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What does a geologist do?

A geologist studies the earth and earth systems and, in my case, resources — from energy resources to water to natural resources. [A geologist] tries to understand the interplay between earth systems.

What are some of the things you are working on?

I'm the Director of the Bureau of Economic Geology, which is the State Geological Survey and the oldest research unit at The University of Texas at Austin. So, I'm the State Geologist of Texas and I spend a lot of time trying to find, attract and work with smart people. [I work] to put different disciplines and groups together to address complicated earth questions. It's a real challenge.

How do you find smart people?

Well, in a variety of ways. I probably spend, most of my life in an airplane these days — a trip a week at least. I travel the world, and I always have my antenna up for interesting, intelligent, thoughtful people, and not necessarily in the field of geology, [but also in] allied fields, or even some different field that we can bring to bear on questions. It's meeting people. It's listening to talks. It's reading.

And what do these people help you do?

One of the big challenges we face these days is trying to transition from a smaller populated globe, that really wasn't very interconnected, to one that's growing in population and very well-connected. We're trying to understand the whole global system now, and address those things on a scale that's not been addressed before. And that's really one of our great challenges — how to think about things globally and their impacts on global population.

Why do we need to think globally now?

Well it's a good question. I think we're fully connected, if you will. There's really no longer the luxury of thinking locally. Everything we do and everything the world does impacts itself across societal boundaries, whether it's energy or water resources or crops or a variety of other resources.

In a broad sense, where does our global energy come from?

Well, energy is an interesting word. If I were a nutritionist, I'd probably talk about carbohydrates, the kind of energy we consume. But I think when people say "energy" now, they're probably talking about

something that either makes something move or creates heat. And those are really the two kinds of energy that we talk about.

It used to be we had a horse and we'd put hay in it — carbon — and it would move. Transportation systems have evolved a bit. Now we put liquid fuels into them — largely oil, which is refined into gasoline — to move. [It's the] same with airplanes and other kinds of transportation.

The other main form of energy is electricity. We like to think of that as a clean form of energy. I plug my plug in and, I often tell people, that means you're plugging into coal. Because, coal is the largest source of heat that turns an electromagnet and creates electricity. Methane, or natural gas, is next, and nuclear or uranium follows that, and then some subsidiary, very small forms. So, in terms of energy, we're really talking about those two things: things that make something move or create heat.

In terms of oil, how does oil get from the ground to the point where we can actually use it?

Oil is a naturally occurring substance and it's formed through many, many years — millions of years. We used to be able to sort of scoop it out of the earth. It came right to surface when it was first discovered in very shallow wells. Now, we're drilling wells that are anywhere from three to five miles deep, sometimes through two miles of the water column. So, the challenges have become great.

An offshore platform in the Gulf of Mexico is like a Mars landing. The technology deployed there to go through two miles of water into three miles of sediment, turn the well bore at the bottom, and tap into a small reservoir of oil, and then produce it safely to the surface and tank it in, is remarkable.

And, we're going into environments that are extreme now — the arctic, Siberia, the sub-Arctic or Antarctic regions, and very deep waters and deserts. It's a tremendous evolution of technology from just 150 years ago to today to search for, drill for, discover, produce and transport oil to markets. When you think about it, the amount of effort that goes into that to deliver a gallon of gasoline for a mere $2.60 today at the pump, relative to a gallon of bottled water, which may cost $3 to $4, is amazing.

Is that why oil is so expensive? Is it because it's becoming hard to find?

Yes. The price of oil is complicated, and the price of gasoline is quite complicated. In its simplest form, oil is only found in large quantities in a limited number of countries. The reserves of oil, which are like the money reserves in a bank, are held by a very few countries.

Many people talk about Big Oil and might think ExxonMobil or Shell or BP. Turns out, in terms of reserves — the actual oil in their bank — ExxonMobil is the twelfth largest company in the world, and it's a distant twelfth. Saudi Aramco is first, and then Iraq and Iran on down. So, the world's largest oil companies, all together, only control less than 10 percent of the world's oil reserves, conventional oil reserves. And that's a big challenge. The price is largely set by the demand and the ability to supply.

