

The Energy Question: Who Decides?

by Dr. Shirley Ann Jackson
President, Rensselaer Polytechnic Institute
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Good morning.

Global energy security is the greatest challenge of our time, inextricably interlinked with our economic security and our national security. The exponential growth in demand for energy — for which there is abundant evidence — presents both extraordinary challenges, and offers equally extraordinary economic opportunities.

A multiplicity of converging factors makes it bluntly obvious that a comprehensive global energy system restructuring has begun.

The question is — will the United States lead the inevitable restructuring, or will it occur without us? Whichever it is, we are challenged to think about energy in new ways.

The combined forces of energy supply uncertainty, rising energy costs, and the impact of climate change are major drivers of global energy restructuring. So, first, let us examine some of the elements of this restructuring:

1. New energy markets are developing worldwide, providing opportunity and options for new players.
2. New major players have emerged who are changing the terms of reference for traditional energy behemoths, especially with regard to oil and gas supply.
3. Nations are realigning in new ways, shifting old alliances.
4. With rising energy costs, corporations are swiftly realigning their priorities, changing how they do business, and making investments to secure market opportunity.
5. Climate change mitigation and new markets, also, are driving new trading schemes, and investments in new sources and new technologies.
6. Oil-generated wealth and other actors are changing who plays in global financial markets.

These factors already are in play, altering how the global energy system works — who plays, how they play, and who reaps the rewards.

I will explore each of these elements, but before I do so, it is important to make a clear distinction.

Many speak of "energy independence." I believe this is a troubling misnomer. There is no "energy independence." The energy challenges we face, we face as a global community — interlinked and interdependent. This has implications for U.S. energy supply, energy costs, and greenhouse gas mitigation.

- New energy markets are emerging because worldwide energy consumption is rising exponentially, driven by population growth, swiftly developing economies, improving living standards, and burgeoning energy-dependent technologies. For example, the transportation sector is growing rapidly in countries like China, where 1,000 cars per day were being added in Beijing, until recently, as China prepares for the 2008 Olympics.
- Consumption of every major energy source, except coal, has increased markedly. Over the next 50 years, if current trends continue, humans will use more energy than in all of previously recorded history. Coal will remain a dominant part of the primary energy mix for some time, as will oil and natural gas — all fossil-based energy sources.
- The growing demand foments geopolitical tensions, and, at the same time, the widening disparity between the energy "haves" and "have-nots" leaves billions stranded in "energy poverty," unable to progress, trapped in substandard living conditions, with inadequate access to food and water, education, health care, and prone to civil unrest.

Ironically, some nations have become very rich from oil, while others are resource-rich, but the general standards of living have not risen to match the revenue generation from oil sales. This is because of governance issues, civil unrest, and other factors. These same issues create greater "above ground" risks in gaining access to energy supplies.

An example is Angola, currently the largest supplier of oil to China, where two out of three Angolans live on less than \$2 per day, in spite of growing oil wealth, but where government officials have enriched themselves.

Traditional country and corporate alignments are shifting, creating new alliances and cooperative agreements, and completely altering not only the geopolitics of energy production, distribution, and markets, but also relationships between and among nations, as well.

The original "seven sisters" — western companies that controlled Middle East oil after World War II — have begun to lose prominence to a new set of seven. Saudi Aramco, Russia's Gazprom, China's CNPC, NIOC of Iran, Venezuela's PDVSA, Brazil's Petrobras, and Petronas of Malaysia control almost a third of the world's oil and gas production, and more than a third of its total oil and gas reserves.

The old "seven sisters," which became four after mergers in the 1990s — Chevron, Exxon-Mobil, BP, and Royal Dutch Shell — produce about 10 percent of the world's oil and gas, and hold just 3 percent of reserves. The International Energy Agency estimates that 90 percent of new production supplies, over the next four decades, will come from developing countries — a big shift from the past 30 years when 40 percent came from industrialized nations. This asymmetry is leading supply countries and their national oil companies to continually change contract terms with traditional international oil and gas companies, and to shift alliances, in order to have greater ownership of assets developed by these companies, and greater shares of oil revenues.

