XIII REPSOL YPF-HARVARD SEMINAR

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THINKING THE UNTHINKABLE

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Editor's Note

Held in May 2003, the XIII Repsol YPF–Harvard Seminar, like the sessions that have preceded it, brought together a small group of senior representatives of governments, industry, international organizations, and academia from about a dozen countries for two days of an off-the-record review of developments in global energy markets.

This year the venue was Salamanca, Spain and the topic of discussion and debate was *Thinking the Unthinkable*.

Following a keynote presentation, the Seminar was organized around three panels, each initiated by invited papers and followed by discussion and debate among the full group of participants. And once again, one of the participants was drafted to serve as rapporteur and guest editor of the proceedings, first to summarize and conclude the deliberations at the end of the Seminar itself and then to help edit and supervise the publication of this volume.

The role of Seminar rapporteur is at once both challenging and rewarding. Challenging because it requires sitting through every

panel, paying close attention to what each presenter and discussant has said or insinuated and finally and importantly, fitting, in real time, the salient points into a larger mosaic that broadly reflects the consensus of the gathering. But this laborious task is also rewarding in that the rapporteurs are positioned, at the end of each Seminar, to have the final say on issues of special concern to themselves.

The rapporteur's *Summary* and *Comment* has been moved to the front of this book, both to frame the deliberations and to provide an early overview of what transpired at Salamanca.

Needless to say, that summary, and the edited text of the presentations that follow, reflect the views of the participants and not necessarily those of the entities with which they are associated or of the organizers of the Seminar.

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THINKING THE UNTHINKABLE

Summary and Comment

Bijan Mossavar-Rahmani
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When those of us involved in the organization of these meetings sat down after the last Seminar held in Palma de Mallorca in July 2001 to plan the thirteenth Seminar, *Thinking the Unthinkable* seemed to be an appropriate theme for the next gathering. The prior decade, notwithstanding some momentous developments such as the opening up of the former Soviet Union to both domestic and international oil companies and significant advances in technology, had for all practical purposes been a relatively surprise-free period for global energy markets, and we suspected that this could not last.

We thought, therefore, that it would be interesting and provocative for the Seminar participants to play the "what-if" game. That is to say, to develop and debate a series of surprise—or shock—scenarios, whether political or economic, that would question the comfortable and comforting consensus over the evolution of worldwide energy markets in such areas as producer-consumer relations, energy prices, and the direction of globalization, liberalization, and deregulation—all topics that have been addressed over the last 15 or so years by participants in these Seminars.

In one of those earlier Seminars, Bill Hogan observed that when it comes to global energy developments, the biggest surprise would be no surprise. Of all the statements I have heard from all the participants at all the Repsol YPF–Harvard Seminars, and I have been privileged to have attended each and every one since 1987, this is the one statement that has been burned into my memory.

No, that's not quite true. I also remember a statement made by Professor Robert Mabro, of Oxford University, in response to a question about the assumptions used in his model to forecast some aspect of oil supply or demand or price. His response was classic. "Model, what model? That would be too much work."

Well, thinking the unthinkable is too much work, too, but we thought it worth the effort for our thirteenth Seminar, originally scheduled for the spring of 2002. But none of us imagined the size and scale and force of the surprises that were to follow.

The first—and in John Deutch's word, "horrible"—unthinkable was, of course, September 11, 2001. This tragedy shocked and awed those of us who live in New York City, but its reverberations have been felt everywhere. Adrián Lajous spoke of a "collective trauma" that followed.

A related unthinkable, at least in the United States, was that the hijackers were almost exclusively Saudi Arabian and that their funding derived directly or indirectly from Saudi Arabia's oil revenues. Humberto Calderón Berti offered that he, for one, was not surprised by this link and added that others would not have been surprised either if they had been paying attention. I noticed him looking at John Deutch when he said this.

We live in complicated times. Isaac Yanovich complained that in his country, Colombia, it is not Saudi Arabia but the international oil companies that finance local terrorists.

