STATEMENT OF DANIEL YERGIN

CHAIRMAN

CAMBRIDGE ENERGY RESEARCH ASSOCIATES

Before the

COMMITTEE ON ENERGY AND COMMERCE

U.S. HOUSE OF REPRESENTATIVES

May 4, 2006

Daniel Yergin
Chairman
Cambridge Energy Research Associates

Daniel Yergin is Chairman of Cambridge Energy Research Associates (CERA). He received the Pulitzer Prize for his work *The Prize: The Epic Quest for Oil, Money and Power.* His most recent book is *Commanding Heights: The Battle for the World Economy.* He chaired the US Department of Energy's Task Force on Strategic Energy Research and Development. He is a member of the Board of the United States Energy Association, and a member of the National Petroleum Council and this year became the only foreign member of the Russian Academy of Oil and Gas. He also serves as CNBC's Global Energy Expert. He is a Trustee of the Brookings Institution, a Director of the US-Russia Business Council and on the Advisory Board of the International Institute for Economics.

Dr. Yergin received his BA from Yale University, and his Ph.D. from Cambridge University, where he was a Marshall Scholar. In November 2005 he was awarded the Medal of the President of the Republic of Italy Dr. Yergin co-founded Cambridge Energy Research Associates, now an IHS company.

It is an honor and privilege to be invited to address this Committee as it begins its important and timely set of hearings on America's energy position. The deep concerns among the American public that are prompting this hearing are evident, and I appreciate the opportunity to contribute to understanding the context. I hope that I can provide a framework for your consideration. If there is a single message, it is that we cannot begin to understand what is happening at the gasoline pump unless we see it in the global context -- involving both crude supply and refining worldwide.

I hope in this hearing to answer four questions:

1. Why have oil prices nearly doubled during the past two years? What are the risks going forward? I would like to present what is happening at the pump in a global context. Although there is no actual supply shortage, the world oil market is very tight, owing not only to rising demand, but also to a "slow motion supply shock" -- what we have called an "aggregate disruption" in excess of two million barrels per day.

2. What are current prices telling us about the world's future oil supply? Oil is a non-renewable resource, but we do not believe the world is imminently facing the specter of running out. Or, to put it differently, this current period is the fifth time the world has run out of oil. The first time was in the 1880s and the last time

before this time, in the 1970s – since which world oil production has increased 60 percent. The prime risks today are not lack of resources underground, but what is happening above ground … politics, geopolitics, and a rebirth in some parts of the world of 1970s style resource nationalism that is riding on the crest of high prices.

3. There is, understandably, much focus on energy security today. But what does the concept mean for the 21st century and how does it need to be updated from traditional definitions? I would like to offer these principles:

   a) Diversification of supply is the starting point
   b) Resilience, a "security margin" in the energy supply system that provides a buffer against shocks and facilitates recovery after disruptions.
   c) Recognizing the reality of integration – there is only one global oil market
   d) The importance of quality information
   e) The need to engage such countries as China, India, and Brazil in the energy security system
   f) Expanding energy security to the include the infrastructure and the entire energy supply chain
   g) Recognizing flexible markets as a source of security
   h) Renewing the commitment to energy efficiency and conservation
   i) Strengthening the investment climate itself
   j) Development and deployment of new technologies

4. Finally, I want to comment about the urgent need to update the SEC-mandated definition of proved reserves, which are still based on the technology of the late 1970s and, as a result, provides a distorted view of our reserve base. That serves neither the interests of consumers, nor investors, nor that of energy security.

II Prices and the Security Premium

As the sense of these hearings indicates, we are at a historic juncture. After a quarter century, the great cushion of surplus oil production capacity that was created by the energy turbulence of the 1970s and early 1980s has been largely spent – at least for the time being. It is on that relatively narrow band of "spare capacity" that so much of the drama in world oil markets is playing out.

The American people clearly want to know why they are paying about $3 -- or more -- at the pump. But we will not find the answer if we only look inside the United States. Sometimes, the debate about energy prices seems to assume that the United States is an island – albeit a very large continental island.

That, of course, is not the case. In the 1970s we imported a third of our oil; today, it is on the order of 60 percent. Our oil imports are larger than the total oil consumption of any other country in the world. What this means is that we are highly integrated into the global marketplace – and are affected by what happens in the market.