Again, as an example, Angola has joined OPEC, and is cooperating less than it used to with the International Monetary Fund.

The fact that many of the new "sisters" are state-owned, and that growth in the oil and gas industry rests in their hands, is restructuring national and international alliances, and will impact them for some decades to come. The emergence of the "sisters" from oil-rich countries have, as well, been the basis for the creation of Sovereign Wealth Funds (SWF).

In another recent example, of country realignment, Gasunie, the Dutch National gas company, has taken a stake (9%) in the controversial Nord Stream Pipeline Project. The pipeline, controlled by Gazprom (the Russian gas monopoly), would carry gas directly from Russia, under the Baltic Sea, to Germany — bypassing Poland, Belarus, Ukraine, and the Baltic States. Some countries (the Baltic States in particular) are objecting to the pipeline on the basis of environmental concerns. For others, such as Poland, it means a revenue loss (from transit fees). For yet others, it can affect supply (Ukraine). The deal, also, gives Gazprom the option to acquire from Gasunie a 9 percent stake in the Balgzand-Bacton pipeline, connecting the Netherlands and the U.K. This would give Gazprom a stake in a British supply pipeline for the first time.

Moves such as this are occurring as more and more countries in the EU worry about energy supply, especially oil and gas, because EU countries import 80 percent of such supplies. These moves are worrisome, as well, because Russia,

very assiduously, uses its oil and gas abundance to lock up deals with more and more European countries, even as many fret about Russia using its dominant energy position as a political tool. This is causing the EU to develop strategies for new and renewable sources of energy and energy efficiency, both to assure supply through diversification, and to mitigate climate change.

China, also, is projected to become the largest emitter of greenhouse gases and other pollutants within a couple of years. The effect of this is global — being felt all the way to California in the U.S. — where, by some estimates, 30 percent of the background sulphate particulate matter in the Western U.S. originates in Asia.

It is, therefore, important to help rapidly developing countries like China to gain energy efficiencies in manufacturing, and in products, while reducing its carbon footprint through the use of renewable and alternative energy sources. Multinational corporations are working with their Chinese suppliers to help them reduce costs by reducing energy use and carbon load. New management techniques and new technologies have important roles to play here.

Moreover, China is on a worldwide march to lock up energy supplies, as well as access to other resources such as minerals and heavy metals. This, especially, is seen in its presence in Africa where it trades infrastructure development, sometimes education, and always embassy presence and diplomatic recognition for such access.

Worldwide, corporations are making changes to mitigate the impact of high energy costs on their bottom lines. At the same time, they are exploiting the business opportunities inherent in the need for alternative sustainable energy sources. Already, they are making large capital investments in renewable energy technologies, creating new supply chains, and new value. A 2007 report by the United Nations Environment Programme's Global Trends in Sustainable Energy Investment found that investment capital flowing into sustainable energy (especially wind, solar, and biofuels) more than doubled in just two years — from \$28 billion in 2004 to \$71 billion in 2006. A similar trajectory is continuing throughout 2007. The International Energy Agency (IEA) estimates that as much as \$16 trillion will be invested in the energy sector through 2030.

- Exxon Mobil, for example, has found opportunities to improve by 15 to 20 percent the energy efficiencies at its refineries and chemical plants, with annual cost savings of \$750 million.
- Microsoft, Google, and HSBC are building data centers alongside hydropower sources to better manage the electric power they demand.
- PepsiCo and Coca-Cola have pledged to buy more than 1.1 billion kilowatt hours of renewable energy over the next three years.

- Wal-Mart has been a leader in stocking energy-efficient products, and has reduced the packaging material of some goods to lower energy content. They, also, have begun a pilot program with suppliers of DVDs, toothpaste, soap, milk, soda, beer, and vacuum cleaners to measure and reduce the energy required to produce and deliver them.

