PEAK OIL PRODUCTION -- (House of Representatives - December 13, 2005)
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The SPEAKER pro tempore. Under the Speaker's announced policy of January 4, 2005, the gentleman from Maryland (Mr. *Bartlett*) is recognized for 60 minutes as the designee of the majority leader.

Mr. BARTLETT of Maryland. Mr. Speaker, I would first like to thank Congressman *Dingell* for his many years of service to his country. Sometimes there is a young person who is very bright and well-achieved. And it is said of them that they are wise beyond their years. Congressman *Dingell* has served 50 years in the Congress. Before that, he served in World War II. Matter of fact, he is just about a year younger than I, so obviously he is not a really young person. I can truly say of Congressman *Dingell* that he, too, is wise beyond his years.

As a matter of fact, the subject I am going to talk about tonight is better

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understood by Congressman *Dingell*, I think, than any other Member of the House. I remember a conversation with him some time ago, several months ago, when he noted that he did not believe that oil would ever be $50 a barrel again. I spoke with him tonight, and he said, you know, we probably had better hope that it is not ever $50 a barrel again because the only thing that could cause it to drop to that level would be the demand construction that would be precipitated by a world crisis. Thank you, Congressman *Dingell*, for your friendship, and I thank you for your contribution to your country.

The first chart is taken from a publication from a report that was funded by the Department of Energy. I want to make that clear. The principal investigator was Robert Hirsch. He works for SAIC, a very prestigious scientific organization.

``The peaking of world oil production presents the U.S. and the world with an unprecedented risk management problem. As peaking is approached, liquid fuel prices and price volatility will increase dramatically, and, without timely mitigation, the economic, social, and political costs will be unprecedented. Viable mitigation options exist on both the supply and demand side, but to have substantial impact, they must be initiated more than a decade in advance of peaking."

Dealing with world oil production peaking will be extremely complex, involve literally trillions of dollars and require many years of intense effort.

Mr. Speaker, what is he referring to? To put this in context, as the next slide shows us, we need to go back about six decades. Working for the Shell Oil Company was a scientist by the name of M. King Hubbert, and he watched the exploitation and exhaustion of oil fields. He found that they all tended to follow a similar pattern. Oil came freely at first and then reached a peak production, and then, not surprisingly, the last oil from the field, as a matter of fact, roughly the last half of the oil from the field, was more difficult to get than the first half of the oil from the field.

So he judged that if he could add up all of the little fields in the country and the curve that would be produced by the exploitation and exhaustion of that, and these are called bell curves, they are typical curves of phenomena, that he then could predict when the United States would peak in oil production.

He made this prediction in 1956, and he said that the United States peak oil production would occur about 1970, certainly in the early 1970s. Right on target, the United States peaked in oil production in 1970 or 1971.

The smooth green curve here shows what he predicted. The somewhat more ragged curve with symbols shows the accurate data points. You see how closely this is for the lower 48 States. It shows how closely they followed his predicted curve.

The red curve is the similar curve for the Soviet Union. You notice that on the down side, they peaked some years ago, after us, but some years ago, and on the down side, when the Soviet Union fell apart, they lost a lot of production capacity. Now they are going to have a second small peak, but then on down. Russia is now a major producer of oil in the world, but they were in the past a larger producer of oil in the world.

The next chart shows the sources from which our oil production has come.

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And notice that this peak, about 1970, and this curve differ from the previous one in that we have added here the oil from Prudhoe Bay in Alaska. There was a tiny blip on the down slope. Without that oil, there was no blip at all. But in spite of that enormous find in Prudhoe Bay, about a fourth of our total production for a number of years, we still continued our slide down the other side of Hubbert's Peak.

I want to note the yellow there, that is the fabled discoveries of oil in the Gulf of Mexico where there are now, I think, what, 4,000 oil wells. That was supposed to solve our problems with oil for quite some time. Notice the fairly trifling contribution it made. This was a big find. But we and the world use a lot of oil, and that kind of puts it in perspective.

The next chart shows two characteristics of the world. The previous one, the one just removed, we were looking at the United States, and in this one we look at the world. And there are really two curves here, and they are superimposed because that helps us to understand the situation a little better.

The bar graph here, the dark shows the discoveries of oil; and notice that we started discovering a lot of oil back in the 1940s and the 1950s and the 1960s; and after the 1980s, that is 25 years ago, we have had diminishing discoveries of oil. The heavy black line here shows the use of oil. For many, many years we were discovering far more oil than we used. But since about the early 1980s, every year we have used more oil than we found. And until today, and that is at this point, you can see that we are using several times as much oil as we find, maybe four barrels of oil used for every barrel of oil that we find.

