PEAK OIL -- (House of Representatives - May 14, 2007)

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

Mr. BARTLETT of Maryland. Mr. Speaker, this is really a very important day in our history. Exactly 50 years ago today in St. Paul, MN, Admiral Hyman Rickover gave a very famous speech. In a few moments, I will have here a copy of that speech, and I want to spend most of the hour that we have this evening going over that speech, because he was amazingly prophetic. This was a speech given to a group of physicians, and it was about energy. Of course, his primary interest was nuclear energy, and this was a speech about energy in general.

As I said, he was amazingly prophetic. He understood some relationships, which today, with 50 years of history behind us, he couldn't have seen. He was amazingly more cognizant of some realities than many of our people today.

We, of course, recognize that for several reasons we need to be moving away from fossil fuels. There are several groups of people with different interests who have really a common goal in their desire to move away from fossil fuels to renewables. And these several groups find common cause, and I hope that there will be less discussion of the potential limitations of the other groups' premise and more focus on a common goal, and that is to help our country and our world move away from fossil fuels to renewables.

The groups that have common cause in this are, first of all, environmentalists, and there are two groups in the environmentalists who are concerned about this. One is a group which is large and growing, and that is a group that believes that our excessive use of fossil fuels releasing carbon dioxide that was sequestered a very long time ago, perhaps millions of years ago, with subtropical seas and plumes of organisms like our algae today, which then fell to the bottom and were covered by sediment washed in from the adjoining hills and then later submerged by movements of tectonic

plates and with time and pressure became what we know today as gas and oil. Coal is a little simpler. It wasn't buried so deep, and you can see in the broken block of coal the ancient fern leaves from which the coal was produced. I saw that many times as a little child in western Pennsylvania, coal country, when I broke lumps of coal to feed our coal furnace. And what we are doing today, of course, is releasing that carbon dioxide very fast. It took maybe millions of years to sequester, but we are releasing it very fast; and so it is producing greenhouse gases, which are warming the Earth and producing temperature changes.

For those who may wonder what difference does it make, a degree here and a degree there. I would like to remind them that during the last Ice Age about 10, 12,000 years ago, our world was only 5 degrees centigrade colder than it is today. That is 9 degrees

Fahrenheit. And what this says is that very small temperature changes can make huge changes in our weather.

A second group of environmentalists who have common cause in wanting to move away from fossil fuels are those who believe that our air is polluted enough and why would we want to pollute it further.

Then there are those who yearn for the day when America was a leading exporter, and they believe that moving from fossil fuels to renewables, sustainable renewables, that we can develop technologies which will be saleable world-around.

And then there is a growing group of people who have major concerns that, with only 2 percent of the known reserves of oil and using 25 percent of the world's oil and importing almost two-thirds of what we use, that this represents a totally unacceptable national security risk, and so their desire is to move from fossil fuels, which we have very little of, to renewables, which we hopefully could produce more of.

And then there is the last group of these five, and by the way, I subscribe in varying degrees to all of these other goals, but the last one is particularly significant because we might somehow make it through, luckily, the other crises that may be there. But the peak oil crisis is one we won't make it through, and that is one that Hyman Rickover talked a good deal about.

Here is his speech. It was for delivery at a banquet of the Annual Scientific Assembly of the Minnesota State Medical Association, St. Paul, MN, May 14, 1957. That is exactly 50 years ago today, and I am very pleased that in the gallery with us is the widow of Admiral Hyman Rickover.

Mrs. Rickover, welcome.

And we are here to celebrate a great American who gave a really, really prophetic speech. And I am going to spend most of the time pretty much reading this speech, and I will put up here some charts from particularly significant quotes from his speech and some others which will help illuminate what he said. The title of his speech was ``Energy Resources and Our Future.'' He starts out by saying:

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

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

Now, all of this is 50 years ago. I want you to listen to how profound his statements were and how completely he recognized the problems that we would be facing.

``We live in what historians may some day call the Fossil Fuel Age. Today coal, oil, and natural gas supply 93 percent of the world's energy; water power accounts for only 1 percent; and the labor of men and domestic animals the remaining 6 percent." Now, those figures have changed somewhat since then.

``This is a startling reversal of corresponding figures for 1850, only a century ago. Then fossil fuels supplied 5 percent of the world's energy, and men and animals 94 percent. Five-sixths of all the coal, oil, and gas consumed since the beginning of the Fossil Fuel Age has been burned up in the last 55 years." Now if you were to bring that forward, it would be a bigger percentage than that.

