire to come.

And then all of the chemicals, something that we rarely, rarely reflect on. Gas and oil are huge feedstocks for a very important petrochemical industry. Most of our insecticides, most of our herbicides and so forth are made from gas and oil. And this is the contribution they make to growing corn. It is really, really quite large there, isn't it?

I have been told that 13 percent of our corn crop would displace 2 percent of our gasoline. But the only fair way to look at the contribution ethanol can make is to grow corn with energy from corn, and you can do that. But if you grow corn with energy from corn, to get a bushel of corn to use here, you have to use three bushels of corn. Remember, the 750,000 Btu inputs to get a million? You need three bushels going in to get one out, which means that it is one to four. You only get a fourth of it out, which means that you are going to have to use 52 percent of your corn crop to displace just 2 percent of our gasoline.

So when you are hearing the euphemistic projections of how much of our gasoline we are going to displace with ethanol, just remember these numbers.

Now, some people are even more enthusiastic about what is called cellulosic ethanol. Cellulose and lignin, particularly cellulose, we can't digest. It is made up of a whole long string of glucose molecules, which is a simple sugar; half of what we call sucrose, which is a double sugar disaccharide. But they are so tightly bound together, we don't have any enzymes in our gut which will release them. And neither does any other animal, by the way.

So, gee, you might say, how do cows, sheep, goats, horses, and guinea pigs make do eating grass and hay? They make do because they have in their gut what are called comincils, animals or little critters that live in there, some of them multi-cellular, some single cells, that have chemicals, enzymes that can split the cellulose into the requisite glucose molecules and then the host simply absorbs those.

We are now able to bioengineer some little organisms that can do that. So now, when you look at the huge piles of beet pulp, look at the corn fields with all the corn fodder out there, people are saying, gee, look how much energy we could get from this agricultural waste. You can get it by burning it, or you can use it by making cellulosic ethanol from it. But, you know, topsoil is topsoil because it has organic material. It gives it tilth. Why does it have to be there? Because without the organic material, the soils can't hold the nutrients and they can't hold the water necessary for growing things. You can't grow plants in stone dust and you can't grow plants in sand. So you have to have organic material there. For a few years, we might be able to mine the organic material and still grow some crops, but there will be diminishing returns. I don't know steady state how much we can take.

Some people are euphemistic about how much we are going to get from sawgrass, prairie grass. They see it growing in huge amounts. But I suspect this year's prairie grass is growing because last year's prairie grass died and is fertilizing it. Now, we certainly can get something from this biomass, from agricultural waste and from growing trees and so forth, but it will not be enormous.

Let me give you some idea of what the challenge is. We use 21 million barrels of oil a day. Each barrel of oil has the energy equivalent of 12 people working all year. Hyman Rickover used data which showed the average family in 1957 used fossil fuel energy resulting in the equivalent of having 33, he said, full-time servants. [Time: 22:30]

If you have some trouble getting your mind around this one barrel of oil and 12 people working all year, and by the way, that is costing you less than $10 per person per year, think how far a gallon of gasoline or diesel fuel, I appreciate the chart from the previous hour which showed how cheap oil was. It costs considerable less than water in the grocery store, by the way. But think how far that gallon of gasoline or diesel fuel carries your car and how long it would take you to pull the car there. And that gives you some idea of the challenge we face.

Another little example: if you are a strong man and work hard all day long, I will get more work out of an electric motor for less than 25 cents' worth of electricity. Now, that may be humbling to recognize that you are worth less than 25 cents a day in terms of fossil fuel energy, but that is the reality.

There are two publications. We have only a few moments remaining. I want to go quickly through some slides here. We have two major studies, one of them is a Corps of Engineers study and these first few slides will be from their study. The second one is the big SAIC study, commonly known as the Hirsch Report. I just want to read quickly some of the things they said. These are paid for by our government. They are out there. You may be asking the question, Gee, why aren't people talking about this and why aren't we doing something about it? Good question.

This is from the Corps of Engineers: the current price of oil is in the 45 to 57 per barrel range and is expected to stay in that range for several years. When they wrote this, by the way, it was about 65. Oil prices may go significantly higher, and some have predicted [Page: H757]prices ranging up to $180 a barrel in a few years.

Oil is the most important form of energy in the world today. Historically, no other energy source equals oil's intrinsic qualities of extractability, transportability, versatility, and cost. The qualities that enabled oil to take over from coal as the front line energy source for the industrialized world in the middle of the 20th century are as relevant today as they were then. And then this quote: In general, all nonrenewable resources follow a natural supply curve, getting more and more till you reach a peak and then falling down the other side. And they are concurring, a careful estimate of all the estimates lead to the conclusion that world oil production may peak within a few short years, after which it will decline. Once peak oil occurs, then the historic patterns of world oil demand and price cycles will cease.

And the last one from this source: Petroleum experts indicate that peaking is either present or imminent; will occur around 2005.

And now some charts from the Hirsch Report. This is very widely publicized. They concluded that we would have unprecedented risk management problems as we face the problem of transitioning from declining quantities of gas and oil and moving to alternatives. The economic, social, and political costs will be unprecedented. And then they state, We cannot conceive of any affordable government-sponsored crash program to accelerate normal replacement schedules. They said we should have started 20 years before peaking. If it is here, we are 20 years too late, aren't we?

And then this quote: The world has never faced a problem like this. There is a third report out there and that is by the Cambridge Energy Research Associates, and they believe that peaking will occur sometime in the future. And they present this little chart. This shows Hubbert's peak here, by the way, and because the actual data points didn't exactly follow his prediction, they are saying that you can't rely on his analysis. The little peak here, by the way, and the next chart will show us, that is from the Alaska oil find. Just a blip and the slide down the other side of Hubbert's peak.

And then in the couple of minutes remaining to us, the last slide we will have a chance to look at here. And this shows several predictions, depending upon whether you think the world will find enormously more oil than we now have found. And I will tell you that most of the experts that I have talked to believe we have found 95 percent of all the oil we will ever find. That is this curve. If you think we are going to double the amount of oil that we have now found, then that is this curve. And the one on top here, and by the way, they say that they don't believe in peaking, but they present this curve which shows peaking. This is unconventional oil.

Make up your own mind how much of that we are going to get, remembering the discussion we had earlier of the difficulty of getting this oil.

Mr. Speaker, we in the world face a huge challenge. I just returned from China. They are talking about post oil. They get it. I wish we did.

END

ENERGY -- (House of Representatives - January 24, 2007) The SPEAKER pro tempore (Mr. Johnson of Georgia). Under the Speaker's announced policy of January 18, 2007, the gentleman from Maryland (Mr. Bartlett) is recognized for 60 minutes as the designee of the minority leader.

Mr. BARTLETT of Maryland. Mr. Speaker, I thought that there was only one speech given in the last century that would become very famous in the few years just ahead of us, and that was the speech given on the 8th day of March in San Antonio, Texas, by M. King Hubbert in 1956, but I just discovered a few days ago a speech which I think may become just about as famous.

This was a speech that was given by the father of the nuclear submarine, Hyman Rickover, and he gave this speech in May 1957. So soon we will reach the 50th anniversary of this very famous speech by the father of the nuclear submarine.

I just wanted to start by reading a couple of things from this speech that he gave. He gave the speech, by the way, to a group of physicians at a banquet of the Annual Scientific Assembly of the Minnesota State Medical Association in St. Paul, Minnesota, May 14, 1957.

The title of the speech had nothing to do with medicine. The title of the speech is ``Energy Resources and Our Future." He says early on in the speech that, ``With high energy consumption goes a high standard of living. Thus the enormous fossil fuel energy which we in this country control feeds machines which make each of us master of an army of mechanical slaves." Now, this was 50 years ago and can you imagine what has happened since then?

``Man's muscle power is rated at 35 watts continuously," that is, 24/7. Of course, you need to sleep and eat and so forth, and so when you are working, you are working at more than 35 watts, but 35 watts continuously, which is one-twentieth of horsepower.

``Machines therefore furnish every American industrial worker with energy equivalent to that of 244 men." So all of those things that we enjoy in our life, the automobile, the refrigerator, the microwave, all of these represent the equivalent of 244 men in place of just the one that can turn these things out with the aid of this fossil fuel energy.

Then he goes on to say, ``While at least 2,000 men push his automobile along the road," probably more than that for an SUV, ``and his family is supplied with 33 faithful household helpers. Each locomotive engineer controls energy equivalent to that of 100,000 men; each jet pilot of 700,000 men. Truly," he says, ``the humblest American enjoys the services of more slaves than were once owned by the richest nobles, and lives better than most ancient kings. In retrospect, and despite wars, revolutions, and disasters, the hundred years just gone by," that was the 100 years up to 1957, it is now 150 years, ``just gone by may well seem like a Golden Age."

