ASOPE™ Newsletter

July 24, 2009 | American Society of Power Engineers, Inc. | Volume 7, Number 2

ASOPE Special News Letter.

The address "Energy Myths and Realities" was given April 2, 2009 by Keith O. Rattie, Chairman, President and CEO of Questar Corporation, at Utah Valley University. Permission to reprint the address was obtained by Mr. Dale Miller President of ASOPE from Reggie Van Wagoner, of Questar Public Relations Group, Questar Corporation. (801-324-5410). This article may also be accessed on the Questar website at http://www.questar.com/1OurCompany/newsreleases/2009_news/UVUSpeech.pdf

ASOPE is a non-profit agency. The views expressed by the writer are not necessarily the views of the BOD or officers of ASOPE. ASOPE does not agree or disagree with the following writings, but we support the reading of educational material which is highly recommended.

Larry Tarvin
Chairman, ASOPE Inc.

Energy Myths and Realities
Keith O. Rattie
Chairman, President and CEO
Questar Corporation
Utah Valley University
April 2, 2009

Good morning, everyone. I'm honored to join you today.

I see a lot of faculty in the audience, but I'm going to address my remarks today primarily to you students of this fine school. Thirty-three years ago I was where you are today, about to graduate (with a degree in electrical engineering), trying to decide what to do with my career. I chose to go to work for an energy company – Chevron – on what turned out to be a false premise: I believed that by the time I reached the age I am today that America and the world would no longer be running on fossil fuels. Chevron was pouring money into alternatives – and they had lots of money and the incentive to find alternatives – and I wanted to be part of the transition.

Fast forward 33 years. Today, you students are being told that before you reach *my age* America and the world *must* stop using fossil fuels.

I'm going to try to do something that seems impossible these days – and that's have an honest conversation about energy policy, global warming and what proposed, cap and

trade" regulation means for you, the generation that will have to live with the consequences of the policy choices we make. My goal is to inform you with easily verifiable facts – not hype and propaganda – and to appeal to your common sense. But first a few words about Questar.

Questar Corp. is the largest public company headquartered in Utah, one of only two Utah-based companies in the S&P 500. Most of you know Questar Corp. as the parent of Questar Gas, the utility that sends you your natural gas bill every month. But outside of Utah and to investors we're known as one of America"s fastest-growing natural gas producers. We also own a natural gas pipeline company. We have terrific people running each of our five major business units, and I'm proud of what they've done to transform this 85-year old company. We're the only Utah-based company ever to make the *Business Week* magazine annual ranking of the 50 top-performing companies in the S&P 500 – we were #5 in both 2007 and 2008, and we're #18 in the top 50 in *Business Week's* 2009 ranking, just out this week.

At Questar our mission is simple: we find, produce and deliver clean energy that makes modern life possible. We focus on natural gas, and that puts us in the "sweet spot" of America"s energy future and the global-warming debate. Natural gas currently provides about one-fourth of America"s energy needs. But when you do the math, the inescapable conclusion is that greater use of natural gas will be a consequence of any policy aimed at cutting human emissions of carbon dioxide (CO_2). You cut CO_2 emissions by up to 50% when you use natural gas instead of coal to generate electricity. You cut CO_2 emissions by 30% and NO_x emissions by 90% when you use natural gas instead of gasoline in a car or truck – and here in Utah you save a lot of money. You can run a car on compressed natural gas at a cost of about 80 cents per gallon equivalent. You also cut CO2 emissions by 30-50% when you use natural gas instead of fuel oil or electricity to heat your home.

But you didn't come here for a commercial about Questar and I didn't come here to give you one. Let's talk about energy.

There may be no greater challenge facing mankind today – and your generation in particular – than figuring out how we're going to meet the energy needs of a planet that may have 9 billion people living on it by the middle of this century. The magnitude of that challenge becomes even more daunting when you consider that of the 6.5 billion people on the planet today, nearly two billion people don't even have electricity – never flipped a light switch.