What followed September 11, José Luis Díaz Fernández reminded us, was surprise after surprise, unthinkable on top of unthinkable. The American invasion of Afghanistan. The American

and British invasion of Iraq. And the demarcation, this time without launching a single smart bomb, of Europe by the U.S. Secretary of Defense, into "Old Europe" and "New Europe." I must admit, the Spanish government's support for the war in Iraq notwithstanding, as I sit in this magnificent hall in this beautiful medieval city of Salamanca, it is difficult for me to think of Spain as anything other than Old Europe. And I mean that in a positive way.

But back to the surprises of the past two years. Besides violence and war, we have been hit by a global economic slump, sharp drops in—some would say the collapse of—world stock markets, the near breakdown of corporate governance which has enriched management but fleeced investors and laid off many thousands of workers while wiping out their retirement nest eggs. The latter has been an American disease but not exclusively so. I would be remiss if I did not mention similar scams in France, notably at Vivendi. More recently, the scourge of severe acute respiratory syndrome (SARS) has hit Asia and threatens the rest of us. The list of unpleasant surprises goes on and on.

Closer to our own industry, the surprises have included:

- Oil and gas prices that have ranged 50 to 100 percent above the mid-term consensus view of 2001. What was bad news for consumers, however, fell into the rare category of pleasant surprises for many of us from industry in this room;
- The implosion of the free-wheeling U.S. energy trading companies—companies touted and promoted in many of our previous Seminars by at least the American participants, and companies some of you in Europe wanted to emulate; and
- More broadly, the apparent weakness of some of the more prevalent models of U.S. energy deregulation, notably in electricity markets, particularly in California, but also in natural gas markets.

Continuing with my list of surprises, I add the shutdown, for safety reasons, of some 17 nuclear reactors in high-tech Japan.

Meanwhile, low-tech Iran, much to the United States' consternation, is building up its nuclear program, enrichment and all, notwithstanding the fact that Iran sits on the world's second-largest reserves of cheap, unused, and easily accessible natural gas and that the nuclear technology being acquired is Chernobyl-quality. John Deutch noted that nuclear power is largely stalled elsewhere in the face of formidable roadblocks, including high costs, questionable safety, and unresolved issues of waste disposal and management.

Another surprise, certainly for our hosts Repsol YPF, was the collapse of the Argentine economy and the ensuing political chaos—with its devaluation, recession, new taxes, foreign exchange controls, and even the threat of nationalization. Only now is some form of stability appearing to be taking hold, but sadly it will last only until the next crisis, which in Argentina will come as surely as day follows night, as Carlos Bulgheroni will probably attest.

But Argentina has not been alone. Humberto Calderón Berti described to us the ongoing dismantling of the oil industry in Venezuela. And we can add Nigeria to the list of oil-producing countries in ongoing and still unresolved civil and political turmoil.

Even our Seminar itself and its other participants have not been immune from the unthinkable.

This Seminar, scheduled for 2002 in Santander, was cancelled at the last minute because of a nationwide strike here in Spain and rescheduled to 2003 in Salamanca.

Who among us would have thought that our keynote speaker in 2001, and before that, in 1997, Ken Lay, then Chairman of Enron, the world's biggest energy trader before its spectacular demise, would become the poster child for bad corporate governance, fraudulent accounting, and the pitfalls of energy deregulation?

Who would have thought that our keynote speaker at the Buenos Aires Seminar in 2000, Domingo Cavallo, then Argentina's Economics Minister, would be blamed for the collapse of that country's economy and arrested?

Who would have thought that the far right—or far out—ideas, many expressed in these Seminars, of one of our regular participants, Richard Perle, would form the backbone of U.S. policy in the Middle East, or that he would become the lightning rod for critics of that policy?

I should quickly add that, rest assured, not everyone who attends these Seminars ends up in trouble, though the above list was by no means exhaustive.

Indeed, countless Seminar alumni continue to serve their countries, their companies, their universities, and their international organizations effectively, honorably, or at least free of public controversy. The fact that some have slipped, or been tripped up, sometimes in spectacular fashion, is another indication that the Repsol YPF–Harvard Seminars draw on the movers and shakers of the energy industry. And these gatherings have been more exciting and provocative forums for discussion and debate because of the contributions of all our participants.

I think I have made my point about unthinkables.

But what have we learned from these deliberations after two days in Salamanca, and what, if anything, can we conclude?

I come back to Bill Hogan's rule: the biggest surprise in our industry is no surprise. I add to that my own observation that the surprises keep getting wackier and stranger.