Now, of course one can only extrapolate into the future. But if you make reasonable assumptions for what we will find, and that is this curve here, we could find more; we could also find less. But if you look back through the last 20 years, this is a fairly optimistic assumption of what we will find for the next 25 or 30 years.

And then, of course, you cannot pump oil that you have not found. And so the consumption curve, this curve, suggests that that will peak in about 5 years. But the consumption curve must have under it exactly the same area as is the area under the discovery curve, because obviously you cannot pump oil that you have not found.

We will come back to this chart a little later, and we will mention some of the critical relationships here a time or two as we address other points.

Now, there are a number of critics, and the next chart points to the statements that one critic has made. And we will come to the floor, Mr. Speaker, in the future to talk about other critics and the points that they have made, and we will carefully and respectfully address each of the points that they make.

This critic made four comments, four points. And what he said was, if we really understood this, you would not have any concern about peak oil because we are really not facing a problem, in his view.

I am only going to talk about the first one now, and then we will put this chart down here, and we will pull it up after we have talked about this one and then talk about the second, third, and fourth bullet here.

In the first bullet, he says: Simply put, known reserves can produce far more oil if more aggressively drilled, as in the United States.

That is true, and it is not true. As the next chart shows, this shows the relationship between drilling and pumping oil in this country. By 1980, when Ronald Reagan became President, we had already slid 10 years down the other side of Hubbert's Peak; and we knew in this country, and the world knew, that M. King Hubbert had been correct, that the United States had peaked in its oil production.

Mr. Speaker, I wonder why there was not more recognition given to the fact that M. King Hubbert also predicted when the world would peak, which, considering events like a worldwide recession and the oil price spike hikes and so forth, would be about now. I wonder why more people were not concerned that maybe if M. King Hubbert were right about the United States, he might be right about the world. And if he was right about the world, then we really ought to be paying attention to that.

This curve shows the effect of the extra drilling that was encouraged by the tax policy of the early Reagan years. It showed that that had no effect on the amount of oil that we pump, because we went from positive, pumping more oil than we were consuming, to negative, pumping less oil than we were consuming, in spite of the fact that there was a very large spike here in increased drilling.

So depending upon the state of exhaustion of the oil fields, increased drilling may not produce any increased flow of oil. It certainly did not here. In spite of all this increased drilling, we produced relatively less and less oil. Now, it is true that if there is still a lot of oil left in the fields, you could exhaust it more quickly by drilling more wells.

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I think that in this country, Mr. Speaker, we have drilled at least three-fourths of all of the oil wells that have been drilled in all of the world. And the critic was saying if we drilled relatively as many wells in Saudi Arabia as we have drilled in this country, that we could get that oil out more quickly. That may be true. But as we will discover a little later in this discussion, Mr. Speaker, that probably is not a good idea.

There is an old adage that says: If you're in a hole, stop digging. And I think a good corollary to that is, if you are climbing a hill and you know that you will fall off the other side, it is obvious that the higher you climb, the greater the fall will be.

So if there is only so much oil there, if we are able to get it out more quickly now by drilling more holes, then does it not stand to reason that there will be even less oil for the future, and the slope down the other side of Hubbert's Peak will be even sharper?

The next slide shows again a relationship between drilling and the amount of oil that you discover. The red curve here is a hyperbolic model. It approaches in ascentot. It will never quite reach the top because it will go up ever more slowly. And the yellow points here show the actual cumulative discovery of oil. And notice that it follows this very clear ascentotic curve.

What that points to, Mr. Speaker, is that there is probably not a lot more oil in the world that we are going to find. For the last number of years, we have had very good techniques: seismic, 3D modeling with computers. We are really very good now at characterizing the geologic formations in which oil is likely to be found, and we have drilled and exploited all of those that held much promise.

The next chart is another one taken from this very excellent report called the ``Hirsch Report,'' done by SAIC, and funded by our own Department of Energy. This shows the net difference between annual world oil reserves, reserve additions, and annual consumption. And this showed when we flipped over from every year finding more oil than we used to the point that for every year since, what, the early 1980s, as you can see from this chart, the world has found less and less oil than it has pumped.

I would like to now come back to the chart that I showed a few minutes ago because I think that this chart actually shows if you make this curve here a straight line, then that produces the curve that you have just seen. I would like to come back to this and point out that the history of discovery indicates that we probably are not going to have any more really large oil fields discovered. The last of the great oil fields were discovered in the 1980s. And in spite of intense drilling and vastly improved discovery techniques, just about on the average every year since then we have found less and less.