Now, the "consensus" back in the mid-1970s was that America and the world were running out of oil. Ironically, some in the media were also claiming a scientific consensus that the planet was cooling, fossil fuels could be to blame, and we were all going to freeze to death unless we kicked our fossil-fuel habit. We were told we needed to find alternatives to oil – fast. That task, we were told, was too important to leave to markets, so government needed to intervene with massive taxpayer subsidies for otherwise uneconomic forms of energy. That thinking led to the now infamous 1977 National Energy Plan, an experiment with central planning that failed miserably. Fast-forward to today, and: déjà vu. This time the fear is not so much that we're running out of oil, but that we're running out of time – the earth is getting hotter, humans are to blame, and we're all doomed if we don't stop using fossil fuels – fast. Once again we're being told that the job is too important to be left to markets.

Well, the doomsters of the 1970s turned out to be remarkably wrong. My bet is that today's doomsters will be proven wrong. Over the past 39 years mankind has consumed nearly twice the world's known oil reserves in 1970 – and today proven oil reserves are nearly double what they were before we started. The story with natural gas is even better – here and around the world enormous amounts of natural gas have been found. More will be found. And guess what? The 30-year cooling trend that led to the *global cooling* scare in the

mid-70s abruptly ended in the late 70s, replaced by a 20-year warming trend that *peaked in 1998*.

The lesson that we should've learned from the 1970s is that when it comes to deciding how much energy gets used, what types of energy get used, and where, how and by whom energy gets used –that job is too important *not* to be left to markets.

Now, I'd love to stand here and debate the science of global warming. The media of course long ago declared that debate over – global warming is a planetary emergency, we've got to change the way we live *now*. I've followed this debate closely for over 15 years. I read everything I get my hands on. I'm an engineer, so I tend to be skeptical when journalists hyperventilate about science – "World coming to an end – details at 11". My research convinces me that claims of a scientific consensus about global warming mislead the public and policy makers – and may reflect another agenda.

Yes, planet earth does appear to be warming – but by a not so unusual and not so alarming *one degree* over the past 100 years. Indeed, global average temperatures have increased by about one degree per century since the end of the so-called Little Ice Age 250 years ago. And, yes CO_2 levels in the upper atmosphere have increased over the past 250 years from about 280 *parts per million* to about 380 parts per million today – that's .00038. What that number tells you is that CO_2 – the gas we all exhale, the gas in a *Diet Coke*, the gas that plants need to grow – is a trace gas, comprising just four out of every 10,000 molecules in the atmosphere. But it's an important trace gas – without CO_2 in the atmosphere, there would be no life on earth. And yes, most scientists believe that humans have caused much of that increase.

But that's where the *alleged* consensus ends. Contrary to the righteous certitude we get from some, no one knows how much warming will occur in the future, nor how much of any warming that does occur will be due to man, and how much to nature. No one knows how warming will affect the planet, or how easily people, plants and animals will adapt to any warming that does occur. When someone tells you they do know, I suggest Mark Twain's advice: respect those who seek the truth, be wary of those who claim to have found it.

My perspective on global warming changed when I began to understand the limitations of the computer models that scientists have built to predict future warming. If the only variable driving the earth's climate were manmade CO_2 then there'd be no debate – global average temperatures would increase by a harmless one degree over the next 100 years. But the earth's climate is what engineers call a "non-linear, dynamic system". The models have dozens of inputs. Many are little more than the opinion of the scientist – in some cases, just a guess. The sun, for example, is by far the biggest driver of the earth's climate. But the intensity of solar radiation from the sun varies over time in ways that can't be accurately modeled. Another example, water vapor is a far more potent greenhouse gas than CO_2. [The media now calls CO_2 a "pollutant". If CO_2 is a "pollutant" then water vapor is also a "pollutant" – that's absurd, but I digress]. Some scientists believe clouds amplify human CO_2 forcing, others believe precipitation acts as the earth's thermostat. But scientists do not agree on how to model clouds, precipitation, and evaporation, thus there's no consensus on this fundamental issue.

