Congressman Roscoe Bartlett
Congressional Record
THE PEAKING OF WORLD OIL
House of Representatives
February 8, 2006

@9:15 pm

[Page: H207]

- - -

The SPEAKER pro tempore (Mr. *Campbell* of California). Under the Speaker's announced policy of January 4, 2005, the gentleman from Maryland (Mr. *Bartlett*) is recognized for 60 minutes.

Mr. BARTLETT of Maryland. Mr. Speaker, sometime ago, our Department of Energy commissioned a study with SAIC, Science Applications International Corporation, to do a study on the peaking of world oil production, impacts mitigation, and risk management. This very prestigious scientific organization took some time to complete this study; and when they completed it, they made a recommendation to the Congress and to the Department of Energy. Part of what they said in their recommendation is included here:

Robert L. Hirsch's Peaking of World Oil Production: Impacts, Mitigation, and Risk Management

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 sides, 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.

``The peaking of world oil production presents the U.S. and the world with an unprecedented risk management problem.''

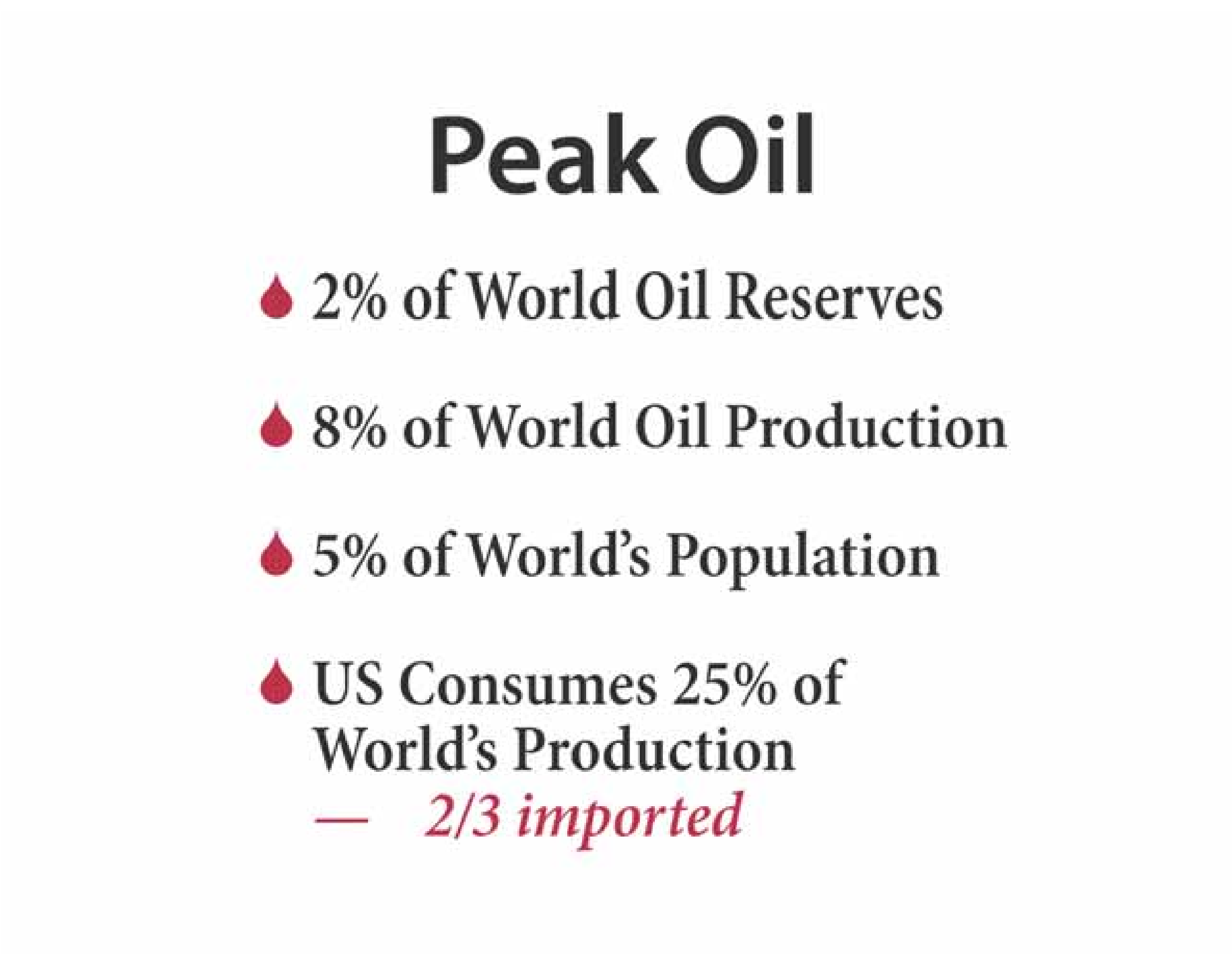
That is quite an adjective to use. No risk problem like this ever in the history of the world is what they are saying: ``..... unprecedented risk management problem. As peaking is approached, liquid fuel prices and price volatility will increase dramatically. And without timely mitigation, the economic, social, and political cost will be unprecedented.''

Again, Mr. Speaker, they are pointing out, and they will use these words in a chart I will have a little later, that the world has never faced a problem like this.

``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.''

When will peaking occur? Do we have a decade? And they are saying if we do not have a decade, we're going to have problems. Dealing with world oil production peaking will be extremely complex, involve literally trillions of dollars, and require many years of intense effort.

Our next chart, which speaks to the same phenomenon, inspired 30 of our leaders, Boyden Gray, McFarland, James Woolsey, and about 27 others, many of them four-star retired admirals and generals, to write a letter to the President.

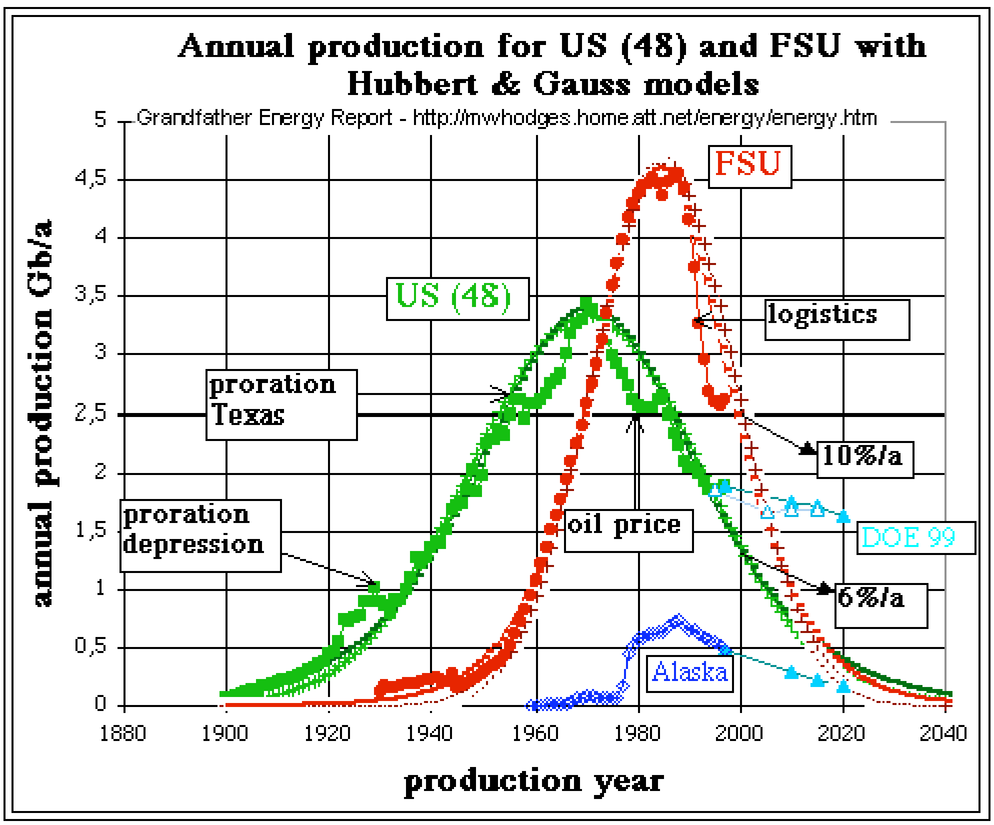


In that letter they said, Mr. President, the fact that we have only 2 percent of the world oil reserves, that we use 25 percent of the world's oil, and we import almost two-thirds of what we use represents a totally unacceptable national security risk. Mr. President, we need to do something about that.

Two other numbers here are of significance. We represent a bit less actually than 5 percent of the world's population, about one person out of 22. And in spite of the fact that we have only 2 percent of the world oil reserves, we produce about 8 percent of the world's oil. We need to keep this in mind for some of the later charts we are going to show, because what this means is that we are pumping our little reserves, only 2 percent, four times faster than the rest of the world.

If we were pumping it as fast, with 2 percent of the reserves, we would be producing 2 percent of the production; but we are producing 8 percent. So if the world is going to run into trouble with decreasing amounts of oil, Mr. Speaker, we are going to get there first because we are pumping our oil more rapidly.

How did we get here? The next chart speaks to that, and we need to go back about six decades.



(FSU) – Former Soviet Union

There was a scientist by the name of M. King Hubbert, who worked for the Shell Oil Company; and he noted the exploitation and exhaustion of individual oil fields. We would find an oil field, we would start pumping, and the oil field would reach a maximum production. And then after the maximum production, at about half of its total ultimate production, it would start falling off. No matter how hard they pumped, it would produce less and less oil, until finally the field petered out.

He rationalized that if he knew how many oil fields there were in the United States and roughly what their reserves were, and if he could predict how many new oil fields the United States would find, he could then add up all these little bell curves and he would get a big bell curve which would tell him when the United States was going to peak in oil production. So he did that in a paper in 1956, and he wrote in that paper that with this analysis he predicted that the United States would peak, and that was the lower 48 at that time, that the United States would peak in oil production and consumption of our own oil about 1970.

Right on schedule, and some authorities will say 1970 and some will say 1971, but as this chart shows, the smooth green curve here was his prediction peaking about 1970, and the more ragged large green symbols represent the actual production, which pretty much followed his curve. And it did peak, as you can see, at about 1970; and it has been downhill since then.

By 1980, we knew very well that we were downhill, and the early Reagan years provided a lot of incentives for drilling. There were a lot of oil wells drilled in our country. Notice the tiny increase from that. It simply brought us back to the curve that had been predicted by M. King Hubbert.

Now, the red curve here is the curve for the Soviet Union. They had more oil than we, and they peaked higher than we. And when the Soviet Union fell apart, you see that they broke away from the predicted decline. They are now going to have a second little peak here, and then it will be falling off. They will never get back to their earlier peak of oil production.

The next chart shows some detail about where our oil has come from through the years.

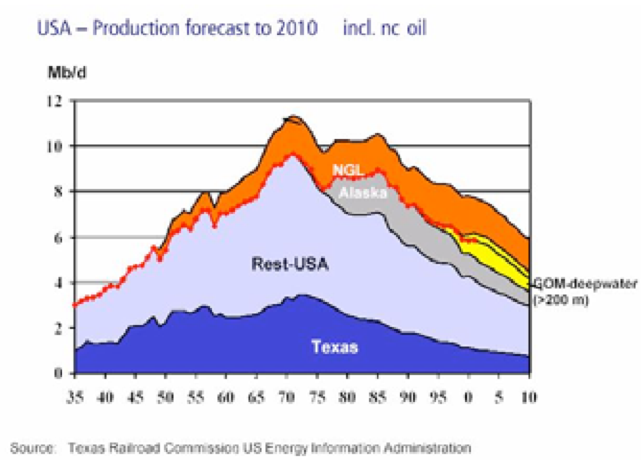


Figure 4: The future oil production profile for the declining oil regions of Texas and Rest of the USA is controlled simply by the physics of depletion, allowing a straightforward extrapolation of existing trends.

And if you are looking only at the lower 48, you are going to be following this curve. And if you add to it the liquids that we are getting from gas, you will see that it still followed Hubbert's curve. It peaked in 1970 and then fall off.

But we found a lot of oil in Alaska. As a matter of fact, I have been there, Mr. Speaker, at mile zero, at Dead Horse, Prudhoe Bay. And through that pipeline has come for the last several years a fourth of all of our domestic production. But notice that in spite of that enormous find of oil in Prudhoe Bay, there was just a little blip on the downside of Hubbert's peak.

This yellow here on the chart is very interesting. That, you may remember, Mr. Speaker, was the fabled Gulf of Mexico oil discoveries. I remember how that was hyped. That was going to save us. There was plenty of oil there.

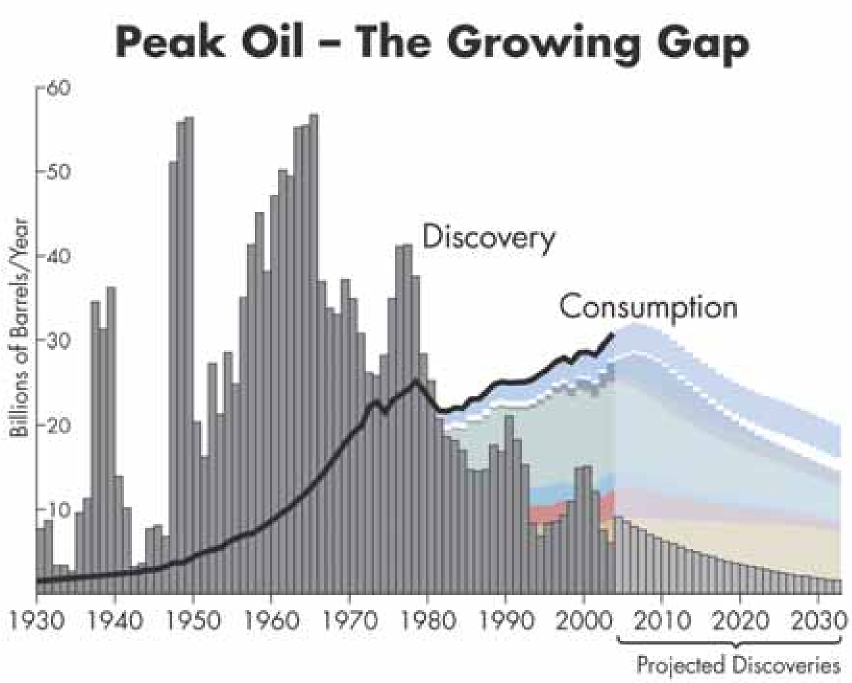
That was all it did, Mr. Speaker. It hardly slowed us down. In terms of the total amount that we were producing,

[Page: H208]

you can hardly see any effect of the Gulf of Mexico oil discovery.

We were thinking about that discovery and those wells in the recent hurricane. There are 4,000 wells in the Gulf of Mexico. By the way, Mr. Speaker, that is about 10 times as many wells as there are in all of Saudi Arabia. We have about 530,000 oil wells in our country, about 80 percent of all the oil wells drilled in all the world. Maybe that is why we are able to produce oil from our reserves relatively four times faster than the rest of the world.

The next chart looks back through history, and it shows two things.