And I would like to point out again something which is very obvious, that you cannot pump oil that you have not found. Now, if you want to change the shape of this consumption curve, and you can change the shape of that curve, if you want to change the shape of that curve and have it ever go up and up, then you are obviously going to have to find a lot more oil.

Now, you can in the short term have it go up somewhat faster if you simply were to drill in Saudi Arabia relatively as many wells as we have drilled in this country. But what that will do, Mr. Speaker, is maybe to extend this curve a bit like this.

But you cannot pump more oil than you have found, so then it will fall off very sharply on the other side. I am not sure that is what our economy needs, and I am not sure that is what the world needs. So I am not certain, Mr. Speaker, that in the absence of finding more oil that it is in anybody's self-interest to find ways to exhaust the oil that we have found more quickly than we are doing it now.

Now, if you believe that just around the corner we are going to find enormous additional amounts of oil, then that might be a supportable philosophy. But I would suggest, looking at this history of our discovery of oil, that it would be very prudent to not use techniques for more rapidly exhausting the oil until you have found more oil, or we are simply going to be building a larger and larger economy in the world that is going to be even more and more difficult to support as we inevitably run down the other side of Hubbert's Peak.

I would like now to put back up the comments of this critic, and we want to look at the second bullet here. There is enough tar and natural gas in the world to fuel the globe for hundreds of years at current rates of consumption. And I should have underlined it there, the ``at current rates of consumption.'' There are two things I want to talk about on this.

The first is that there is a great deal of natural gas and other sources of hydrocarbons in the world. I am not sure that they are economically exploitable. And the second thing is at current-use rates. Let me finish this, and then I will put the next chart up. And that does not include even more massive amounts of coal that could be turned into gas and oil, and indeed it can be turned into gas and oil.

That is the way Hitler ran his country and his military in World War II, because we cut him off from oil and he made oil from coal. As a matter of fact, when I was a little boy, the lamps you now call kerosene lamps we called coal oil lamps. And that is because it was coal oil that first replaced whale oil before we learned how to refine crude oil and make kerosene. So we can do that.

The next chart points to what Albert Einstein said was the most powerful force in the universe. After we discovered nuclear power as a result of his theory of relativity and his contributions, he was asked, Dr. Einstein, we have now discovered this incredible power source, energy source. What will be next? And he said, you know, the most powerful force in the universe is the power of compound interest.

Now, that is an exponential function. What we show here are several curves, and this lower curve here shows a 2 percent growth rate; and the straight line shows, if you extrapolate that out without compounding, that is you do not add this year's growth to the baseline for next year's growth, if you have money and interest and you take the interest every year and do not let it accumulate. But notice how much it grows if you let it accumulate. And this is only a 2 percent growth rate. There is a 4 percent growth rate. Notice how much more quickly it grows. By the way, a 2 percent growth rate doubles in 35 years.

This steepest curve here is a 10 percent growth rate. I would like to remind you that that is pretty much the curve that China is on, and India very close behind them. China, about 9.5 percent; 10 percent growth rate doubles in 7 years. It is four times bigger in 14 years, it is 8 times bigger in 21 years. That is exponential growth.

[Time: 21:45]

Mr. Speaker, if you will do a Google search for Dr. Albert Bartlett, not a relative of mine, but he gives the most interesting 1-hour lecture I have ever heard, and pull up his lecture on exponential growth and energy. He has some excellent analogies to help understand exponential growth.

I will give just one true story from an ancient kingdom where one of the citizens of the kingdom invented chess. The king was so impressed he called his citizen in and said, I will give you any reasonable request for the contribution you make for inventing chess.

The inventor said, I am a simple man with simple needs; Mr. King, if you will simply take my chess board and put one grain of wheat on the first square and double that and put two grains of wheat on the second square and double it and four on the third square and eight on the fourth until you have finally filled all of the squares of my chess board, that is all the reward I would ask. The king thought, silly man, I would have given him a great deal more. No problem.

But had the king understood the power of exponential growth, he would have had to place on that chess board more wheat than the world has harvested in the last 40 years. That is the power of compound growth.

We see that in the next chart that looks at one of these assumptions, and that is that we have a lot of coal. We do. We have 250 years of coal at current use. But if you have to use more of it, and we certainly will have to use more of it as we have less natural gas; today that topped $15 for a thousand cubic feet, the highest ever, and if you increase the use of coal only 2 percent a year and compound that, notice what

happens. It shrinks to about 85 years. That is the power of compound growth. And for much of its use, you will not be able to use coal, you will have to make it, as the critics suggested, into gas and oil, and that takes energy to do that, and so now it has shrunk down to about 50 years.