Others have commented on this incredible energy density in these fossil fuels by noting that just one barrel of oil contains the energy equivalent of 12 men working all year. If you look at the cost of that at the pump, that is roughly $10 a year. For $10 a year, you can have a servant work for you all year long. You may have some trouble getting your mind around that, but imagine how far that gallon of gasoline or diesel fuel, still cheaper, by the way, than water in the grocery store, how far that takes your SUV or your car or your truck and how long it would take you to pull your SUV or truck or car the distance that that gallon of diesel fuel or gasoline takes it. I drive a Prius. We get about 50 miles per gallon. How long would it take me to pull my Prius 50 miles?

Let me give another little example to help you understand the incredible energy density in these fossil fuels and how much they have improved our life and how totally dependent we are on them.

If a big man goes outside and is working really hard all day long doing physical work, I can get more work out of an electric motor for less than 25 cents' worth of electricity. That may be humbling to recognize that in terms of fossil fuel energy, our muscle power is worth less than 25 cents a day, but understanding that helps us to understand how totally dependent we have come to be on these fossil fuels.

A little later in his speech, Hyman Rickover said, ``I think no further elaboration is needed to demonstrate the significance of energy resources for our own future. Our civilization rests upon a technological base which requires enormous quantities of fossil fuels. What assurance do we then have that our energy needs will continue to be supplied by fossil fuels?'' And then this answer, 50 years ago, when we were king of oil, biggest producers, biggest consumers in the world, I think biggest exporters in the world, ``The answer is,'' he says, ``in the long run, none.''

There is no assurance that we can have these fossil fuels for the long term. ``The earth is finite,'' he says. ``Fossil fuels are not renewable. In this respect our energy base differs from that of all earlier civilizations. They could have maintained their energy supply by careful cultivation,'' when we got our energy from the soil. ``We cannot. Fuel that has been burned is gone forever. Fuel is even more evanescent than metals. Metals, too, are nonrenewable resources threatened with ultimate extinction, but something can be salvaged from scrap. Fuel leaves no scrap and there is nothing man can do to rebuild exhausted fossil fuel reserves. They were created by solar energy,'' he says, ``500 million years ago and took eons to grow to their present volume.''

Another quote from his talk. ``In the 8,000 years from the beginning of history to the year 2000 A.D., world population will have grown from 10 million to 4 billion.'' Actually, he missed it a little. It is now 7 billion, as you will see in a moment, ``with 90 percent of that growth taking place during the last 5 percent of that period, in 400 years. It took the first 3,000 years of recorded history to accomplish the first doubling of population, 100 years for the last doubling, but the next doubling will require only 50 years.'' As a matter of fact, it required less than that, because today we have about nearly 7 billion people in the world rather than just 4 billion.

Another quote from his talk. ``High-energy consumption has always been a prerequisite of political power ..... Ultimately," he says, ``the Nation which controls the largest energy resources will become dominant. If we give thought to the problem of energy resources, if we act wisely and in time to conserve what we have and prepare well for necessary future changes, we shall insure this dominant position for our own country."

Have we done that? In no way have we done that.

Another quote from his talk. ``I suggest that this is a good time to think soberly about our responsibilities to our descendants, those who will ring out the Fossil Fuel Age ..... We might even, if we wanted, give a break to these youngsters by cutting fuel and metal consumption," this was 50 years ago, ``by cutting fuel and metal consumption a little here and there so as to provide a safer margin for the necessary adjustments which eventually must be made in a world without fossil fuels."

I just came back about 3 weeks ago from a trip to China. Nine Members of Congress went. We met with a number of the top officials in China, and I was pleased and surprised. We went to talk about energy primarily, and they began every discussion of energy by talking about post-oil. Hyman Rickover 50 years ago understood that one day we would be talking about post-oil. The Chinese now are talking about post-oil. By the way, they do not mean that there is not going to be anymore oil in the world. Nobody is telling you that.

What they mean by post-oil is that it will be post the peak production of oil, where we can no longer produce additional oil so we are going to have to make do with what we have. As a matter of fact, each year after that there would be less and less oil available for us to use.

The next chart. There is nothing man can do to rebuild exhausted fossil fuel reserves, and this is part of the quote I just made. They were created by solar energy a very long time ago and took eons to grow into their present volume. In the face of the basic factor, fossil fuel reserves are finite. The exact length of time these reserves will last is important in only one respect. The longer they last, the more time do we have to invent ways of living off renewable substitute energy sources and to adjust our economy to the vast changes which we can expect from such a shift. This is 50 years ago.

He is saying the same thing that our President said last night in the State of the Union message, that we should get busy with preparing for a transition from fossil fuels to renewables.

Then I really love this quote. I am a father of 10, a grandfather of 15 and a great-grandfather of two. ``Fossil fuels resemble capital in the bank. A prudent and responsible parent will use his capital sparingly in order to pass on to his children as much as possible of his inheritance."

Do you think, Mr. Speaker, that we have been using fossil fuel energy sparingly? I doubt that you would find very much concurrence for this anywhere in this country, and certainly worldwide. When you look from other places to this country and see this one person out of 22 using 25 percent of all of the world's energy, you will have nobody over there saying we have used our energy sparingly. ``A selfish and irresponsible parent will squander it in riotous living and care not one whit how his offspring will fair."

I have characterized our relationship with energy as the equivalent of the pig who found the feed room door open and just went in and pigged out. That is what we have been doing. When our children and our grandchildren and great grandchildren look back in a world with diminishing fossil fuel availability, and, by the way, saddled with a huge debt that we are passing on to them, they may well ask themselves the question, how could they have done it?

When we found this incredible wealth under the ground, that provides the equivalent of 33 servants, 100,000 people pushing your train, 244 people pushing your automobile down the road, when we found this incredible fuel fossil fuel energy under the ground, why didn't somebody stop and ask the question, what should we do with this to provide the most good for the most people for the longest time? That clearly is not what we did.

What we did was to extract this oil from the ground as quickly as possible; to use it as prolifically as possible; to develop a lifestyle ever more and more dependent on fossil fuel; to develop an agriculture where one person out of 50 feeds the rest and much of the world; where the man sits on top of a 150 horsepower tractor and uses fertilizers produced from natural gas to grow his crops.

The next chart here is a really interesting one. Suppose the size of the countries in the world was determined by how much oil they have. This is the world according to oil. If you look at our military might, if you look at our economic might, we are really big. But when you look at the oil we have, here we are, itty-bitty United States. Notice Alaska is pretty big here, a fair amount of oil up there.

But look at Saudi Arabia, Iraq, Kuwait. Little Kuwait. Look at a map and see how little Kuwait is. But look at the oil they have. This is what the world would like look like if the countries were sized relative to the amount of oil they have.

Look at Russia there. People talk about the huge reserves in Russia. It is dwarfed by Saudi Arabia and Iraq, and even little Kuwait has more oil than Russia. Look at Venezuela down here. It is probably twice the size of the United States in terms of what they have in oil. Look at some of the African countries here. Nigeria, what, way bigger than the United States. Libya, bigger than the United States in terms of the amount of oil that they have.

The next chart, this was predicted by that second famous speech that I mentioned that was given in the last century, and that is the talk given by M. King Hubbard on the 8th day of March, 1956, to a group of petroleum engineers in San Antonio, Texas, and a lot of other oilmen there. This was the time, you remember, when the United States was the biggest oil producer in the world, the biggest consumer of oil in the world, and I think maybe the biggest exporter of oil in the world.

What M. King Hubbard told hose assembled people was that in just about 14 years, the United States would reach its maximum oil production and then, no matter what we did, the oil production would drop off after that.

How did he know that that was going to happen? He had watched the exploitation and exhaustion of individual oil fields, and each one of them followed what we call a bell curve. That is a curve that goes ever up and up and reaches a peak and comes down the other side. You get a bell curve if you weigh people and see how much they weigh. There will be a few very light people, a few very heavy people. Most of them are in the middle. How tall people are, how many mice are in a litter of mice and so forth, most of the things in a natural world follow a bell curve. He predicted that we would follow a bell curve.

When he noticed each one of these little fields, he saw when they reached a peak, they had pumped about half of all the oil they would ever pump. So he theorized if he knew how many little fields we had, little bell curves, and how many more we were likely to find, and if you added all those up, you could predict when we would reach the peak. So he did that, and he said that was going to be about 1970.

And the Shell Oil Company, for whom he worked, said, please don't do that and embarrass us. You make a fool of yourself and embarrass yourself. He gave the talk and for a while he was kind of a humorous person. But then he became an icon in his own time, because right on schedule in 1970, we peaked in oil production.

Now, this curve that I have here is one that is taken from the Cambridge Energy Research Associates, and I use this especially because you may hear from these people, they are called CERA, and they are predicting that there is lots more oil out there, we are going to find a whole lot more oil, not to worry. They use this to make the point that M. King Hubbard really didn't know what he was talking about and he really was wrong.