With the world industrializing as it is now in very large, populated areas — the Middle East, Far East, Asia, China and India — the demand pull is extreme and the ability to supply is stressed. So it's pretty basic economics. I think that's truly what's stressing the oil systems and, therefore, the gasoline.

Again, I would say to everyone that it's a remarkably cheap form of energy, even today. We've been very used to inexpensive energy. I think it's starting to go up toward something that will be good for us. It will make us understand and think about how we use energy, which is important.

In terms of the price of gasoline, if you go back to 1973, when I was beginning to learn how to drive a car, there was a supply cutoff. A cartel, which was OPEC, essentially, cut off the supply of oil and drove the price up. In cost-adjusted dollars, inflation-adjusted dollars, it was $80 a barrel of oil. So, we're not quite there yet.

Over the last three decades, the price of oil has been remarkably flat. Now it's had fluctuations within it as a function of supply and demand on an annual scale. Climate or temperature drives that. Is it going be a cold winter or a hot summer? The demand goes up and down, so you see price variations. Geopolitics also causes that. Are there wars or conflicts that cutoff certain supplies? Whether in Venezuela, Mexico or the Middle East? So that can have a big impact on the price of a barrel of oil, which feeds directly into the price of a gallon of gasoline.

Are we running out of oil?

We will not run out of oil because we will and are transitioning to other kinds of fuel. There's an expression: "The Stone Age didn't end for lack of stones."And, the Oil Age won't end for lack of oil. In fact, interestingly enough, oil peaked as a percentage of global energy consumption in 1982 at just under 50 percent. In 1982, oil supply was just under 50 percent of all global energy. And today it's down below 40 percent and has been declining as a percentage steadily. So oil's heyday has come and is slowly going.

Coal peaked at the turn of the last century. Methane and other fuels are now slowly rising. So it's a really elegant mix and it's driven by efficiency. It's taking carbon, coal, hydrocarbons, complex, mixed fuel — and then methane [which is] one carbon and four hydrogen molecules, a very clean fuel, transitional fuel. [methane] is an efficiency driver from carbon to more hydrogen, and that energy mix. So we won't run out of oil. We will simply have other choices and technology allows that.

Do you feel a lot of the discussions about oil are alarmism?

There are actually three schools of thought, and there are folks at either end. Early peakers are folks that are alarmed that we might run out very soon. Folks on the other end would say, "We'll never run out of oil and we'll continue to use it." And then there's sort of a broad group of people in the middle that are looking at realistic transitions from today's energy to tomorrow's energy. For example, when we didn't run out of coal, we made other choices. It turns out when we went to transportation fuels, we needed a liquid fuel to go into combustion engines. So, we went to oil.

Most of our power generators now have been built in the last two decades to run on methane. We didn't run out of coal or heating oil or fuel oil. We are choosing methane instead. It's a more efficient fuel and a cleaner fuel.

We're not going to run out of oil [because of] driving cars and flying airplanes. We're going to develop, when the cost gets too high — both environmentally and economically — other forms of fuel in which to move ourselves around the earth.

Are we consuming more energy now than ever before?

We consume more energy now than ever before. The world has been on a steady increase in energy consumption, checked in the mid 1970s with the first major embargo of oil. For about a decade it leveled off, and then we've been on a steady increase since then globally. It's driven by many things. Population increases, and then the demands for energy are greater for each person based on industrialization.

What is the solution to the long-term need for us to transition? Is there one solution or many solutions in terms of other kinds or ways of using or finding oil, or using other technologies, like nuclear, wind or solar?

The question as to what are the solutions — well, my main solution to the American people would be: be patient. We like to fix things quickly. We're sort of an impatient society and energy is not something that lends itself to quick transitions. The global infrastructure for energy is in the trillions and trillions of dollars. So nothing is going happen quickly. Patience is the first need.