With just 2 percent growth, we will be really lucky if we can get by with increasing the use of coal only 2 percent, but that now lasts only 50 years. It is there. It is a very valuable resource, and we need to use it, but it is not a long-term solution to our problem.

The next chart shows something which is really very interesting. This shows the current consumption, and it is making an interesting assumption. I would like to pause for just a moment because, in another life, I had a course in statistics, and they give you some probabilities here. That is what statistics is all about, probabilities. They have the 95 percent probability and the 50 percent probability and the 5 percent probability. The 5 percent probability means only 1 time in 20 would you expect that to happen. The 95 percent probability is what is called statistically significant, and 97 percent probability is highly significant.

What they have done here is to take the mean and to assume that is the expected value. No, Mr. Speaker, that is not the expected value. The 50 percent probability means there is 50 percent probability it could be more. There is also 50 percent probability it could be less. What they have done, they say that is the mean. That is really, I think, a major distortion of statistics and reflects a misunderstanding of statistics because it could be just as well less than that as more than that.

But this red curve assumes that there will be 50 percent more. The total amount of oil most authorities believe that was recoverable, and we have recovered about half of it, was about 20,000 giga barrels. That is 2,000 billion barrels. This mean is 3,000. This is roughly the 2,000 here, and the 3,000 is here. Notice, even if you assume, which I think is a very rash assumption, that there will be 50 percent more oil than most of the world's experts believe, notice how little that pushes out the peaking. That is what exponential growth does.

Albert Bartlett uses another interesting explanation of exponential growth. He has a little colony of microbes that are growing in a liter flask and notices that they are doubling every minute. When they are only partially full, they say, we better be looking for more territory because we are soon going to fill up this liter vessel. They send out scouts and find not one or two or three more liters. Wow, three times as much as they now have. That should last them for a long time. Remember, they are doubling every minute.

If they fill their present liter flask at midnight, 1 minute after midnight they fill the second one because they double every minute, and in 2 minutes after midnight, they fill the third and the fourth.

That shows why if we find 50 percent more oil than most of the experts believe is there, that will only push out peak oil those relatively few years. If by some means you are able to extract oil more quickly, like drilling a whole lot more wells or using this enhanced recovery technique, you might push the peak out to 2037, but this curve acknowledges a reality that you cannot pump what is not there. And so now you fall off very quickly, and the area between these two curves is going to have to equal the area between these two curves.

So from a very real perspective, Mr. Speaker, if we are not going to find enormously more oil or gas or coal or large amounts of alternatives, it will not be in the long-term best interest of the world to exploit our present reserves more quickly.

The next chart shows the characteristics that any alternatives will have to be useful because the primary crisis that we face is not just an energy crisis; it is really a crisis of liquid fuels because that is where our economy and the world's economy will be first impacted.

This is an interesting chart, and it has an ordinate and an abscissa. The ordinate is energy-profit ratio. The energy-profit ratio is the amount of energy you have to put in to get out a certain amount of energy, and obviously, the best energy sources will be those where you put in just a little bit of energy, like drilling one well and getting out an awful lot of oil. And the energy profit ratios may be 60 or 80 or 100, and some even 200. That means you get out 200 times as much energy as put into drilling and developing the field.

Now on the abscissa here, we have economic

effectiveness in transport. What that means is how convenient it is to use transport. The source that is the highest in both of these is the giant oil fields. None of those exist in this country. They are all in the Middle East and many in Saudi Arabia. But notice that they have a very high energy-profit ratio and also a very high economic effectiveness in transport.

Our oils were just as effective in transport, so they are way over here in the abscissa. But notice they are much more expensive to get than the Middle East oil. This is 1970, and now they are harder and harder to get, and so now we are down at this point where it is maybe five to one. We put in one unit of energy and get out five units of energy.

Notice where the tar sands and ethanol are. They are really easy to use once you develop them, but you get very little more energy out of them than you put in them.

Over here we have hydro, coal-fired and nuclear, photo voltaics, and they have really improved, and direct use of coal. So any alternative that we are going to develop to replace our current oil for transportation needs to be put on this table, this chart, to see where it fits. It must have a very high energy-profit ratio, and it should have a very high economic effectiveness in transport quotient.