Today, the balance between supply and demand in the world oil market is very tight. Part of the reason is the surge in economic growth in both developed and developing countries – of which the growth of China and, to a lesser regard, India provide the most noteworthy examples. But the demand surge turned into slower growth in 2005 and the data is still preliminary for 2006.

Meanwhile, the focus of the market has shifted from demand to supply. We are currently experiencing that slow motion supply shock, the aggregate disruption of more than two million barrels per day, to which I referred before.

What explains the sharp rise in oil prices over the past eight weeks?

1. The first is the real disruption of a significant part of Nigeria's oil production owing to an insurgency in Nigeria's Delta region. Workers have been evacuated, and the local insurgents are threatening further attacks. This means the loss of a high quality light sweet oil particularly well-suited for making gasoline.

2. The second is the ratcheting up of tensions over Iran's nuclear program with a fear of a disruption of Iran's 2.5 mbd of exports. Some Iranian spokesmen threaten to unleash an "oil crisis" while others seek to separate oil from atoms. But in a market this tight, the risk of escalation is enough to send crude oil prices up.

3. The third factor is at home – the rapid switch over from MTBE to ethanol on the East Coast and in Texas has added pressure to what has been for a number of years the most difficult period in the gasoline market – the spring makeover of gasoline from winter to summer blends. This year's switchover has been made more arduous by the consequences of last year's hurricanes. Refineries need downtime for maintenance and to prepare for the switch to ultra-low sulfur diesel in the summer. The shifting from MTBE to ethanol has required changes all along the supply chain – different suppliers, different transportation (trucks and rail cars instead of pipelines) and different locations for blending (terminals instead of refineries.) Normally a change over like this would be done in a couple of years. As it turned out, 270 days a very compressed time for conversion in the face of other challenges, including the unexpected fury of the hurricanes that occurred after the passage of the energy bill.

We would expect that the transition will be complete by the time most Americans begin their serious summer driving. But there is little reason to think that the tension over Iran's nuclear program will abate, and much uncertainty remains over what will happen in Nigeria. So we must look to the impact of fundamentals for price moderation -- in the build-up of supplies from elsewhere, the relatively high level of crude oil inventories, and the demand response to higher prices.

The Demand Surge

The last decade has witnessed a substantial increase in the world's demand for oil, primarily because of the dramatic economic growth in developing countries, in particular China and India. As late as 1993, China was self-sufficient in oil. Since then, its GDP has almost tripled and its demand for oil has more than doubled. Today, China imports 3 million barrels of oil per day, which accounts for almost half of its total consumption. China's share of the world oil market is about 8 percent, but its share of total growth in demand since 2000 has been 30 percent.

The impact of growth in China, India, and elsewhere on the global demand for energy has been far-reaching. In the 1970s, North America consumed twice as much oil as Asia. In 2004 and 2005, for the first time ever, Asia's oil consumption exceeded North America's. The trend will continue: half of the total growth in oil consumption in the next 15 years will come from Asia, according to CERA's projections.

However, Asia's growing impact became widely apparent only in 2004, when the best global economic performance in a generation translated into a "demand shock"—that is, unexpected surge in petroleum consumption that was more than double the annual average growth rates of the preceding decade. China's demand in 2004 rose by an extraordinary 16 per-cent compared to 2003, driven partly by electricity bottlenecks that led to a sharp rise in oil use for improvised electric generation. US consumption also grew strongly in 2004, as did that of other countries. The result was the tightest oil market in three decades (except for the first couple of months after Saddam's invasion of Kuwait in 1990).

The torrid pace of demand in 2004 did not continue into 2005. Last year China's demand grew by 1.7 percent – compared to the 16 percent in 2004 – and world demand grew just 1 percent.

Refining Capacity

Refining capacity is a major constraint on supply, because there is a significant mismatch between the refined product requirements of the world's consumers and refineries' capabilities. Although often presented solely as a US problem, inadequate refining capacity is in fact a global phenomenon. The biggest growth in demand worldwide has been for what are called "middle distillates": diesel, jet fuel, and heating oil. Diesel is a favorite fuel of European motorists, half of whom now buy diesel cars, and it is increasingly used to power economic growth in Asia, where it is utilized not just for transportation but also to generate electricity. But the global refining system does not have enough so-called deep conversion capacity to turn heavier crudes into middle distillates. This shortfall in capacity has created additional demand for the lighter grades of crude.