``These fuels have been known to man for more than 3,000 years. In parts of China, coal was used for domestic heating and cooking, and natural gas for lighting as early as 1000 B.C. But these early uses were sporadic and of no economic significance. Fossil fuels did not become a major source of energy until machines running on coal, gas, or oil were invented. Wood, for example, was the most important fuel until 1800, when it was replaced by coal. Coal, in turn, has only recently been surpassed by oil in this country.

``Once in full swing, fossil fuel consumption'' had been ``accelerated at phenomenal rates. All the fossil fuels used before 1900 would not last 5 years at today's rate of consumption." And that was 50 years ago. What would it be today?

``Nowhere are these rates higher and growing faster than in the United States. Our country, with only 6 percent of the world's population," today a bit less than 5, ``uses one-third of the world's total energy input." Today it is about 25 percent because much of the rest of the world is catching up with us, but, still, 25 percent for less than 5 percent of the world's population is very significant.

``This proportion would be even greater except that we use energy more efficiently than other countries." Still true today, only we use 25 percent of the world's energy. We use it more efficiently than most of the rest of the world.

``Each American has at his disposal, each year, energy equivalent to that obtainable from eight tons of coal." This was just 50 years ago. It would be more than that today.

Time magazine, a little while back, had on its cover, and you may remember that, a pile of coal that they said was a quarter of a ton, and that was the amount of coal that would be saved for power production if you unscrewed that incandescent light and put in it one of the little fluorescent bulbs that you can screw into a regular socket.

[Time: 20:45]

This is six times the world's per capita energy consumption, what we were using in this country. Though not quite so spectacular, corresponding figures for other highly industrialized countries also show above average consumption figures. The United Kingdom, for example, uses more than three times as much energy as the world average.

I want you to look at this first chart while I am reading this because you have to look at the colors and what each of the men stand for and each of those different colors to understand this. But this was in his day, 50 years ago. What would these numbers be today?

With high energy consumption goes a high standard of living. Thus the enormous fossil fuel energy which we in this country control feeds machines which make each of us master of an army of mechanical slaves. Man's muscle power is rated at 35 watts continuously, or 120th horsepower. That is on a 24/7 basis. It's a bit more than that. I generally think of about a 70 watt bulb if you're awake and not working much. Machines therefore furnish every American industrial worker with energy equivalent to that of 244 men, while at least 2,000 men push his automobile along the road and his family is supplied with 33 faithful household helpers. Each locomotive engineer, as you can see on the chart, controls energy equivalent to that of 100,000 men, each jet pilot of 700,000 men. Truly, he says, the humblest American enjoys the services of more slaves than were once owned by the richest nobles and lives better than most ancient kings. In retrospect, and despite wars, revolutions and disasters, the hundred years just gone by may well seem like a Golden Age. And we have continued that Golden Age another 50 years, until today. And then he says, whether this Golden Age will continue depends entirely upon our ability to keep energy supplies in balance with the needs of our growing population.

Before I go into this question, let me review briefly the role of energy resources and the rise and falls of civilizations. And as I read, you may look at the next chart because some of the quotes in the next couple of paragraphs are in this chart.

I would like for you to pay particular attention to this because he describes very well the contribution that energy has made to the development of civilization. And if we understand how energy contributed to the development of civilization, we will get some clue as to what will happen when we start down the other side of this curve.

He mentions a little later that 8,000 years of recorded history in the age of oil will span but a brief time, probably about 300 years. We are about 150 years through the age of oil. So, concentrate on what he is saying about the contribution of energy to the development of civilization, because unless we are really clever and using the new technologies we have found, it is possible that we will see a reversal of this as energy becomes less and less available. Will civilization decline with decreasing energy as it increased with increasing energy?

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

Surplus energy provides a material foundation for civilized living, a comfortable and tasteful home instead of a bare shelter; attractive clothing, instead of mere covering to keep warm; appetizing food, instead of anything that suffices to appease hunger. It provides the freedom from toil without which there can be no art, music, literature or learning.

There is no need to belabor the point. What lifted man, one of the weaker mammals, above the animal world was that he could devise with his brain ways to increase the energy at his disposal and use the leisure so gained to cultivate his mind and spirit. He refers to us as one of the weaker mammals, and that is true. We cannot run nearly as fast as many. We have nowhere near the strength. A chimpanzee our size has several times our strength. Our sense of smell is really very poor compared to a dog, and a dog very poor compared to male moth that can detect the presence of a female 10 kilometers away and detect the concentration gradient so that he knows which direction to fly to find her. We are indeed one of the weaker mammals, but we have dominated the world because of our ability to control energy.