Globalization of capital, climate change mitigation, and mounting investment volume, from multiple sources, are creating opportunities for new markets, as well. Some, such as the European Trading Scheme (ETS) or the UN Clean Development Mechanism (CDM) are government-sponsored programs, established under the Kyoto Protocol. Others have sprung up voluntarily, such as the Chicago Climate Exchange (CCE) which integrates voluntary, legally binding emissions reductions with emissions trading, and offsets for six greenhouse gases.

In the financial services sector, Sovereign wealth funds (SWF) (described earlier) have emerged as important new players in global financial markets, and may affect energy markets. These are nation-owned entities that have used primarily oil revenues to accumulate and manage national funds for investment objectives. Worldwide, it is estimated that some \$3 trillion have been assembled in SWFs, especially out of the Middle East, and is likely to reach \$7.5 trillion by 2012. The availability of these substantial funds, their sovereign support, and appetite for risk offer both challenges and opportunities for governments and corporations, and is changing behaviors between and among these entities.

These funds, together with central banks in emerging markets, hedge funds, and private equity, are beginning to play, in a major way, into financial markets. They are moving to participate in IPOs, provide additional financial backing in business deals, and take major financial stakes in various stocks and other financial instruments.

The six broad considerations I have outlined tell us that our nation's economic security and our national security are inextricably interlinked with global energy security. We must understand that this is a challenge without borders, whose elements are interrelated and interdependent, but which affect us directly.

We must understand the comprehensive global energy system, its impact on markets, and national alignments, as we shape our national energy goals and strategies. We also must realize that energy security and climate change are linked challenges.

COMPREHENSIVE ENERGY ROAD MAP

I would like to return, now, to my distinction between energy security and

energy independence, and to examine energy security in more detail. I would define energy security as having an adequate and sustainable supply of energy to meet the needs and aspirations of citizens, commercial enterprises, and public sector functions, and to provide that supply in as environmentally benign a way as possible. The practical definition — that is, the set of strategies for achieving energy security — varies according to nation and region. To reach it for own country — we must build a comprehensive energy roadmap. At its core, it should adhere to five basic principles:

- First — redundancy of supply and diversity of source — where optimum source is linked to specific sector of use. This entails maximizing domestic production and ensuring reliable sources for necessary fuel imports. This provides protection against supply disruption events, such as natural disasters or geopolitical instability, and a hedge against price volatility.
- Second — support for well-functioning energy markets. This includes ensuring a level playing field with regard to the profitability of fuel production and energy generation for suppliers, as well as mechanisms to secure financing for long-term strategic investments. The latter is frequently a sticking point of energy insecurity for developing countries. This, also, means understanding and/or developing new schemes and instruments for trading in energy markets.
- Third — investment in sound infrastructure for energy generation, transmission, and distribution, including the necessary regulatory and operational protocols to ensure the safe, secure, and reliable performance of refineries, power plants, the electrical grid, and other facilities.
- Fourth — providing for environmental sustainability and energy conservation — which calculates full lifecycle costs, including environmental, of goods — from production through use and eventual disposal.
- Fifth — the development of policy alternatives which balance requirements (mainly regulations) with incentives. These include consistency of regulation, and transparent price signals.

The carbon content of fuels, processes, and commercial and consumer goods, has begun to get a lot of attention, with Congress expected to ultimately pass legislation that would regulate, and hopefully, reduce carbon content or carbon dioxide production through financial incentives.

In fact, last Thursday, a Senate Subcommittee approved a bill to establish a cap-and-trade system for carbon dioxide in which allowances would cost money — although it is not yet clear what the House of Representatives will do.

Others have proposed a carbon tax to reduce carbon load.

All schemes would have industry and the consumer pay the carbon cost. A

carbon tax and a cap-and-trade system both depend upon the ability to measure the true carbon content of products and processes in a consistent way.