I think if you look at the broad classes again of power generation, we can now gasify and liquefy coal and, in fact, have been able to for 40 to 50 years. But we're getting to the point now where we can afford to do

that, and then capture the emissions and store the emissions in the earth back from where they came. So instead of pulverizing and burning coal, we can gasify coal and burn the syngas. That's a neat technological solution that will be cleaner atmospherically, but also address some of the supply issues that we face with oil and natural gas.

Another example is tar sands, heavy oils and oils in shales. There is natural gas that's found in coal and in shale. These are rocks that we were never able to produce fuels from in the past. They're called unconventional, or frontier, resources, and they're vast. The world is just now beginning to look at these unconventional sources. I think that that will be a neat bridge from today to tomorrow.

The important point of that is, those fuels are found geopolitically and geographically in many more places than conventional oil and natural gas. So it broadens the geopolitical spectrum and allows for competition, or access, to play a role in energy supply. And that's a neat thing, because it will then allow us to stabilize our energy price and not be at the constraints of geopolitical factions that may or may not be friendly to democracy. So, I look at those unconventional forms and say, let's go. Let's get to those and transition from today to tomorrow.

Why do we need a transition?

Transition from one energy form to another happens naturally. And again, I think it's driven by efficiencies. We quit riding horses because it wasn't the best way to move a whole lot of people around and went to cars. Actually, we went through buggies and then old cars and new cars. So, I think that transition — efficiency — is economically driven. It's not something we can necessarily dictate. It's driven by the market. I think it is critical, and it's happening, and I think it's important that it's happening. And it's exciting.

I think it's important and critical that we are transitioning, slowly, away from oil and from solid coal. Let me just give you some numbers. In 1980, 91 percent of the world's energy came from coal, oil, or natural gas. Today, it's 86 percent. So, two percent a decade is sort of the pace of that transition. Now, within that mix, you see less oil, more methane and coal, [which] surprisingly, has been flat. And coal will remain flat because we can use it in a gasified or liquefied form. It's more expensive, but we can gasify or liquefy it.

You see a slow transition away from hydrocarbons or fossil fuels, and the mix changing from solids and liquids to gasses. And that's an elegant, efficiency-driven transition. It's important and it's already happening. The market's driving it.

Where is our society headed and what do we need to be doing?

I would answer that on multiple scales. In the next decade or two or five, I think we need to recognize that fossil fuels are going to be part of that mix. It's just impossible to transition the global energy infrastructure, economically or quickly enough to other things.

In that scenario, we need to recognize that it's important that we support and adapt to changing hydrocarbon mixes from solids to gases. I understand completely why the world doesn't understand that. Fossil fuels are fossil fuels. Well, it turns out, coal and oil and natural gas are quite different things. So that transitional mix will happen in the next two to five decades.

[In terms of that mix], what's happening is we're going more toward methane and other forms of energy. Methane is four hydrogen [atoms] to one carbon [atom]. We've talked about the hydrogen economy and that may be where we go. You need to get hydrogen from somewhere. It doesn't float around as a free ion. So you either split a methane molecule or a water molecule, which is two hydrogen [atoms] and an oxygen [atom]. It takes energy to do that.

We're really looking at how do you create motion, turn turbines or generate heat from other sources of motion, be that wind, which is a tremendous supplement for energy, or bio-resources.

We've heard of biofuels, and they're going to be a good supplement. I think if we force them to be a major component, we'll look back and sort of kick ourselves, because the resource demands, in terms of energy input, soils, water use and food replacement, are too great to have them be on a scale that we need. Hydrothermal is also an interesting supplement.

Ultimately, the only truly renewable source of energy in the world is the sun. And when that's not renewable, we have a different problem. It's the only one that is, sort of, forever there. That's where research and technology are going — how to harness the energy from the sun, capture it in forms that we can move around efficiently and then use it to do the things we do with other forms of energy now.

What the mix is going to be and what it's going to look like in the next fifty years?