But the reality for American consumers is that whether you buy that the science is settled or not, the *political science* is settled. With the media cheering them on, Congress has promised to "do something". CO2 regulation is coming, whether it will do any good or not. Indeed, President Obama's hope of shrinking the now the massive federal budget deficit depends on vast new revenues from a tax on carbon energy – so called "cap and trade". Harry Reid has promised cap and trade legislation by August.

Under cap-and-trade, the government would try to create a market for CO_2 by selling credits to companies that emit CO_2. They would set a cap for the maximum amount of CO_2 emissions. Over time, the cap would ratchet down. In theory, this will force companies to invest in lower-carbon technologies, thus reducing emissions to avoid the cost of buying credits from other companies that have already met their emissions goals. The costs of the credits would be passed on to consumers. Because virtually everything we do and consume in modern life has a carbon footprint the cost of just about everything will go up. This in theory will cause each of us to choose products that have a lower carbon footprint. Any way you slice it, cap and trade is a tax on the way we live our lives – one designed to produce a windfall for government.

The long term goal with cap and trade is, 80 by 50'– an 80% reduction in CO_2 emissions by 2050. Let's do the easy math on what ‚80 by 50" means to you, using Utah as an example. Utah"s carbon footprint today is about 66 MM tons of CO_2 per year. Utah's population today is 2.6 MM. You divide those two numbers, and the average Utahan today has a carbon footprint of about 25 tons of CO_2 per year. An 80% reduction in Utah's carbon footprint by 2050 implies a reduction from 66 MM tons today to about 13 MM tons per year by 2050. But Utah's population is growing at over 2% per year, so by 2050 there will be about 6 MM people living in this state. 13 MM tons divided by 6 MM people = 2.2 tons per person per year. Under ‚80 by 50' by the time you folks reach my age you'll have to live your lives with an annual carbon allowance of no more than 2.2 tons of CO_2 per year.

Question: when was the last time Utah's carbon footprint was as low as 2.2 tons per person per year? Answer: probably not since Brigham Young and the Mormon pioneers first entered the Salt Lake Valley (1847).

You reach a similar conclusion when you do the math on ‚80 by 50' for the entire U.S. ‚80 by 50' would require a reduction in America's CO_2 emissions from about 20 tons per person per year today, to about 2 tons per person per year in 2050. When was the last time America's carbon footprint was as low as 2 tons per person per year? Probably not since the Pilgrims arrived at Plymouth Rock in 1620.

In short, '80 by 50' means that by the time you folks reach my age, you won't be allowed to use anything made with – or made possible by – fossil fuels.

So I want to focus you on this critical question: "How on God's green earth – pun intended – are *you* going to do what my generation said we'd do but didn't – and that's wean yourselves from fossil fuels in just four decades?" That's a question that each of you, and indeed, all Americans need to ask now – because when it comes to "how" there clearly is *no consensus*. Simply put, with today's energy technologies, we can't get there from here.

The hallmark of this dilemma is our inability to reconcile our prosperity and our way of life with our environmental ideals. We like our cars. We like our freedom to "move about the country" – drive to work, fly to conferences, visit distant friends and family. We aspire to own the biggest house we can afford. We like to keep our homes and offices warm in the winter, cool in the summer. We like devices that use electricity – computers, flat screen TVs, cell phones, the Internet, and many other conveniences of modern life that come with a power cord. We like food that's low cost, high quality, and free of bugs – which means farmers must use fertilizers and pesticides made from fossil fuels. We like things made of plastic and clothes made with synthetic fibers – and all of these things depend on abundant, affordable, growing supplies of energy.

And guess what? We share this planet with 6.2 billion other people *who all want the same things*.