They are saying that because the total U.S. production, and this, by the way, is with Prudo Bay and the Gulf of Mexico in, if you put only the lower 48 in, which is what M. King Hubbard was predicting, this was the actual on the green, and his prediction was the yellow here, and they said, gee, he was off. That doesn't look like it is very far off to me.

Let's look at another chart which shows the same data. This shows two peaks here. The smooth green symbols here are the prediction of M. King Hubbard. The more ragged ones are the actual data points.

You see right on schedule we peaked in 1970. We have been going down ever since. The red one is the former Soviet Union, FSU, and they kind of fell apart and didn't reach their potential. They are having a second little peak now and are going down.

Do you remember from that chart of the world according to oil, they were maybe twice the United States? They aren't using anywhere near as much oil as we are, so now they are a major exporter. But they don't have all that much oil. As you can see here, the area under this curve represents how much oil they have, the area under this curve represents how much oil we have, and you can see the general relationships there.

The next chart shows where our oil has come from. M. King Hubbard predicted only Texas and the rest of the United States, and that was his prediction and that was the actual data points. Then we found oil in Alaska and we learned to make oil from gas, non-gas liquids, natural

gas liquids.

This is the oil that we found in the Gulf of Mexico. You remember those fabled discoveries in the Gulf of Mexico? I remember them. We were home free. They were going to solve our oil problem for the foreseeable future. You can hardly see their contributions as we slid down the other side of Hubbard's peak.

The next chart shows another depiction of peak oil, and this is one again from Energy Information Area, the EIA, quoted in the Hirsch Report. Let me spend a moment on what the Hirsch Report is.

Our government has paid for two big studies of the fossil fuel energy situation. One of those was financed by the Department of Energy, done by SAIC, a very prestigious, large scientific organization, and Dr. Hirsch was the principal investigator there, so it is frequently referred to as the Hirsch Report. He here is reporting this information that came from our Energy Information Agency, which is a part of our Department of Energy.

Here they are using some very interesting statistical terms, but they aren't true statistical term. I have had the EIA people come in and talk with them at the office about this, because I had some trouble understanding it.

A couple of Congresses ago, I was the Chair of the Energy Subcommittee on Science and I wanted to determine the dimensions of the problem. So we had experts come in from around the world to tell us how much oil they thought remained in the world and how much more oil they thought we would find.

I was quite surprised at the relative unanimity. They all were pretty close to 1,000 gigabarrels, maybe 970 to 1,040. Now, I use gigabarrels instead of million barrels and that is because the British billion is not our billion. The British billion is a million million. Our billion is a thousand million. But everybody understands a giga. So when you hear ``giga'' used, you know that is an international term. A thousand gigabarrels, which is 1 trillion barrels of oil, that is what remains.

You remember at the peak of that curve, M. King Hubbard said about half of the oil would be used, so that means we have used about 1,000 gigabarrels, and here they have the total of 2,248 gigabarrels. So about half of that has been used and about half of that remains.

Now, they are using some very interesting techniques here, and they did some simulations, and I have no idea what the inputs were into the simulations, but they have convinced themselves that there is a high probability that we will find twice as much more oil as all the oil that now exists out there unpumped. So they said gee, halfway between what they say is the low probability and the high probability is the mean, which is the expected yield. So they believe we are going to get, this is a total of 3,000, so we are going to get another 2,000 gigabarrels of oil. That is this red curve here.

What they show is that even if that is true, Mr. Speaker, even if that is true, and I think the odds that that is true are very small, but even if that is true, that pushes the peak out only to 2016.

What the dotted curve here shows is what you might be able to do with enhanced oil recovery, pump live steam down there and a bunch of solvents and push water in there, and maybe you can get it quicker. But if you get it quicker look what happens to the other side. Just a demonstration that you can't pump what is not there, and the total volume you will pump is the area under this curve. If you get it sooner, you won't have it later. Notice how quickly that curve drops down.

If they don't find the additional enormous quantities of oil that they believe they will find, then we are about here and the peak will occur at about 2005 or so, which is where M. King Hubbard said that the peak would occur. By the way, he predicted it in 1969, a year before the United States peak. He was confident enough of his analytical techniques that he predicted the world would be peaking about now.

The next chart is another chart from CERA, and it depicts some of the same information on that chart a little differently.

This is the curve, the peaking curve, if there is a roughly 2 trillion, 2000 gigabarrels. You will notice slightly different figures between these, because there is not unanimity on how much is there, but it is roughly 1.9 to 2.2. This is in the same ballpark. If that is the case, then peaking according to them is going to occur fairly soon according to them.

But if you find another 1 trillion barrels of oil, that pushes peaking out only to what, 2035, something like that. That is not all that far off. And the probability we are going to find that oil is very, very small, as we will see in a few moments.

Now he has piled on top of that, CERA has piled on top of that, an enormous amount of oil that they think we are going to get from unconventional oil sources. This is like the Canadian tar sands and like our oil shales out in the West.

We may or may not get enormous quantities of oil from that. There are potentially huge quantities there. There is more potential oil in the tar sands of Canada than all of the known reserves in the world. That big map we saw, there is more potential oil there.

But there is also an incredible amount of potential energy in the tides, but we have not been very successful in harnessing that energy from the tides. Canada is now getting about 1 million barrels of oil with a shovel that lifts 100 tons and dumps it into a truck that hauls 400 tons. They then haul it and cook it with enormous amounts of energy from natural gas, which is stranded. By ``stranded'' we mean there are not very many people there to use it.

Since it is expensive to ship, why, it is cheaper there, and so they are producing that oil at about 18 to 25 dollars a barrel. I understand they are getting 55, today, dollars a barrel for it. That is a pretty good dollar profit ratio. But they know this is not sustainable for several reasons. One is they are using water faster than they can supply it. The energy from the gas will run out. They are thinking of building a nuclear power plant, and they have a huge, relatively huge, lake there of tailing water they call it. It is really very toxic water, so there are huge environmental impacts of it. And furthermore, this vein of the tar sands will shortly duck under an overlay so that they will no longer be able to deadlift it or surface mine it, whatever you want to call it. They will now have to develop it in situ, and they have not even experimented with how they are going to do that.

The next chart has a little simple schematic. And by the way, you can make this peak look very hard and sharp or spread it out by the scale you use on the abscissa and the ordinate. Here we have spread it out because we have an expanded scale on the abscissa and a restricted one on the ordinate here. But that yellow area represents the additional oil we would like to have, because growth is exponential at about 2 percent. And if we reach the peak, I think we are about here. We are now having some problems with meeting the demand, which is why oil is going from 50 to 60 to 78 at the highest a few months ago.

And by the way, they showed undulating plateau in that last big chart I showed, and I agree with them. May I put that chart up for just another moment? That is a very interesting one. I want to focus on this. They are saying that there is no such thing as peak oil. And this is what they show. Tell me that is not a peak. This is from their publication. And it is an article where they are kind of pooh-poohing the idea of peak oil, and they are showing peak oil. For every potential level of oil that they think will be there, they are showing a peak. They are just showing it, and I agree with them that it is going to be undulating plateau. It is not going to be a smooth thing. The curve just under it shows it very smooth because we have simplified it. And what it shows is, and, by the way, the 2 percent growth, it doubles in 35 years. This point is doubled this point, so that is a 35-year period there. So you see it takes a while to get through that peak.

The next chart is one that if you had only one chart to look at and talk about relative to oil, this would be the chart. And you could spend a very long time looking at this chart and talking about it. The big bars here show the discoveries. And you notice that there was a rash of discoveries way back in the 1940s, 16 years before M. King Hubbert made his prediction. By the way, he made that prediction here in 1956, about here. Wow. Look how much more we discovered after that. And he was able to predict how much more we would discover and correctly predict when we would reach peak oil production.

The solid line here shows the consumption. And obviously up until about 1980 we were always finding more than we were consuming. Now, remember, underneath this curve represents all that we have used. So we have used this much of what we found. But this much of what we found was left over that we could use in the future. So ever since 1980, now, we have been finding less and less oil and using more and more oil. Notice a little stuttering here in the 1970s. The Arab oil embargo. The oil price spike hikes, the big push for efficiency in our country. Your air conditioner now uses about half the energy that it used in 1970.

Well, what will the future look like? The folks who put this chart together believe that peaking will occur at about 2010. Who knows? We really won't know until after it has peaked and you look back and see the data. It could be peaking now. It could be 5 years from now, it could be 10 years from now. But both of these are very, very short term in terms of what we need to do to address this.