I will return now to the next of these points made by the critic. He says we have just produced the tip of the shale gas iceberg, and the likely resources in the U.S. are vast. What he is saying is, do not worry about energy; there is absolutely an enormous amount of energy in these shale gases. What they are, are gases trapped so tightly in shale that the only way to get them out is to drill a well and then to put sand and water in that well under a very high pressure, kind of an explosive pressure that fractures the rock and pushes the sand in between the levels of the shale so the gas can now come out. Yes, there is a lot of gas there, and you can get it out by doing that, but it is quite expensive. It is one well for every one relatively small area of the reservoir where this gas is trapped.

What I want to show now is a number of potential sources of energy. As we run down the other side of Hubbard's peak, we are going to have to turn to other sources of energy. Some of those are finite like the tar sands and the oil shales and the shale gas that he was talking about, and coal and nuclear fission and nuclear fusion. I guess the nuclear thing ought to be put in a category kind of by itself because if you are talking about the light water reactors and fissile uranium, you are talking about a finite source. If you are talking about nuclear fusion, and I support all of the money that that technology can absorb, but I do not think that it is likely in any timely manner that we are going to have economically viable fusion to produce power. The general estimates are, in 30 to 50 years, that technology may have matured to where you will be using electricity produced by fusion. That is what happens in the sun and in the hydrogen bomb.

If we were to go to breeder reactors, they are pretty much sustainable, and they would not be finite, so nuclear is in a category by itself. We need to exploit all of these areas, but the energy-profit ratio is very low for those.

Let me give an example of an enormous amount of energy, and we really would have no energy problem if we just could harness that energy. It is called the tides. Every day, the moon lifts all of the oceans about 2 feet. I just pick up two 5-gallon buckets of water, and they are pretty heavy. Can you imagine the amount of energy it takes to lift the oceans 2 feet every day? The oceans are three-fourths of the earth's surface. If we just could capture that energy, we would be home free. But the problem is the energy-profit ratio is very low. There is a lot of energy there. It is very disbursed, very diffuse, very hard to harness, and we still try.

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Ocean thermal gradients are another potential source. Here are some potentially enormous sources of energy.

Solar. If we paved our desserts with solar cells, we would have all of the energy we needed. That is a big if. It is about as big an if as getting all of this gas out of the gas shales.

Wind. If we put a wind machine every place the wind was blowing, we would produce incredible amounts of energy, but it is very diffuse, very expensive to build them, and it would take a long time to build enough of them to make any real difference.

Geothermal. If we just drilled down deep enough to tap into the molten core of the earth, there is essentially inexhaustible energy there. But again, the energy-profit ratio, except for a few places where the crust is thin, is very high, and so we are not doing that.

I would like just a word of caution about energy from agriculture. I am a big fan of energy from agriculture, but you must recognize its limitations.

[Time: 22:00]

We barely are able to feed the world. Now, you would not believe that by looking at many Americans, but tonight maybe a fifth of the world will go to bed hungry. And so if we are going to take what would otherwise be a food crop like corn or sugarcane and use it for energy, then we have to ask the question, How will we feed the world?

Another caution about energy from agriculture. A lot of the sources of energy are from what is called cellulose or agricultural waste like beet pulp and corn fodder and soybean stocks and switch grass. Now, all of these things are organic. All of them, in one way or another, by sheet composting or some other composting techniques, are returned to the soil to help make what we call top soil. And topsoil is different from subsoil because it has organic material in it that supports life, and it has a quality which we call tilth which is not there if you take the organic material away.

To rob our topsoils of organic material will be the exact equivalent of mining them. You may get away with it for a year or two or a few, Mr. Speaker; but in the long run, unless you husband our topsoils, we will not be able to continue to grow the food we need.

Now, there are potentials for getting energy from agriculture. But they are going to necessarily be limited by our need to feed the world and our need to maintain our top soil. I just heard the other day that for every bushel of corn that we produce in Iowa, three bushels of topsoil go down the Mississippi River. So in spite of no-till farming and the other advanced techniques we have, we still have a problem holding our topsoil.

Here is a great one: waste to energy. Up here in Montgomery County there is a facility that burns waste to produce electricity. I would be proud to have my church next to it or live next to it. You would think it is an office building from the front. The waste comes in in big containers on the back of trucks or trains, and you do not even see it. It is really quite an engineering marvel. We are producing some energy that way. We could produce more and probably should produce more.

The last bullet here: hydrogen. Hydrogen, Mr. Speaker, is not an energy source. Hydrogen is simply a convenient way, and sometimes not all that convenient way because of what it is, an explosive gas. But it is a way to move energy from one place to another. If you think of it in terms of a battery, then you get the notion of where hydrogen is going to fit into our economy. It is a good idea, because when you finally use the hydrogen, it produces, well, we say no pollutants. It produces a little bit of heat. And it produces water, but you know that is really no pollutants compared to what we get from the internal combustion energy in burning gasoline or diesel fuel.