America's energy use has been growing at 1-2% per year, driven by population growth and prosperity. But while our way of life depends on ever-increasing amounts of energy, we're downright schizophrenic when it comes to the things that energy companies must do to deliver the energy that makes modern life possible.

We want energy security – we don't like being dependent on foreign oil. But we also don't like drilling in the U.S. Millions of acres of prospective onshore public lands here in the Rockies plus the entire east and west coast of the U.S. are off-limits to drilling for a variety of reasons. We hate paying $2 per gallon for gasoline – but not as much as we hate the refineries that turn unusable crude oil into gasoline. We haven't allowed anyone to build a new refinery in the U.S. in over 30 years. We expect the lights to come on when we flip the switch, but we don't like coal, the source of 40% of our electricity – it's dirty and mining scars the earth. We also don't like nuclear power, the source of nearly 20% of our electricity – it's clean, France likes it, but we're afraid of it. Hydropower is clean and renewable. But it too has been blacklisted – dams hurt fish.

We don't want pollution of any kind, in any amount, but we also don't want to be asked: "how much are we willing to pay for environmental perfection?" When it comes to global warming, *Time* magazine tells us to "be worried, be very worried" – and we say we are – but we don't act that way.

Let me suggest that our conversation about how to reduce CO_2 emissions must begin with a few "inconvenient" realities.

Reality 1: Worldwide demand for energy will grow by 30-50% over the next two decades – and more than double by the time you're my age. Simply put, America and the rest of the world will need all the energy that markets can deliver.

Reality 2: There are no near-term *alternatives* to oil, natural gas, and coal. Like it or not, the world runs on fossil fuels, and it will for decades to come. The U.S. government's own forecast shows that fossil fuels will supply about 85% of world energy demand in 2030 – roughly the same as today. Yes, someday the world may run on alternatives. But that day is still a long way off. It's not about will. It's not about who's in the White House. It's about thermodynamics and economics.

Now, I was told back in the 1970s what you're being told today: that wind and solar power are „alternatives" to fossil fuels. A more honest description would be „supplements". Taken together, wind and solar power today account for just one-sixth of 1% of America's annual energy usage. Let me repeat that statistic – one-sixth of 1%.

Here's a pie chart showing total U.S. primary energy demand today. I "asked" PowerPoint to show a wedge for the portion of the U.S. energy pie that comes from wind and solar. But PowerPoint won't make a wedge for wind and solar – just a thin line.

Over the past 30 years our government has pumped roughly $20 billion in subsidies into wind and solar power, and all we've got to show for it is this thin line!

Undaunted by this, President Obama proposes to *double* wind and solar power consumption in this country by the end of his first term. Great – that means the line on this pie chart would become a slightly thicker line in four years. I would point out that wind and solar power doubled in just the last three years of the Bush administration. Granted, W. started from a smaller baseline, so doubling again over the next four years will be a taller order. But if President Obama's goal is achieved, wind and solar together will grow from one-sixth of 1% to one-third of 1% of total primary energy use – and that assumes U.S. energy consumption remains flat, which of course it will not. The problems with wind and solar power become apparent when you look at their footprint. To generate electricity comparable

to a 1,000 MW gas-fired power plant you'd have to build a wind farm with at least 500 very tall windmills occupying more than 30,000 acres of land. Then there's solar power. I'm holding a *Denver Post* article that tells the story of an 8.2 MW solar-power plant built on 82 acres in Colorado. The *Post* proudly hails it "America's most productive utility-scale solar electricity plant". But when you account for the fact that the sun doesn't always shine, you'd need over 250 of these plants, on over 20,000 acres to replace just one 1,000 MW gas-fired power plant that can be built on *less than 40 acres*.