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

Now, some of the things he says here you are going to have to relate to 50 years ago. He talks about India and China in a few moments. And clearly they now have entered the industrialized part of the world and are growing very rapidly. But what he said about them then was very true of them then and true of other just beginning to develop countries today.

Slave labor was necessary for the city-states and the empires of antiquity. They frequently had slave populations larger than their free citizenry. As long as slaves were abundant and no moral censure attached to their ownership, incentives to search for alternative sources of energy were lacking. And this is a really interesting statement. ``This may well have been the single most important reason why engineering advanced very little in ancient times.'' Through all of the Dark Ages, centuries, civilization advanced very little because engineering advanced very little, and he thinks this may have been because of the availability of slave labor.

The next chart. A reduction of per capita energy consumption has always, in the past, led to a decline in civilization and a reversion to a more primitive way of life. And he

gives some fascinating examples. For example, exhaustion of wood fuel is believed to have been the primary reason for the fall of the Mayan civilization on this continent and the decline of once fourishing civilizations in Asia. India and China once had large forests, as did much of the Middle East. Deforestation not only lessened the energy base, but had a further disastrous effect; lacking plant cover, soil washed away. And with soil erosion, the nutritional base was reduced as well.

Another cause of declining civilization comes with pressure of population on available land. A point is reached where the land can no longer support both the people and their domestic animals. Horses and mules disappear first. Finally, even the versatile water buffalo is displaced by man, who is 2.5 times as efficient an energy converter as are draft animals. It must always be remembered that while domestic animals and agricultural machines increase productivity per man, maximum productivity per acre is achieved only by intensive manual cultivation. And as he points out, the press of populations will eventually lead to this state in much of the world.

It is a sobering thought that the impoverished people of Asia, who today seldom go to sleep with their hunger completely satisfied, and remember, this is 50 years ago, were once far more civilized and lived better than the people of the West. And not so very long ago either. It was the stories brought back by Marco Polo of the marvelous civilization in China which turned Europe's eyes to the riches of the East and induced adventurous sailors to brave the high seas in their small vessels searching for a direct route to the fabulous Orient. The ``wealth of the Indies'' is a phrase still used, but whatever wealth may have been there is certainly not evident in the life of the people today. This is 50 years ago. They are now using energy, very large amounts of it. China probably has a greater percent increase in energy than about any other country and their economy is growing; the last quarter for which I saw data, 11.4 percent.

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

Anyone who has watched a sweating Chinese farm worker, and again, this is 50 years ago, strain at his heavily laden wheelbarrow, creaking along a cobblestone road, or who has flinched as he drives past an endless procession of human beasts of burden moving to market in Java, the slender women bent under mountainous loads heaped on their heads, anyone who has seen statistics translated into flesh and bone realizes the degradation of man's stature when his muscle power becomes the only energy source he can afford. Civilization must wither when human beings are so degraded.

Where slavery represented a major source of energy, its abolition had the immediate effect of reducing energy consumption. Thus, when this time-honored institution came

under more censure by Christianity, civilization declined until other sources of energy could be found. Slavery is incompatible with Christian belief in the worth of the humblest individual as a child of God.

As Christianity spread through the Roman empire and masters freed their slaves in obedience to the teaching of the church, the energy base of Roman civilization crumbled. This, some historians believe, may have been a major factor in the decline of Rome and the temporary reversion to a more primitive way of life during the Dark Ages.

Slavery gradually disappeared throughout the Western world, except in its milder form of serfdom. That it has revived a thousand years later merely shows man's inability to stifle his conscience, at least for a while, when his economic needs are great. Eventually, even the needs of overseas plantation economies did not suffice to keep alive a practice so deeply repugnant to Western man's deepest convictions.

It may well be that it was unwillingness to depend on slave labor for their energy needs which turned the minds of medieval Europeans to search for alternative sources of energy, thus

sparking the Power Revolution of the Middle Age which, in turn, paved the way for the Industrial Revolution of the 19th century.

When slavery disappeared in the West, engineering advanced. Men began to harness the power of nature by utilizing water and wind as energy sources. The sailing ship, in particular, which replaced the slave-driven galley of antiquity, was vastly improved by medieval shipbuilders and became the first machine enabling man to control large amounts of inanimate energy.

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

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

today, their populations are growing so that the European percentage of the world is not as high as it was 50 years ago.