And you can now use it, not in an internal combustion engine, but if we ever perfect them, we can use it in a fuel cell which gets at least twice the efficiency of the internal combustion engine. So you are now burning something, using something that produces, at the point of use, essentially no pollutants, and which produces about twice the net energy output that you can get by burning it in a combustion engine. So it is a good idea, but fraught with problems because if you are going to carry it as a gas, you have to really compress it, a big thick vessel, the lightest element we have, gas molecules just wanting to separate themselves and get out of there, so you have to have a big heavy vessel to contain it.

If you want to liquify it, it is very cold, a lot of insulation, again a big problem. And the experts believe that if it ever becomes a part of our economy, that it is going to be in a solid state form, in other words, a hydrogen battery. So if you will think of it as something maybe quite better than the electron battery that you have in your car, but very similar to that because it is simply something that takes energy from one place, a nuclear power plant for instance, producing electricity that is then used to split water and produce the hydrogen, taken to another place where you use it like using it in your car.

The next chart shows the details on one of these possible alternatives, and that is ethanol. And on the right, we show there the energy balance in getting gasoline from fuel oil. And it shows there that you must start out with 1.23 million BTUs of fossil energy to produce 1 million BTUs. That is quite reasonable. You have got to drill for the oil. You have got to transport it. You have got to refine it. You have got to haul it to the service station. You have got to pump it out. That all takes energy, and so you put in 1.23 units and you get out 1 unit of energy.

Now, when it comes to corn, to ethanol, which you get from corn here, you start with solar energy. So you would expect that there is going to be some contribution of solar energy. And this, by the way, I am told by some people, is quite optimistic because Dr. Pimental believes that the usual ways of producing ethanol use more energy than you get out of the ethanol because of all of the applications of fossil fuels to building the farm equipment, plowing the ground, putting the corn in, harvesting the corn, that if you account for all the fossil fuel inputs, he says with the usual techniques you use, you get less energy out of the ethanol than you put in growing the corn.

But I think we will do better than that, and we may get to this goal, and that is, you put in .74 units of energy, and you get out one. Well, that is not a really big energy-profit ratio. You would probably never drill an oil well if that is all you got out of it. That is a very low energy-profit ratio. But it is one of the things that we will need to turn to.

The bottom little pie chart here shows something that will stun most people. Notice the big purple, nearly half segment of that circle. That is the energy that goes into producing corn from natural gas producing the nitrogen fertilizer. Very few people know, Mr. Speaker, that essentially the only source today of nitrogen fertilizer is natural gas. When natural gas is gone, we are going to have to find another big energy

source to produce nitrogen fertilizer.

By the way, before we learned how to do that, the only source of nitrogen fertilizer were the barn yard manures. We still have those today, but they do not go very far with the enormous agricultural lands we have, and guano. Guano were the droppings of bats and birds over thousands of years in the tropical islands on the cliffs and the bat caves, and there was a generation ago a major industry of mining guano. If we wait another 10,000 years, there will be some more guano.

If you look at this circle, you will see the contribution of oil and gas and natural gas to producing corn. It is hydrocarbon, very energy intensive. Almost literally, Mr. Speaker, the food you eat is gas and oil. If it were not for gas and oil, you would not be eating that food.

The next chart kind of puts this challenge in perspective, and the analogy I like to use here is that we, in our country, are very much like the young couple that had their grandparents die and left them a big inheritance. And so they have established a lifestyle where 85 percent of all the money they spend comes from their grandparents' inheritance, and only 15 percent comes from their earnings. And they look at the rate they are spending it and at the size of their grandparents' inheritance, and it is going to run out a long time before they retire.

So obviously this young couple is going to do one or both of two things:

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either they are going to have to spend less money, or they are going to have to make more money. And I use that 85/15. Others will tell you it is 86/14, not quite as good as the 85/15, because this is exactly where we are in energy use in our country. Eighty-five percent of the energy we use comes from natural gas, today at the highest price ever, over $15, and oil and coal. And only 15 percent of it comes from other sources. A bit more than half of that 15 percent, 8 percent of it, comes from nuclear. It is 20 percent of our electricity, but only 8 percent of our total energy production.