What will the future look like? They have predicted that future oil discoveries will follow, and of course they won't be smooth like that, but on the average they will follow the curve like that. And you can't pump what you haven't found. And if you were to put a smooth curve over this discovery curve, and you have an area under that which will equal the amount which will be the total amount of oil you have found, that is adding up all these little bars here, and the area under that discovery curve cannot be different than the area ultimately under the consumption curve. So you can make this curve go, within limits, any way you want, within reason. You can use vigorous enhanced oil recovery techniques and get it out quicker, and you can maybe delay the peak a little bit. But you can't pump what is not there. And so it ultimately is going to fall off much, much faster. This is a very interesting chart. We could spend a lot of

[Page: H933]time looking at this. But what you cannot do is pump oil that you have not found.

Now, what CERA is predicting is that you are going to find as much more oil as all of the reserves that now exist. The reserves that exist, and I calculated this, I think that this area pretty much fills in this. So the reserve that exists is this. They think we are going to find that much more oil? What do you think when you look at this chart? Do you think it is reasonable that they are going to find that much more oil?

Mr. Speaker, this is a chart which kind of smooths out those big different bar graphs that we saw before. Now, as early finds in the 19, here, they have a little spike here and a big spike here. You can smooth that whole thing out, of course. But this is roughly a graph drawn through the bar graphs on that previous chart. And now we are down here at this point in time. And the Energy Information Agency, using those three numbers that we used before, the 95 percent, which they say is low, the 50 percent, which they say is the mean, and the 5 percent, which they say is high, and they think that because the 50 percentile is halfway between the 95 and the 5, that that is the most likely thing. Well, anybody in statistics knows that if it is 95 percent more probable, it is more probable than 50 percent probable. That is pretty simple to understand, I think.

Well, the red dots here indicate what the actual data have been. Now, their projection was that this discovery line would follow the green. Clearly it has been following what you would expect it to follow, the 95 percent probability.

The next chart is an interesting one, and Hyman Rickover referred to this. He referred to 8,000 years of recorded history. And he, at that time, noted that they were about 100 years into the age of oil. Today we are about 150 years into the age of oil. And ultimately, out of 8,000 years of recorded history, the age of oil will be but a blip in the history of man. It will occupy maybe 300 years from when we first found it and started to really exploit it until it becomes so difficult to get and so expensive that we won't be getting much of it again.

This is a little chart that shows the development of the industrial revolution. It started with wood. Brown, here. The hills of New England were denuded carrying charcoal to England to make steel there. Come up to Frederick County where I live, and we have a little historic site up there, Catoctin Furnace. We denuded the hills up there where Camp David is now to make charcoal to make steel at Catoctin Furnace.

Then we discovered coal. And on the ordinate here, it is a quadrillion Btus, how much energy we were producing. Look how much more energy we were able to produce with coal. The coal locomotive. Lots more energy in coal than there is in wood, so we could do a lot more things with.

The industrial revolution was kind of stuttering when we discovered gas and oil, and then look what happened. And if you could superimpose on this a chart of the population growth in the world, it would look just about like this. Remember Hyman Rickover said that it was going to grow from that half billion back here to 4 billion? It really grew to almost 7 billion, which is where we are today. So that population curve with appropriate dimensions would just about follow exactly the energy use curve. This is an incredible amount of energy we are using that obviously could not continue.

A really interesting statistic. Up until the Carter years, every decade, the world used as much oil as it had used in all of previous history. That is this curve. Now, in the 1970s you see what happened. We really had a shock, and we stopped and took some sense of where we were. And we drove smaller cars, and we developed more efficient refrigerators and air conditioners, and we reduced energy. We had a big recession, a big worldwide recession as a result of that. So energy use went down.

But now look. It is climbing back up again. Three hundred years, the age of oil, it will be but a blip in the history of man.

Again, I ask, what will future people think when they look back at this and say, why didn't we stop when we found this incredible wealth under the ground to ask what could we do with this to get the most good for the most people for the longer time? That is obviously the question that almost nobody asked. What we asked was, how can we use more and more of this to improve more and more our quality of life, as if it were forever. Obviously, as Hyman Rickover said 50 years ago, it can't be forever.

The next chart is a really interesting one. As I mentioned, we are 1 person out of 22, and we use a fourth of the world's energy. Energy use is on the abscissa here, and how good you feel about life is on the ordinate. And notice that we are way out there. We feel pretty good about life, but not as good as many others.

We are just here. There are all of those who feel better about life. And we clearly are using the most energy. Only little Switzerland comes close to us in using energy.

Interesting chart here. If you could draw a line through this, you would see that with little energy it is really tough to feel good about life. But when you come up here to what, a fifth of the amount of energy we use, a lot of people, Colombia, Brazil, Mexico, China, they feel about as good about life as we do. If you look at the countries in Europe here, you will find that many of those use about half the energy we use, and they feel just as good about life as we feel.

What this points out is that it is possible to live a quality life using much less energy than we use, and all you have to do is to look at these countries that use very much less energy than we do and feel just about as good, and some of them better. All of these above my arm here feel better about life than we feel about life. And they are using less energy than we are using.

Well, what now? Well, obviously, we must transition. Geology will assure it, as anticipated by Hyman Rickover in that very fascinating speech to the physicians 50 years ago. We will transition ultimately as we go through the age of oil from the fossil fuels to renewables. We have available to us some finite sources, and I mentioned the tar sands, and we have about as large a potential supply of energy in our West called the oil shales, a little bit different. They aren't really oil. You put a solvent in, they won't flow out. But if you cook them, they will turn to oil, and you can then refine it. And there is potentially a huge amount of energy there. But can we get it?

The Shell Oil Company has gone there doing some experimentation. And a year or so ago I was a speaker out in Denver, Colorado, at the American chapter of the Peak Oil Association. And the investigator for the Shell Oil Company that conducted this little experiment was there and reported on it. And what he said in his report there was very different than the stories you read in the papers. The stories in the papers said, you know, don't worry about energy. We have this huge potential amount there, and we have found a way to get it. That is not what he said.

Let me tell you what they did. What they did was, and I am not sure of the reasoning because I hear two reasons for it. One was that there was an aquifer there they didn't want to contaminate. And the other had something to do with the mechanics of sequestering the oil. But they drilled a series of holes around the periphery, and then they froze the ground, and they froze it for a year so that now they had, in effect, a frozen vessel.

The second argument was that they did that to contain the heat. That is a little hard for me to understand how a frozen vessel contains heat, but that is the argument that I was given. Then at the end of the year they went in and drilled a second set of holes, and then they pumped heat down there, and they cooked it for a year. And then they drilled a third set of holes, and then when they got to the bottom of those holes, they turned it sideways, which they can do now, and drilled it horizontally. So the oil that was loosened by cooking it in the second set of wells they drilled now flowed down through the shale and was picked up by those horizontal channels from the third set of wells they drilled. And they pumped for several years a really meaningful amount of oil from that. So there is potentially a lot of oil there. [Time: 17:30]

But what the investigator told us was that it would be, I think he said, something like 2013 before they could even decide whether it was economically feasible to develop those fields.

[Page: H934]

So there is huge potential there. There are also huge challenges there. But it is energy. We will develop some of it. But it is finite. It will not last forever either. And there is going to be enormous cost in developing it, both economic cost and environmental costs.

Now, you can trade the environmental cost for economic cost. If you do not mind polluting the environment you can develop it for less money. At the moment, most of us believe we should not be polluting our environment so we spend the money necessary that we do not, although they are not really doing that in Alberta, Canada. They are using up precious water, and they have a relatively huge lake of tailing water as they call it, which is really pretty toxic stuff.

Coal. We and China have a lot of coal. China was suffocating themselves with coal smoke. They closed down some of their coal-fired power plants. People will tell you that we have 500 years of coal. That is just not true. It is true that we have 250 years of coal at current use rates. We will put the next chart up in front of this one.

Be very careful when people tell you we have so much of something at current use rates. When Albert Einstein was asked what the next big force in the universe was going to be after nuclear energy, which had such a dramatic increase over any kind of energy we had before that, his answer was, compound interest, he said was the most powerful force in the universe.

And there is a really interesting talk given, he is not my relative, I wish he were so I had some of his genes, but Dr. Albert Bartlett, Professor Emeritus at the University of Colorado has given a talk on energy I think some 1,600 times. Just do Albert Bartlett and energy and you will pull it up. It was the most fascinating 1-hour talk I ever listened to, and I am sure you will agree.

But he says that the biggest failure of our industrialized society is our inability to understand the exponential function. You see this coal that will last us 250 years at current use rates if we increase its use only 2 percent, and we will have to do better than that. By the way, coal has been in the past a big source of gas and oil.

Hitler ran his whole country and his whole military on it. And when we were limiting the opportunities for trade in South Africa, they were making gas and oil from coal. When I was a little boy, it was coal oil. And I thought it was all one word, coal oil that replaced whale oil in the lamps. I kept calling it coal oil a long time after they were getting it from kerosene rather than coal.

But if you increase it just 2 percent, that shrinks its usable duration to about 85 years. But obviously for many of our uses you cannot use coal, you have got to use it as a gas or liquid. If you use some of the energy from the coal to make it into a gas or liquid you have now shrunk it to 50 years.