Meanwhile, much of the rest of the world did not even keep energy sources in balance with population growth. Per capita energy consumption actually diminished in large areas. It is this difference in energy consumption which has resulted in an ever-widening gap between the one-third minority who live in high-energy countries and the two-thirds majority who live in low-energy areas. These so-called underdeveloped countries are now finding it far more difficult to catch up with the fortunate minority than it was for Europe to initiate transition from low energy to high-energy consumption. For one thing, their ratio of land to people is much less favorable. And we see this in much of Africa, Darfur, for instance, where the arable land is really very small compared to the people. And you see what that has done to their standard of living and to their culture.

For one thing, the ratio of land to people is much less favorable. For another, they have no outlet for surplice populations to ease the transitions since all the empty spaces have already been taken over by people of European stock.

[Time: 21:00]

This was a correct observation 50 years ago.

``Almost all of today's low energy countries have a population density so great that it perpetuates dependence on intensive manual agriculture, which alone can yield barely enough food for their people. They do not have enough acreage per capita to justify using domestic animals or farm machinery, although better seeds, better soil management and better hand tools could bring some improvement."

I think he would be very pleased that today that has happened and they can live better, even with this high population density per arable land than they could then.

``A very large part of their working population must nevertheless remain on the land, and this limits the amount of surplus energy that can be produced. Most of these countries must choose between using this small energy surplus to raise their very low standard of living or postpone present rewards for the sake of future gain while investing the surplus in new industries."

A very good explanation of how difficult it is for some of these undeveloped countries to enter the march of the developing countries.

``The choice is difficult because there is no guarantee that today's denial may not prove to have been in vain. This is so because of the rapidity with which public health measures have reduced mortality rates, resulting in population growth as high or even higher than

that of the high energy nations. Theirs is a bitter choice. It accounts for much of their anti-Western feeling and may well portend a prolonged period of world instability."

That is quite prophetic, isn't it? We see a period of world instability now, and how much has this energy imbalance contributed to it?

``How closely energy consumption is related to the standard of living can be illustrated by the example of India."

Then he goes back to the India of 50 years ago, where the people lived really a hand-to-mouth existence, where their infant mortality rate was four times ours and life expectancy for people less than one-half of that of industrialized nations. Fortunately, India is now industrializing, and these numbers are changing.

He says, ``I think no further elaboration is needed to demonstrate the significance of energy resources for our future. Our civilization rests upon a technological base which requires enormous quantities of fossil fuels."

And this is a really significant statement. ``What assurance do we then have that our energy needs will continue to be supplied by fossil fuels."

Let me repeat the question again. What assurance do we then have that our energy needs will continue to be supplied by fossil fuels? ``The answer is, in the long run, none."

He saw this 50 years ago. There are a lot of people today in our country and in others also who, with the 50 years of history since Hyman Rickover, still don't understand that in the long run, there is no assurance that fossil fuels will meet our energy needs.

Then he goes on to say, ``The Earth is finite. Fossil fuels are not renewable. In this respect, our energy base differs from that of all earlier civilizations."

A major report done by SAIC called the ``Hirsch Report on Energy and the Energy Future" says that the world has never faced a problem like this, and Hyman Rickover understood that 50 years ago.

``In this respect, our energy base differs from that of all earlier civilizations. They could have maintained their energy supply by careful cultivation. We cannot. Fuel that has been burned is gone forever. Fuel is even more evanescent than metals. Metals too are non-renewable resources threatened with ultimate extinction, but something can be salvaged from scrap. Fuel leaves no scrap and there is nothing man can do to rebuild exhausted fossil fuel reserves."

Some of these quotes appear in the next chart.

``They were created by solar energy 500 million years ago and took eons to grow to their present volume. In the face of the basic fact that fossil fuel reserves are finite, the exact length of time these reserves will last is important in only one respect."

Wow, I wish that our leaders could read this.

``The longer they last, the more time that we have to invent ways of living off renewable or substitute energy sources and to adjust our economy to the vast changes which we can expect from such a shift."

And in spite of increasing evidence from the engineering and scientific world, a large percent of our people and, unfortunately, of our leadership, are effectively in denial of this.

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

He is using this and talking about energy and our relationship to energy and how we are using it.

When we found this incredible wealth under the ground, and Admiral Rickover understood how incredible it was, we really should have stopped and asked ourselves the question, what can we do with this to provide the most good for the most people for the longest time? That clearly is not what we did. With no more responsibility than the kids who found the cookie jar or

the hog who found the feed room door open, we just have been pigging out, and we want to continue to do that.