Nevertheless, refining is a high-focus issue in the United States. The number of U.S. refineries has gone down by about half since the 1970s. Many of these were the small "tea kettle" refineries that were intended to take advantage of the "small refiner bias" under the 1970s control system.

Yet what truly counts is not the number of refineries but the capacity – the number of barrels that can be produced. Here we see a different trend. Overall, capacity went down until the early 1990s and then began to increase again with larger, more efficient refineries. This does not reflect the building of new refineries, which has been hampered by costs, siting, and permitting. Rather it is expansion and upgrading of existing refineries and what is called "refinery creep"—which when added up has taken some big steps. Capacity is up 15 percent – 2.2 mbd – since then. This 2.2 mbd expansion in capacity is the equivalent of adding 10 new good-sized refineries over the last dozen years.

There is unease, of course, about dependence on imported refined products and possible threats to the supply chain. At this point, half of total refined products imports come from Western Europe, Canada, and the Caribbean (excluding Venezuela). Western Europe has been the largest source because it has excess gasoline production.

Slow Motion Supply Shock: the Aggregate Disruption

But what has now become clear in 2006 is that we are experiencing a slow motion supply shock – an aggregate disruption that, at present, we would put at 2.2 million barrels per day.

Nigeria	550,000 bd
Venezuela	400,000 bd
Iraq	900,000 bd
US Gulf	324,000 bd

A good part of Gulf of Mexico production is slated to soon start up again (as is hurricane season.) In the meantime, other transitory interruptions elsewhere in the world can, at least for short periods, take additional oil off the market.

These disruptions have, with the strength of demand, resulted in a very tight oil market and one that is more vulnerable to any further problems. Market psychology – anticipation of risk – becomes more powerful, translating into a scarcity or risk premium. We currently estimate that premium at $10 -15 a barrel. At the present time, the most important contributors to the premium are the unrest in Nigeria, and uncertainty about what will happen there, and the ratcheting up of tension over Iran's nuclear progress and the fear that in one way or another, Iran's 2.5 mbd of exports may be disrupted, with additional collateral effects. Without these circumstance, we would not be seeing oil over $70 per barrel.

IV Growing Resource Base – and the "Undulating Plateau"

As always happens when prices are high and supplies are uncertain, there is much discussion about whether the world is going to run out of oil. In the 1970s, the term was "the oil mountain," as in "the world was about to fall off the oil mountain." The geographic imagery has gotten higher -- today it is "peak." Our research leads us to conclude that "peak" is a misleading image. Based upon our analysis of oil fields and investment programs , and drawing on the databases of our parent company IHS, which has the largest collection of data on world production, we see a substantial buildup in

world oil production capacity for a number of years. A more relevant description is "plateau" in production capacity that might be reached closer to the middle of the century.

We currently project worldwide liquids production capacity (not actual production) to grow from 88.7 mbd in 2006 to 105.3 mbd in 2015. This involves a growing role for non-traditional liquids – oil sands, gas-to-liquids, ultra deep water. This represents a widening of the definition of oil. Such a development and accords with the history of the industry, in which non-conventional technologies are introduced and, over time become conventional.

The risks are not below ground, in terms of shortage of resources, but above ground – political decisions by governments, conflict, natural disaster, or price volatility. Rising costs and shortage of people are also of concern. Our *CERA Capital Costs Index* indicates that offshore costs are up 42 % since 2000 – and 14% just in the last half-year.

After 2010, growth in capacity will be concentrated in what we call the "0il 15" – which will likely cause increased foreign policy concern.

I want to emphasize that this outlook does not detract, at all, from the need to develop new technologies, new energy options, alternatives, and new unconventional production. It does argue strongly for a need to integrate energy and foreign policy in a considered way – a point I will develop later.

Modernizing Reserve Disclosure

I have spoken about the need to understand future resources and to expand our concepts of energy security. Let me mention one area in which the US government could address both. The system for reserves disclosure mandated by the Securities and Exchange Commission was established by the US Congress in the mid-1970s, after the first Oil Shock, for reasons of energy security – to answer the questions "how much oil is actually there?"