Companies are beginning to jump into lowering carbon and energy content in their products in a big way — sometimes in anticipation of regulation, sometimes for good business reasons. This is not entirely easy, since not all companies measure supply-chain emissions of carbon dioxide, because they do not control all elements of their supply chains. General Electric is an example. What companies are focusing on is the carbon and energy content of products — but consistent definitions are hard to come by.

As Congress debates current legislation, and as Presidential candidates lay out their own programs, each proposal must be examined to determine if it would lead to a comprehensive national energy roadmap.

INNOVATION

I would add a sixth element to a comprehensive energy formula; and that is continuing, robust innovation — both in terms of technological advances, as well as business process innovations, and policy alternatives.

We must innovate the technologies which uncover and exploit new fossil energy sources (such as oil shale or methane hydrates) and improve their extraction. We must innovate the technologies which conserve energy and protect the environment. And, we must innovate the technologies which lead to alternative energy sources, which are reliable, cost-effective, safe, as environmentally benign as possible, and sustainable.

In terms of policy, technological innovation must be seen as both a policy tool, and a policy outcome. Public policy can be the driver of technological innovation, if, one provides both requirements and incentives — for example, with regard to nuclear power, or alternative and renewable energy sources. In these cases, technological innovation is an outcome of policy. Innovation can be a public policy tool. If, for example, one chooses to set standards — such as reducing carbon dioxide load in the atmosphere — then technological innovation plays a role in schemes such as carbon capture and sequestration, or in completely closing the carbon cycle, either through technology or through biologically-based schemes. We need technologies and approaches which recognize that energy security and climate change mitigation are linked challenges.

The challenges are great, but hidden within them is tremendous economic opportunity.

Like corporations and markets, states in this country, and even cities, are not waiting for a national energy plan, but, already, are enacting legislation and regulations addressing both energy costs and climate change mitigation, and,

like corporations, are exploiting economic opportunity.

- A 1999 Texas state law requires utilities to produce 5,880 megawatts of electricity from renewable sources by 2015. As a result energy technology investment in the state has topped \$1 billion, and it is estimated that carbon dioxide emissions already have been reduced by 3.3 million tons. Texas now leads the nation in wind-produced electricity.
- As early as 1983, Iowa passed a renewable energy requirement, and, experienced something of a boom in wind turbine production, such that wind power development, now, is taught in many of the state's community colleges.
- Last week, GE Energy announced a major expansion at its downtown Schenectady plant, adding as many as 500 new jobs for engineers and technicians in the alternative-energy sector, giving a much needed boost to the struggling economy in upstate New York.
- In New York City, Mayor Michael Bloomberg has called for a 30 percent reduction in greenhouse gases by 2030. And, Chicago announced a plan to reduce its emissions 80 percent by 2050.
- The federal government also has been getting into the game. News reports noted yesterday that in 2004, the Environmental Protection Agency (EPA) and the Commerce Department formed the Green Suppliers Network to help small companies learn less carbon intensive, more profitable management and manufacturing techniques
- There are other examples.

HUMAN CAPITAL

Innovation requires investment in research and development, but innovation fundamentally requires people. The question is, are we, as a nation, equipped with the human capital for the robust innovation the energy challenge demands of us? As a university president, and as a theoretical physicist, I have deep concerns that our national innovation capacity is in jeopardy. Converging forces have created what I call the "Quiet Crisis," which is eroding the production of scientists, mathematicians, engineers, and technologists we need. The scientists and engineers who came of age in the post-Sputnik era, are beginning to retire. At the same time, we are no longer producing sufficient numbers of new graduates to replace them. This looming talent crisis already is evident in the nuclear and the oil and gas sectors.

The rate of growth of talented international scientists, engineers, and graduate students coming to the United States has slowed, with the number down 27 percent since 2003. Other nations are investing in their own education and research enterprises, offering new opportunities for their own scientists and

engineers to study and to work at home. The "flattening" world means that they, also, can find employment elsewhere, not necessarily in the U.S.