They asked me to vote to drill offshore and in ANWR, and I asked them, if you could pump ANWR tomorrow, what would you do the day after tomorrow? And there will be a day after tomorrow. I have 10 children, 15 grandchildren and two great grandchildren, so I really relate to this description of a selfish and irresponsible parent.

One of the writers has noted that future generations looking back on us may ask themselves, how could the monsters have done that? How could they have taken this incredible wealth without any thought for tomorrow and just gone through it?

Now the urge is just to find what little remains as quickly as we can. Where is the moral responsibility for our kids and our grandkids? Where is the moral responsibility for generations yet unborn?

``Engineers whose work familiarizes them with energy statistics; far-seeing industrialists who know that energy is the principal factor which must enter into all planning for the future; responsible governments who realize that the well-being of their citizens and the political power of their countries depend on adequate energy supplies; all these have begun to be concerned about energy resources."

Boy, if that was true then, why, something happened, because far too few people today are concerned about energy resources.

``In this country," he says, then 50 years ago, ``in this country especially, many studies have been made in the last few years seeking to discover accurate information on fossil fuel reserves and foreseeable fuel needs. Statistics involving the human factor, of course, are never exact. The size of useable reserves depends on the ability of engineers to improve the efficiency of fuel extraction and use."

The next chart is one that I will spend just a moment on, because it really amplifies what he is saying. This is referred to as the oil chart, and you can get a very large one if you do a Google search for that, and this is simply an insert in it.

What this shows in the bars is the discovery of oil, and anyone who has been through a seventh grade math class knows that if you add up all of these little bars, you will have determined the total amount of oil that we have found. Indeed, if you make a smooth curve over them, the area under that curve will be the total amount of oil that we have discovered. The heavy black line here represents the oil that we have used.

Now, one thing is certain: You cannot use oil that you haven't found. So what will the future look like?

You can extrapolate from this chart, which shows that ever since about 1980 we have progressively used more and more oil than we have found. The discoveries of oil have been falling off. You see they started back there in the 1960s or 1970s. There were very large discoveries, and they have fallen off ever since then.

Now, there are those who would have you believe that we are going to find much more oil as all the oil which still exists, all the recoverable oil which still exists, and that is about half of what was ever found. This represents all the oil that was ever found, and the area under this use curve up, until this point, represents about half of that area under the curve.

So we have used about half of all the oil we have found, and there are some who would have you to believe that we will find as much more oil as all the oil which still exists that is recoverable.

``The size of usable reserves depends on the ability of engineers to improve the efficiency of fuel extraction and use. It also depends on discovery of new methods to obtain energy from inferior resources at cost which can be borne without unduly

depressing the standard of living. Estimates of future needs in turn rely heavily on population figures, which must always allow for a large element of uncertainty, particularly as man reaches a point where he is more and more able to control his own way of life."

The next chart shows the estimates made by a number of different sources as to when we will reach that point where we can no longer increase the amount of oil that we are producing per day. As you can see, some of them have enormous uncertainties. Some have very little uncertainty. They are pretty sure when it is going to occur.

As you notice, the vast majority of them believe it is going to occur before 2020. Indeed, 35, I think, of the 45 oil-producing nations in the world have already peaked, and you may have noted an interesting article, upper right hand of the Wall Street Journal a week or two ago that the big oil field, the second largest oil field in the world, in Mexico, has declined 20 percent in production in the last 2 years.

``Current estimates of fossil fuel reserves vary to an astonishing degree."

It was true then; it is true now.

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

That really hasn't seemed to matter, simply because we have had so much energy available. The best iron ores in our country today I understand are the taconite ores with one-half of one percent iron. In years gone by, our iron ores were so rich in iron that you could literally smelt them in a backyard smelter. If you drive up into Frederick County just a few miles above my home, you will come to Catoctin Furnace and the hills up there in northern Frederick County were denuded making charcoal for that furnace. But we couldn't do that today, because the grade of iron is much too poor to smelt in a furnace like that.

The next chart shows a very interesting one, and I just want to read his comments relative to this:

``But the most significant distinction between optimistic and pessimistic fuel reserve statistics is that the optimists generally speak of the immediate future, the next 25 years or so, while the pessimists thinks in terms of a century from now. A century or even two is a short span in the history of a great people. It seems sensible to me to take a long view, even if this involves facing unpleasant facts."

What we have here is a very interesting chart. A little later, if time permits, we will read his discussion of the growth of civilization and how it is rapidly expanding now.