It shows two curves, one superimposed on the other. One of the curves is the discovery curve, and this shows when we found the big oil fields starting way back in the 1930s, and then a lot of them in the 1940s, and some big oil fields found in the 1950s. But notice that this follows kind of a curve like so, and it peaks at about 1970, and it has been falling off ever since that. In spite of very large profits from the oil companies, they are not finding much more oil.

I might note, Mr. Speaker, that the profits for the oil companies was inevitable. They do not set the price of oil. Chevron and BP and ExxonMobil, they do not set the price of oil. The price of oil is set by you and me and all the other roughly 7 billion people in the world who use oil.

[Time: 21:15]

We set the price by our demand relative to the supply. As supply has fallen off in the last several years, the price has gone up. Oil companies that were making money at $25 a barrel, how much more money do you think they will make when oil is $65 a barrel? We should not be carping about how much money they make; what we should be looking at is how responsibly they use the profits they make.

Some of those profits need to be invested in finding new oil fields, but the experts do not think there is much more to find.

Several Congresses ago I was chairman of the Energy Subcommittee on Science, and I wanted to determine the dimensions of the problem. We had the world's experts in to talk about how much oil is out there that we can realistically pump. There was general agreement, quite surprising agreement, that it is roughly 1,000 gigabarrels. Giga is used because in Europe a billion is not our billion so if you say billion, not everybody will understand it. So giga means a billion, and it means the same thing around the world.

A thousand gigabarrels is about a trillion barrels of oil. That may sound like a lot, but it is about the amount of oil that we have pumped so far in all of history. If you divide the 84 billion barrels a day that we are using today into that trillion barrels of oil, it comes out to about 40 years. Most of the experts believe we have found about 95 percent of all of the oil we will find. We now have very sophisticated seismic techniques with 3-D computer modeling. This is what they believe will be found, this gray-shaded area over here. It is not going to follow that smooth curve, but on average that is how much they think we will find.

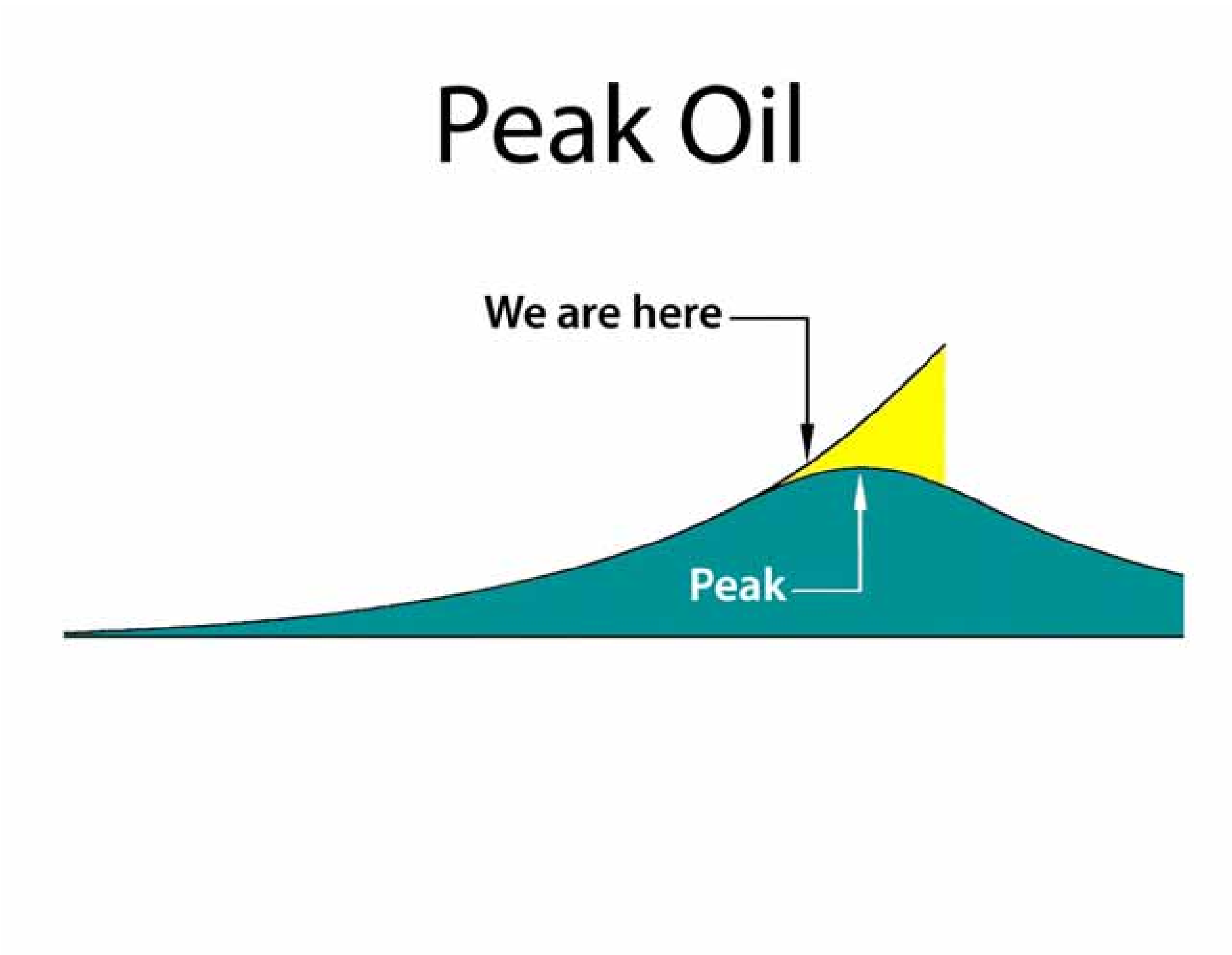
The solid black line here represents the amount of oil we have been using. Up until about 1980, we always found more oil than we were using. There was always a big reserve out there. Since 1980, we have found less and less oil, and we have been using more and more oil. We have been able to do that because we are now using up some of these reserves we found before.

All of the oil that we can use has to be all the oil that is there. If you have not found it, you cannot pump it. So you make your own judgment how much oil you think we are going to find in the future, then you add that to the reserves back here. That is going to be the area under this curve from now on.

By the way, this 40 years that I mentioned, that is not a plateau. You do not plateau out for 40 years and then fall off a cliff. It is going to follow that typical bell curve of every oil field. By the way, 33 of the top 45 oil-producing countries have now peaked. It is only a few that have not peaked.

What will this curve look like from here on? We can change the shape. If we use some of our good recovery enhancement techniques, we can pump oil a little faster, and we may pump a little more, so we may get a little more out of these fields than depicted here. This is not all of the oil in the fields because probably half of the oil there will not get pumped because it is so difficult to get, it is going to cost more energy to get the oil than you get out of the oil. So you get to the point of you stop getting the oil. As the old farmer said, at that point ``the juice ain't worth the squeezing,'' so we stop trying to get oil at that point.

The next chart shows a simple schematic that depicts the problem and where we are.



Everybody may not agree this is where we are. Most of the people that have thought about peak oil think we are here or will shortly be here. This is a 2 percent growth curve. With 2 percent growth, that doubles in 35 years. This point is twice that point, and so this is a 35-year period from here to here.

Notice what this chart points out is that you start having a problem before peaking because the exponential use curve, the demand curve keeps going up like this, whereas when we reach peak oil, it will of necessity level off, and then no matter what we do, it will inexorably go downhill after that. It does for individual oil fields. It has for the United States.

By the way, the same M. King Hubbard that predicted we would peak in about 1970, he was right on. He predicted that the world would peak about now. If he was right about the United States, maybe he is right about the world, and maybe we should have been paying some attention to that.

I would submit that we have now, in common parlance, we have blown 25 years when we knew very well M. King Hubbard was right about the United States. If he was right about the United States, would not it have been prudent to recognize that maybe he just might be right about the world? If he is right about the world, the world is about to peak in oil production now, then we should have been doing something during these last 25 years so this would be a smoother transition.

The next chart shows us the alternatives.

- Potential Alternative Solutions
  - Finite Resources:
    - Tar Sands
    - Oil Shale
    - Coal
    - Nuclear Fission
    - Nuclear Fusion
  - Renewable Resources:
    - Solar
    - Wind
    - Geothermal
    - Ocean Energy
    - Agricultural Resources:
      - Soy/Biodiesel
      - Ethanol
      - Methanol
      - Biomass
    - Waste to Energy
    - Hydrogen from Renewables

As the world peaks in oil production, we are going to have to, first of all, turn to some finite resources, and we are now doing that. I will chat for a moment about those. And those will not last forever. They are finite, as the word implies, except for nuclear, which is kind of different. The only nuclear that is finite is light water reactors that use fissionable uranium. If we go to breeder reactors, as the term implies, you make more fuel than you are using, and that could go on and on. You have to accept the problems you buy there with the enrichment and moving fuel around that could make bombs and so forth.

Of course, the one thing that gets us home free is nuclear fusion. If we could harness the kind of energy that the sun sends down to us every day, we are home free. But, Mr. Speaker, the odds of our doing that are a bit like you or me solving our personal economic problems by winning the lottery. That would be nice, and by the way, I do not play the lottery, but I do not think that rational people count on solving their economic problems by winning the lottery, and neither do I think that we should count on solving our energy problems of the future by nuclear fusion. That does not mean I do not support it. I vote every year for all of the money, $250 million or so, that we put into that, because we have to try. If we do not successfully harness nuclear fusion, we have a really challenging road ahead.

Let us look at these finite resources and what kind of potential we can expect from them. There is a lot of suggestion today about the tar sands up in Alberta, Canada. There are enormous reserves there. The reserves there are at least as large of all of the oil reserves in all of the world. Then what we are worrying about? Well, because it is there does not necessarily mean that we can harness it in enough quantities or soon enough to really make a big contribution.

As an example, Mr. Speaker, every day the Moon goes around the Earth roughly in a day, and it lifts the oceans about 2 feet. That is an incredible amount of energy. I carry two gallon buckets of water and lift them up, that is a lot of energy. If we could harness the energy of the tides, we would be home free. There is an old adage that says energy to be effective must be

[Page: H209]

concentrated, and because those tides are spread out over all of the oceans of all of the world, it is difficult to harness them.

The tar sands are a little like that. There is an incredible amount of energy there, and the Canadians are working very hard at harnessing that. Let me see if I can remember the numbers. I think they have a shovel in Alberta, Canada, that lifts 100 tons at a time and dumps it into a truck that carries 400 tons, and I think those are the right numbers. It carries them to a place where they are cooked, because the oil in those tar sands is a bit better, but kind of like the oil in your asphalt road. If you put a blow torch on an asphalt road and mix it with some lighter fuels, it will flow. That is kind of like what we are doing with the tar sands. They are working very hard, and they are producing a million barrels a day. We will talk in just a moment about energy profit ratio. They are making a lot of dollars doing that because it costs them less than $30 a barrel to make it. The oil is now bringing $60-some a barrel, so the dollar-profit ratio is up there. They are using, I have heard, maybe more energy from natural gas to produce the oil than they are getting out of the oil. That makes good sense for them because they have natural gas there, and it is hard to ship, and it is relatively cheap, and the oil is easy to ship and in high demand at $60-some a barrel.

Mr. Speaker, by the end of the day, we really need to be thinking about energy profit ratio because that is what will be telling. They are now producing a million barrels a day, and if they work real hard, they will be producing 2 million barrels a day in 5 years. Big deal.

The world today is using 84 million barrels a day, and if they work really hard, 10 years from now they will be producing 3 times as much as today, 3 million barrels a day, but the world would like to be using another 40 million barrels a day. I do not think it will be there, but if you project our current demand for those 10 years, we would like to be using another 40 million barrels of oil, and they will be producing another 2 million barrels of oil, \1/20\ of the additional oil the world would like to use. Although there is a lot of energy there, and I am sure that we will find techniques to get it out that have some energy profit ratio so there will be energy there for a long time, but it is not going to be available anywhere near the quantities needed to meet the needs of contending with the crisis that will occur with peak oil.

Now, the oil shales in our country are very much the same thing. Recently you may have read of an experiment out in Colorado. I think it was Shell Oil Company that devised a new technique for getting the oil out of the oil shales, which is like the oil in the tar sands. It is very thick and will not flow.

What they did to avoid polluting the groundwater was drill a series of holes in a circle, and then they froze the ground because the oil will not move through frozen ground. Inside that frozen vessel, if you will, they cooked and cooked it for a year. They put steam down and cooked it for a year. After that year, they started sucking on the oil, and for another year they cooked and they sucked, and they got a pretty meaningful amount of oil out of that.

There is an awful lot of oil in the oil shales, maybe about as much as in the tar sands, but the scale, scaling up for this is incredibly difficult. I am not sure what the energy profit ratio is, because if you have to freeze the perimeter of that big vessel, if that is what you want to call it, and then you have to cook it for a couple of years, obviously you are putting a lot of energy in. They believe they got more energy out than they put in. But still, the energy profit ratio is not going to be enormous. Even if you can make that attractive, you still have the problem of scale. With the world using 84 billion barrels of oil a day, you have to have a lot of a million here, a million there before it adds up to what we are using.

Coal, you may hear people do not worry about energy, we have 500 years of coal. That is not true. At current use rates, we have about 250 years of coal. That is a long time, so why are we worrying? If we have 250 years of coal at current use rates, and obviously you can do with coal what we do with oil. Hitler did it. When we denied him access to oil, he made oil out of coal. When I was a little boy, the lamps that we call kerosene lamps today, we called them coal oil lamps because they were filled with oil, made from oil. So if you must use coal, if you have greater demand than we use today, that 250 years quickly shrinks. I have a chart a little later that shows that. But it quickly shrinks to about 85 years, and if you have to use some of the energy to convert the coal since you cannot have a trunkload of coal in your car, the energy to do that now shrinks that supply. There is only a 2 percent growth rate, and I think we will have to use it at much more than 2 percent growth rate, and it shrinks it to 50 years. So we have to husband that resource very wisely.

We have already chatted briefly about nuclear fission and nuclear fusion. Today we produce 20 percent of our electricity from nuclear. France produces 75 or 80. If you have some concerns about nuclear power, when you drive tonight note that every fifth business and every fifth house would be dark if were not for nuclear energy.

[Time: 21:30]

One-fifth, 20 percent, of all the electricity in our country comes from nuclear. Well, once these are gone, and they will be gone, except nuclear breeder reactors, as many of those as we want to have and maybe, maybe if we are lucky nuclear fusion. But we will transition, Mr. Speaker, whether we like it or not, as the world runs out of oil, we will transition to the renewables. What are they? They are solar and wind and geothermal. Geothermal is when we tap into the molten core of the Earth when we are close enough to that that you can get some heat from that. If you go to Iceland, there is not a chimney there because all of their energy comes from geothermal.

We are trying very hard, as I mentioned previously, to tap into ocean energy. It is not just the tides. It is the waves. It is the thermal gradients in the ocean, the cold water at the depths, the warmer water on top, kind of a thermal couple effect that you can get there.