As you drive home tonight, Mr. Speaker, every fifth house and every fifth business would be dark if it were not for the electricity produced by nuclear power. And here we have blown up the 7 percent of renewable energy. Now, as we run down the other side of Hubbert's Peak, and as we exhaust, as we surely will, in time, the fossil fuels in our world, this is what we will have to deal with, nuclear and renewables. Look at what these renewables are. Conventional hydro. Nearly half of it. We have tapped out in our country. We might get some microhydro, but the big stuff we have dammed up all the rivers we should have and maybe a few that we should not have.

Second largest contributor: wood. That is the paper industry and the timber industry, wisely using what would otherwise be a waste product.

And then burning waste. I mentioned that in a former chart, and that is 8 percent now. That is 8 percent of 7 percent. That is not a lot, by the way. That could grow and should grow.

And then we get down to the things that we increasingly will have to rely on. Now, this is the 2000 chart, and things like solar and wind have been growing at 30 percent. Mr. Speaker, that doubles in about 2 1/2 years. It is four times bigger in 5 years. So this is 5 years later. So let us say it is four times bigger. So instead of being .07 percent, that is what 1 percent of 7 percent is, is it not, .07 percent, instead of being .07 percent, it is .28 percent. Big deal. A little over one-fourth of 1 percent.

Now, eventually we will have to be getting a major proportion of our energy from such things as solar and wind and agricultural. Today they are trifling amounts. And it takes quite awhile to ramp these things up and a lot of investment. It takes investments of both time and energy and also money.

The next chart, I think, is one that puts in perspective what we are talking about better than perhaps any other chart. And I want to look at the top here. The bottom of it, by the way, we simply, for a short time period, explode the petroleum and natural gas. They are joined here, and it is a little better to see them together. But this shows the history of the world from 1600s on, and it shows the Industrial Revolution that began with wood and we were making steel when we were using charcoal from wood.

And then it shows what happened with coal and how much more energy on the ordinate here is quadrillion BTUs of energy. Notice what happened when we found oil and gas. It exploded. That is the result of exponential growth. That is 2 percent exponential growth.

Now, it is very steep because we have really compressed the abscissa here. And the previous charts, we will show another one that shows it in a big spread out curve like this. But that is spreading out only a few years. If you expanded this abscissa, that curve would look like that.

And by the way, the world's population has generally followed this. We started out with about a billion people, more or less here. And now we have 7 billion people.

Mr. Speaker, we are about 100 to 150 years into the age of oil. It is probable that we are halfway through the age of oil. I would submit that when we found that incredible wealth under the ground, that we collectively, our country and all the other countries in the world, should have stopped and said, gee, what will we do with this? Now, this was incredible wealth. Let me give you a couple of examples of what this meant. One barrel of oil, the refined product which you can buy for less, about a hundred dollars, will give you the work output of 12 people working all year for you. Imagine how far 1 gallon of gas or diesel fuel will carry your car and how long it would take you to pull your car or SUV or truck that far. You get some idea of the quality of energy, of the energy density in these fossil fuels.

If you worked really hard all day long at manual labor, I will get more work out of an electric motor with less than 25 cents' worth of electricity. That is the quality of this wealth that we found. What we should have done is say, gee, what will we do with this, so that mankind, for now and for the future, will benefit most from this incredible wealth that we found under the ground. We did not do that. What we did, we collectively, the whole world, what we did was to pile in and exploit this just as quickly and irresponsibly as the kids who found the cookie jar.

We really, Mr. Speaker, should have taken note--what will we do with this incredible wealth so that it will do the most good for the most people for the most time? In another 100, 150 years we will be through the age of oil, and 5,000 years of recorded history will be just a blip on this long screen. What will our world be like when we have run down the other side of Hubbert's Peak, when we have exhausted the natural gas, when we have converted the coal to gas and oil and used that?

[Time: 22:15]

What will we feed our people, 7 billion people now?

The next chart shows some of these characteristics. This shows kind of the energy density quality. These are gigajoules per ton. A joule is a measure of energy. It is a scientific one that most people do not use in their usual discussions, but it shows here, we start with crude oil, and it gets better and better as we refine it. And then the things that we are going to have to replace it with, domestic refuge, brown coal, that will be gone. Straw, dung. We do not burn much dried dung in our country. In some parts of the world, they cook their meals and warm their houses with dried dung. Wood. Black coal, that will be gone. When we are through the age of oil, we will have used the coal. Ethanol, it does not look at all that bad here, does it? Way short of the energy density of these hydrocarbons from fossil fuels but better than most of these other things, many of which will be gone anyhow by that time. This speaks to the challenge that we have.