The *Salt Lake Tribune* recently celebrated the startup of a 14 MW geothermal plant near Beaver, Utah. That's wonderful! But the *Tribune* failed to put 14 MW into perspective. Utah has over 7,000 MW of installed generating capacity, primarily coal. America has about 1,000,000 MW of installed capacity. Because U.S. demand for electricity has been growing at 1-2 % per year, on average we've been adding 10-20,000 MW of new capacity *every year* to keep pace with growth. Around the world coal demand is booming – 200,000 MW of new coal capacity is under construction, over 30,000 MW in China alone. In fact, there are 30 coal plants under construction in the U.S. today that when complete will burn about 70 million tons of coal per year.

Why has my generation failed to develop wind and solar? Because our energy choices are ruthlessly ruled, not by political judgments, but by the immutable laws of thermodynamics. In engineer-speak, turning diffused sources of energy such as photons in sunlight or the kinetic energy in wind requires *massive* investment to concentrate that energy into a form that's usable on any meaningful scale.

What's more, the wind doesn't always blow and the sun doesn't always shine. Unless or until there's a major breakthrough in high-density electricity storage – a problem that has confounded scientists for more than 100 years – wind and solar can never be relied upon to provide base load power.

But it's not just thermodynamics. It's economics. Over the past 150 years America has invested trillions of dollars in our existing energy systems – power plants, the grid, steam and gas turbines, railroads, pipelines, distribution, refineries, service stations, home heating, boilers, cars, trucks and planes, etc. Changing that infrastructure to a system based on renewable energy will take decades and massive new investment.

To be clear, we need all the wind and solar power *the markets can deliver at prices we can afford*. But please, let's get real – wind and solar are not "alternatives" to fossil fuels.

Reality 3: You can argue about whether global warming is a serious problem or not, but there's no argument about the consequences of cap and trade regulation – it's going to drive the cost of energy painfully higher. That's the whole point of cap and trade – to drive up the cost of fossil energy so that otherwise uneconomic "alternatives" can compete. Some put the total cost of cap and trade to U.S. consumers at $2 trillion over the next decade and $6 trillion between now and 2050 – not to mention the net loss of jobs in energy-intensive industries that must compete in global markets. Given this staggering cost, I hope you'll ask: will cap and trade work? If Europe's experience with cap and trade is an indication, the answer is "no".

With much fanfare, the European Union (EU) adopted a cap and trade scheme in an effort to meet their Kyoto commitments to cut CO_2 emissions to below 1990 levels by 2012. How are they doing? So far, all but one EU country is getting an "F". Since 2000 Europe's CO_2 emissions per unit of GDP have grown faster than the U.S.! The U.S. of course did not implement Kyoto – nor did over 150 other countries. There's a good reason why most of the world rejected Kyoto: with today's energy technologies there's no way to sever the link between CO2 emissions and modern life. Europe's cap and trade scheme was designed to fail – and it's working as designed.

Let's do the math to explain why Kyoto would have failed in the U.S. and why Obama's cap and trade scheme is also likely to fail. Americans were responsible for about 5 billion metric tons of CO_2 emissions in 1990. By 2005 that amount had risen to over 5.8 billion tons. If the U.S. Senate had ratified the Kyoto treaty back in the 1990s America would've promised to cut manmade CO_2 emissions in this country to 7% below that 1990 level – to about 4.6 billion tons, a 1.2 billion ton per year cut by 2012.

What would it take to cut U.S. CO_2 emissions by 1.2 billion tons per year by 2012? A lot more sacrifice than riding a Schwinn to work or school, or changing light bulbs.

We could've banned gasoline. In 2005 gasoline use in America caused about 1.1B tons of CO2. That would almost get us there. Or, we could shut down over half of the coal-fired power plants in this country. Coal plants generated about 2 B tons of CO_2 in 2005. Of course, before we did that we'd have to get over 60 million Americans and a bunch of American businesses to volunteer to go without electricity.

This simple math is not friendly to those who demand that government mandate sharp cuts in manmade CO2 emissions – *now*.

Reality 4: Even if America does cut CO_2 emissions, those same computer models that predict manmade warming over the next century also predict that Kyoto-type CO_2 cuts would have *no discernible impact* on global temperatures for decades, if ever. When was the last time you read that in the paper? We've been told that Kyoto was "just a first step." Your generation may want to ask: "what's the second step?"