Then there is lots and lots of talk about getting energy from agriculture. Soy diesel, bio diesel, ethanol, methanol, biomass. The President mentioned it in his State of the Union. He said we are hooked on oil and have got to wean ourselves from that, and technology will do it. And he talked about some exciting technology, about taking some biomass like soybean stubble and corn stalks and switch grass. What is switch grass? Switch grass is prairie grass, and a lot of it grows. Of the prairie that we did not plow up and let that return to switch grass, it is a big crop every year. And they are talking about harvesting that and using something like culling cellulosic ethanol. We bioengineered a little organism that can split cellulose into its requisite glucose molecules. It is made of sugar. Sure does not taste like sugar. See, because the human's molecules are so closely tied together that the enzymes in our body cannot split them. But these little bioengineered organisms can do that, so we break cellulose down to glucose, and then we ferment the glucose, and we get ethanol from it. And there is a lot of talk about that.

And biomass. Waste energy. Burning waste. There is a plant not far from here in Montgomery County, I would be proud to have it by my church. It looks like an office building. You do not even know it is an incinerator burning trash and producing electricity. They bring the trash in by truck or train in containers. You do not even see it until it is inside the building and then they dump it. Really interesting to watch it because that trash comes in with all sorts of things in it. They have a crane there that picks it up and drops it to see if there is something evil in it like a tank of propane. You would not want to put that in the fire. It might explode. And if they drop it and there is nothing evil-looking in it, they pick it up again and drop it over into the fire. It is really worth a trip there. And we now get a meaningful amount of energy, as a later chart will show from waste to energy.

Then hydrogen. Many people think that we do not have to worry about energy because we have got hydrogen. Hydrogen, Mr. Speaker, is not an energy source. Hydrogen is simply a way of transferring energy from one point

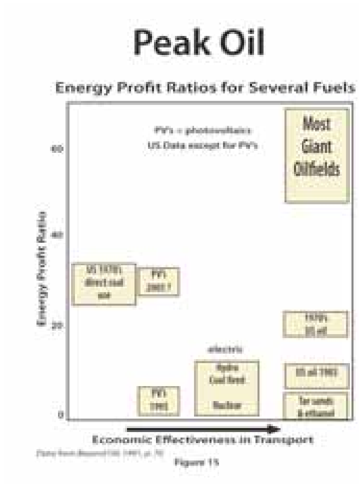
[Page: H210]

to another. It will always cost more energy to make hydrogen than you will get out of the hydrogen. I can say that with some confidence because just as sure as there will never be a perpetual motion machine, we will never suspend the second law of thermodynamics. And that says that when you transfer energy from one form to another, you will always loose some energy in that transfer. Why are we so enthusiastic about hydrogen if that is true? It is because hydrogen has some incredible capabilities. When you burn it, you get water. That is really not very polluting, is it? And further more, hydrogen is a great thing to put in a fuel cell. And a fuel cell gets twice the efficiency of a reciprocating engine. So I am not depreciating the value of looking at hydrogen. I am simply pointing out that hydrogen is little more than a battery which takes energy from one place to another place. As a matter of fact, in a recent hearing, we had three experts on hydrogen, and there are three ways that you could transport hydrogen. One is as a liquid. It must be really, really cold, several hundred degrees below zero to keep it as a liquid, which means you have to have a lot of insulation, and even then it is going to boil off, so you have got to use it faster than that boils off.

The other way to carry it is as a gas. Well, hydrogen is the lightest element we have. Those gas molecules are really trying to get apart from each other, so it takes a really high pressure vessel to contain hydrogen.

The third way to transport hydrogen is in solid state. You adhere the hydrogen either by some adhesion or by some chemical process. You carry it in a solid state. That is very much like the way we carry electrons in what we call a battery. Hydrogen is a proton plus an electron; and so, and I asked the question, is a hydrogen battery inherently going to be more efficient than an electron battery? Well, we really need to look at hydrogen, but it is not a salvation to our problems.

The next chart looks at the characteristics that we are going to want to find in whatever alternative we turn to, and here we have on the ordinate the energy profit ratio.

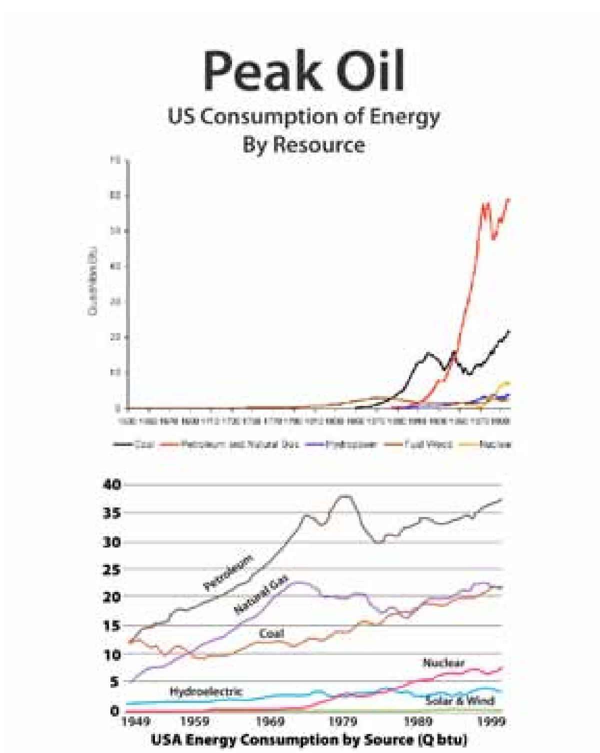


I have talked about energy profit ratio. That is how much energy you put in compared to how much energy you get out. And our big oil fields here, you see, they are up at 60 to one. As a matter of fact, the charts were even higher. Some of those were more than 100 to one. By the way, there were none of those in our country. They exist only in the Middle East and the big Gharwar oil field-the granddaddy of all oil fields is in Saudi Arabia.

And the energy profit ratio is 60. You put in one unit of energy, one BTU, and you get out 60 BTUs. The abscissa here is economic effectiveness in transport, that is, how handy is it to use. And we are talking primarily about transportation and liquid fuels, how handy is it to use. Well, oil of course is the handiest thing to use. It is way over here on the right. And it had an enormous energy profit ratio if it came from the giant oil fields. In 1970, when we peaked, our energy profit ratio was down here. Now it is harder and harder to get our oil, and so by 1985 the energy profit ratio had slid down to here. Notice where the energy profit ratio is for tar sands and ethanol and that sort of source: way down here, just about zero. In fact, some people think that the energy profit ratio for ethanol, the way that it is frequently made, is below zero here, that more energy goes into making ethanol from the fossil fuels that made the tractor and plows field and makes the fertilizer and so forth than you get out of the ethanol.

Well, here we have some of the other things: hydro, coal fired, nuclear, photovoltaics. They now are getting much better. They are moving up in energy profit ratio. Wind machines should be on here too, and they would be about in this same category. So whatever alternative energy source we use, to see how useful it is going to be, we need to put it on this chart: does it have a high energy profit ratio, and is it really convenient to use for transportation.

The next chart is one which really has the long look.



I like this chart because it is kind of humbling. It kind of puts us and oil and our whole history into perspective. Here we have only about 400 years, a little less than 400 years out of 5,000 years of recorded history. But for the first 4,600 years not a whole lot happened. And so if you extended this back 4,600 years, it would look very much the same. Very little energy produced. Here you see it. Wood. And then we learned how to use it more effectively. The Industrial Revolution started here in the early 1800s. We denuded the hills of New England to send charcoal to England to make steel. There is a little historic place called Catoctin Furnace up in Frederick County, and we denuded our hills up there to make charcoal for Catoctin Furnace. And then we found coal.

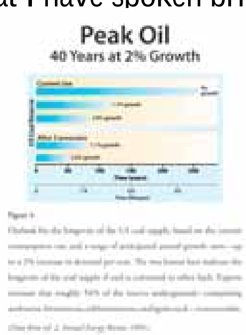
Oh, the ordinate here is quadrillion BTUs, how much energy you are producing. And then we found coal. And boy, look what happened. Look what happened. We really took off. The coal was very limited in what it could do compared with gas and oil, and the red curve here is gas and oil. And look what happened. It just took off and was reaching for the sky. Notice here the worldwide recession after the Arab-induced oil price spike hikes, worldwide recession, and we did use less oil. So we can economize. We can be more efficient. We can use less.

I might point out, Mr. Speaker, that the world's population has pretty much followed this. Just this afternoon I was looking at a chart of world population. Half a billion, a billion people for way back as far as we can look in history. And then we start the Industrial Revolution, and the world's population took off and it mirrors this. From a half a million, half a billion to a billion people up to now nearly seven billion people.

If, in fact we are at peak oil, and almost nobody denies, the most optimistic estimate I have ever seen is that we will reach peak oil at about 2035 or 2036. You know, that is not forever in the future. Most authorities believe that we are either here or it is very imminent. But if we have reached peak oil, we are about halfway through the age of oil. That is incredible. Out of 5,000 years of recorded history, 150 years now we are into the age of oil. In another 150 years we will be through the age of oil. Our great grandchildren will live then. What will their world be like? We face a lot of really serious challenges.

Mr. Speaker, when I think back, and someone asked me the other day how long I have been thinking about this subject, and maybe it is because I am a scientist. I knew that the fossil fuels could not be forever and so maybe 30, 40 years ago, when I was teaching school and doing research, I started asking myself that question, what does that mean, not forever? Do we have another 10 years, a hundred years, a thousand years? Obviously, it is not going to last forever. But what does that mean? And so I have been following this for 30, 40 years now.

The next chart looks at something that I have spoken briefly about and that is coal.



And some will tell you, and I have heard a lot of people who ought to know better say, do not worry, we have got 250 years of coal. That is true, at current use rates. But if you start increasing coal only 2 percent a year, you know, Albert Einstein was asked after the discovery of nuclear energy, what is next? What is the most powerful force in the universe, Dr. Einstein? You know what his response was? The power of compound interest. That is exponential growth. Compound interest.

And if you grow only 2 percent a year, that 250 years now immediately shrinks to about, what, 85 years here? And obviously you cannot fill your trunk up with coal. You are going to have to convert it to a gas or a liquid. And so when you have used some energy to convert it to a gas or a liquid, after conversion you have got about 50 years left. That is a long time. And it is a meaningful resource. But it is not forever. And by the way, there are one of two penalties you are going to pay for burning coal. Either you are going to pay a big environmental penalty if you do not clean it up. And every year we vote some billions of dollars for clean coal technology. And still we have too much CO2, too much pollution from coal.

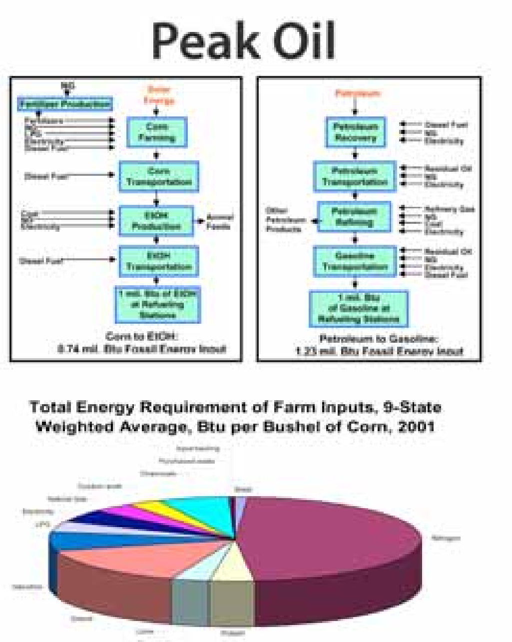
And by the way, Mr. Speaker, the use of coal is not without its price. We have had, what, 16 miners killed in West Virginia in the last couple of weeks in producing coal.

When was the last time you heard that a worker in a nuclear power plant

[Page: H211]

was killed or injured? The answer is, never in this country. It just has not happened. I lived through the Three Mile Island disaster. I was not very far from it in Frederick, Maryland. There was a lot of hoopla about that. Very little actual effects of that. I have some friends who have been avidly antinuclear. When they are considering the alternative of shivering in the dark as we run down the other side of Hubbert's peak, they are wisely taking a new look at nuclear.

Our next chart is a very interesting one.



We have talked about the potential from agriculture. Let me make two generalizations as a caution. We are barely able to feed the world. Tonight, 20 percent of the world or so will go to bed hungry. How much food can we convert to energy and still feed the world, particularly if we permit the world's population to increase as it is today?

The other caution is, how much biomass can we take from our land and still have topsoil? With all of our good techniques today, no till farming and so forth, every bushel of corn we grow in Iowa is accompanied by three bushels of topsoil that go down the Mississippi River.

Now, topsoil is topsoil, rather than subsoil simply because it has organic matter in it. And that organic matter, the humus comes from decaying organic material. And if you are taking all that organic material off to burn or to ferment or whatever you are going to do with it, I am not certain how long we can maintain the quality of our topsoil so that we can continue to produce the food and fiber that we need and that the world needs.

On the top here are shown two depictions. One is the amount of energy you get out of petroleum. Obviously, you do not get all the energy in your car. It takes energy to drill the wells, to pump it out, to transport it, to refine it, to haul it to the gas station and so forth.

[Time: 21:45]

So when we get out 1 million BTUs, there are probably, they estimate, it took 1.23 million BTUs input. So you do not get it all in your car. You would not expect to.

Now, what about the energy profit ratio here of ethanol? And here we are getting a lot of energy from the sun. What does that mean in terms of the final product? And I am told by some this is a pretty optimistic assessment here. But even if we reach this, you have put in .74 million BTUs. Almost three-fourths of the energy you get out of ethanol is represented by the energy that went into producing ethanol. There is an energy profit ratio, although some have disputed that. There is a doctor in the East here and one in the West, and they have done what they say is a very good analysis of all the energy, and it is hard to keep track of that, Mr. Speaker. It is not just the diesel fuel they use in the tractors. How much energy does it take to make the tractor? Every automobile tire has the equivalent of 6 gallons of oil in it. As you burn the tire, you get some sense that that is probably pretty close to the truth.