The "1978 System," as put in place reflects the best practices of the time. It was based upon the 1965 definition of The Society of Petroleum Engineers (SPE) and discussions in the 1970s. Since then, the SPE has revised its definition three times and is in the process of doing so again. However, the SEC's system still relies on the definition of 1965 and the practices of the 1970s. Thus registrants are basically restricted to the technology of those years in reporting reserves – which has led to a growing divergence between what is reported under the SEC's 1978 system and how companies, using more modern technologies and tools, assess their own reserve position, on which they base investments of hundreds of million of dollars – and, now more frequently, several billion dollars.

The changes have been enormous since the 1970s. Back then there was no digital revolution, and the frontier for offshore developments was 600 feet of water; today it is 12,000 feet. The rules do not recognize the vast technical progress over the last 30 years, and as a result, standard techniques used today by companies to set multibillion investment programs are not approved, or only partly approved, for use in describing proved reserves for disclosure purposes to investors.

In addition, the rules simply have not kept up with the globalization of the industry. They were devised for onshore operations in "Texlahoma," the "oil patch" of Texas, Louisiana and Oklahoma that was the center of industry activity in the '50s and '60s. Today more than 80% of the total of companies' proved reserves are outside the US; and the differences among the fiscal regimes in several countries make it harder, not easier, to compare domestic and international reserves. As perverse as it may sound, under the "production sharing agreements" that are common in many oil-producing countries, when the price goes up, the proved reserves go down.

Major projects today dwarf those in the past, both in size and complexity. "Non-traditional projects: are drawing on increasing share of capital, but they are not adequately accommodated under the "1978 system." This includes a significant part of Canadian oil sands, gas-to-liquids and projects in what's called the "ultra-deep-water." And yet these "non-traditional-liquids will account for as much as 45% of oil production capacity in North America by 2010. Nor does the current system fully account for larger, commodity-driven liquefied natural gas business that will be critical to the future US natural gas supplies.

But the industry is still required to report using the technology of the 1970s -- when no one had a cell phone or a personal computer, let alone access to the Internet. It is as though companies preparing financial reports to the SEC in 2006 could do so only use typewriters and carbon paper. Modernizing the reserves disclosure would clearly

improve understanding of the resource base and its potential and provide clarification for purposes of energy security.

Energy Security in the 21st Century

What has been the paradigm of energy security for the past three decades is too limited and must be expanded to include many new factors. Moreover, it must be recognized that energy security does not stand by itself but is lodged in the larger relations among nations and how they interact with one another. Energy security will be the number one topic on the agenda when the group of eight highly industrialized countries (G8) meets in St. Petersburg in July. The renewed focus on energy security is driven in part by an exceedingly tight oil market and by high oil prices, which have doubled over the past three years. But it is also fueled by the threat of terrorism, instability in some exporting nations, a nationalist backlash, fears of a scramble for supplies, geopolitical rivalries, and countries' fundamental need for energy to power their economic growth.

Concerns over energy security are not limited to oil. When it comes to natural gas, rising demand and constrained supplies mean that North America can no longer be self-reliant, and so the United States is joining the new global market in natural gas that will link countries, continents, and prices together in an unprecedented way.

At the same time, a new range of vulnerabilities has become more evident. Al Qaeda has threatened to attack what Osama bin Laden calls the "hinges" of the world's economy, that is, its critical infrastructure—of which energy is among the most crucial elements. The world will increasingly depend on new sources of supply from places where security systems are still being developed. And the vulnerabilities are not limited to threats of

terrorism, political turmoil, armed conflict, and piracy. In August and September 2005, Hurricanes Katrina and Rita delivered the world's first integrated energy shock, simultaneously disrupting flows of oil, natural gas, and electric power.

The key to energy security has been diversification. This remains true, but a wider approach is now required that takes into account the rapid evolution of the global energy trade, supply-chain vulnerabilities, terrorism, and the integration of major new economies into the world market.

The current energy security system was created in response to the 1973 Arab oil embargo to ensure coordination among the industrialized countries in the event of a disruption in supply, encourage collaboration on energy policies, avoid bruising scrambles for supplies, and deter any future use of an "oil weapon" by exporters. Its key elements are the Paris-based International Energy Agency (IEA), whose members are the industrialized countries; strategic stockpiles of oil, including the US Strategic Petroleum Reserve; continued monitoring and analysis of energy markets and policies; and energy conservation and coordinated emergency sharing of supplies in the event of a disruption. Experience has shown that to maintain energy security countries need to recognize several key principles.