Let us put the critics chart back up again. And the fourth one here, By the time we are close to peaking out on all of the types of hydrocarbon molecules which can be refined into oil, a host of competing fuel technologies will have overtaken hydrocarbons altogether, using technologies that no one can anticipate today.

I hope he is right. I hope he is right. I also hope that everybody who has played the lottery today is going to win. Obviously, only one out of the millions who played it is going to win. And I think the odds of this happy scenario happening are roughly the same odds that you or I, and I do not play the lottery, but if I did, the odds of my winning the lottery. What could it possibly be?

I would submit that we need to be very careful how quickly we exhaust the resources we have until we are sure what these miracle replacements are going to be. Once they are out there and definable and achievable, then, yes, okay. But short of that, we really need to husband what we have so that we can make this transition as smooth as possible.

The next chart are some quotes that I would like to spend just a moment on because I think they are so significant. Again I would like to emphasize, this is a report that was funded by our Department of Energy, done by the very prestigious SAIC, Dr. Robert Hirsch, a real authority that headed this, and let me read what they said: World oil peaking is going to happen. No wishful thinking will avoid it. It is going to happen. World production of conventional oil will reach a maximum and decline thereafter. It happened in our country. King Hubbert predicted it. Why will it not happen in the world? It will happen in the world. The only question is, when it will happen? Predicting the peaking is extremely difficult because of geological complexities, measurement problems, pricing variations, demand, elasticity, political influences. Peaking will happen

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but the timing is uncertain. Most of the authorities believe that it will be within the next decade: Oil peaking presents a unique challenge. And then I emphasize here, The world, he says, has never faced a problem like this. And the first chart, it said, unprecedented challenges. Never have there been challenges like this. Without massive mitigation, more than a decade before the fact, the problem will be pervasive and will not be temporary.

Previous energy transitions, wood to coal and coal to oil, as we just looked at, were gradual and evolutionary. Oil peaking will be abrupt and revolutionary, he says.

In our closing moments, I would like to just show some of the things that they were doing. What they have done is to simplify this bell curve to make it a little triangle because they want to use that to depict the solutions that they are suggesting are possible. On the bottom here is an interesting one, and what it shows is that oil price spike hikes have not made any difference in the amount of oil that is available.

This is the production of oil, and this is price spike hike. If making more profit because it sells for more would stimulate production, then one would have thought we would see a big production peak follow this. Notice we do not really see any big production peak following that.

Now, they have simplified this bell curve, and the next chart shows the reason why. This is just a little schematic, and they have a number of alternatives that they could use to fill the gap. The gap is going up like this, and then it is going to fall off, and we would like it to keep on going up so we could keep using more and more, and these are things we would fill the gap with.

The next chart shows what happens if we wait until it happens. Then we have a major, major economic problem because it takes quite a while to get these things going. If we anticipate it by 10 years, we have less of a problem but still a problem. To not have a meaningful problem, we must anticipate it by 20 years. Clearly, we have probably passed that point. By most people's reckoning, we have passed that point.

The next chart is a little schematic that I think shows it very well. This, again, is a 2-percent curve. This is a schematic curve, and what it shows is a 2-percent increase in the rate at which we are using it, which has been the rate at which we are producing it. That will slow as we reach peak oil. And notice that the gap starts to occur before we reach peak oil.

I would submit, Mr. Speaker, that what we do not want to do is to try to meet the challenge of filling that gap because, if we do, we only have a really sharp decline on the other side. What we really need to do is to depress our use with conservation efficiency so that we have something to invest in the alternatives that we must invest in. With oil at $60 a barrel, obviously there is not as much as we would like to have or it would be cheaper.

I would like to close by putting up again this chart which I think is so significant. This is kind of a global long-term look at the problem. This is where we are, about halfway through the age of oil. Now, we have been as a world and as a country, as a society, rather grossly irresponsible up to this time.

Mr. Speaker, whether we like it or not, oil will peak. We will start down the other side. We will shift to the alternatives. That will be a much less traumatic transition if we plan for it. And my urging tonight is that we need in our country to address this problem with the kind of an overall commitment we had when we fought World War II, and I lived through that, with the kind of a technical commitment we had to putting a man on the moon and the kind of urgency we had in the Manhattan Project. Mr. Speaker, I think that if we have a national, an international program that has those elements in it, that we probably can have a relatively smooth landing. Minus that, it could be a very rough landing not just for us but for all of the world.

Mr. Speaker, the great ingenuity of the American people cannot be harnessed, and I hope that we can challenge them so that we will meet this challenge and have a relatively smooth transition.

ENDS