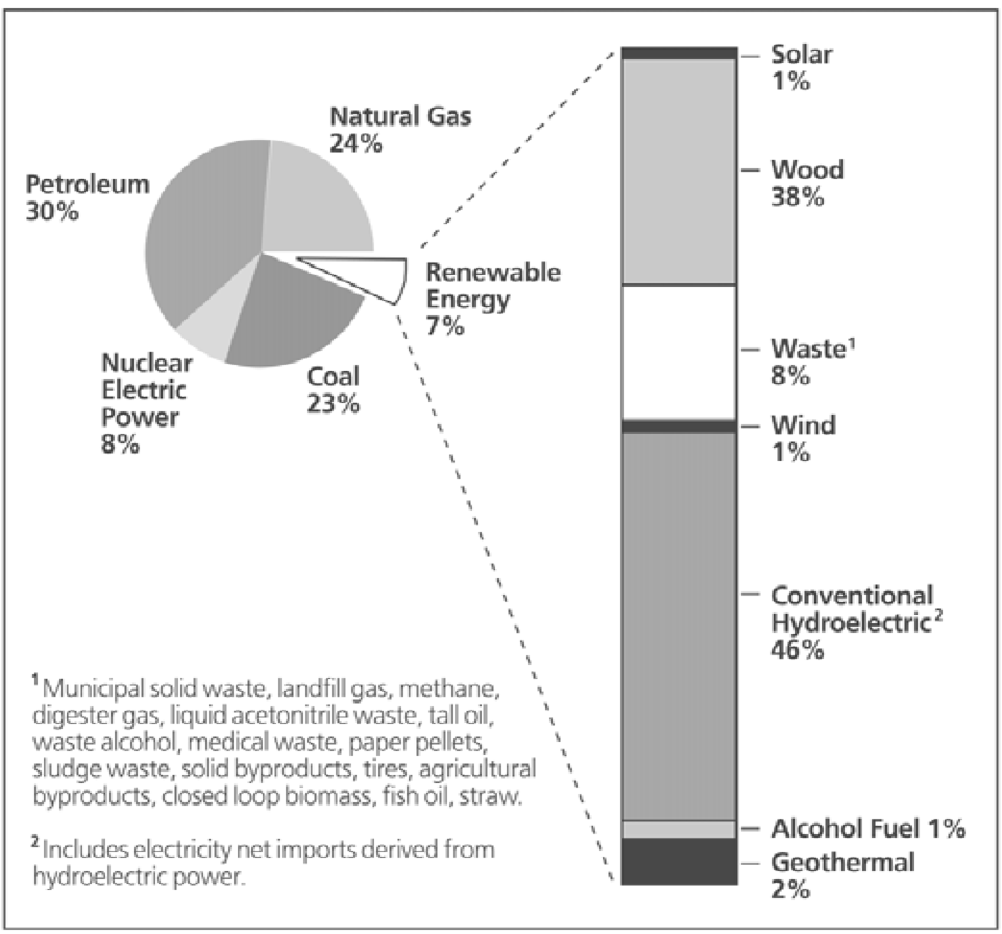
These two scientists believe that today in the way that some ethanol is made, it takes more energy from fossil fuels to make the ethanol that we get out of the ethanol. Even if that is true, there is a good byproduct remaining, all the fat and all the protein. Tofu is a protein, by the way. That is the protein from soybeans. We get a similar protein from corn. So we can use that as animal food or human food.

The bottom chart here shows some of the challenge of getting energy from corn. This is a pie chart which shows the total amount of energy that goes into producing a bushel of corn. And notice, Mr. Speaker, that almost half of that total energy comes from nitrogen. That is because nitrogen fertilizer is made from natural gas. Before we learned how to do that, the only source of nitrogen fertilizer was barnyard manure and what we call guano. Guano is the droppings of bats and birds for very long periods of time, hundreds of years, maybe thousands of years, and it accumulated on the tropical islands, and in the case of bats, we mined that to get guano. That is gone. If we wait another 10-, 20-, 30,000 years, there will be some more. But it takes a very long time to accumulate that.

This is all the other energy that goes into producing a bushel of corn. Potash was mined using fossil fuels. Phosphate was mined using fossil fuels. The lime was quarried using fossil fuels. Here is the diesel fuel that ran the tractor and the combine, the gasoline that is used in some of the farm equipment, liquid gas, electricity, all of which is produced by fossil fuels, most of it by fossil fuels, some by nuclear, 20 percent by nuclear. The custom work, the diesel that went into doing the work, the energy, the fossil energy it took to build the tractor and so forth. And many of the chemicals we use in agriculture are made from oil. The water is pumped using energy. The hauling, the seed, fossil fuel energy goes into producing all of this.

Mr. Speaker, how will we feed the world once we run down the other side of Hubbert's peak?

The next chart, this is a really interesting one.



Renewable energy as share of U.S. energy comsumption, 2000
(Source: U.S. Energy Information Administration)

I use an analogy here that helps me to understand this. I imagine a young couple that has just gotten married, and their grandparents died and left them a pretty big inheritance. So they have now established a life-style where 85 percent of all the money they spend comes from their grandparents' inheritance and only 15 percent from their income. And they look at the amount they are spending and at the size of the grandparents' inheritance and say, gee, this is not going to last until we retire. So obviously they have got to do one or both of two things: Either they have got to spend less money, or they have got to earn more money.

I use that 85-15. Others may use 86-14. The 85 or the 86 is the percentage of energy in our economy that we get from the fossil fuels, natural gas and petroleum and coal. Only 15 percent in this depiction do we get from nonfossil fuel sources. A bit more than half of that, nuclear energy, 8 percent, that is, 8 of 15, a bit more than half, comes from nuclear. That is 20 percent of electricity, but 8 percent of our total energy use heating buildings and manufacturing and so forth. Seven percent of it comes from renewables. Remember that previous chart? Ultimately we will transition to these renewables, with the exception of what we will get from nuclear. When we are through the age of oil, it will all be renewables.

What are they? Solar. This is a 2000 chart. We are better today. In 2000, solar represented 1 percent of 7 percent. That is .07 percent. It has been growing at 30 percent a year. That doubles in about 3 years. So now, big deal, it is .28 percent of our total energy.

Wood, 38 percent. Not the West Virginia hillbilly, but this is the timber industry and the paper industry wisely using a waste product, what would otherwise be a waste product.

I mentioned waste before. That is 8 percent of our total renewable energy. We ought to be producing a lot more of that. Landfills are pretty silly when you think that you could be producing electricity with that rather than worrying about the methane that is produced there. They do harvest some of that, by the way, and use it.

Wind, another 1 percent. By the way, wind and solar are essentially the same energy source. The wind blows because of the differential heating of the sun; so they both go back to the sun. We can now produce electricity from wind at 2 1/2 cents a kilowatt hour. That is really competitive. Why are we not producing more of it? Wind farms are growing. You may see them. Some people do not like the look of those. I think that the big wind machines are pretty handsome. That is about where solar is today, about .28 percent of our total energy.

How long will it take us to get to any meaningful percentage there? Because that is increasingly what we are going to have to rely on in the future.

Conventional hydro, almost half of all of our renewables comes from an energy source that is not going to grow in our country. We have dammed every river that should be dammed and probably a few that should not; so that is not likely to grow.

Now we are down here to agriculture, alcohol fuels and so forth. Again, almost in the noise level. And geothermal, where we are close enough to the molten core of the Earth, we really should tap into that. That is free. It is forever if you use it properly.

The next chart shows us something very interesting.

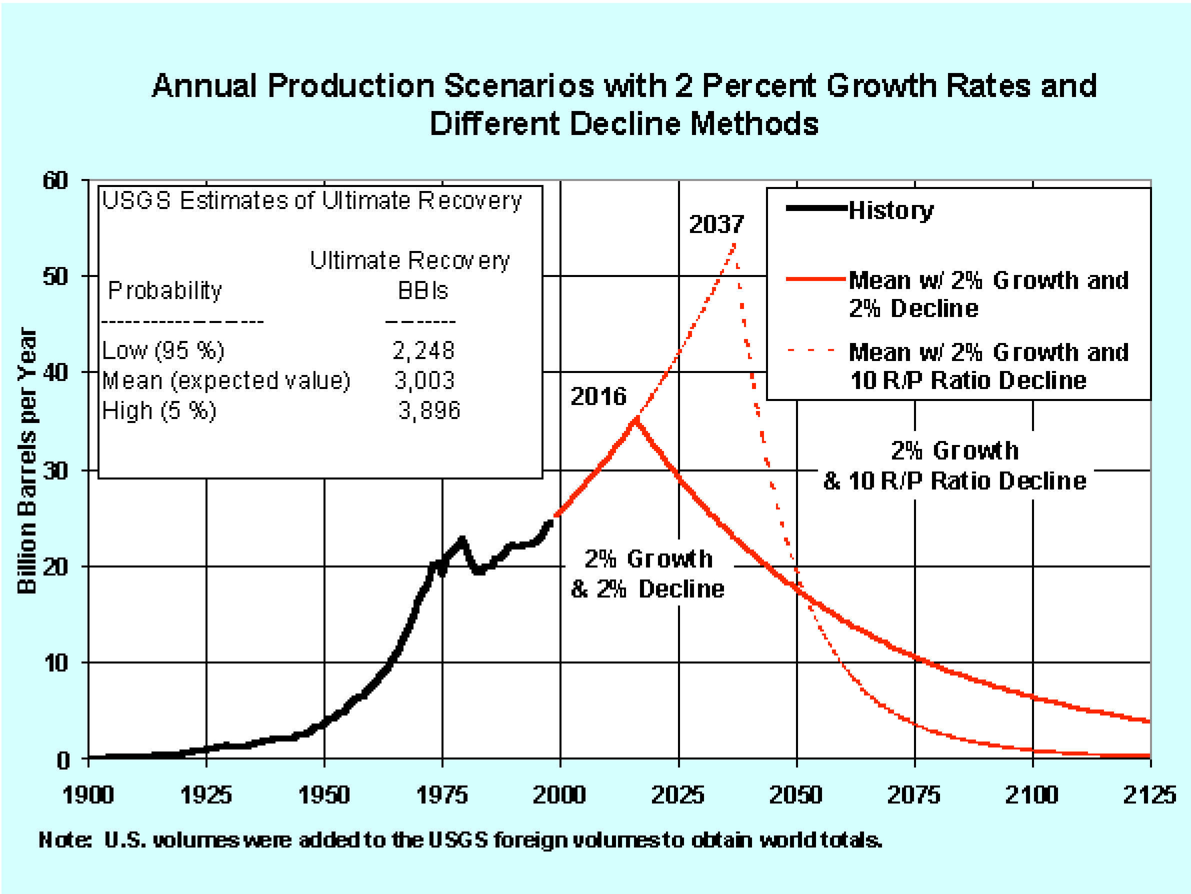


Figure A-1. Two EIA oil production scenarios based on expected ultimate world-recoverable oil of 3,003 billion barrels and a 2 percent annual world oil demand escalation

Mr. Speaker, I would like to get some input from statisticians on this because everybody knows

[Page: H212]

the jargon of something which is statistically significant. There is a 95 percent probability, there is a 5 percent probability, and so forth. And here they have done something which I find very strange. If you are looking at the path that a hurricane is going to take, you notice it starts out very narrow. It could get pretty good for the next few hours, but when it gets out to hours and days, it gets broader and broader. Now, the hurricane maybe will go down the middle, but there is just as big a chance it will go to the left as there is that it will go to the right. And what these folk are doing and what they are using here is statistical jargon. They are saying a high 5 percent probability, low 95 percent, and the mean is what is in the middle. Now, that could just as well be a whole lot less as that much more. So the real peak is probably going to occur about right here.

This is where we are now. This is the 2000 chart. We are about right here. They are using this mean here. No one that I know of believes that the ultimate recovery, 1 billion barrels of oil, is 3 trillion. But even if you use the 3 trillion, that takes you only to this point. It pushes peak oil out only to 2016.

The next one is a really interesting one. If you assume that you are going to get it faster and move the peak out to 2037, look what happens after that. You fall off a cliff.

So we need to be careful about this enhanced oil recovery, because if there is only so much to pump, and you pump it sooner rather than later, later you are going to have less to pump.

Back to Robert Hirsch and the study done by SAIC.

Robert L. Hirsch's Peaking of World Oil Production: Impacts, Mitigation, and Risk Management

World Oil Peaking is Going to Happen
World production of conventional oil will reach a maximum and decline thereafter. That maximum is called the peak. A number of competent forecasters project peaking within a decade; others contend it will occur later. Prediction of the peaking is extremely difficult because of geological complexities, measurement problems, pricing variations, demand elasticity, and political influences. Peaking will happen, but the timing is uncertain.

Oil Peaking Presents a Unique Challenge
The world has never faced a problem 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) were gradual and evolutionary; oil peaking will be abrupt and revolutionary.

They say on Page 64, ``World oil peaking is going to happen.'' And down here he says that oil peaking presents a unique challenge. The world has never faced a problem like this without massive mitigation, more than a decade before the fact. And remember, Mr. Speaker, very few authorities believe that peak oil is more than a decade from now. So we are pretty much here.

The next chart points out something very interesting, and that is that this really is a worldwide problem.

We are all in the same boat on this little planet Earth traveling through space. There is only so much oil. There are about 7 billion people, and clearly we would do better to engage the nations of the world in a competition to achieve sustainability instead of a consumption contest, which is now what we are doing: Who can use the most oil to grow their economy the fastest?

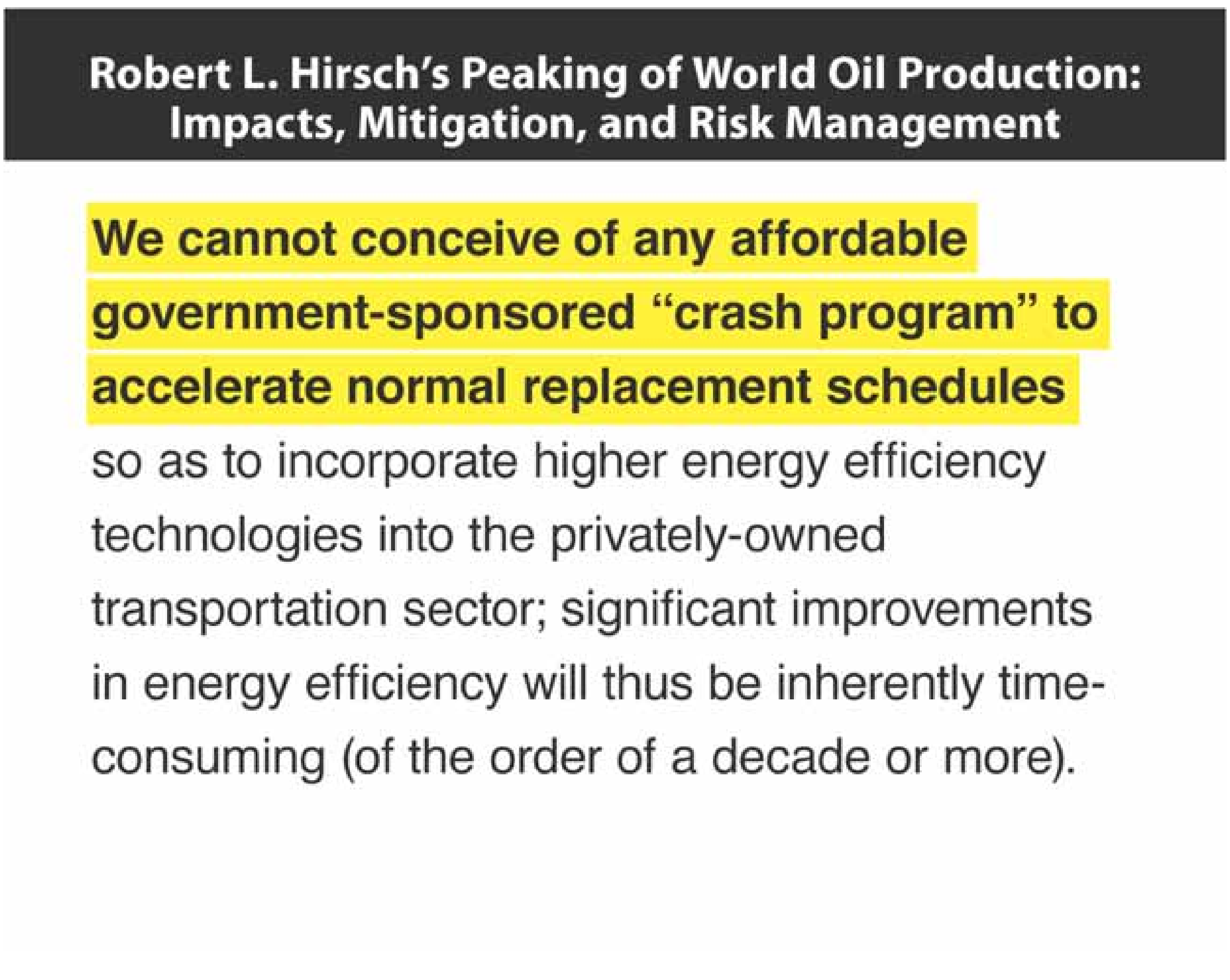
The next chart shows ideally what we need to be about.