1. The first is diversification of supply. Multiplying one's supply sources reduces the impact of a disruption in supply from one source by providing alternatives, serving the interests of both consumers and producers, for whom stable markets are a prime concern. But diversification is not enough.

2. A second principle is resilience, a "security margin" in the energy supply system that provides a buffer against shocks and facilitates recovery after disruptions. Resilience can come from many factors, including sufficient spare production capacity, strategic reserves, backup supplies of equipment, adequate storage capacity along the supply chain, and the stockpiling of critical parts for electric power production and distribution, as well as carefully conceived plans for responding to disruptions that may affect large regions.
3. Hence the third principle: recognizing the reality of integration. There is only one oil market, a complex and worldwide system that moves and consumes about 86 million barrels of oil every day. For all consumers, security resides in the stability of this market. Secession is not an option.
4. A fourth principle is the importance of information. High-quality information underpins well-functioning markets. Information is crucial in a crisis, when consumer panics can be instigated by a mixture of actual disruptions, rumors, and fear. Reality can be obscured by accusations, acrimony, outrage, transforming a difficult situation into something much worse. In such situations, governments and the private sector should collaborate to counter panics with high-quality, timely information.

As important as these principles are, the past several years have highlighted the need to expand the concept of energy security in two critical dimensions:

5. the recognition of the globalization of the energy security system, which can be achieved especially by engaging China and India, and

6. the acknowledgment of the fact that the entire energy supply chain needs to be protected.

It is important to get China's situation into perspective. Despite all the attention being paid to China's efforts to secure international petroleum reserves, for example, the entire amount that China currently produces per day outside of its own borders is equivalent to just 10 percent of the daily production of one of the supermajor oil companies. If there were a serious controversy between the United States and China involving oil or gas, it would likely arise not because of a competition in a well-functioning global market for the resources themselves, but rather because they had become enmeshed in larger foreign policy controversies (such as a clash over a specific regime or over how to respond to Iran's nuclear program). Indeed, from the viewpoint of consumers in North America, Europe, and Japan, Chinese and Indian investment in the development of new energy supplies around the world is not a threat but something to be desired, because it means there will be more energy available for everyone in the years ahead as India's and China's demand grows.

It would be wiser—and indeed it is urgent—to engage these two giants in the global network of trade and investment rather than see them tilt toward a mercantilist, state-to-state approach. Engaging India and China will require understanding what energy security means for them. Both countries are rapidly moving from self-sufficiency to integration into the world economy, which means they will grow increasingly dependent on global markets even as they are under tremendous pressure to deliver economic growth for their huge populations, which cope with energy shortages and blackouts on a

daily basis. Thus, the primary concern for both China and India is to ensure that they have sufficient energy to support economic growth and prevent debilitating energy shortfalls that could trigger social and political turbulence.

The concept of energy security needs to be expanded to include the protection of the entire energy supply chain and infrastructure. None of the world's complex, integrated supply chains were built with security, defined in this broad way, in mind. Hurricanes Katrina and Rita brought a new perspective to the security question by demonstrating how fundamental the electric grid is to everything else.

Energy interdependence and the growing scale of energy trade require continuing collaboration among both producers and consumers to ensure the security of the entire supply chain. Long-distance, cross-border pipelines are becoming an ever-larger fixture in the global energy trade. There are also many chokepoints along the transportation routes of seaborne oil and, in many cases, liquefied natural gas (LNG) that create particular vulnerabilities.

The challenge of energy security will grow more urgent in the years ahead, because the scale of the global trade in energy will grow substantially as world markets become more integrated. Currently, every day some 40 million barrels of oil cross oceans on tankers; by 2020, that number could jump to 67 million. By then, without major technical changes, the United States could be importing 70 percent of its oil (compared to 58 percent today and 33 percent in 1973), and so could China.

But in the United States, as in other countries, the lines of responsibility—and the sources of funding—for protecting critical infrastructures, such as energy, are far from clear. The private sector, the federal government, and state and local agencies need to take steps to better coordinate their activities.