But the reality is that it does not matter who owns the resource today, it is all traded in a global marketplace. And the guy who has the dollars buys the oil or the gas. And so whether we like it or not, there is no alternative that we are going to share our oil with the world. Because, you see if we use oil from our coal, that just frees up some oil from pumping it out of the ground that somebody else can use.

So the effect is as if we were sharing our oil with the world so that 50 years from now, we use a fourth, you remember the rest of the world uses the other three-fourths, that means that now shrinks to 12 1/2 years. So that marvelous 200 years of coal at no growth for us now shrinks to 50 years when we increase its growth to only 2 percent, and use some of it, the energy, to convert it to gas and oil. And then we realize that we are going to have to share this, no alternative, unless we have a big enough Navy to say, it is ours and we can keep you from coming and getting it. We are going to have to share it with the world so now it lasts 12 1/2 years.

Let's go back to this chart. Going just for a few moments about nuclear. If you were in France, you would get about 80, 85 percent of all of your electricity from nuclear. We get in our country 20 percent of our electricity from nuclear, that is a lot. When you go home tonight look out your window, and every fifth business and every fifth house would be dark if it were not for nuclear energy.

We have never had an accident. We have never had a fatality. Three Mile Island, it behaved just as it was supposed to behave. I lived within the radiation zone of that. And we contained that. That was not a disaster. It was just a demonstration that we were building them right, because when we had the meltdown at Three Mile Island we contained that. There was little effect from it.

There are three different ways you can get nuclear energy. One is the way we get it from lightwater reactors. That uses fissionable uranium. There is a finite supply of fissionable uranium in the world.

And I get wildly divergent estimates of how long it will last, 15 years, 100 years. Again, this is at that current use rate. So you have to ask the person, what rate of use are you assuming when you make this projection? This reminds me, by the way, that we need an honest broker to help us agree on the facts.

It is hard to have a rational discussion when you cannot agree on the facts. And I think the right candidate to do this is the National Academy of Sciences. Enormously respected, very competent. And I have talked with them, and they would be interested in doing this. We just need to fund them so they can do it.

We need to have a rational discussion of this. And we cannot have that when there is big differences of opinion as to what the facts are.

Well, ultimately one day sooner or later, there will not be enough fissionable uranium to go to lightwater reactors. So then we are going to have to go to the second type of fission reactors, that is the breeder reactor. France already uses those. The only ones we had we used for making weapons. We now do not do that anymore. They have problems.

The big advantage, of course, is they are what the name implies, they are breeder reactors, they make more fuel that they use. The problems are that they have a byproduct that we must store away for a quarter of a million years. I cannot even imagine that. A quarter of a million years.

I think there is a challenge here. Anything that is so hot that has no much energy in it that I cannot get near it for a quarter of a million years, don't you think ought to have enough energy there that we can do something meaningful with it?

Now we have been profligate in our use of energy, all energy including nuclear energy. And we use only a tiny fraction of the nuclear energy in the isotope when we say it is no longer good for our reactors, so we put some more in. But I think there is a big challenge there. I think there is a potential source of energy from these byproducts. If it is so hot, such high radiation that I cannot get near it for a quarter of a

million years, it ought to have some usable energy in it. We have very creative, innovative people. I think that we can find that if we realize that we need to.

The third type of nuclear energy is the type that is represented in the sun and every other star out there in the Milky Way. The sun is a nuclear reactor. And it is fusion reaction, it is like our hydrogen bomb. By the way, it will one day run down too. But that will be in millions of years in the future, so in our context we do not need to think about that.

We have been spending money on fusion, about $250 million a year. We are always about 30 years away from a solution. I gladly would vote for the money that we spend there. I think that we have got to do that. If we can conquer the enormous engineering challenges then we are home free. That is the only energy source out there that can take the place of fossil fuels. But I think the odds of doing that are about the same as the odds of winning the lottery. And if you are satisfied that you are going to meet your financial obligations by playing the lottery, then you are probably satisfied that we are going to meet our energy needs with nuclear fusion. Please do not bet the ranch on it.

Well, once we have gone through these finite sources and we have done what we can with nuclear, I have friends that have been devoutly antinuclear, but they are very bright people. And when they are looking at a very probable alternative, that is, shivering in the dark, not enough energy to [Page: H935]keep warm, not enough energy to run the lights, nuclear does not look all that bad to many people who before were not enthusiastic about it when the alternative might be shivering in the dark.

Well, then we have renewable resources. And as Dr. Rickover said, by and by, we will have transitioned to these renewable resources. There will come a day when the fossil fuels are so scarce, so hard to get, so expensive, that we are getting little or none of them. And we will have, by that time, have transitioned, like it or not, we will have transitioned to these renewables. What are they? There is the sun. As I look at what the sun does, I am not surprised that the ancients worshiped the sun.

Almost all of the energy that we have been talking about here came from the sun. It was the sun that permitted the organic materials to grow in those subtropical seas that existed. The Earth, a long time ago, was much warmer than the Earth today. They were up there in the North Shore of Alaska, and in the North Sea off England producing these organic materials that settled to the bottom, infiltrated by runoff from the adjacent hills, probably. This is all theory. As good an explanation as I have heard as to how it got there. Tectonic moved. It opened up. It sank down. Near enough, proper pressure, proper heat, enough time, and by and by it becomes gas and oil, with a dome over so the gas cannot escape.

Then you have a good field. You get gas from it. You get oil from it. And if you drill into the oil and seal off the gas, the gas pressure above is putting pressure on the oil, so you have a gusher, it just pushes it up the pipe. So you see that this is the way it was formed. We have an explanation for what we find when we drill out there.

So all of the gas and oil came from the sun. When I was a little boy, we had a coal furnace. And we had run a mined coal from dust to big lumps, and some lumps so big that you could not put them in the furnace. And there was a sledgehammer by the wall, and we would break the lumps so we could get them in the furnace.

I remember as a little kid the feelings that I had, and I still get a chill when I think of this. I would break open the lump of that coal and there would be a fern leaf. You did not have to tell me where the coal came from. I knew where the coal came from. It came from ancient vegetation that grew and fell over and was covered up and ultimately became coal. We can see this process in the making in England, of the bogs there, it is not coal yet but you can take it out and burn it.

Wind. The wind blows because the sun shines. It is differential heating of the Earth that makes the wind blow.

Here is one that is not due to the sun. This is geothermal. True geothermal, not tying your heat pump to groundwater or earth, which makes a whole lot more sense than trying to coal the winter air and heat the summer air, which is what your radiational air conditioner and heat system, heat pump does.

But this is tapping into the heat from the molten core of the Earth. You go to Iceland, there is not a single chimney because they have a lot of geothermal, that is where they get their energy.

Ocean energy. Except for the tides, all of ocean energy is really a second-hand sun energy. It is the sun which differentially heats the waters. It is the sun which produces ultimately the Gulf Stream and the Japanese current, which carries so much warmth to northern Europe. Look at England on a globe. You will see that England is about mid-Canada, that is certainly not their climate, that is because of what the sun does in heating that water and setting up this conveyor belt.

The tides, of course, are produced by the Moon. There a lot of potential energy there. And then a very popular potential source of energy today, the President talked about it last night in his State of the Union, energy sources from agriculture.

Hyman Rickover in his speech here talked about that. And he said that ultimately, if you are getting energy from agriculture, you are going to be competing with one of two things, either you compete with food, and today corn is over $4 a barrel, it is ordinarily about $2 a barrel so that our dairy farmers and chicken farmers and hog farmers are now having a hard time making ends meet, because corn has about doubled in price, and that is because using corn for ethanol is competing with corn for food.

If we all became vegetarians, by the way, we would all have a whole lot more corn to use for energy. Soy diesel, biodiesel, these are all attractive sources. The second potential source of energy from agriculture was biomass. And the President talked a lot about that last night.

But Hyman Rickover very astutely noted that today's crops grow because last year's crops died and are fertilizing them. He noted that you will need to return the biomass to the soils if you are going to keep productivity going. [Time: 17:45]

Now, we can get some energy from ethanol, and we can get some energy from biomass by burning it or fermenting it, but there are limits as to how much we can get there. And the incredible amount of energy that we use from fossil fuels presents a huge challenge to try to find enough disparate sources of energy to add up to equal the energy that we get there.

Waste energy, that is an interesting one, and we ought to be doing more of that. It is a very good idea. But remember, that big pile of waste that you see at the city dump is the result of profligate use of energy. In an energy-deficient world, we are not going to have those huge piles of waste. That is really secondhand use of fossil fuels because that is how the waste got there.

Hydrogen. Hydrogen is not an energy source. We must make hydrogen. The second law of thermal dynamics says you will always get less energy out of hydrogen than it took to make it. So why are we talking about hydrogen? For two reasons. One, when you burn it, it is really clean. You get water.