By the way, Mr. Speaker, I think that if we do not have a national and indeed international program which kind of has the breadth of putting a man on the Moon and the intensity of the Manhattan Project, I think we are in for a pretty rough landing.

First of all, there is voluntarily conservation, and we can do that. We can conserve. California did. They had no rolling blackouts because they voluntarily reduced their electricity use by 11 percent in a single year. That is big. We start out with voluntary conservation, ride with two in the car, turn our thermostat down, put a sweater on. To organize voluntary conservation, working together to provide for the van pools and so forth, then the government can provide some monetary incentives, giving you the incentive to do the right thing. And then efficiency, of course. These were two words that were absent from the President's very good message on energy, conservation and efficiency.

I am a conservative. My wife says she thinks that there ought to be some relationship between conservation and conservatives. Does that make sense, Mr. Speaker?

The next chart we are going back again to the Hirsch report.



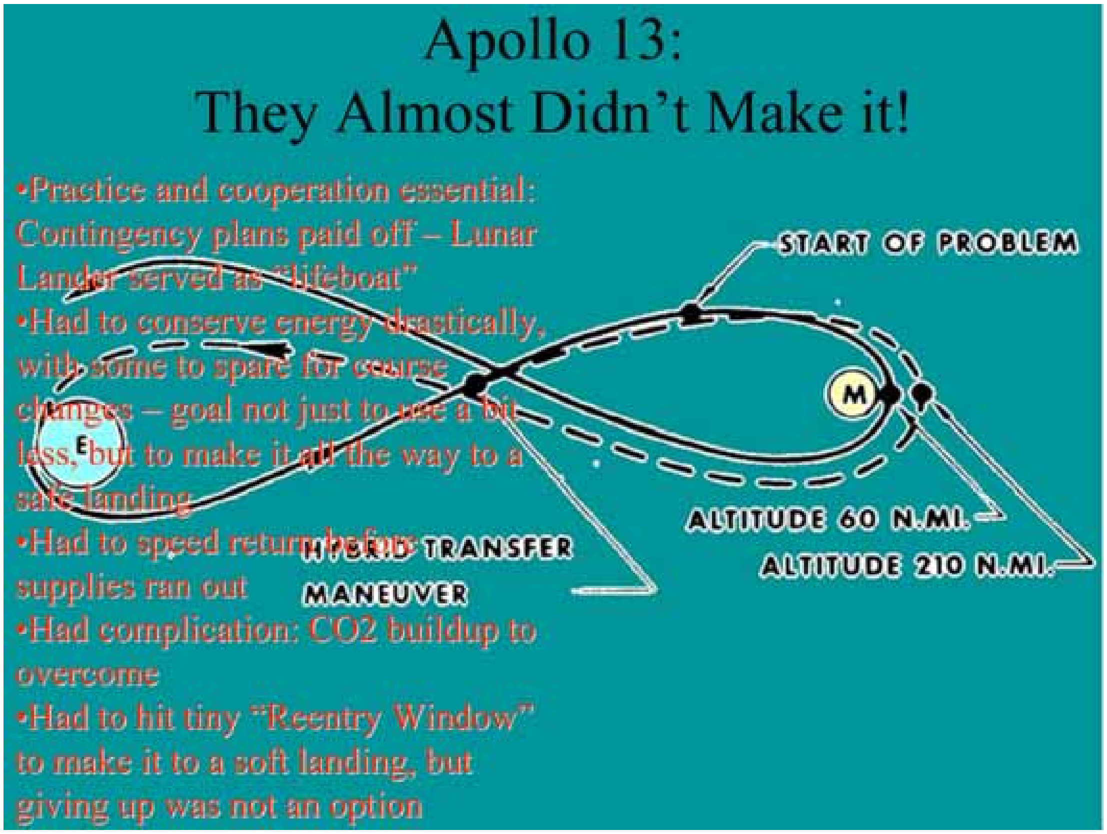
That was such a great study. They said on page 24, ``We cannot conceive of any affordable government-sponsored crash program to accelerate normal replacement schedules so as to incorporate higher energy efficiency technologies into the private-owned transportation sector. Significant improvements in energy efficiency will thus be inherently time-consuming of the order of a decade or so.''

For instance, if everyone was to drive a hybrid car, which gets two or three times the mileage of an ordinary car, it takes one or two decades to turn over the motor fleet; 28 years, I think, for the big trucks; much less than that for the vanity of cars and so forth.

The next chart, this is something that we are doing out in Frederick.

We wanted to demonstrate that it was possible to be totally self-sufficient, so we have proposed, and we have funding to do it thanks to the generosity of the taxpayers, that we are going to build a welcome center coming down into Frederick that is totally energy self-sufficient. We will get all of our water from the rain. We will handle all of our waste without putting anything into the ground, with composting toilets and constructed wetlands and so forth. We will produce all of our energy with wind machines and solar panels and so forth. This should in the next couple of years be existing. If you go up 270 into Frederick and start down the hill where you look over the Frederick Valley and see the city there, on your right will be the Goodloe Byron Overlook. If you pull in there, you will be at this welcome center, which will have a lot of what we call benign technologies.

In the few minutes remaining, I would like to use the *Apollo 13* as an example of the challenge that we have.

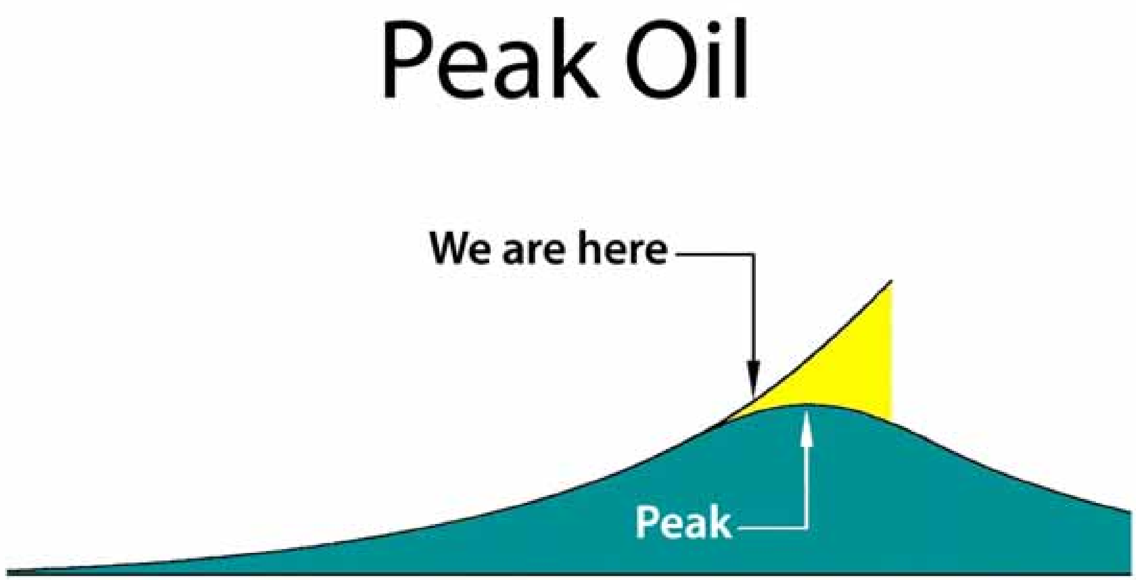


You may remember the *Apollo 13*. They had an explosion in one of their oxygen tanks. They had two oxygen tanks. And that explosion caused the other oxygen tank to leak. So not only were they going to be short of oxygen for themselves if they were not careful, they were going to be short of energy because they were using that oxygen to combine with hydrogen in a fuel cell to produce energy.

[Time: 22:00]

What they had available to them was the module, the lunar lander. They turned around, as you may know. They had to evaluate what they had to work with, and that is all they had to work with, what was in that little spacecraft out there. What could they do with that? They had a big challenge of C02 buildup and what they were going to do to manage that so that they could get back. They had a very narrow window.

There are a lot of analogies between the *Apollo 13* and where we are today. They had a challenge not of their choosing. We did not choose to reach peak oil at this time, but they were faced with the inevitable decision of either making the right choices or not making it through, and we are faced with very much that same kind of a dilemma. We have some choices to make now, and the next chart points to the kinds of choices that we have and what I think we need to be doing.



I want to refer you to an earlier chart which, by the way, we had that bell curve and we had the consumption going up like so, and there is a gap there.

A lot of people are trying to fill the gap. Here is that chart. Put that in front of this one. We will talk about that in just a moment. A lot of people are talking about filling the gap so that we continue on this course and use ever more and more.

I would suggest, Mr. Speaker, it is not what our challenge should be. As a matter of fact, to get alternative energy sources, we are going to have to invest three things. Money, we will not worry about that. We will borrow that from our kids and our grandkids, I am sorry to say; but we cannot borrow time from them, and you cannot borrow energy from them. We have run out of time. We are using all the oil that is available. If there was more oil than we would like to use, it would not be a sixty-couple dollars a barrel, would it? So in order to have any energy to invest in the alternative, we have to reduce our demand for oil so we have something to invest.

Trying to fill the gap just puts off the inevitable. If, in fact, we are able to do that momentarily, since there is not going to be much more oil found out there, the experts believe all you are doing now is setting yourself up for a bigger fall later. The old adage, in a hole, stop digging, the corollary to that is you are climbing a hill and you are going to fall off the other side, the higher you climb, the further you fall. This is pretty much where we are with oil. Let us go back now about the choices before us now.

Like *Apollo 13*, we have got to develop those contingency plans. What will we do? We need to prepare proactively. We have almost run out of time to do that. We must reduce energy consumption to make some energy available. That will

[Page: H213]

buy some time. By the way, the cheapest oil is the oil you do not use. We have bought some time so we can make investments now in more efficiency, first of all, and then in these alternatives which we will increasingly turn to.

The ultimate goal is to achieve sustainable growth. By the way, Mr. Speaker, there is no such thing as sustainable growth, whether short term you may make it appear to be so; but ultimately there is no such thing as continued forever sustainable growth. We are going to have to learn to be happy with being satisfied with what we have got.

I think, Mr. Speaker, we have some really, really great times ahead of us. I can imagine nothing more than all Americans feeling really good about contributing to a solution to this problem.

What we really need is leadership that the American people understand that they really can contribute. We have enormous creativity and entrepreneurship. We need to harness that. The next big burst in economic efficiency and growth can be in developing these alternatives and more efficient ways of doing things.

The ultimate goal, and we will get to that goal, we will transition. When the age of oil is finished and there is no more oil that can be gotten without paying more for the oil than you get out of it, we will have been transitioned to the renewables. What will life be like then? What will life be like in that transition?

This is really a good-news story. The sooner we start to address this problem, the less traumatic will be the transition. I like to think, Mr. Speaker, that if we harness the creativity and the energy of the American people, there is nothing that will make sleep so refreshing other than just knowing you really contributed something that day.

Mr. Speaker, I think that we have a bright future ahead of us. Unless we recognize, we probably are approaching peak oil. I would encourage, Mr. Speaker, that you go do a Google search for peak oil, pull up the articles on peak oil or do Hubbert's peak, you will find essentially the same articles there. There is a lot of information out there.

The average person is so consumed with the necessities of life, the tyranny of the urgent that pushes the important off the table: you really need to change the diapers; you really do need to be responsible; you also need to be thinking about tomorrow. We think about our next election. The board of directors thinks about the next quarterly report. Who is looking 5 years from now, 10 years from now?

Mr. Speaker, I think we have a great future ahead of us. The American people will respond if properly challenged.

END

Congressman Roscoe Bartlett
Congressional Record
THE PEAKING OF WORLD OIL
House of Representatives
February 8, 2006

Appendix of Charts

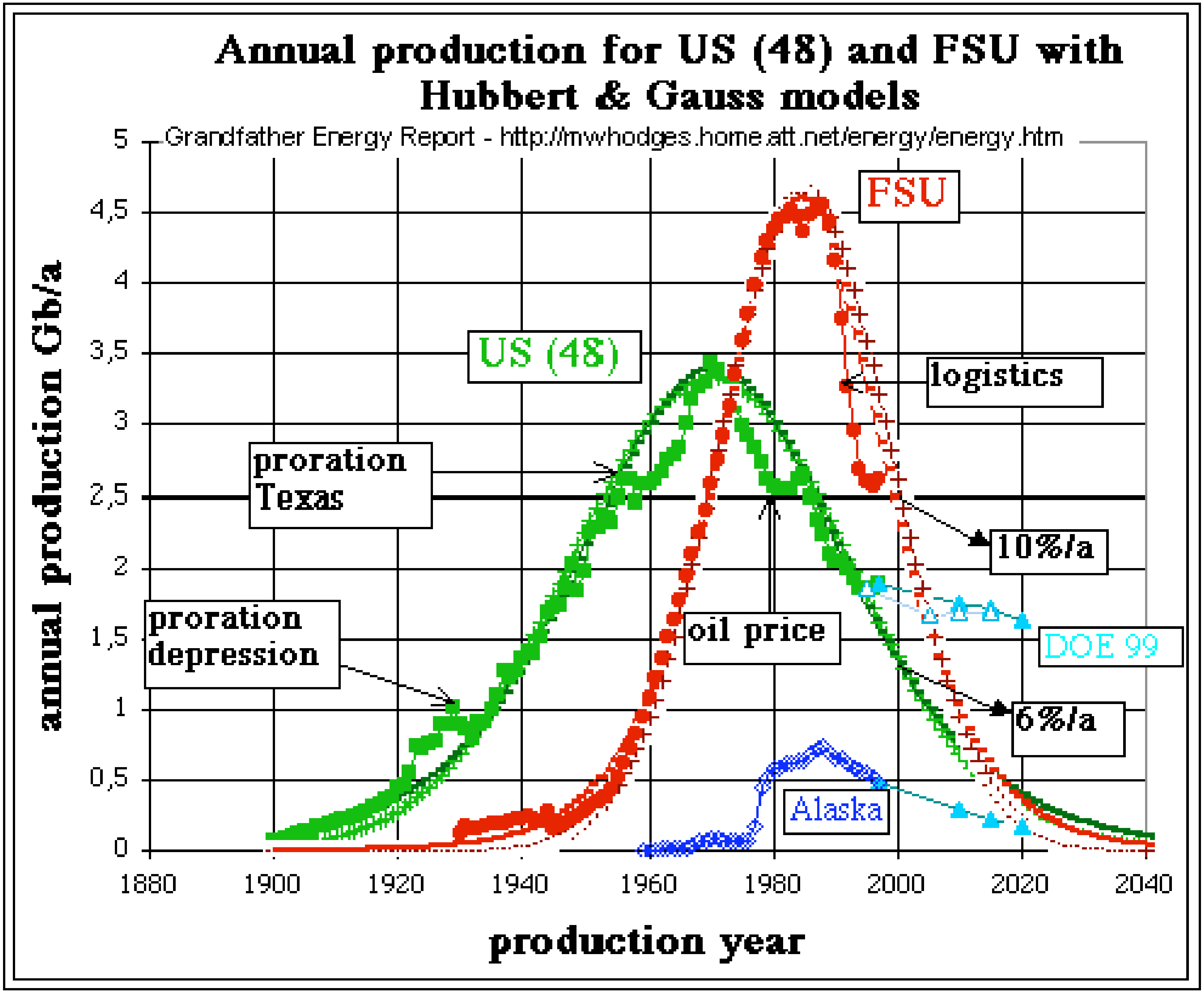
Robert L. Hirsch's Peaking of World Oil Production: Impacts, Mitigation, and Risk Management

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 sides, 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.