With that I move on to Noah's rule: don't just predict rain; build an ark. To which I add my own observation that the last major flood—the one of Biblical proportions—was, you will recall, in the Middle East.

What does building an ark mean in practical terms?

To the Bush-Cheney-Rumsfeld-Wolfowitz and, yes, Perle, team, it means reshaping the political landscape of the Middle East, home to some 50 percent of the world's oil reserves and of 30 percent of its current production, starting with the just-completed invasion of Iraq.

Like many of you, I do not subscribe to the theories that this war was about handing over Iraq's oil to American oil companies. Vicky Bailey restated the U.S. government's position that Iraq's oil will belong to the people of Iraq, and we will accept her word as authoritative and final. But she was also quick to say that as a matter of broad policy, this administration is looking for reliable, stable, and affordably priced oil. We can all expect that in the coming months and years, more oil will be forthcoming from Iraq into the global market, and as it does, that oil companies from the "coalition of the willing," including incidentally, our host, Repsol YPF, will be especially well positioned to make that happen, and to profit from it. Why not?

And even if the U.S. military does not now turn left or right to attack another Middle Eastern country, the politics of oil in that region will be substantially altered for a long time to come.

Let me now begin to explain why I believe that the changes beginning to unfold in the Middle East may reshape what Adrián Lajous called the architecture of the world oil market in a way that could ultimately prove, not only momentous, but very positive for all—or nearly all—the players.

We are accustomed to thinking about oil supply disruptions as resulting from deliberate action by a producing country or a coalition of producing countries in pursuit of some political aim; indeed, the Arab oil embargo of 1973 was just that. But in the ensuing 30 years, disruptions to oil supplies have been set off by, and these disruptions will likely continue to result from, uprisings triggered by political desperation caused, importantly, by economic mismanagement of national economies of the oil-producing countries.

It is one of the great ironies of the past century that oil has become an albatross around the necks of the populations of so many countries that produce it. The "black curse" is what my own great-uncle, Iranian Prime Minister Mohammad Mossadeq, called oil when he nationalized Luis Xavier Navarro's company's Iranian oil assets 50 years ago. In those days the company was called the Anglo-Iranian Oil Company and not "Beyond Petroleum." Mossadeq was subsequently removed from power by one of John Deutch's predecessors,

and the United States returned the Shah to the throne, and invited the British but also the American and even the French oil companies to operate, control, and profit handsomely from Iran's oil fields.

Somehow I doubt the French will have it so easy this time in Iraq.

In many similar countries, large oil revenues have proven a huge obstacle to the formation of democratic institutions by concentrating economic resources and thus political authority in the hands of a small elite, which power and money quickly corrupts. Some start out as, and others evolve into, murderous autocracies like Saddam Hussein's Iraq. Civil society is destroyed or not allowed to take root. Balanced economic development, too, suffers, as rising real exchange rates destroy the competitiveness of agriculture and other labor-intensive export industries. What revenues are not wasted through cronyism are spent on the military whose task is to preserve the status quo and sometimes to invade an unfortunate neighbor.

The result? Nigerians today are as poor as the day oil was discovered. After 100 years in the top ranks of the world oil producers, Iran now ranks only 111th in the world in gross national income per head. Iraq is in tatters. Saudi Arabia is the greatest paradox of all. No country is so rich and yet so poor. This one sits on a quarter of the world's oil reserves, produces each day more oil than anyone else, has a population of less than 20 million spread out over a land mass the size of the European Union, yet with a per capita annual income less than Latvia's and only a third of what it was 20 years ago. The country's second-largest export after oil is, you guessed it, cash. Followed somewhere down the list by terrorism. And on and on.

How do we get out of this miserable mess?

The U.S. administration's goal in Iraq, at least as articulated by those who have a plan besides ridding the population of Saddam Hussein (described by Humberto Calderón Berti as the biggest weapon of mass destruction, though like the rest, nowhere to be found) seems to be to foster institutions that will convert the country into a model of peaceful, responsible, and democratic governance. And one to be emulated by other oil producers in the region.

A country with an oil bureaucracy whose managers and technicians are widely respected for their professionalism and integrity, who operate within a transparent legal and fiscal regime, and who are ultimately answerable to their real stakeholders, the population at large.