Secondly, if we ever get an economically feasible fuel cell, hydrogen is a great candidate for the fuel cell. But minus a good fuel cell, there will not be a viable hydrogen economy because you will always get less energy out of hydrogen than it took to make it. If you are simply burning the hydrogen, you could have gotten more energy by burning the gas from which you got the electricity which you used to split the water to get hydrogen.

So that is why there is such a focus on fuel cells, because it opens up the promise of a really clean fuel with at least twice the efficiency of the reciprocating engine.

The next chart, and I would like to talk about this one in terms of a young couple whose grandparents have died and left them a big inheritance, and they have now established a life-style. Hyman Rickover described that life-style with 33 servants, or the equivalent. They have established a life-style where 85 percent of the money they spend comes from their grandparents' inheritance, and only 15 percent comes from their income. It is not going to last long enough for them to retire. They have to do something. They have to spend less money or make more money.

That is exactly where we are energywise. Eighty-five percent of our energy comes from fossil fuels: coal, petroleum, natural gas. Only 15 percent comes from other sources, and a bit more than half of that comes from nuclear. That could grow, and probably should grow. And that leaves 7 percent, and this is in 2000. We are a little better today than we were in 2000, but the challenges are huge. Even with 30 percent growth, when you are going from 0.07 percent, in 2000 that is the contribution that solar made to our energy supply. It is minuscule. And the noise level.

We are doing much better today, and it is growing rapidly, but it is still a tiny fraction of the energy we use.

Notice wood here, more than a third of all of the renewables. That is the timber industry and the paper industry wisely using a by-product.

Waste to energy we talked about.

Wind is just another way to use sun energy.

Conventional hydro, we have maxed out on that. We can maybe get some microhydro. We have about maxed out on that.

The next chart, briefly, what do we need to do. We need a program, if we [Page: H936]are going to have a relatively smooth ride, and we have waited too long to address this problem, but we need a program that has the total commitment of World War II, that has the technology focus of putting a man on the moon, and has the urgency of the Manhattan Project.

We need a vigorous conservation time to buy time, free up some energy, buy some time, use it wisely, invest it in those things that will do the most good for the most people. We could become a major exporter. We have a very innovative society. We have a farm bill that is challenging our farmers. And if a farm can't be energy independent, we have big problems because that is where a lot of energy could be produced.

This is challenging our farm people to develop a farm where they produce twice as much energy as they use so there is some for the city person.

Mr. Speaker, www.bartlett.house.gov will get you access to all of this material. [Begin Insert]

Mr. Speaker, I submit into the Congressional Record the entire speech ``Energy Resources and Our Future,'' by Admiral Hyman Rickover, Chief, Naval Reactors Branch, Division of Reactor Development, U.S. Atomic Energy Commission and Assistant Chief of the Bureau of Ships for Nuclear Propulsion, Navy Department, prepared for delivery at a Banquet of the Annual Scientific Assembly of the Minnesota State Medical Association, St. Paul, Minnesota on May 14, 1957. [End Insert]

Energy Resources and Our Future

I am honored to be here tonight, though it is no easy thing, I assure you, for a layman to face up to an audience of physicians. A single one of you, sitting behind his desk, can be quite formidable.

My speech has no medical connotations. This may be a relief to you after the solid professional fare you have been absorbing. I should like to discuss a matter which will, I hope, be of interest to you as responsible citizens: the significance of energy resources in the shaping of our future.

We live in what historians may some day call the Fossil Fuel Age. Today coal, oil, and natural gas supply 93% of the world's energy; water power accounts for only 1%; and the labor of men and domestic animals the remaining 6%. This is a startling reversal of corresponding figures for 1850--only a century ago. Then fossil fuels supplied 5% of the world's energy, and men and animals 94%. Five sixths of all the coal, oil, and gas consumed since the beginning of the Fossil Fuel Age has been burned up in the last 55 years.

These fuels have been known to man for more than 3,000 years. In parts of China, coal was used for domestic heating and cooking, and natural gas for lighting as early as 1000 B.C. The Babylonians burned asphalt a thousand years earlier. But these early uses were sporadic and of no economic significance. Fossil fuels did not become a major source of energy until machines running on coal, gas, or oil were invented. Wood, for example, was the most important fuel until 1880 when it was replaced by coal; coal, in turn, has only recently been surpassed by oil in this country.

Once in full swing, fossil fuel consumption has accelerated at phenomenal rates. All the fossil fuels used before 1900 would not last five years at today's rates of consumption.

Nowhere are these rates higher and growing faster than in the United States. Our country, with only 6% of the world's population, uses one third of the world's total energy input; this proportion would be even greater except that we use energy more efficiently than other countries. Each American has at his disposal, each year, energy equivalent to that obtainable from eight tons of coal. This is six times the world's per capita energy consumption. Though not quite so spectacular, corresponding figures for other highly industrialized countries also show above average consumption figures. The United Kingdom, for example, uses more than three times as much energy as the world average.

With high energy consumption goes a high standard of living. Thus the enormous fossil energy which we in this country control feeds machines which make each of us master of an army of mechanical slaves. Man's muscle power is rated at 35 watts continuously, or one-twentieth horsepower. Machines therefore furnish every American industrial worker with energy equivalent to that of 244 men, while at least 2,000 men push his automobile along the road, and his family is supplied with 33 faithful household helpers. Each locomotive engineer controls energy equivalent to that of 100,000 men; each jet pilot of 700,000 men. Truly, the humblest American enjoys the services of more slaves than were once owned by the richest nobles, and lives better than most ancient kings. In retrospect, and despite wars, revolutions, and disasters, the hundred years just gone by may well seem like a Golden Age.

Whether this Golden Age will continue depends entirely upon our ability to keep energy supplies in balance with the needs of our growing population. Before I go into this question, let me review briefly the role of energy resources in the rise and fall of civilizations.

Possession of surplus energy is, of course, a requisite for any kind of civilization, for if man possesses merely the energy of his own muscles, he must expend all his strength--mental and physical--to obtain the bare necessities of life.

Surplus energy provides the material foundation for civilized living--a comfortable and tasteful home instead of a bare shelter; attractive clothing instead of mere covering to keep warm; appetizing food instead of anything that suffices to appease hunger. It provides the freedom from toil without which there can be no art, music, literature, or learning. There is no need to belabor the point. What lifted man--one of the weaker mammals--above the animal world was that he could devise, with his brain, ways to increase the energy at his disposal, and use the leisure so gained to cultivate his mind and spirit. Where man must rely solely on the energy of his own body, he can sustain only the most meager existence.

Man's first step on the ladder of civilization dates from his discovery of fire and his domestication of animals. With these energy resources he was able to build a pastoral culture. To move upward to an agricultural civilization he needed more energy. In the past this was found in the labor of dependent members of large patriarchal families, augmented by slaves obtained through purchase or as war booty. There are some backward communities which to this day depend on this type of energy.

Slave labor was necessary for the city-states and the empires of antiquity; they frequently had slave populations larger than their free citizenry. As long as slaves were abundant and no moral censure attached to their ownership, incentives to search for alternative sources of energy were lacking; this may well have been the single most important reason why engineering advanced very little in ancient times.

A reduction of per capita energy consumption has always in the past led to a decline in civilization and a reversion to a more primitive way of life. For example, exhaustion of wood fuel is believed to have been the primary reason for the fall of the Mayan Civilization on this continent and of the decline of once flourishing civilizations in Asia. India and China once had large forests, as did much of the Middle East. Deforestation not only lessened the energy base but had a further disastrous effect: lacking plant cover, soil washed away, and with soil erosion the nutritional base was reduced as well.

Another cause of declining civilization comes with pressure of population on available land. A point is reached where the land can no longer support both the people and their domestic animals. Horses and mules disappear first. Finally even the versatile water buffalo is displaced by man who is two and one half times as efficient an energy converter as are draft animals. It must always be remembered that while domestic animals and agricultural machines increase productivity per man, maximum productivity per acre is achieved only by intensive manual cultivation.

It is a sobering thought that the impoverished people of Asia, who today seldom go to sleep with their hunger completely satisfied, were once far more civilized and lived much better than the people of the West. And not so very long ago, either. It was the stories brought back by Marco Polo of the marvelous civilization in China which turned Europe's eyes to the riches of the East, and induced adventurous sailors to brave the high seas in their small vessels searching for a direct route to the fabulous Orient. The ``wealth of the Indies'' is a phrase still used, but whatever wealth may be there it certainly is not evident in the life of the people today.

Asia failed to keep technological pace with the needs of her growing populations and sank into such poverty that in many places man has become again the primary source of energy, since other energy converters have become too expensive. This must be obvious to the most casual observer. What this means is quite simply a reversion to a more primitive stage of civilization with all that it implies for human dignity and happiness.