As we transition over the next fifty years, we're going to transition away from coal, oil, and natural gas — the fossil fuels — into nuclear energy, solar energy, wind energy, biofuels and hydrothermal. It's important to recognize the mix of fossil fuels is itself transitioning from solid fuels to liquid fuels, which actually peaked in the mid-1980s, to natural gas. And, we'll have natural gas around, or syngases, from those other fuels for many years.

For clarity, please define methane.

Methane is what we mean when we say natural gas. It's a CH_4 molecule — one carbon [atom] and four hydrogen [atoms] — and it's produced naturally from the earth. It's what we use to power many of the generators in power plants. We use it for home heating. It's what you burn in your oven or your natural gas stove or your heaters.

Please continue the discussion of the energy mix.

Around 1980, coal, oil and natural gas represented 91 percent of the world's energy mix. Today it's down to 86 percent. Within that, coal has remained flat, oil has decreased from almost 50 percent to below 40 percent, and methane has come up to almost 25 percent now. So, you see that transition in the fossil fuels away from solids to gasified forms of solids, away from liquids and into the natural gas.

Nuclear and hydro dams each represent about six percent to seven percent of energy, globally. And if you add all those up, you have most of the world's energy. If you take the emerging forms of energy — wind, solar, hydrothermal and biofuels, they are on the order of five percent to six percent. If you remove the biomass part out of that — the wind, solar and hydrothermal — they're about one percent.

You'll often hear that they [biomass fuels] are increasing dramatically each year, and they are. The challenge becomes how do you take them from one percent, which is the percentage they've been for several decades, to a larger percentage? It is important for everyone to understand that all of those fuels are increasing in their absolute use — all of them —because the global demand for energy continues to rise. So we're using more oil, more coal, more methane, more nuclear, more hydro, more wind, more solar— all of them. We're increasing globally because of that global demand.

What innovations are happening within higher education to help make this transition?

The universities have an important role to play in energy, along with the private sector and governments. I think seeking a balance between those three is a great challenge. Energy is such a complicated topic that we can't seem to get our arms around it politically, and the industry is driven by quarterly returns, as they should be. The universities have a role in the longer outlook.

What is the biggest problem facing our society right now in terms of energy demands?

The largest problem that we face in our society today is understanding energy and energy systems. They're complicated, and I think when we have other global-scale crises, we tend to dive into those, whether it's health or drugs or other kinds of things. We have that similar issue with energy right now.

We need to begin to understand where we are with energy today and where we're going, both in our schools — in science and technology for kids in the U.S. — and globally, so our political leaders can respond to an educated public. It's not that they don't understand these things, they do. But they need to do things that respond to their voting public. If the voters don't understand, then the politicians don't have the luxury to react accordingly.

What are some of the misperceptions?

The misperceptions with energy right now are that we have choices that will provide the scale of energy that we need. And in fact, we don't. We don't have choices today. We have coal, we have oil, we have natural gas and we have uranium. Coal is about 25 percent. Oil is about 40 percent but decreasing. Natural gas is around 24 percent and increasing. And uranium, or nuclear, is around six percent to seven percent but increasing in several places globally, not here in the U.S. yet. And those are the only four choices we have to provide the scale of energy that we demand both in the U.S. and globally.

Probably the greatest misperception is that there is something called renewable energy. Unfortunately, that's an oxymoron. No energy is renewable. Once you use it, it takes a different form, but we can't renew that form. We have sources of motion that we can renew and I think that's an important thing for people to understand.

So whether it's wind blowing, or water falling through a dam, or sun that's not blocked by clouds, or oil, or natural gas, or coal, which are truly finite natural resources, or uranium — it's the same. None of those are renewable. So we have to make intelligent choices about how we use the sources that we have. Again, the only source that truly is renewable on a human scale that matters is the sun.

Do you see solar as being the future ultimately?