Now who can take issue with that?

Well, I can think of nearly every Middle Eastern oil-producing regime, and for good measure, I can throw in the regimes of Venezuela, Algeria, Libya, Nigeria, Egypt, and Angola, among others.

These countries share at least two interrelated characteristics: state ownership and control of all or nearly all oil resources and also membership in OPEC or at least OPEC fellow-traveler status.

The initial idea of OPEC was a noble one. Bring together a small group of resource-rich countries whose oil reserves, production, exports, prices, and thus revenues were dictated by a cartel of international oil companies acting in their own interests. By comparing notes, exchanging ideas, and eventually coordinating efforts, these countries hoped to get a more equitable piece of their national patrimony. A number of us in this room, myself included, worked for or with OPEC over the years, often proudly so.

But somewhere along the way, probably within the last 25 years, OPEC lost its way and was hijacked by the corrupt and undemocratic regimes that comprise it.

OPEC was transformed into an entity reviled by consumers as a greedy cartel bent on self-interest and cheered by producers as a champion of national rights and higher oil prices. But this preoccupation by both sides with prices and production levels has successfully shifted the debate away from more profound questions. Is the OPEC-inspired nationalization model best for managing a country's oil resources? Do OPEC's collective policies result in the optimal mix of prices and production? What is the level of each country's oil revenues and where do these go? The answers to these questions are no, no, and no one will tell.

I submit that these countries would be best served by abandoning this failed OPEC experiment, eliminating national oil companies, opening their oil sectors to domestic and foreign private companies with the managerial, financial, and technological capabilities required to really grow the business and whose involvement will invariably increase transparency, competition, and accountability while reducing cronyism, corruption, and waste.

If some of you might think I am being a bit harsh, I made much the same point in a large public conference in Tehran a couple of years ago and received a standing ovation from the audience comprised mostly of managers of the national oil company.

These are issues deserving of more discussion and debate, and there is enough here to fill an entire new Seminar, still within our theme of thinking the unthinkable. But I think that post-September 11, profound change is already on its way.

The inaugural meeting of OPEC was held in Baghdad in September 1960; participants from other countries remember the streets filled with tanks and soldiers of an Iraqi regime then fearful for its survival. It would be ironic if tanks and soldiers in Baghdad, though this time American ones, signaled the beginning of the end of the organization just over four decades later.

There is another saying that I would like to quote. It is used in Houston, an oil city, but it seems appropriate here in Salamanca as well. "If you don't like the weather, stick around; it will be different tomorrow."

Indeed, as someone said, and it may not have been at one of these Seminars, "The snow in Spain falls plainly in May." As indeed it has this year, to the surprise of those who drove from Madrid to Salamanca. John Deutch referred to this unusual seasonal phenomenon as an ice age—a weather pattern that seems to fly in the face of the coming global warming that preoccupies Rob Stavins.

We have spent the last two days chronicling bad news. There have been some positive developments since we last met as well. Indeed, thinking the unthinkable need not be an exercise in pessimism or despair, as Robert Priddle reminded us.

One piece of good news for José Luis Díaz Fernández and Bill Hogan, both of whom expressed considerable despair and depression that solutions to global energy problems appear intractable, is that between January 1, 2001 and January 1, 2003, higher oil prices and advances in exploration and drilling technologies allowing access to deeper, more remote, and generally more difficult fields in more parts of the world, have led to a nearly 20 percent increase in global oil reserves and to a nearly 10 percent increase in global natural gas reserves. And much of this increase has come from onshore and offshore areas outside the OPEC countries.

Claude Mandil cited statistics about OPEC's declining market share to make the same point, although he did not seem to be too happy about this. His organization, the International Energy Agency, was set up by the consuming countries in the wake of the Arab oil embargo to counter OPEC's every move. Now he reports that under his watch, the two organizations meet to consult and cavort. How very French!

Back to the good news. Petrobras, Brazil's state oil company represented here by its chief executive, José Eduardo Dutra, began production last year off the coast of the Atlantic Ocean in some 8,500 feet of water, an impressive logistical feat, indeed. Surely, Alfonso Cortina, who in his remarks touted the importance of technology, is applauding.