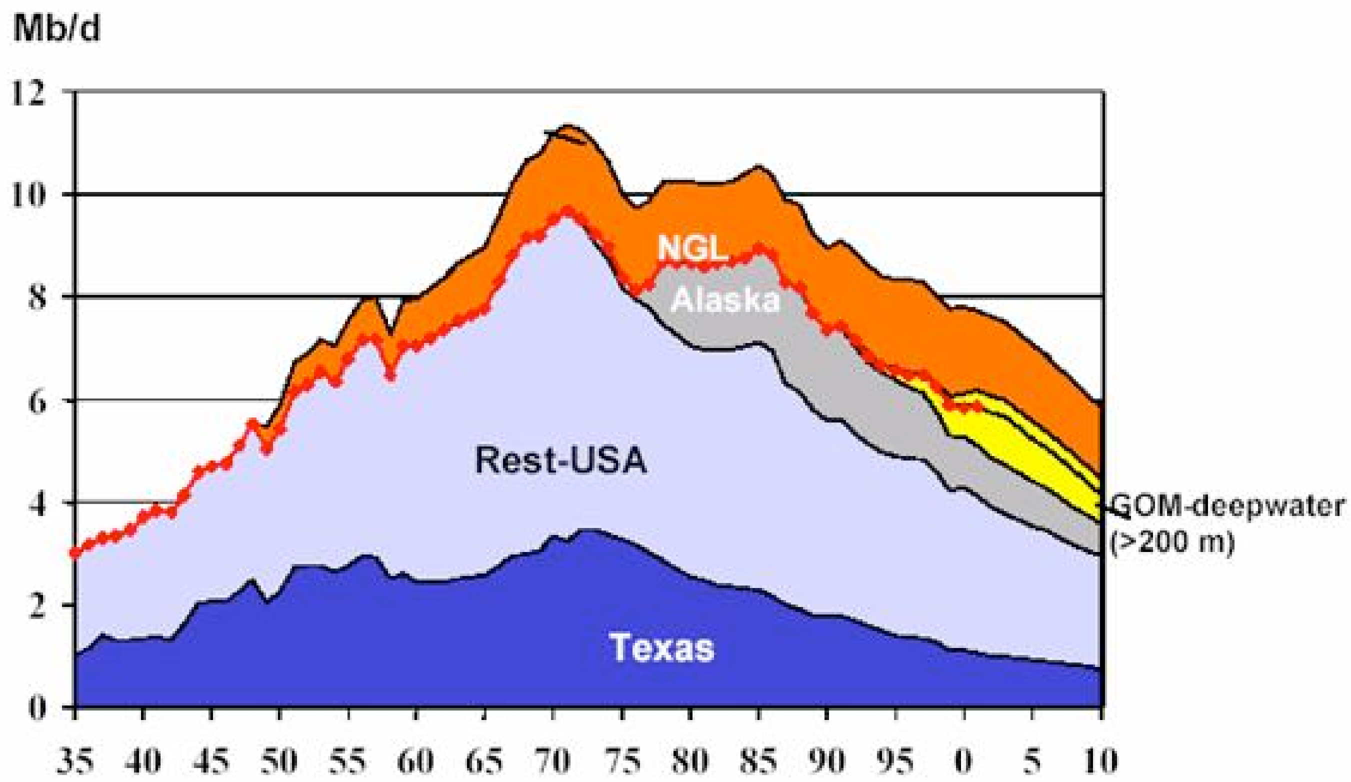
Peak Oil

- 2% of World Oil Reserves
- 8% of World Oil Production
- 5% of World's Population
- US Consumes 25% of World's Production
  — *2/3 imported*



(FSU) – Former Soviet Union

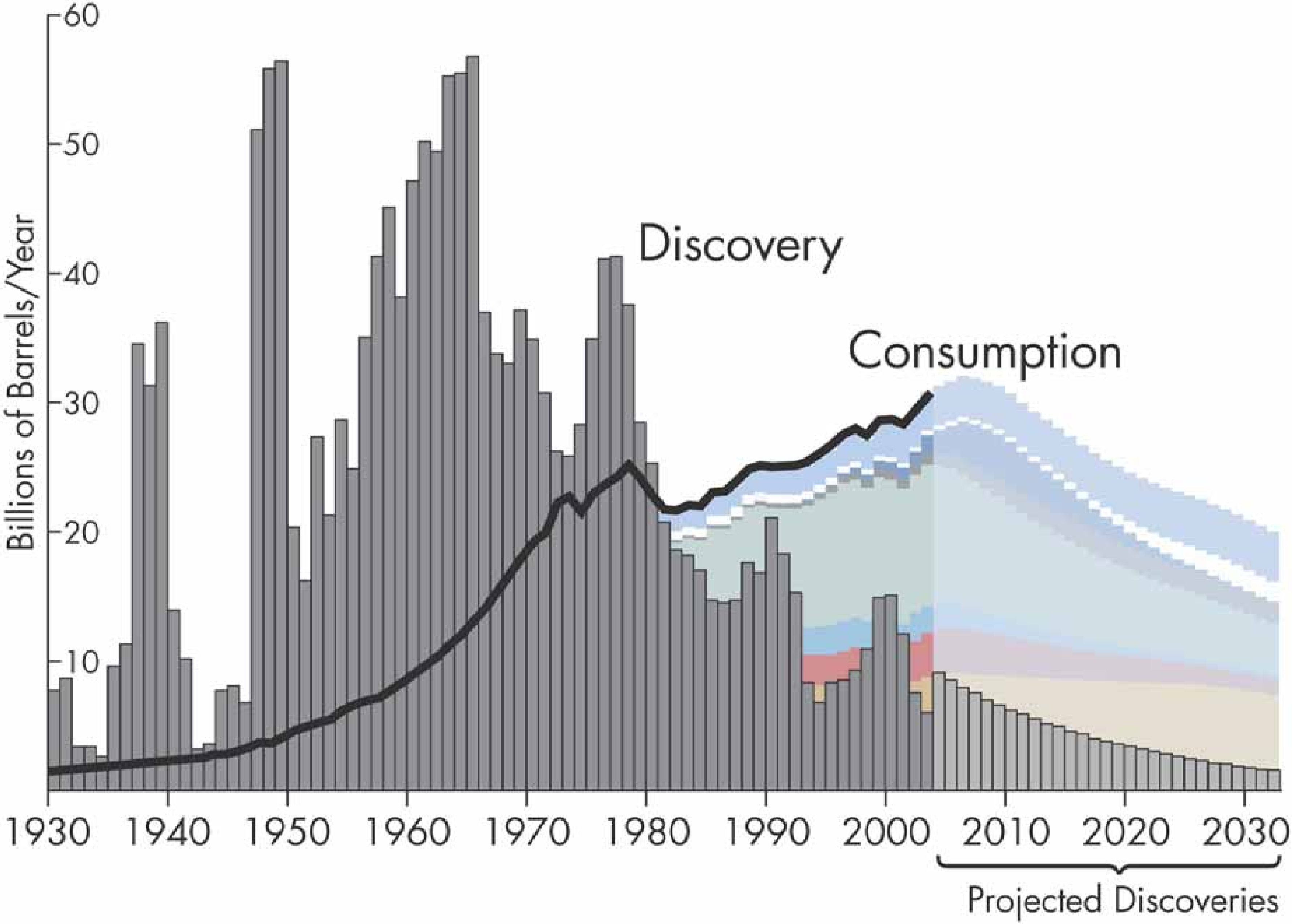
USA – Production forecast to 2010   incl. nc oil



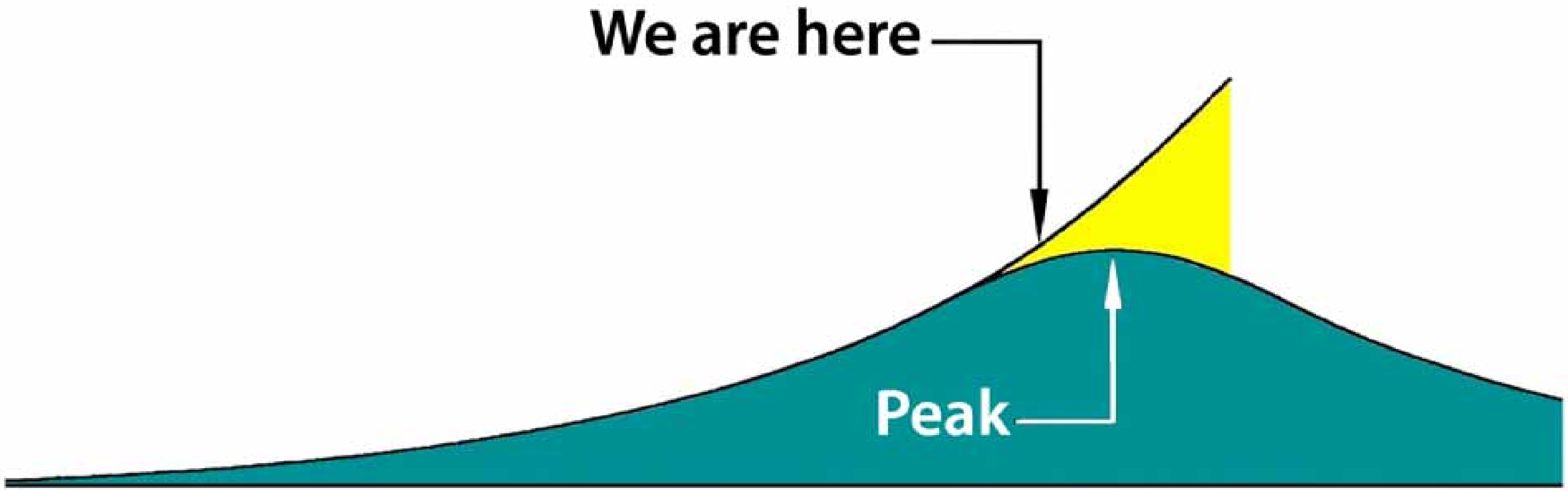
Source: Texas Railroad Commission US Energy Information Administration

Figure 4: The future oil production profile for the declining oil regions of Texas and Rest of the USA is controlled simply by the physics of depletion, allowing a straightforward extrapolation of existing trends.

Peak Oil – The Growing Gap



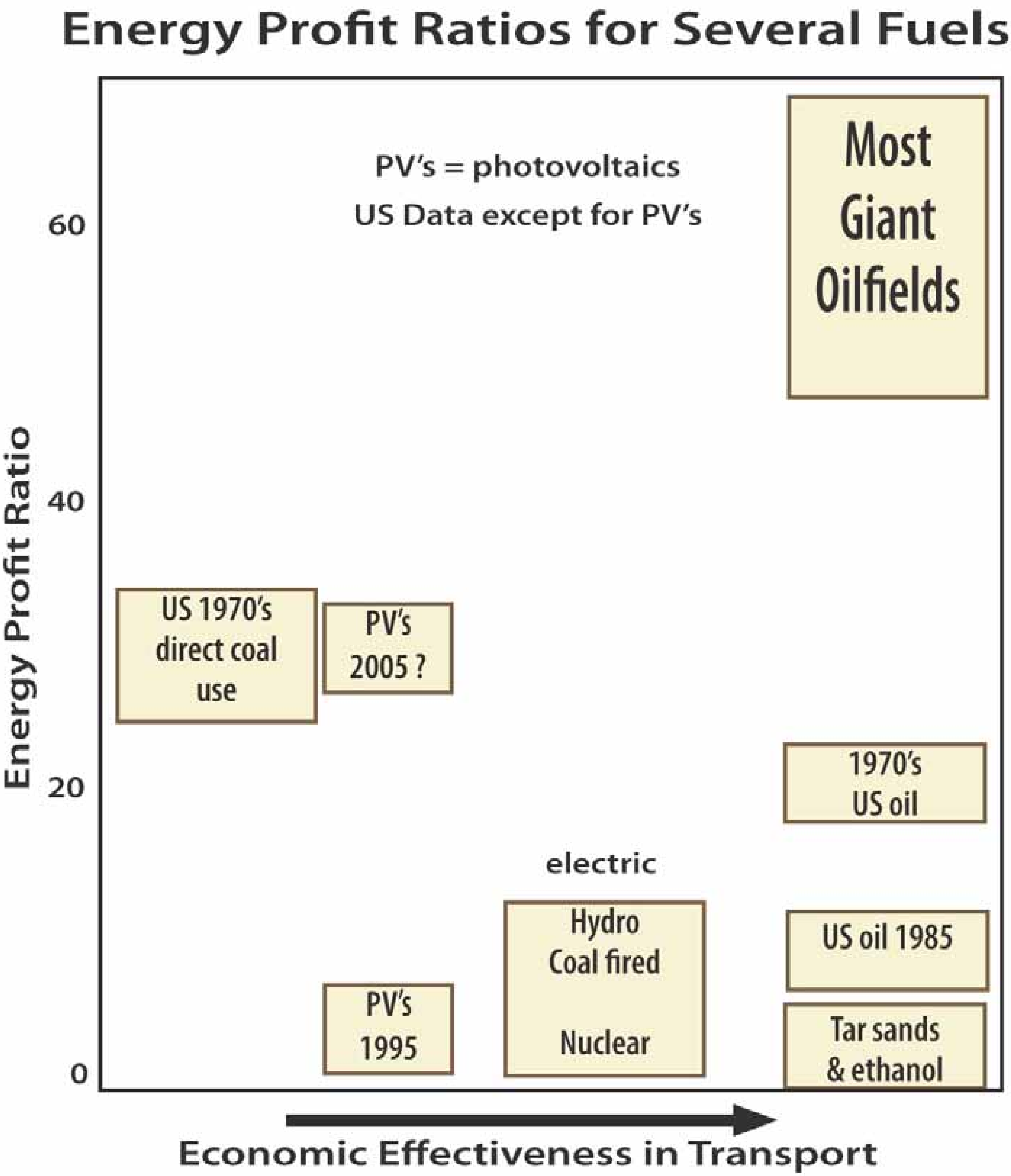
Peak Oil



- Potential Alternative Solutions

  - Finite Resources:
    - Tar Sands
    - Oil Shale
    - Coal
    - Nuclear Fission
    - Nuclear Fusion
  - Renewable Resources:
    - Solar
    - Wind
    - Geothermal
    - Ocean Energy
    - Agricultural Resources:
      - Soy/Biodiesel
      - Ethanol
      - Methanol