7. Markets need to be recognized as a source of security in themselves. The energy security system was created when energy prices were regulated in the United States, energy trading was only just beginning, and futures markets were several years away.

Today, large, flexible, and well-functioning energy markets provide security by absorbing shocks and allowing supply and demand to respond more quickly and with greater ingenuity than a controlled system could. Such markets will guarantee security for the growing LNG market and thereby boost the confidence of the countries that import it. There is much to be said in terms of resisting the temptation to intervene and micromanage markets. . Intervention and controls, however well meaning, can backfire, slowing and even preventing the movement of supplies to respond to disruptions. At least in the United States, any price spike or disruption evokes the memory of the infamous gas lines of the 1970s. Yet those lines were to a considerable degree self-inflicted—the consequence of price controls and a heavy-handed allocation system that sent gasoline where it was not needed and denied its being sent where it was.

Contrast that to what happened immediately after Hurricane Katrina. A major disruption to the US oil supply was compounded by reports of price spiking and of stations running out of gasoline, which together could have created new gas lines along the East Coast.

Yet the markets were back in balance sooner and prices came down more quickly than almost anyone had expected. Emergency supplies from the US Strategic Petroleum Reserve and other IEA reserves were released, sending a "do not panic" message to the market. At the same time, two critical regulatory restrictions were eased. One was the Jones Act (which bars non-US-flagged ships from carrying cargo between US ports), which was waived to allow non-US tankers to ship supplies bottlenecked on the Gulf Coast around Florida to the East Coast, where they were needed. The other was the set of "boutique gasoline" regulations that require different qualities of gasoline for different cities, which were temporarily lifted to permit supplies from other parts of the country to move into the Southeast. The experience highlights the need to incorporate regulatory and environmental flexibility—and a clear understanding of the impediments to adjustment—into the energy security machinery in order to cope as effectively as possible with disruptions and emergencies.

7. The US government and the private sector should also make a renewed commitment to energy efficiency and conservation. Although often underrated, the impact of conservation on the economy has been enormous over the past several decades. Over the past 30 years, US GDP has grown by 150 percent, while US energy consumption has grown by only 25 percent. In the 1970s and 1980s, many considered that kind of decoupling impossible, or at least certain to be economically ruinous. Current and future advances in technology could permit very large additional gains, which would be highly beneficial not only for advanced economies such as that of the United States, but also for the economies

of countries such as India and China (in fact, China has recently made conservation a priority).

8. The investment climate itself must become a key concern in energy security. There needs to be a continual flow of investment and technology in order for new resources to be developed. The IEA recently estimated that as much as $16 trillion will be required for new energy development over the next 25 years. These capital flows will not materialize without reasonable and stable investment frame-works, timely decision making by governments, and open markets.

New Technologies

9. Development of new technologies will remain the fundamental starting principle of energy security for both oil and gas. This will require new generation of nuclear power and "clean coal" technologies and encouraging a growing role for a variety of renewable energy sources as they become more competitive. It will also require investing in new technologies, ranging from near-term ones, such as the conversion of natural gas into a liquid fuel, to ones that are still in the lab, such as the biological engineering of energy supplies. Investment in technology all along the energy spectrum is surging today, and this will have a positive effect not only on the future energy picture but also on the environment.

We talked earlier of the widening definition of oil. We will also see the widening definition of gasoline with what has recently become a broad commitment to introducing ethanol into the gasoline pool. Undoubtedly we will see a substantial growth of ethanol and the infrastructure to support it. But we have to remember the overall scale of the

target envisioned in the 2005 legislation would be about five percent of total supply. Given the current incentive to step up in investment, the number could be somewhat higher. Achieving much larger objectives depends on substantial advances in the science of cellulosic ethanol. Certainly this will be a major focus of effort in the years ahead.

Finally, we must return to the larger context. Energy security indeed exists in a larger context. In a world of increasing interdependence, energy security will depend much on how countries manage their relations with one another, whether bilaterally or within multilateral frameworks. That is why energy security will be one of the main challenges for US foreign policy in the years ahead. Part of that challenge will be anticipating and assessing the "what ifs." And that requires looking not only around the corner, but also beyond the ups and downs of cycles to both the reality of an ever more complex and integrated global energy system and the relations among the countries that participate in it.