Actually, if this were a chart of the growth of civilization, it would not look much different than this, because civilizations have grown as energy has become available. This goes back only about 400 years. We could extend this line back here, this is burning of wood for fuel, we could extend it back another couple of centuries and you would still have about the same population. Very low population.

Then we discovered the industrial age with wood, and then coal, and then look what happened when we found gas and oil? The energy production just exploded, and, with that, the population. He has a very interesting discussion of population in a moment or two.

I want you to note on this graph what happened in the 1970s. The rate of rise of that curve before the 1970s gave us a stunning statistic. Each decade, the world was using as much oil as it had used in all of previous history. If you think about that, what that means is when you have used half your oil, just 10 years of oil at that use rate remains.

Now we are doing much better than that now, and you can see how this has tipped over and is following a different curve.

``For it is an unpleasant fact that according to our best estimates, total fossil fuel reserves recoverable at not over twice today's unit cost are likely to run out at sometime between the years 2000 and 2050."

So he was predicting that we would reach this point sometime in this half a century.

[Time: 21:15]

If present standard of living and population growth rates are taken into account, oil and natural gas will disappear first, coal last. There will be coal left in the Earth, but it will be so difficult to mine that energy costs will rise to economically intolerable

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heights so that it would then become necessary either to discover new energy sources or to lower standards of living drastically.

For more than 100 years, we have stoked ever growing numbers, and this is a poetic the way explains this. For more than 100 years, we have stoked ever-growing numbers of machines with coal; for 50 years we have pumped gas and oil into our factories, cars, trucks, ships, planes and homes without giving a thought to the future. Occasionally, the voice of a Cassandra has been raised only to be quickly silenced when a lucky discovery revised estimates of our oil reserves upward or a new coal field was found in some

remote spot. Fewer such lucky discoveries can be expected in the future, especially in industrialized countries where extensive mapping of resources has been done. Yet the popularizers of scientific news would have us believe there is no cause for anxiety, that reserves will last thousands of years, and that before they run out, science will have produced miracles. Our past history and security have given us the sentimental belief that the things we fear will never really happen, that everything turns out right in the end, but prudent men will reject these tranquilizers, he says, and prefer to face the facts so they can plan intelligently for the needs of their posterity. Wouldn't it be nice if we were doing that?

Looking to the future from the mid-20th century, we cannot feel overly confident that present high standards of living will of a certainty continue through the next century and beyond. Fossil fuel costs will begin to rise as the best and most accessible reserves are exhausted, and more effort will be required to obtain the same energy from remaining reserves.

I suspect oil was $2 or $3 a barrel when he wrote this. Today it is over $60 a barrel.

It is likely also that fossil fuel costs will soon definitely be more expensive. Can we feel certain when economically recoverable fossil fuels are gone, science will have learned how to maintain a high standard of living on renewable energy sources?

I believe it would be wise to assume that the principal renewable fuel sources which we can expect to tap before fossil fuels run out will supply only 7 to 15 percent of our energy needs.

I would like to look at the next chart because he was really prophetic in what he said in 1957.

Here we have a chart that shows where we get our energy from. I use the analogy of a couple whose grandparents have died and left them a large inheritance and they now have established a quite lavish lifestyle where 85 percent of the money they spend comes from the inheritance and only 15 percent earnings. They note with their age and the amount of inheritance and the way they are spending it, it is going to run out before they retire. They either have to spend less or make more or a combination. I use that 85-15 because it is pretty precisely where we are relative to energy. So 85 or 86 percent of our energy comes from fossil fuels: Coal, petroleum and natural gas. And only 15 percent of it comes from what they call renewables, something other than these fossil fuels. More than half comes from nuclear here. So it leaves only 7 percent to come from the true renewables. And those that we will have to increasingly depend on in the future, and this is a 2000 chart, solar was 1 percent of 7 percent. That is 0.07 percent. So today it is 5 or 6 times bigger. Big deal. It is still less than 1 percent.

Wood waste products is from paper industry and lumbering. Waste energy is a really great idea, but remember that these enormous piles of waste are the result of profligate use of fossil fuels. In a fossil fuel deficient world, there will be diminished piles of waste.

Wind can produce electricity at 2.5 cents a kilowatt hour, growing roughly at 30 percent a year, but when you start at 0.07 percent, it takes a lot of years to matter much.

Nearly half of all of this renewable comes from something we cannot increase in our country, that is major hydro. Micro hydro, where you are using energy from small streams, with small turbines, some guess it may produce as much as this, but that is thousands of these streams and energy produced locally for a home or a couple of homes. We cannot increase conventional hydroelectric because we have probably dammed up all the rivers we should have and maybe some we shouldn't have.