Anyone who has watched a sweating Chinese farm worker strain at his heavily laden wheelbarrow, creaking along a cobblestone road, or who has flinched as he drives past an endless procession of human beasts of burden moving to market in Java--the slender women bent under mountainous loads heaped on their heads--anyone who has seen statistics translated into flesh and bone, realizes the degradation of man's stature when his muscle power becomes the only energy source he can afford. Civilization must wither when human beings are so degraded.

Where slavery represented a major source of energy, its abolition had the immediate effect of reducing energy consumption. Thus when this time-honored institution came under moral censure by Christianity, civilization declined until other sources of energy could be found. Slavery is incompatible with Christian belief in the worth of the humblest individual as a child of God. As Christianity spread through the Roman Empire and masters freed their slaves--in obedience to the teaching of the Church--the energy base of Roman civilization crumbled. This, some historians believe, may have been a major factor in the decline of Rome and the temporary reversion to a more primitive way of life during the Dark Ages. Slavery gradually disappeared throughout the Western world, except in its milder form of serfdom. That it was revived a thousand years later merely shows man's ability to stifle his conscience-- [Page: H937]at least for a while--when his economic needs are great. Eventually, even the needs of overseas plantation economies did not suffice to keep alive a practice so deeply repugnant to Western man's deepest convictions.

It may well be that it was unwillingness to depend on slave labor for their energy needs which turned the minds of medieval Europeans to search for alternate sources of energy, thus sparking the Power Revolution of the Middle Ages which, in turn, paved the way for the Industrial Revolution of the 19th Century. When slavery disappeared in the West engineering advanced. Men began to harness the power of nature by utilizing water and wind as energy sources. The sailing ship, in particular, which replaced the slave-driven galley of antiquity, was vastly improved by medieval shipbuilders and became the first machine enabling man to control large amounts of inanimate energy.

The next important high-energy converter used by Europeans was gunpowder--an energy source far superior to the muscular strength of the strongest bowman or lancer. With ships that could navigate the high seas and arms that could outfire any hand weapon, Europe was now powerful enough to preempt for herself the vast empty areas of the Western Hemisphere into which she poured her surplus populations to build new nations of European stock. With these ships and arms she also gained political control over populous areas in Africa and Asia from which she drew the raw materials needed to speed her industrialization, thus complementing her naval and military dominance with economic and commercial supremacy.

When a low-energy society comes in contact with a high-energy society, the advantage always lies with the latter. The Europeans not only achieved standards of living vastly higher than those of the rest of the world, but they did this while their population was growing at rates far surpassing those of other peoples. In fact, they doubled their share of total world population in the short span of three centuries. From one sixth in 1650, the people of European stock increased to almost one third of total world population by 1950.

Meanwhile much of the rest of the world did not even keep energy sources in balance with population growth. Per capita energy consumption actually diminished in large areas. It is this difference in energy consumption which has resulted in an ever-widening gap between the one-third minority who live in high-energy countries and the two-thirds majority who live in low-energy areas.

These so-called underdeveloped countries are now finding it far more difficult to catch up with the fortunate minority than it was for Europe to initiate transition from low-energy to high-energy consumption. For one thing, their ratio of land to people is much less favorable; for another, they have no outlet for surplus populations to ease the transition since all the empty spaces have already been taken over by people of European stock.

Almost all of today's low-energy countries have a population density so great that it perpetuates dependence on intensive manual agriculture which alone can yield barely enough food for their people. They do not have enough acreage, per capita, to justify using domestic animals or farm machinery, although better seeds, better soil management, and better hand tools could bring some improvement. A very large part of their working population must nevertheless remain on the land, and this limits the amount of surplus energy that can be produced. Most of these countries must choose between using this small energy surplus to raise their very low standard of living or postpone present rewards for the sake of future gain by investing the surplus in new industries. The choice is difficult because there is no guarantee that today's denial may not prove to have been in vain. This is so because of the rapidity with which public health measures have reduced mortality rates, resulting in population growth as high or even higher than that of the high-energy nations. Theirs is a bitter choice; it accounts for much of their anti-Western feeling and may well portend a prolonged period of world instability.

How closely energy consumption is related to standards of living may be illustrated by the example of India. Despite intelligent and sustained efforts made since independence, India's per capita income is still only 20 cents daily; her infant mortality is four times ours; and the life expectance of her people is less than one half that of the industrialized countries of the West. These are ultimate consequences of India's very low energy consumption: one-fourteenth of world average; one-eightieth of ours.

Ominous, too, is the fact that while world food production increased 9% in the six years from 1945-51, world population increased by 12%. Not only is world population increasing faster than world food production, but unfortunately, increases in food production tend to occur in the already well-fed, high-energy countries rather than in the undernourished, low-energy countries where food is most lacking.

I think no further elaboration is needed to demonstrate the significance of energy resources for our own future. Our civilization rests upon a technological base which requires enormous quantities of fossil fuels. What assurance do we then have that our energy needs will continue to be supplied by fossil fuels: The answer is--in the long run--none.

The earth is finite. Fossil fuels are not renewable. In this respect our energy base differs from that of all earlier civilizations. They could have maintained their energy supply by careful cultivation. We cannot. Fuel that has been burned is gone forever. Fuel is even more evanescent than metals. Metals, too, are non-renewable resources threatened with ultimate extinction, but something can be salvaged from scrap. Fuel leaves no scrap and there is nothing man can do to rebuild exhausted fossil fuel reserves. They were created by solar energy 500 million years ago and took eons to grow to their present volume.

In the face of the basic fact that fossil fuel reserves are finite, the exact length of time these reserves will last is important in only one respect: the longer they last, the more time do we have, to invent ways of living off renewable or substitute energy sources and to adjust our economy to the vast changes which we can expect from such a shift.

Fossil fuels resemble capital in the bank. A prudent and responsible parent will use his capital sparingly in order to pass on to his children as much as possible of his inheritance. A selfish and irresponsible parent will squander it in riotous living and care not one whit how his offspring will fare.

Engineers whose work familiarizes them with energy statistics; far-seeing industrialists who know that energy is the principal factor which must enter into all planning for the future; responsible governments who realize that the well-being of their citizens and the political power of their countries depend on adequate energy supplies--all these have begun to be concerned about energy resources. In this country, especially, many studies have been made in the last few years, seeking to discover accurate information on fossil-fuel reserves and foreseeable fuel needs.

Statistics involving the human factor are, of course, never exact. The size of usable reserves depends on the ability of engineers to improve the efficiency of fuel extraction and use. It also depends on discovery of new methods to obtain energy from inferior resources at costs which can be borne without unduly depressing the standard of living. Estimates of future needs, in turn, rely heavily on population figures which must always allow for a large element of uncertainty, particularly as man reaches a point where he is more and more able to control his own way of life.

Current estimates of fossil fuel reserves vary to an astonishing degree. In part this is because the results differ greatly if cost of extraction is disregarded or if in calculating how long reserves will last, population growth is not taken into consideration; or, equally important, not enough weight is given to increased fuel consumption required to process inferior or substitute metals. We are rapidly approaching the time when exhaustion of better grade metals will force us to turn to poorer grades requiring in most cases greater expenditure of energy per unit of metal.

But the most significant distinction between optimistic and pessimistic fuel reserve statistics is that the optimists generally speak of the immediate future--the next twenty-five years or so--while the pessimists think in terms of a century from now. A century or even two is a short span in the history of a great people. It seems sensible to me to take a long view, even if this involves facing unpleasant facts.

For it is an unpleasant fact that according to our best estimates, total fossil fuel reserves recoverable at not over twice today's unit cost, are likely to run out at some time between the years 2000 and 2050, if present standards of living and population growth rates are taken into account. Oil and natural gas will disappear first, coal last. There will be coal left in the earth, of course. But it will be so difficult to mine that energy costs would rise to economically intolerable heights, so that it would then become necessary either to discover new energy sources or to lower standards of living drastically.

For more than one hundred years we have stoked ever growing numbers of machines with coal; for fifty years we have pumped gas and oil into our factories, cars, trucks, tractors, ships, planes, and homes without giving a thought to the future. Occasionally the voice of a Cassandra has been raised only to be quickly silenced when a lucky discovery revised estimates of our oil reserves upward, or a new coalfield was found in some remote spot. Fewer such lucky discoveries can be expected in the future, especially in industrialized countries where extensive mapping of resources has been done. Yet the popularizers of scientific news would have us believe that there is no cause for anxiety, that reserves will last thousands of years, and that before they run out science will have produced miracles. Our past history and security have given us the sentimental belief that the things we fear will never really happen--that everything turns out right in the end. But, prudent men will reject these tranquilizers and prefer to face the facts so that they can plan intelligently for the needs of their posterity.