Solar, absolutely, is the ultimate future. It's the only form I think we will be able to capture and harness. But I don't want to have that be interpreted to mean a decade from now we could be running 20 percent or 30 percent of our U.S. energy from solar. Unfortunately, it won't happen. There are tremendous advances that have to be made in materials and storage and transportation of electricity before that can happen. But certainly we could increase those technologies and deploy solar more than we do today.

What are reserves, and what is the big misperception about then?

When people think of reserves, I think the most common form is bank reserves. There's "X" amount of dollars in a bank. Well, it turns out that banks actually have networks of reserves all over the world.

I tend to think of reserves for things like oil or coal or methane like an Easter egg hunt. If I go out and hunt for Easter eggs and only find 20, and I use that as my sample, I really don't know how many other eggs are out there. I found 20 in 20 minutes and there may be a 100, or there may be 500 more. But I could use that as a sample and say, "Boy, I'm gonna guess that there's a 100 based on the area that I know and the time I took to find them."

Now let's introduce a robin egg and an ostrich egg. Well, they're birds' eggs, but they're not chickens' eggs. So they're different, but they're still eggs. And now let's introduce a snake egg or a reptile [egg]. Those are really different, but they're still eggs. And that's the same kind of issue we have with oil reserves.

When people talk about oil running out, they're really talking about conventional oil. The chicken egg. But now we find an ostrich egg, which may be oil in a shale, or a robin egg, which is a tar sand. Or, maybe we even find a snake egg, which was liquefying coal.

There are tremendous amounts of hydrocarbon reserves in the world today — resources, which are not proven, out there, somewhere that technology and economics will allow us to find and produce and bring to market.

You see that [misperceptions] routinely through time. We talk about falling off the cliff or running out. But technology and economics just seem to have a way of inventing new ideas, new approaches, and new ways to bring to market those forms of energy.

Are you optimistic that we can innovate and create technology to transition away from the traditional sources?

I'm extremely optimistic that we can, that we are and will transition from today's energy to tomorrow's [energy]. There will be bumps along the way, and largely those are going to be things that are forced into the market as sort of a knee-jerk reaction to something like the price of gasoline going up when they shouldn't be forced into the market.

Heavy subsidies for any particular kind of fuel is not a good idea, whether that's oil, gas, coal, biofuels, wind or solar. Now, investment and subsidization to encourage development are wise things to do. Then the market takes over. And we demand it, and by demand and investment, then we will pull those to where they need to be. But we can't sustain things that, in fact, have proven for a long time not to be a good solution. You try. They don't always work and you try something else.

So I'm extremely optimistic that we are transitioning to where we need to be. We need to continue to do that. We can't live in the "coal past," although we can gasify and liquefy coal, which is sort of part of the bridge. We can't live in the "oil past," but we're going to be using oil for many, many years as we slowly wean ourselves away from that and on to something else.

It's the high drama that puts spikes into a market that really, in the end, isn't healthy. And I think we all feel that, individually, whenever we make dramatic decisions. You always say sleep on it. We need to sleep on it. It is my hope that the world will be able to do this in a way that makes good sense. We are crossing cultural boundaries now.

Perhaps more importantly, there's also neat research going on in looking toward the future. And the real challenge is: "How do we store and move the energy more efficiently than we do today?" We're terrible at storing energy. I mean, you have a battery in your flashlight and you know how long it lasts. Well, big batteries aren't much better. So we don't store energy well. And we also don't move it around very efficiently. We either burn it to move the cars that it drives, or we transport it along electronic wires, which lose electricity all along the way. Those are two great challenges, and I think they're being addressed in our nanotechnology centers through really elegant and very inventive looks at different materials.

Is nuclear energy making a comeback? It seems like we've been hearing a lot of talk about it.

Yes. Nuclear energy probably is making a global comeback. If you look at the geopolitical spectrum of the world and break it into about eight or nine big sectors, hydrocarbons account for 85 percent of the mix everywhere in the world except Europe — Western Europe where they are 75 percent. And it's some component of coal, oil, or natural gas, depending on what they have.