Alcohol fuel 1 percent, 0.07 percent. I would like to note a recent article in the Washington Post and I think I have a chart. Let's put that chart up.

This is the energy produced from corn by converting it into ethanol. I refer to the bottom first because this points out something that very few people know. Farmers know it because they are paying an enormous amount for nitrogen fertilizer. It is almost all produced from natural gas. Almost half of the energy used to produce a bushel of corn comes from nitrogen fertilizer, ordinarily produced from natural gas and little of it is in this country. It is produced where natural gas is stranded; that is, there is natural gas but not very many people to use it, and it is hard to transport. So they are using it to produce nitrogen fertilizer.

This shows a comparison what you get from petroleum and what you get from corn ethanol. They are noting here that you get 0.75 million Btus for every one that went in. This recent article in the Washington Post said if we use all of our corn to produce ethanol, that is no tortillas for Mexicans and no corn for our pigs and chickens, all of it for ethanol, and you discounted for the fossil fuel input, which this says is 75 percent, they used 80 percent, some would say it is 100 percent, we use as much energy if you cost all of the energy that goes into producing as you get out of it, but the article assumed 80 percent, that it would replace 2.4 percent of our gasoline. That is discounting it for the fossil fuel input. And they noted if you tuned up your car and put air in the tires, you would save as much gas.

So this points out some of the challenges we have. This is because of the enormous energy density in these fossil fuels.

One barrel of oil has the energy equivalent of the work output of 12 people for a year. That means in terms of work output, the energy you get from these fossil fuels from oil, represents hiring a man for $10 for a whole year. No wonder we have such a magnificent quality of life with energy this relatively cheap. Gas at $3 a gallon is still cheaper than water in the grocery store if you buy water in small bottles.

My next chart is one that Hyman Rickover referred to as more promise for nuclear fuels. I want to spend just a moment on some of his concerns for the sources of energy that we are lauding today. He says wood fuel and foreign waste are dubious as substitutes because of growing food requirements to be anticipated. He anticipated the tension

between food and energy. In just 2 months last year, corn almost doubled from $2.11 a bushel to $4.08 a bushel, and tortillas went up in price for the Mexicans and my dairy farmers are going bankrupt because of the price of feed for their cattle.

Land is more likely to be used for food production than for tree crops. He was thinking of biomass. Farm waste may be more urgently needed to fertilize the soil than to fuel machines.

There is a lot of hype today about biomass, and it is worth noting that you will never get more energy from any biological source than you can by burning it. What we do in the other ways of using it is sometimes just a slow process of burning it, but you end up with the same product. You end up with carbon dioxide and water.

Our topsoil is our topsoil because of organic material, and his caution was if you keep removing this organic material, you are mining the soil and you will end up with poorer soil and not enough food production.

Wind and water power can furnish only a very small percentage of our energy needs. That was true then because we didn't have the big wind machines we have today that produce electricity at 2.5 cents a kilowatt hour, but that is such a tiny percentage of the total production it will take a long time to ramp up.

More promising is the outlook for fossil fuels. These are not properly speaking renewable energy sources, and let's take a look at this chart. We have finite sources here, and actually the second bullet looks at nuclear energy which is not really finite. Fissionable uranium may be. There is a limited supply of that in the world. That

fuels the light water reactors that essentially every nation today uses for its electricity production. In France, it is 75 percent of their electricity.

In spite of that, we are still the largest nuclear energy producer in the world. It is only 20 percent of our electricity, while in France it is 75 percent of their electricity. We are so much bigger economy than France, quantity-wise, we are the biggest producer of energy from nuclear today.

Let's look at the finite resources which he talks about. The tar sands, the oil shales, coal. There is more potential energy in the tar sands in Canada than all the oil reserves in the world. So why then aren't we complacent about the future because there is potentially so much energy there? And there may be more energy in the tides. The Moon lifts the whole ocean 2 feet a day. The problem is harnessing the energy, and we have a similar problem harnessing the energy in the tar sands. They are getting about a million barrels a day, a bit over 1 percent of the 84-85 million barrels a day of oil production. They have a shovel which lifts 100 tons. It dumps it into a truck that hauls 400 tons. They haul it to a cooker which I am told uses more energy from natural gas than they get out of the oil. The gas is stranded so it is not worth much in dollars and cents, and they are producing oil at about

$18 to $25 a barrel and it is selling for over $60, so it is economically productive to do. But they know this is not sustainable because they will run out of the gas, and now they are thinking of building a nuclear power plant. But if you think of this as a vein, it is largely surface and they can do surface mining. But it will shortly duck under a heavy overlay, and they will have to develop a technology to develop it in situ, and they don't know how doable that is. There has been some experiments in doing that by Shell Oil Company. They believe it will be several years before they know if it is economically feasible for getting energy. So there are potentially huge amounts of oil available in the tar sands and the oil shales, but the big problem is the difficulty in getting them out.