There has been a parallel decline of investment in U.S. basic research, especially in the physical sciences and engineering. Federal investment in scientific research has been shrinking, driven by concern over "big government," limits on federal spending, concern for federal deficit growth, and confidence in market-driven private sector research. The American Association for the Advancement of Science estimates that, overall, federal science research spending has declined by half since 1970, as a percentage of Gross Domestic Product (GDP).

Finally, our demographics have shifted. The "new majority" in the United States now comprises young women and the racial and ethnic groups which, traditionally, have been underrepresented in our advanced science and engineering schools. It is to these "nontraditional" young people to whom we, also, must look for our future scientists and engineers.

This "Quiet Crisis" is "quiet" because the true impact unfolds gradually over time — it takes decades to educate a biomolecular researcher or a nuclear engineer. It is a "crisis" because our national innovative capacity rests solely upon their talents, and upon our ability to interest and excite them to the marvels of science and engineering — to the wonders of discovery and innovation.

Due to the efforts of many, from multiple sectors, we have a new law, the America COMPETES Act, which seeks to address and mitigate the challenges, and to create a specific new governmental entity, ARPA-E, to spur new technological development, and to speed market adoption of technological innovation in the energy arena.

What we need now is funding, and cross-governmental coordination, to flesh out a robust energy roadmap, and to enlist all relevant government departments and agencies to make it come to life.

LEADERSHIP

We are a year out from national elections. At this time next year, we will have elected a new president. To achieve a comprehensive national energy plan, requires the full weight and leadership of the nation's chief executive, as well as strong, coordinated leadership in Congress, and associated leadership at the state level. Only stability and consistency of outlook, and linked federal and state regulatory policies and incentives, can give us a comprehensive national energy roadmap which will make a real difference. These same elements are important to provide signals and confidence to the corporate and financial communities that invest in new energy systems and technologies, and to ensure that investments in new energy markets make business sense.

There are many who are looking ahead to this time and these issues. Currently, I am co-chairing (with Jim Owens, CEO of Caterpillar, and Mike Langford, National President of the Utility Workers Union of America) an Energy Security, Innovation, and Sustainability Initiative launched by the Council on Competitiveness. It involves a series of high-level, expert progressive dialogues taking place over the course of the next year, to help provide a framework for responsible public policy development, and an energy roadmap for the future, within the context of what drives corporate investment, human resource development, and local and state strategy.

CONCLUSION

To reiterate, true global energy security will require a more complete understanding of energy markets and geopolitics, the new players, and the new alignments. It also will require innovation of the highest order. Meeting global energy needs, also, will require unleashing the human talent needed to accelerate innovation.

We have addressed challenges like this before.

The launch of the Soviet satellite Sputnik in 1957, followed by the history-making flight of a cosmonaut in 1961, set in motion a space race that was transformational.

President John F. Kennedy issued a call to action in May 1961, urging that the United States rally its intellectual, industrial, and economic resources to put a man on the moon before the end of the decade. The Congress and the country responded. The wave of activity that followed included an intensive focus on identifying and providing the necessary education and research supports.

Those who responded to Kennedy's appeal became the engineers, mathematicians, and scientists who have comprised the backbone of our economic prosperity for the last 50 years — strengthening our economic and national security for a generation. They made exponential advances in an extraordinary number of fields including health and medicine, communications, and transportation. The advances have had global impact, changing where we live, how long we live, and the way we live.

Nations are realigning, corporations are reassessing and making investment decisions, U.S. states are legislating changes, and while national legislation under debate addresses some aspects, we still have no comprehensive national energy plan.

We need a new call to action — a call that will ignite our commitment and our collective imagination — a call that will secure the investment and the

innovation needed — a call for a comprehensive energy roadmap. In short, we need a national conversation, led by our national leadership, to help our citizenry understand what is at stake, and to motivate all to action.

The open question remains, will we have the leadership to enter, as a nation, more fully into the global energy restructuring, or will it go on without us?

Indeed, global energy security is the space race of this millennium.

Thank you.

I will be pleased to answer any questions.

Related Web Links:

Global Energy Security

America's Quiet Crisis

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