Peak Oil

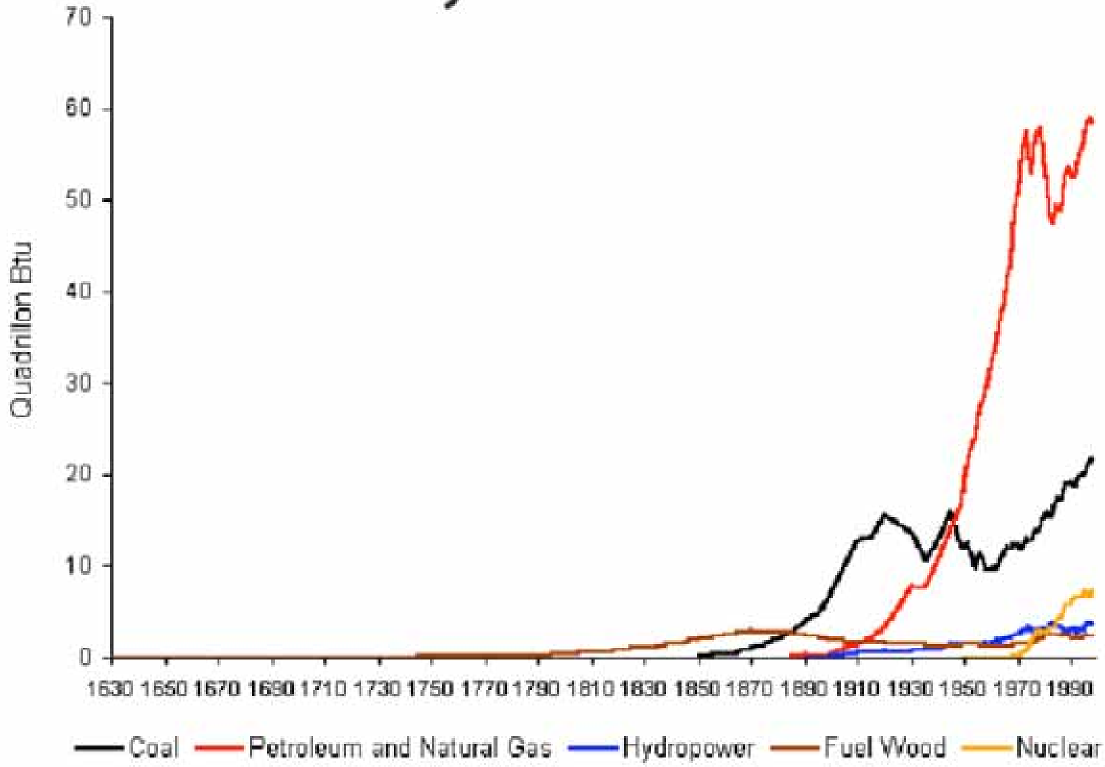


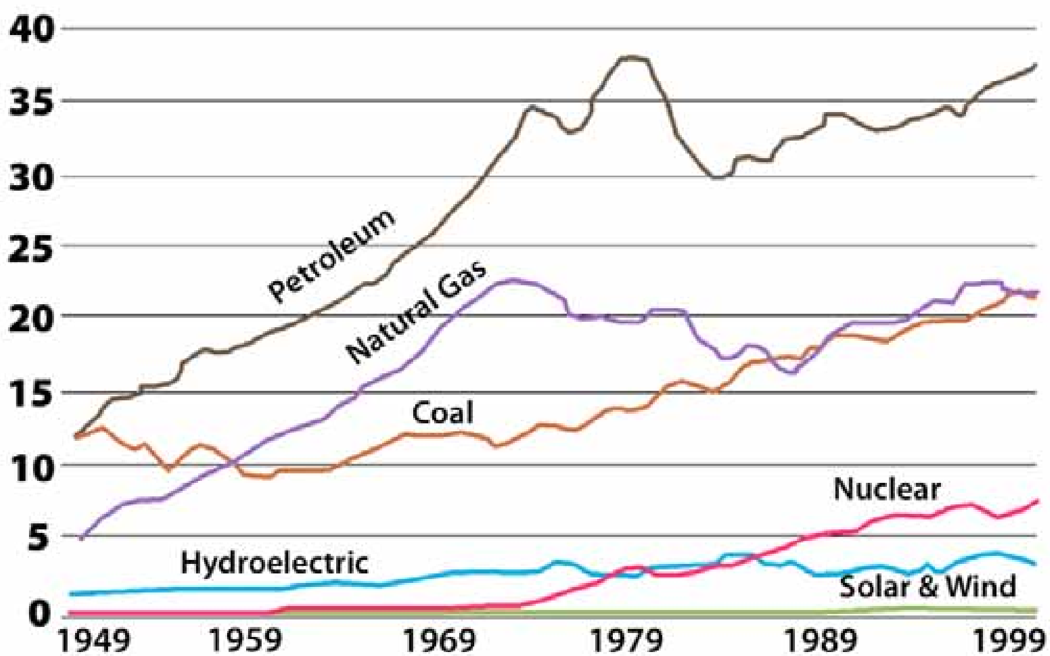
Data from Beyond Oil, 1991, p. 70

Figure 15

Peak Oil

US Consumption of Energy
By Resource





USA Energy Consumption by Source (Q btu)

Peak Oil

40 Years at 2% Growth

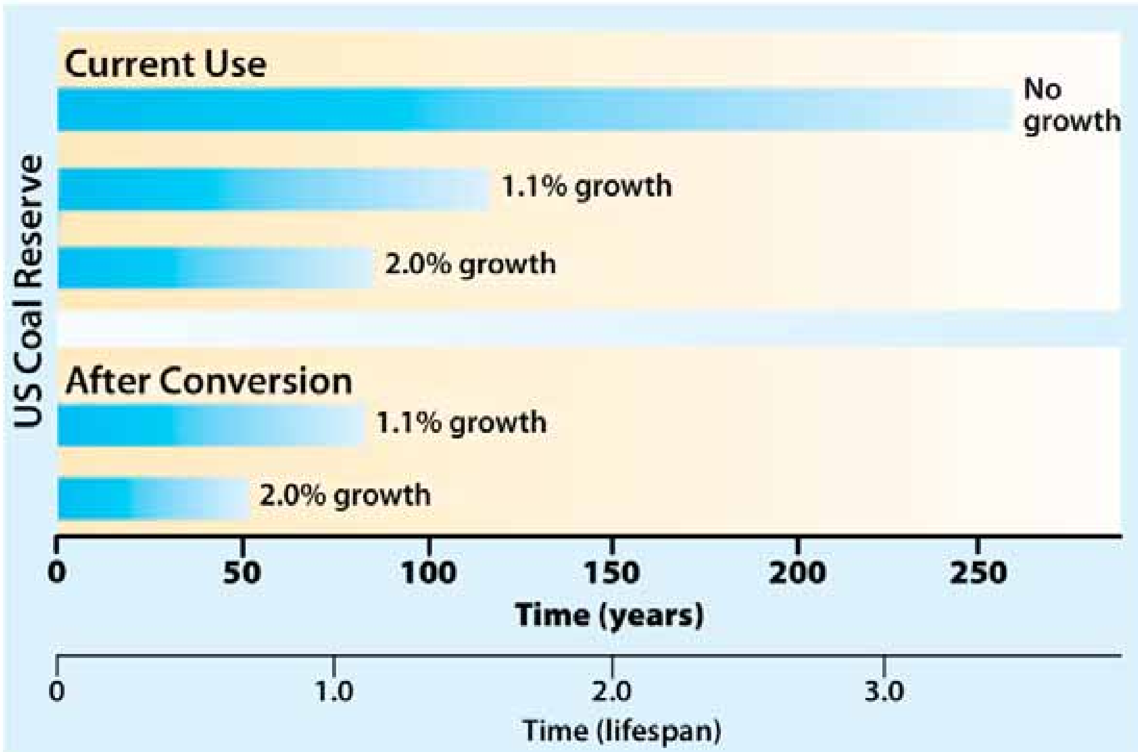
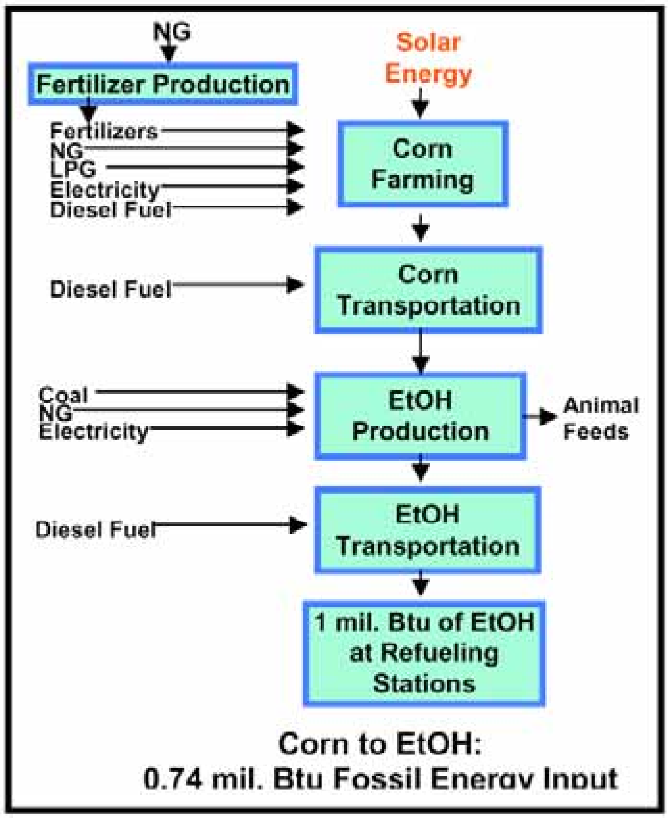


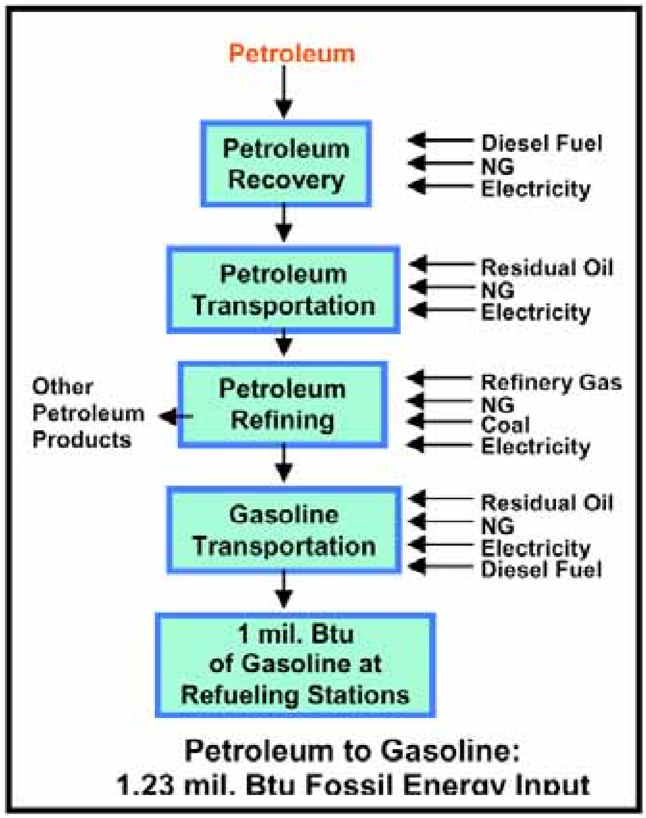
Figure 4.

Outlook for the longevity of the US coal supply, based on the current consumption rate and a range of anticipated annual growth rates—up to a 2% increase in demand per year. The two lowest bars indicate the longevity of the coal supply if coal is converted to other fuels. Experts estimate that roughly 54% of the reserve underground—comprising anthracite, bituminous, subbituminous, and lignite rock—is recoverable.

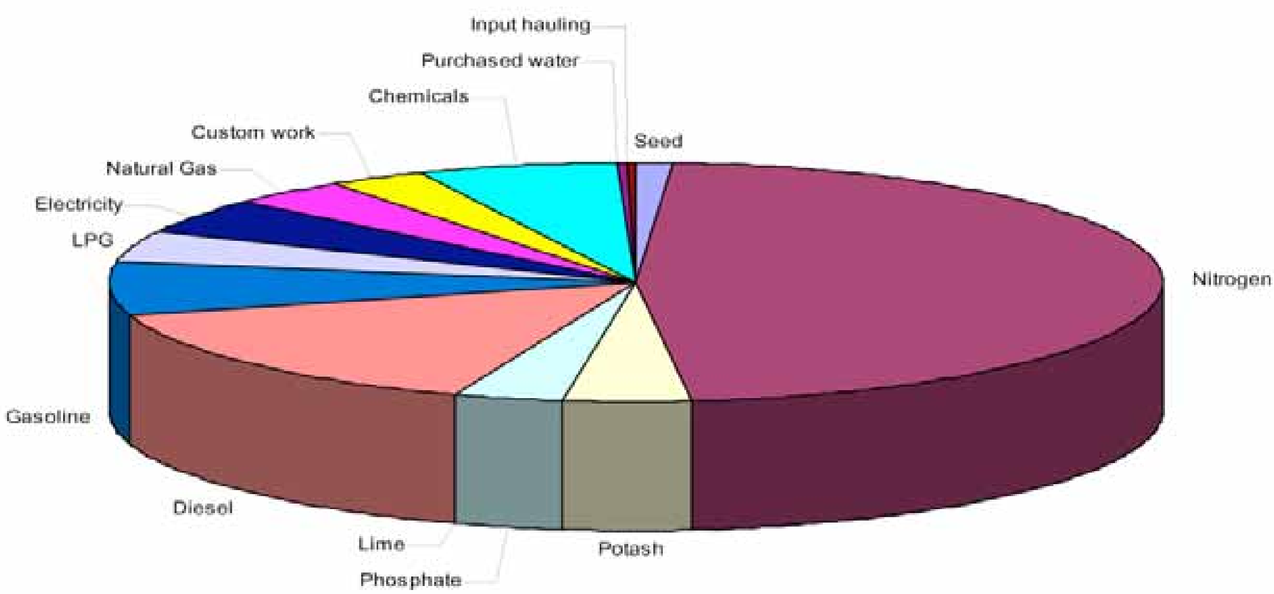
(Data from ref. 2, Annual Energy Review 1999.)