That begs another question: "how much are Americans willing to pay for ‚a first step" that has *no discernible effect* on global climate?" The answer here in Utah is: not much, according to a poll conducted by Dan Jones & Associates published in the *Deseret News.* 63% of those surveyed said they worry about global warming. But when asked how much they'd be willing to see their electricity bills go up to help cut CO2 emissions, only half were willing to pay more for electricity. Only 18% were willing to see their power bill go up by 10% or more. Only 3% were willing to see their power bill go up by 20%.

Here's the rub: many Europeans today pay up to 20% more for electricity as a result of their *failed* efforts to sever the link between modern life and CO_2 emissions. So, if Americans aren't willing to pay a lot more for their energy, how do we reduce CO2 emissions? Well, here are several things we should do.

First, we should improve energy efficiency. Second, we should stop wasting energy. Third, we should conserve energy. Fourth, we should rethink our overblown fear of nuclear power. Fifth, if we let markets work, markets on their own will continue to substitute low-carbon natural gas for coal and oil.

Indeed, 2008 will be remembered in the energy industry as the year U.S. natural gas producers changed the game for domestic energy policy. Smart people in my industry have, cracked the code" – they've figured out how to produce stunning amounts of natural gas from shale formations right here in the U.S. As a result, we now know that America and the world are "swimming" in natural gas. U.S. onshore natural gas production has grown rapidly over the past three years – a feat that most energy experts thought impossible a few years ago. America's known natural gas resource base now exceeds 100 years of supply at current U.S. consumption – and that number is growing. Abundant supply means that natural gas prices over the next decade and beyond will likely be much lower than over the past five years. While prices may spike from time to time in response to sudden, unexpected changes in supply or demand – for example, hurricanes in the Gulf of Mexico or extreme cold or hot weather – these spikes will be temporary. Indeed, the price of natural

gas today is less than $24 per barrel equivalent – a bargain, even without taking into account lower CO_2 emissions.

Greater use of natural gas produced in America – by American companies who hire American workers and pay American taxes – will help reduce oil imports. Unlike oil, 98% of America's natural gas supply comes from North America.

And get this: we don't need massive investment in new power plants to use more natural gas for electric generation. I mentioned earlier that America has about one million MW of installed electric generation capacity. Forty percent of that capacity runs on natural gas – about 400,000 MW, compared to just 312,000 MW of coal capacity. But unlike those coal plants, which run at an average load factor of about 75%, America's existing natural gas-fired power plants operate with an average load factor of less than 25%. Turns out that the market has found a way to cut CO_2 emissions without driving the price of electricity through the roof – natural gas's share of the electricity market is growing, and it will continue to grow – with or without cap and trade.

Sixth, your generation needs to focus on new technology and not just assume it, as many in my generation did back in the 70s – and as many in Congress continue to do today. Just one example: there's no such thing as "clean" coal, though I should quickly add that given America and the world's dependence on coal for electric generation, we do need to fund R&D aimed at capturing and storing CO2 from coal plants.

To be sure, CO_2 capture and sequestration (underground storage) will be hugely expensive and it'll take decades to implement *on any meaningful scale*. The high costs will be passed through in electricity rates to consumers. To transport massive amounts of CO_2 captured at coal plants we'll have to build a massive pipeline grid that some estimate could be comparable to our existing natural gas pipeline grid. Then we'll have to drill thousands of wells to store CO_2 in the ground. The facilities required to inject CO_2 into the earth will use huge amounts of energy – which ironically will come from fossil fuels, negating some of the carbon-reduction benefits. and where are we going to put all this CO_2? Questar owns and operates underground natural gas storage facilities. Gas storage is in high demand – we're always looking for suitable underground formations. But I can tell you that there aren't many.