If you break that down further by country, you can see tremendous differences in the mix. So, for example, Japan and France have chosen nuclear energy for their power supplies. Sixty to 80 percent of their power now comes from uranium or nuclear energy.

Why is it so important to transition away from fossil fuels?

There's a pretty neat waltz that goes on between what I call the Three E's — energy, environment and economy, and that waltz is being played out on the global stage and is leading us away from fossil fuels

to other forms, which it needs to. The global environment is dependent on us not burning things and sending the emissions into the air. So that's going to drive the dance.

The industrializing global economy craves energy. The world's most affluent countries have access to energy and reasonably priced energy. So they're going to want that. So it's going to drive us towards finding other forms of energy that can supply that.

We have to balance those off, because you [don't] want to see the world's environment get hurt or send the world into a global recession. We don't invest in the environment much when we're in extreme economic hardship or hard times. So that dance, that waltz between energy, environment, and economy is critical. And governments have a role to play. Industry — the private sector — has a role, and universities have a role to play.

It's not that simple, but I think, with the right amount of thought and work and communication, we can get there. It's not going to be solved with sound bites and it's not gonna be solved in a year.

It's difficult to reduce the energy issue, if you will, to a one-liner, because when you're talking about the environment and the economy and energy, you're really talking about the world's most important opportunity or problem. All medical care, all food supplies, all environmental issues rely on energy — stable energy. If we have blackouts, everything falls down.

It's a complicated issue that truly depends on the interplay of all of those things. And if we try to address only one component, the others will suffer. Any time things are interwoven like that, "The devil's in the details," and we really need to think carefully about the pace of the transition and the direction we go.

Let me put it this way. If we're going to build a bridge from today to tomorrow, usually when bridges are built, they're built from both sides and they meet in the middle of whatever body they're trying to cross. If we're going to start building from today, and we make a choice out in the future and start building back — and it's a different choice and they don't meet — we have a major issue.

So the choices have to be thought through and considered, and they have to be adapted by enough people that they will meet in that metaphorical middle. When you're dealing with a global economy, getting world opinion to be consistent is not simple. So, we simply can't reduce that to a sound bite.

Overall, how important is energy to a healthy society?

Well, energy is vital to a healthy society. It drives food storage. It drives our ability to do all research and technology. It's everything that we do, and you can see that when you have blackouts. Crime goes up. Energy is sort of our lifeblood, whatever forms we use. It's what drives the worlds' societies. Therefore, we just can't be flippant about the choices that we make.

So what is the biggest problem, do you think, facing us in terms of our society with relation to energy?

I think the greatest issue facing the society today with energy is our lack of understanding of energy. The greatest crisis that we face is the crisis of misperception. We educate ourselves about many things: health and drug, and crime, et cetera. I put energy right up there with it. It is so critical to all the other systems that we have in the world, that an understanding is the first thing we must have. Because, from that, I think will come elected officials who can then react intelligently and not be driven by a lack of understanding, and students who are educated and can drive themselves towards solutions in the future and get excited about it.

We have a crisis in science and technology in the U. S. right now in terms of enrollment declines and global competition. It will get our kids interested [again] in that bigger picture, and they need to be, because it is such a vital component of everything that drives modern societies.

That makes economic sense, environmental sense and energy sense. It's a complicated picture. And when you start crossing cultural boundaries, and political boundaries, and socioeconomic boundaries, that balance is going to be tricky. It's hard enough to do it across our fifty States and even in North America.

So that's a great challenge. It's going to require that many different disciplines be involved in order to happen well. Otherwise, economies make other choices, and they aren't necessarily the choices of the future.

Are you concerned that we might make big choices for political reasons?

I think that what drives energy choices globally is our economics. Today, the Chinese are trying to access every form of energy that they can, but the big ones are coal, which they have a tremendous resource base. It's pulverized combusted coal. They've not gasified it — or liquefied it, which is the coal of the future. That is a small example of choices that are made in order to continue to industrialize and gain access to energy. I think we need to be working very closely together so that people can make technology choices that are in the future instead of in the past and still satisfy the energy demands of the economy.