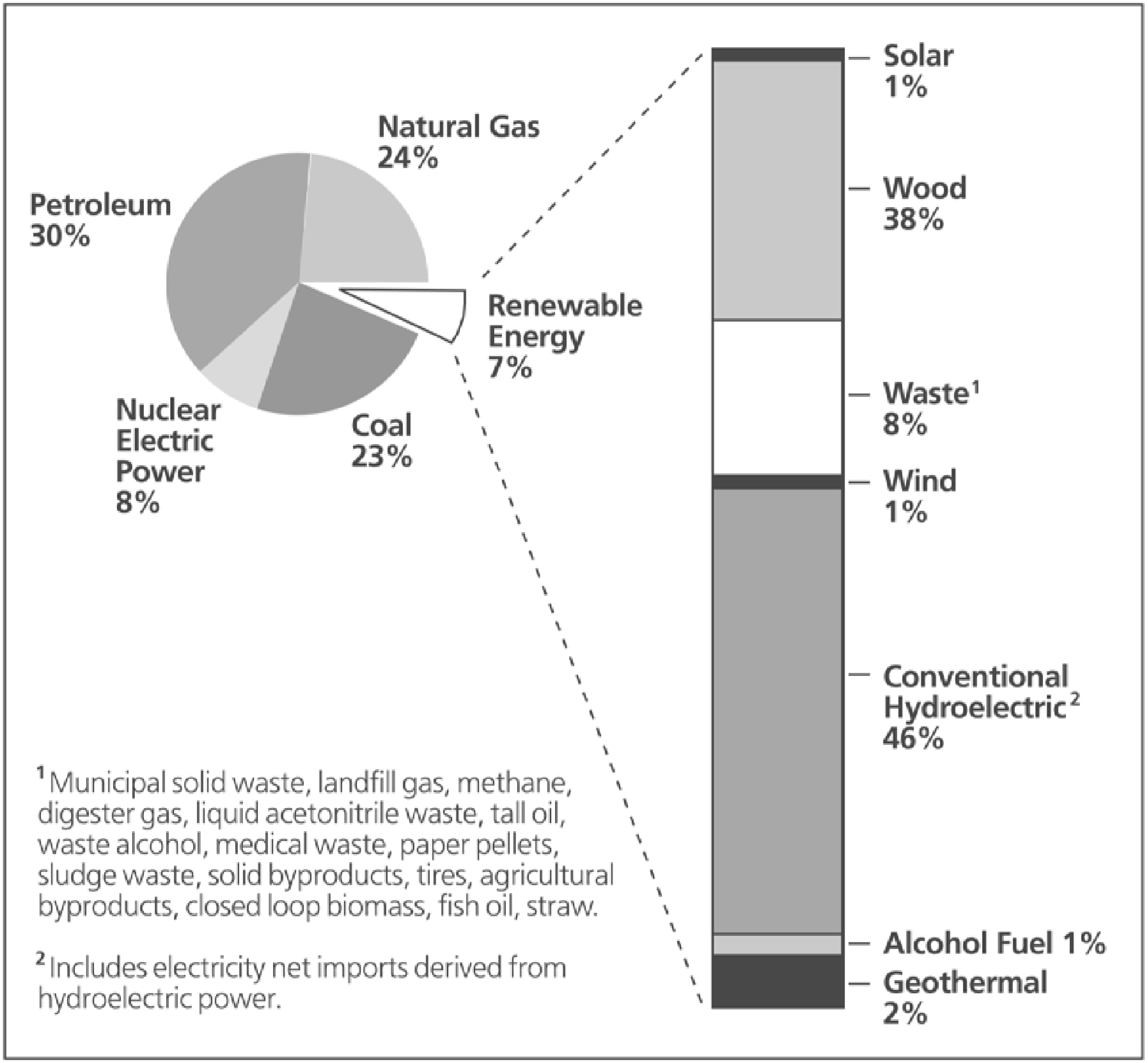
Peak Oil





Total Energy Requirement of Farm Inputs, 9-State Weighted Average, Btu per Bushel of Corn, 2001





Renewable energy as share of U.S. energy comsumption, 2000
(Source: U.S. Energy Information Administration)

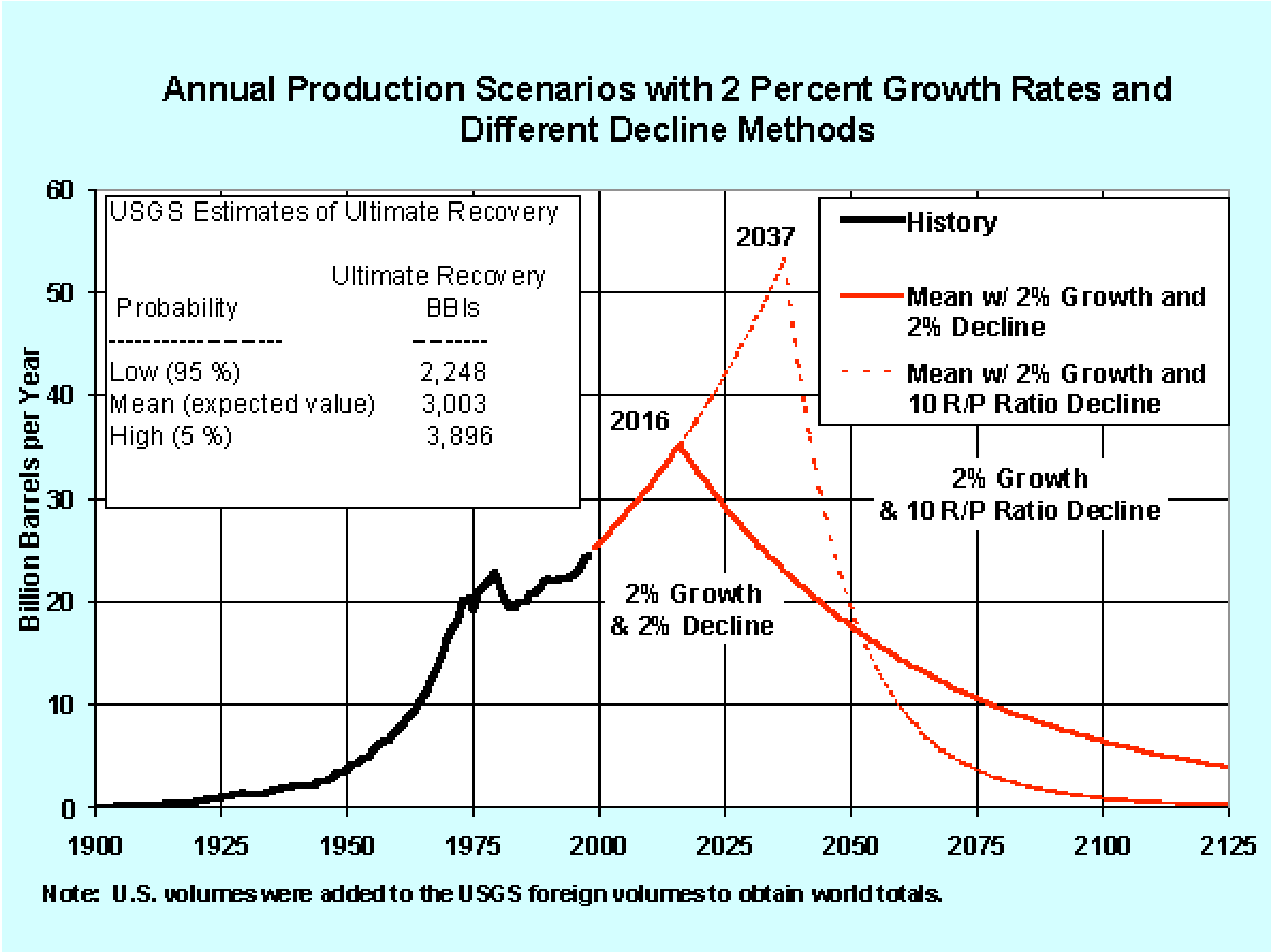


Figure A-1. Two EIA oil production scenarios based on expected ultimate world-recoverable oil of 3,003 billion barrels and a 2 percent annual world oil demand

Robert L. Hirsch's Peaking of World Oil Production: Impacts, Mitigation, and Risk Management

World Oil Peaking is Going to Happen

World production of conventional oil will reach a maximum and decline thereafter. That maximum is called the peak. A number of competent forecasters project peaking within a decade; others contend it will occur later. Prediction of the peaking is extremely difficult because of geological complexities, measurement problems, pricing variations, demand elasticity, and political influences. Peaking will happen, but the timing is uncertain.

Oil Peaking Presents a Unique Challenge

The world has never faced a problem 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) were gradual and evolutionary; oil peaking will be abrupt and revolutionary.

International Cooperation

We are all in the same boat!

Clearly, we would do better to engage the Nations of the world in a competition to achieve sustainability, instead of a consumption contest!

Peak Oil

We Will Need to Start Immediately on Three Fronts, Simultaneously:

Most Urgent:

Prepare Proactively -

Like Apollo 13 Astronauts, develop contingency plans for dealing with anticipatable disruptions

Most Important:

Reduce Energy Consumption Dramatically -

Short Term:

By Conservation, to Buy Time, Save Money & Energy

Long Term:

Develop Efficient "Leapfrog" Technologies

Ultimate Goal:

Achieve Sustainability-

Short Term:

Use Saved Resources Wisely, Develop Alternatives with Highest Energy Profit Ratios

Long Term:

Develop, Demonstrate, Implement, & Rely Upon Self-Powered (Non-Fossil), Housing, Agriculture, & Industries

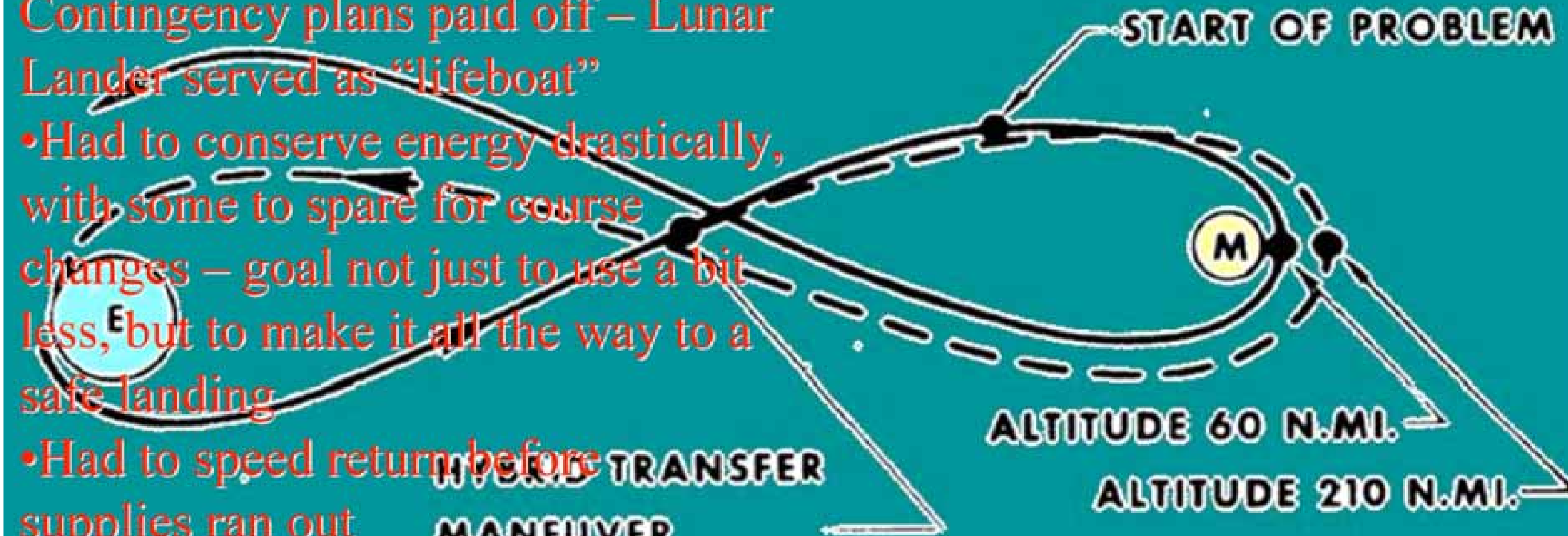
Robert L. Hirsch's Peaking of World Oil Production: Impacts, Mitigation, and Risk Management

We cannot conceive of any affordable government-sponsored "crash program" to accelerate normal replacement schedules so as to incorporate higher energy efficiency technologies into the privately-owned transportation sector; significant improvements in energy efficiency will thus be inherently time-consuming (of the order of a decade or more).

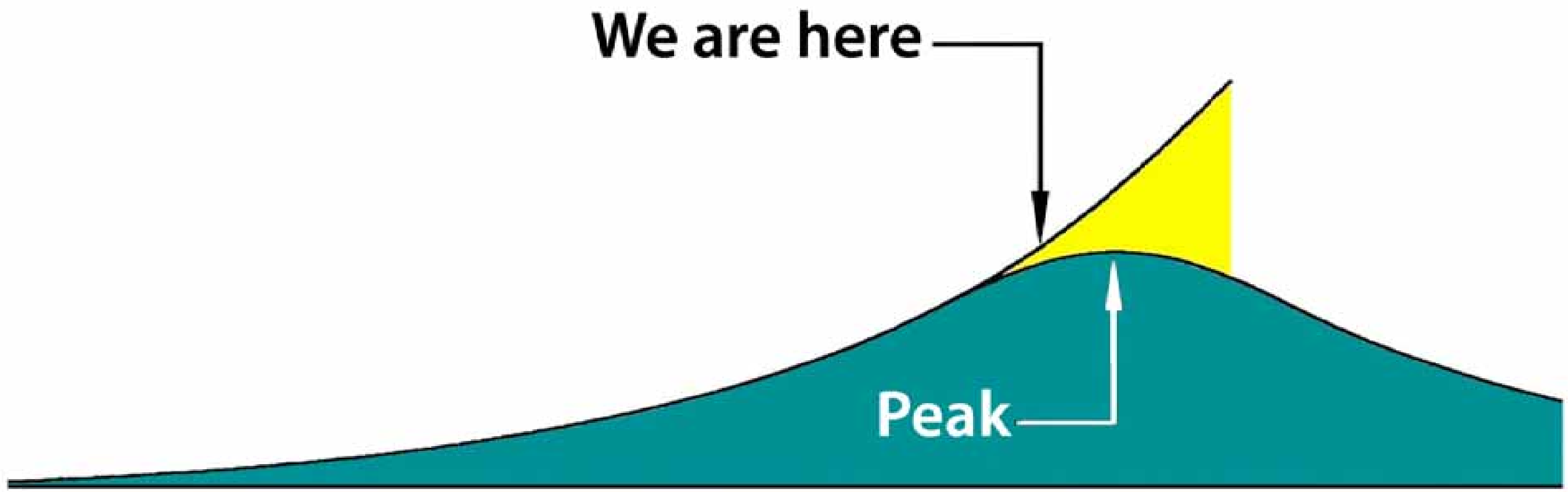

South Elevation
Subsurface Flow Wetland
Sustainability
Western Maryland Welcome Center

Apollo 13:
They Almost Didn't Make it!

- Practice and cooperation essential: Contingency plans paid off – Lunar Lander served as "lifeboat"
- Had to conserve energy drastically, with some to spare for course changes – goal not just to use a bit less, but to make it all the way to a safe landing
- Had to speed return before supplies ran out
- Had complication: CO_2 buildup to overcome
- Had to hit tiny "Reentry Window" to make it to a soft landing, but giving up was not an option



Peak Oil



Peak Oil

We Will Need to Start Immediately on Three Fronts, Simultaneously:

Most Urgent:

Prepare Proactively -

Like Apollo 13 Astronauts, develop contingency plans for dealing with anticipatable disruptions

Most Important:

Reduce Energy Consumption Dramatically -

Short Term:

By Conservation, to Buy Time, Save Money & Energy

Long Term:

Develop Efficient "Leapfrog" Technologies

Ultimate Goal:

Achieve Sustainability-

Short Term:

Use Saved Resources Wisely, Develop Alternatives with Highest Energy Profit Ratios

Long Term:

Develop, Demonstrate, Implement, & Rely Upon Self-Powered (Non-Fossil), Housing, Agriculture, & Industries