Looking into the future, from the mid-20th Century, we cannot feel overly confident that present high standards of living will of a certainty continue through the next century and beyond. Fossil fuel costs will soon definitely begin to rise as the best and most accessible reserves are exhausted, and more effort will be required to obtain the same energy from remaining reserves. It is likely also that liquid fuel synthesized from coal will be more expensive. Can we feel certain that when economically recoverable fossil [Page:

H938]fuels are gone science will have learned how to maintain a high standard of living on renewable energy sources?

I believe it would be wise to assume that the principal renewable fuel sources which we can expect to tap before fossil reserves run out will supply only 7 to 15% of future energy needs. The five most important of these renewable sources are wood fuel, farm wastes, wind, water power, and solar heat.

Wood fuel and farm wastes are dubious as substitutes because of growing food requirements to be anticipated. Land is more likely to be used for food production than for tree crops; farm wastes may be more urgently needed to fertilize the soil than to fuel machines.

Wind and water power can furnish only a very small percentage of our energy needs. Moreover, as with solar energy, expensive structures would be required, making use of land and metals which will also be in short supply. Nor would anything we know today justify putting too much reliance on solar energy though it will probably prove feasible for home heating in favorable localities and for cooking in hot countries which lack wood, such as India.

More promising is the outlook for nuclear fuels. These are not, properly speaking, renewable energy sources, at least not in the present state of technology, but their capacity to ``breed'' and the very high energy output from small quantities of fissionable material, as well as the fact that such materials are relatively abundant, do seem to put nuclear fuels into a separate category from exhaustible fossil fuels. The disposal of radioactive wastes from nuclear power plants is, however, a problem which must be solved before there can be any widespread use of nuclear power.

Another limit in the use of nuclear power is that we do not know today how to employ it otherwise than in large units to produce electricity or to supply heating. Because of its inherent characteristics, nuclear fuel cannot be used directly in small machines, such as cars, trucks, or tractors. It is doubtful that it could in the foreseeable future furnish economical fuel for civilian airplanes or ships, except very large ones. Rather than nuclear locomotives, it might prove advantageous to move trains by electricity produced in nuclear central stations. We are only at the beginning of nuclear technology, so it is difficult to predict what we may expect.

Transportation--the lifeblood of all technically advanced civilizations--seems to be assured, once we have borne the initial high cost of electrifying railroads and replacing buses with streetcars or interurban electric trains. But, unless science can perform the miracle of synthesizing automobile fuel from some energy source as yet unknown or unless trolley wires power electric automobiles on all streets and highways, it will be wise to face up to the possibility of the ultimate disappearance of automobiles, trucks, [Begin Insert] buses, and tractors. Before all the oil is gone and hydrogenation of coal for synthetic liquid fuels has come to an end, the cost of automotive fuel may have risen to a point where private cars will be too expensive to run and public transportation again becomes a profitable business.

Today the automobile is the most uneconomical user of energy. Its efficiency is 5 percent compared with 23 percent for the Diesel-electric railway. It is the most ravenous devourer of fossil fuels, accounting for over half of the total oil consumption in this country. And the oil we use in the United States in one year took nature about 14 million years to create. Curiously, the automobile, which is the greatest single cause of the rapid exhaustion of oil reserves, may eventually be the first fuel consumer to suffer. Reduction in automotive use would necessitate an extraordinarily costly reorganization of the pattern of living in industrialized nations, particularly in the United States. It would seem prudent to bear this in mind in future planning of cities and industrial locations.

Our present known reserves of fissionable materials are many times as large as our net economically recoverable reserves of coal. A point will be reached before this century is over when fossil fuel costs will have risen high enough to make nuclear fuels economically competitive. Before that time comes we shall have to make great efforts to raise our entire body of engineering and scientific knowledge to a higher plateau. We must also induce many more young Americans to become metallurgical and nuclear engineers. Else we shall not have the knowledge or the people to build and run the nuclear power plants which ultimately may have to furnish the major part of our energy needs. If we start to plan now, we may be able to achieve the requisite level of scientific and engineering knowledge before our fossil fuel reserves give out, but the margin of safety is not large. This is also based on the assumption that atomic war can be avoided and that population growth will not exceed that now calculated by demographic experts.

War, of course, cancels all man's expectations. Even growing world tension just short of war could have far-reaching effects. In this country it might, on the one hand, lead to greater conservation of domestic fuels, to increased oil imports, and to an acceleration in scientific research which might turn up unexpected new energy sources. On the other hand, the resulting armaments race would deplete metal reserves more rapidly, hastening the day when inferior metals must be utilized with consequent greater expenditure of energy. Underdeveloped nations with fossil fuel deposits might be coerced into withholding them from the free world or may themselves decide to retain them for their own future use. The effect on Europe, which depends on coal and oil imports, would be disastrous and we would have to share our own supplies or lose our allies.

Barring atomic war or unexpected changes in the population curve, we can count on an increase in world population from two and one half billion today to four billion in the year 2000; six to eight billion by 2050. The United States is expected to quadruple its population during the 20th Century--from 75 million in 1900 to 300 million in 2000--and to reach at least 375 million in 2050. This would almost exactly equal India's present population which she supports on just a little under half of our land area.

It is an awesome thing to contemplate a graph of world population growth from prehistoric times--tens of thousands of years ago--to the day after tomorrow--let us say the year 2000 AD. If we visualize the population curve as a road which starts at sea level and rises in proportion as world population increases, we should see it stretching endlessly, almost level, for 99 percent of the time that man has inhabited the earth. In 6000 B.C., when recorded history begins, the road is running at a height of about 70 feet above sea level, which corresponds to a population of 10 million. Seven thousand years later--in 1000 AD.--the road has reached an elevation of 1,600 feet; the gradation now becomes steeper, and 600 years later the road is 2,900 feet high. During the short span of the next 400 years--from 1600 to 2000--it suddenly turns sharply upward at an almost perpendicular inclination and goes straight up to an elevation of 29,000 feet--the height of Mt. Everest, the world's tallest mountain.

In the 8,000 years from the beginning of history to the year 2000 AD. world population will have grown from 10 million to 4 billion, with 90 percent of that growth taking place during the last 5 percent of that period, in 400 years. It took the first 3,000 years of recorded history to accomplish the first doubling of population, 100 years for the last doubling, but the next doubling will require only 50 years. Calculations give us the astonishing estimate that one out of every 20 human beings born into this world is alive today.

The rapidity of population growth has not given us enough time to readjust our thinking. Not much more than a century ago our country--the very spot on which I now stand was a wilderness in which a pioneer could find complete freedom from men and from government. If things became too crowded--if he saw his neighbor's chimney smoke--he could, and often did, pack up and move west. We began life in 1776 as a nation of less than four million people--spread over a vast continent--with seemingly inexhaustible riches of nature all about. We conserved what was scarce--human labor--and squandered what seemed abundant--natural resources--and we are still doing the same today.

Much of the wilderness which nurtured what is most dynamic in the American character has now been buried under cities, factories and suburban developments where each picture window looks out on nothing more inspiring than the neighbor's back yard with the smoke of his fire in the wire basket clearly visible.

Life in crowded communities cannot be the same as life on the frontier. We are no longer free, as was the pioneer--to work for our own immediate needs regardless of the future. We are no longer as independent of men and of government as were Americans two or three generations ago. An ever larger share of what we earn must go to solve problems caused by crowded living--bigger governments; bigger city, state, and federal budgets to pay for more public services. Merely to supply us with enough water and to carry away our waste products becomes more difficult and expansive daily. More laws and law enforcement agencies are needed to regulate human relations in urban industrial communities and on crowded highways than in the America of Thomas Jefferson. [End Insert]

Certainly no one likes taxes, but we must become reconciled to larger taxes in the larger America of tomorrow.

I suggest that this is a good time to think soberly about our responsibilities to our descendents--those who will ring out the Fossil Fuel Age. Our greatest responsibility, as parents and as citizens, is to give America's youngsters the best possible education. We need the best teachers and enough of them to prepare our young people for a future immeasurably more complex than the present, and calling for ever larger numbers of competent and highly trained men and women. This means that we must not delay building more schools, colleges, and playgrounds. It means that we must reconcile ourselves to continuing higher taxes to build up and maintain at decent salaries a greatly enlarged corps of much better trained teachers, even at the cost of denying ourselves such momentary pleasures as buying a bigger new car, or a TV set, or household gadget. We should find--I believe--that these small self-denials would be far more than offset by the benefits they would buy for tomorrow's America. We might even--if we wanted--give a break to these youngsters by cutting fuel and metal consumption a little here and there so as to provide a safer margin for the necessary adjustments which eventually must be made in a world without fossil fuels.

One final thought I should like to leave with you. High-energy consumption has always been a prerequisite of political power. [Page: H939]The tendency is for political power to be concentrated in an ever-smaller number of countries. Ultimately, the nation which controls the largest energy resources will become dominant. If we give thought to the problem of energy resources, if we act wisely and in time to conserve what we have and prepare well for necessary future changes, we shall insure this dominant position for our own country. END