Is having an SUV giving money to the terrorists?

Is having an SUV funding the terrorists? There's a great *Dilbert* comic. Dilbert is explaining to his dog, Dogbert, that he just bought a hybrid, "Cause I don't want to fund terrorism." And Dogbert explains that, in fact, oil is a fungible commodity, which means interchangeable, and that the oil will be sold to someone else and the dollars will go to the same economies regardless. And Dilbert says, "Well, at least my dollar won't be going there, and therefore I'll be making a statement." And Dogbert says, "And the statement will be, 'I don't understand what fungible means.'"

I think for better or for worse, Scott Adams, who's the author of *Dilbert*, is right. These are now global commodities. Natural gas isn't quite a global commodity yet. We don't move it around the oceans well yet. LNG — Liquefied Natural Gas — is the way to move natural gas around the ocean, and that's starting to happen. But certainly, oil and coal are. They are truly global commodities. Because the world is demanding energy at the pace that it is, unfortunately, [if we don't consume the energy] someone else will consume those same molecules.

Do you think that we're consuming too much energy, or do we just have to find more sources of energy? Or is it a combination of both?

I'm going to talk to you a little bit about efficiency and conservation, and it's probably not going to be an answer that is popular. Unfortunately, the more efficient we get with energy systems, the more total energy we consume.

Why does that happen? It happens because we get more of those things. We've got more efficient refrigerators. How many refrigerators do many of us have in our homes now? We used to have one television. Unfortunately, now many of us have two or three or five. Computers are a tremendous pull on power. We now have multiple computers in homes. Cars? One car used to [be enough]. We drove a Volkswagen when I was growing up. Now, two cars, three cars. If we're getting more miles to the gallon, we tend to drive more miles.

So there's a misperception, a second great misperception. There's a misperception that as we make our energy systems more efficient, we reduce energy consumption. Unfortunately just the opposite happens.

How do you address that consumption issue?

There are many things we can do, again, to consume less energy. I think if you build cars smaller or [make] light bulbs dimmer or refrigerators smaller, you're not making things more efficient. You're making

them smaller and dimmer and [occupying] less volume. You have to add up the whole. What drives peoples' behavior to consume less of things are economics. If it costs too much to do "this," I'm going to make a different choice. And, in the end, that's what will drive us away from burning gasoline to burning something else, or, hopefully, perhaps creating energy some other way.

Is there a need to be cleaner? And what impact does fossil fuels have on the environment?

The burning of coal has had a tremendous impact on emissions in the atmosphere. The burning of oil has had the same — and even methane, which is much cleaner. Any time you burn something, whether it's wood or hay or fossil fuels — carbon-based fuels — you have an environmental impact.

I think we've gotten much better about that through the years. For example, catalytic converters have come into cars. So we've seen some improvements. They're incremental improvements. Eventually, we will have automobiles and transportation systems that don't combust fossil fuels, and that is probably fifty to a hundred years down the road.

In the interim, we need to continue to just drive towards standards that improve those emissions. There are other environmental impacts as well that come from the use of all sorts of chemical and combustion processes.

Again, I think the environmental standards in this country have improved tremendously. They have room to continue to improve. The world needs to continue to follow that lead. I think we've done a tremendous job and should continue to improve.

The last great oil spill in this country was probably about 1989, if I'm right, *Valdez*. That's not a bad record. Seventeen years. If we grounded the U.S. air fleets every time a plane crashed, none of us would fly. Two major hurricanes came through the Gulf last year and you would've read about it, I promise you, if there were oil spills. We have many, many hundreds of platforms out there and there wasn't any major spill or leak from that.

So again, I would say, the records are improving. They're not broadcast very well because it's not an industry that people like to like. They like to hate it. But I think we have room to improve. Improvements have been great and continue to be made. It's critical that we do it.

You know, we all live in this world. Nobody I know sets out to ruin it. We all demand products and things. The greatest way that we can make a statement is to consume things that you believe are created in a way that make good sense.