Adrián Lajous spoke of the untapped potential of other areas, including his own Mexico.

Paul Portney pointed to the importance of tapping just such new resources as one of his five pillars of sound energy security policy.

Still in the good news category is the continuation of efforts at liberalization and deregulation of electricity markets, in fits and starts, in both the United States and Europe.

Theresa Flaim noted that while electricity market restructuring has proven much harder than thought at first, its advantages to consumers outweigh its costs and risks.

In Bill Hogan´s view, the California crisis resulted from mishandling of circumstances unique to California, including a poorly designed deregulation model.

Bill Massey has been busy absorbing the lessons of California to help guide restructuring elsewhere, recognizing the need to address the mishmash of sometimes conflicting state and federal rules.

Meanwhile, deregulation and liberalization in Europe, according to María Luisa Huidobro and Michel Massoni, continue to evolve. Somewhat faster in Spain and somewhat slower in France, which we were reminded, once again, is a Latin country and not an Anglo-Saxon one. Latin or otherwise, it is unthinkable that France will abandon its national champions, the entrenched utilities, as noted by Evanan Romero, complicating efforts elsewhere in Europe.

Having captured snippets of our two-day conversation, I now close as I do each year, by thanking, on behalf of all the participants, our hosts, Repsol YPF and its Chairman, Alfonso Cortina; the Fundación Repsol YPF and its President, José Luis Díaz Fernández; and Harvard University's John F. Kennedy School of Government represented by Bill Hogan, together with their hard-charging colleagues, for the excellent organization of this, the thirteenth Seminar.

Little did we think when we first launched these Seminars in 1987 that we would still be gathering for discussion, and for camaraderie, into the next century. I, for one, am pleased that we have. For this has proven to be one more instance in which an unthinkable can be pleasant, productive, and positive, too.

Opening Session

Welcome and Introduction

Alfonso Cortina
Repsol YPF

It is a great pleasure for me to welcome you to this XIII Repsol YPF–Harvard Seminar on Energy Policy.

For those of you less familiar with the tradition of these meetings, let me give you a brief outline of their history. The first Seminar took place 16 years ago, in 1987. Since that time, we have held a Seminar almost every year, always in different venues across Spain, with the exception of the eleventh Seminar, which was held in Buenos Aires in the year 2000.

A long list of distinguished persons from all over the world has enriched the intellectual discourse of our Seminars. Those of you who participated in past sessions can attest to the wide range of technical expertise and geographical origins represented by the speakers who have been seated at this traditionally U-shaped table.

These Seminars have produced a very fruitful cooperation between Repsol YPF and Harvard University. Furthermore, the experience of the Seminars and the interactive discussion among the

Seminar's principals have prompted us to create a new program at Harvard. Today it is an honor for me to formally announce the launching of the Repsol YPF–Harvard Kennedy School Fellows Program. With our joint support, the program will promote research and the development of scholars at Harvard University in energy, energy policy, and related areas. Their research output will contribute to this Seminar series, to papers and books, and to the educational activities of our Instituto Superior de la Energía (ISE) in Spain. We at Repsol YPF are proud to be promoting, financing, and collaborating in the development of such a program through the Fundación Repsol YPF.

In the first Seminars, we analyzed the oil market situation and trends. Later we extended this analysis to natural gas and power, giving special attention to the evolution of regulatory frameworks. The dramatic terrorist attacks of September 11, 2001, and the Iraqi war led us to focus this Seminar on a study of the consequences of both events for future developments in energy policy in the developed countries where oil and natural gas supplies are projected to be increasingly vulnerable, particularly in the United States and the European Union (EU).

Before focusing on the central issues in the agenda of our Seminar, a few words on the situation of the world economy, which is very much affected by the oil market evolution and by geopolitical developments. Despite the prevailing uncertainties and the current weakness in activity, the most likely scenario is a progressive, if unspectacular, world economic recovery.

Looking at recent geopolitical developments, it appears that the most acute source of risk has now receded. With the ending of war and the securing of Iraqi oil fields, the threat of an oil crisis sending the world economy into outright recession has subsided. However, the more diffuse perception of a still insecure economic environment may prevail for some time. The timing of the recovery will depend on how far industrial economies have purged past imbalances (overinvestment, inflated share prices, balance sheet exposure, and so on), and how much support is being provided by national economic poli-

cies. In this respect, fiscal and monetary conditions within the industrial countries remain accommodating enough to support an incipient recovery.