Seventh (for anyone who's still counting!) it's time to have an honest conversation about alternative responses to global warming than what will likely be a futile attempt to eliminate the use of fossil fuels. What about adapting to warming? In truth, while many scientists believe man's use of fossil fuels is at least partly responsible for global warming, many also believe the amount of warming will be modest and the planet will easily adapt. Just about everyone agrees that a modest amount of warming won't harm the planet. In fact, highly respected scientists such as Harvard astrophysicist Willie Soon believe that added CO_2 in the atmosphere may actually benefit mankind because more CO_2 helps plants grow. When was the last time you read that in the paper?

You've no doubt heard the argument that even if global warming turns out not to be as bad as some are saying, we should still cut CO_2 emissions – as an insurance policy – the so-called precautionary principle. While appealing in its simplicity, there are three major problems with the precautionary principle.

First, none of us live our lives according to the precautionary principle. Let me give you an example. Around the world about 1.2 million people die each year in car accidents – about 3,200 deaths a day. At that pace, 120 million people will die this century in a car wreck somewhere in the world. We could save 120 million lives by imposing a 5 MPH speed limit worldwide. Show of hands: how many would be willing to live with a 5 MPH speed limit to save 120 million lives? Most of us won't – we accept trade-offs. We implicitly do a cost-

benefit analysis and conclude that we're not going to do without our cars, even if doing so would save 120 million lives. So before we start down this expensive and likely futile cap and trade path, don't you think we should insist on an honest analysis of alternative responses to global warming?

Second, the media dwells on the potential harm from global warming, but ignores the fact that the costs borne to address it will also *do harm*. We have a finite amount of wealth in the world. We have a long list of problems – hunger, poverty, malaria, nuclear proliferation, HIV, just to name a few. Your generation should ask: how can we do the most good with our limited wealth? The opportunity cost of diverting a large part of current wealth to solve a potential problem 50-100 years from now means we do "less good" dealing with our current problems.

Third, economists will tell you that the consequence of a cap and trade tax on energy will be slower economic growth. Slower growth, compounded over decades, means that we leave future generations with less wealth to deal with the consequences of global warming, whatever they may be.

In truth, humans are remarkably adaptive. People live north of the Arctic Circle where temperatures are below zero most of the year. Roughly one-third of mankind today lives in tropical climates where temperatures routinely exceed 100 degrees. In fact, you can take every one of the theoretical problems caused by global warming and identify lower-cost ways to deal with that problem than rationing energy use. For example, if arctic ice melts and causes the sea level to rise, a wealthier world will adapt over time by moving away from the beach or building retaining walls to protect beachfront property. Fine, you say. But how do we save the polar bear? I'd first point out that polar bears have survived sometimes dramatic climate changes over thousands of years, most recently the so called "medieval warm period" (1000-1300 A.D.) in which large parts of the arctic glaciers disappeared and Greenland was truly "green". Contrary to that heart-wrenching image on the cover of *Time* of an apparently doomed polar bear floating on a chunk of ice, polar bears can swim for miles. In addition, more polar bears die each year from gunshot wounds than from drowning. So instead of rationing carbon energy, maybe the first thing we should do to protect polar bears is to stop shooting them!

Let me close by returning to the lessons my generation learned from the 1970s energy crisis. We learned that energy choices favored by politicians but not confirmed by markets are destined to fail. If history has taught us anything it's that we should resist the temptation to ask politicians to substitute their judgments for that of the market, and let markets determine how much energy gets used, what types of energy get used, where, how and by whom energy gets used. In truth, no source of energy is perfect, thus only markets can weigh the pros and cons of each source. Government's role is to set *reasonable* standards for environmental performance, and make sure markets work.

I've covered a lot of ground this morning. I hope I've challenged your thinking about your energy future. Mostly, I hope you continue to enjoy freedom, prosperity – and abundant supplies of energy at prices you can afford! Thank you for your attention, and now I'll be glad to take rebuttal!