We have a chart that I would like to look at that looks at coal because everybody is going to tell you not to worry about nature because we have got so much coal. Okay, we don't have that chart.

Let me talk about the coal chart. We have 250 years of coal. That is true at current use rates. But if you increase the use of coal only 2 percent, that 250 years drops to 85 years.

[Time: 21:30]

Well, a 2 percent increase doubles in 35 years. It's four times bigger in 70 years, and it's eight times bigger in 105 years, and we're talking about 250 years. So now our 250 years of coal shrinks to only 85 years if we are increasing its use only 2 percent, and we will certainly have to increase the use more than that as we find less and less readily available oil and gas.

But for most uses, coal is not very convenient. So we are going to have to convert it to a liquid or a gas, and that will use some of the energy of coal. So now it shrinks to 50 years, but the reality in today's world is that energy is fungible, particularly liquid fuel energy, and we're going to have to share that with the world. There's not much of a way not to share that with the world. If you do that, since we use 25 percent of the world's energy, that now reduces it to 12 1/2 years.

Be very cautious when somebody tells you about a resource that will last so many years at current use rates. It was Albert Einstein I think who said that the most powerful force in the universe was the power of compound interest.

We are running out of time, and I wanted to get to another quote here from Admiral Rickover's speech because he was so prophetic in his speech. ``In the 8,000 years from the beginning of history to the year 2000 A.D. world population will have grown from 10 million to 4 billion.'' He kind of missed that. We are what, over 6 billion today, but that is an enormous growth. ``With 90 percent of that growth taking place during the last 5 percent of that period.'' It would be more than 95 percent because we are now over 6 billion rather than 4 billion. ``It took the first 3,000 years of recorded history to accomplish the first doubling of population, 100 years for the last doubling, but the next doubling will require only 50 years.'' Matter of fact, it occurred in less than 50 years.

And then another chart from Admiral Rickover's talk: ``One final thought I should like to leave with you. High-energy consumption has always been a prerequisite of political power. The tendency is for political power to be concentrated in an ever-smaller number of countries. Ultimately, the Nation which controls the largest energy resources will become dominant. If we give thought to the problem of energy resources, if we act wisely and in time to conserve what we have and prepare well for necessary future changes, we shall insure this dominant position for our own country."

Mr. Speaker, I wonder if Admiral Rickover would think that we have done that. ``If we give thought to the problem of energy resources, if we act wisely and in time to conserve what we have and prepare well for necessary future changes, we shall insure this dominant position for our own country." That's the dominant position where you control a lot of the energy. We have only 2 percent of the world's energy. We use 25 percent of the world's energy. In a chart which shows the 10 largest oil containing countries we're not even near that.

Our oil companies, which pump a fair amount of oil, own very little oil. They are pumping somebody else's oil. The oil resources which we own in this country are very small. The largest, 70 percent, of all the resources of course are in the Middle East and northern Africa.

As I read this talk from Admiral Rickover, I was reminded of how wise and farseeing he was. He says, for instance, ``It will be wise to face up to the possibility of the ultimate disappearance of automobiles, trucks, buses and tractors."

Let me read that paragraph. That's a pretty interesting paragraph. ``Transportation, the lifeblood of all technically advanced civilizations, seems to be assured, once we have borne the initial high cost of electrifying railroads and replacing buses with streetcars or interurban electric trains."

He's talking about nuclear energy, which could be huge, compared to the rate at which we are using now which produces electricity. Of course, today we don't have much that runs on electricity. We have torn out all of our streetcar lines. We're now replacing what we call light rail, I think that's what streetcars were, and we are using railroads. Very little for transportation of people.

``But, unless science can perform the miracle of synthesizing automobile fuel from some energy source as yet unknown," and I thought here of our corn ethanol and we were going to get so much from that. That article says if we turn all the corn into ethanol, discounted it for fossil fuel input, it would displace 2.4 percent of our gasoline.

Well, I commend this reading of Admiral Hyman Rickover's speech to anyone who's interested in energy. He was really farseeing.

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