Let me now turn to more long-term and Seminar-oriented issues.

All the forecasts regarding the structure of world primary energy demand by the end of the next decade, including those issued by the International Energy Agency, the European Commission (EC), and the U.S. Department of Energy, agree that oil and natural gas will continue to hold a significant role in the world energy matrix, providing approximately two-thirds of total consumption.

Given this situation, it is reasonable to ask whether there will be adequate reserves to meet this demand. I believe the answer is "yes." In the late 1960s, there were recoverable oil reserves equivalent to 30 years' consumption and natural gas for 50 years. Now, by contrast, despite the considerable increase in demand during the past 30 years, there are enough known oil reserves to cover 40 years' supply, and natural gas for more than 60 years.

Nevertheless, the unbalanced distribution of these reserves should be emphasized. In fact, the OECD countries have only 8 percent of the world's oil reserves, whereas they consume 63 percent of world oil production; and 10 percent of the natural gas reserves, compared to 50 percent consumption.

Both the Bush Administration and the EC are worried about the West's dependence on oil supplies from trouble-prone areas. Particularly since September 11, Washington has pursued a strategy directed at reducing oil imported into the United States from such countries as Saudi Arabia and Iraq.

The EU, using the EC's Green Book, *Towards a European Strategy for the Security of Energy Supply,* has also launched a public debate on the supply security issue. The Green Book underlines that oil and natural gas will continue to play a crucial part in meeting the energy requirements of the EU until 2020 and well beyond. It forecasts that oil and natural gas consumption will increase from 63 percent today to 67 percent of the EU energy matrix by 2020.

The possibilities of replacing oil and natural gas with other energy sources seem quite limited in the next few decades. In particular, there is an increasing popular rejection of nuclear fission energy. You may remember the recent decisions in Belgium, Germany, and Sweden where it was decided not to replace the nuclear plants in service in those countries at the end of their life cycle.

As for coal, in spite of the enormous existing reserves, geographical distribution, and price stability, there are limitations on its use, caused particularly by its adverse environmental impact. These limitations are likely to persist for decades to come.

Finally, it appears that renewable energies will not, in the medium term, become a massive source of energy supply. Wind energy, solar, and biomass bear high production costs. Also, wind and solar energies are irregularly available, which will make it necessary to keep fossil energy reserves on hand.

For the longer term, there are two energy sources that will play an important role. The first is nuclear fusion energy, which produces a radioactive waste much less contaminating than fission, and, properly managed, should win social acceptance more easily. With respect to nuclear fusion, I would like to point out that Spain has proposed Vandellós, in Tarragona, as the site for installing an experimental fusion reactor for which there is a proposed investment of more than $3 billion. Should this project be located in our country, it would represent a great technological boost. The excellent conditions of the Vandellós site reinforce the strong position of the Spanish academic and scientific community with respect to nuclear fusion knowledge and background. The recent visit to Spain by U.S. Secretary of Energy Spencer Abraham gives us grounds to be optimistic about the success of the Spanish proposal.

The second is the use of hydrogen as the energy source for the future. The availability of hydrogen in adequate quantity and at a competitive price will make it possible to manufacture cars driven by electricity from fuel cells. Repsol YPF, together with Gas Natural SDG, Air Liquide, and companies in the automotive sector have begun a pilot

project for the Madrid Town Council buses, wherein hydrogen will be obtained from natural gas at the pumping station. This venture is the first of its kind in Europe to utilize decentralized hydrogen. In the longer run, perhaps large-scale hydrogen production will be achieved by electrolysis of water using electricity from nuclear fusion plants, thus paving the way for the development of a hydrogen distribution system.

Therefore, we may start by assuming that liquid and gaseous hydrocarbons will remain the predominant energy sources in the next decades.

In spite of the uneven distribution of reserves that I have noted previously, I do not believe there will be significant supply problems. The industrialized countries depend on oil and natural gas imports, but no more so than the countries sitting on these hydrocarbon reserves depend for revenues on their exports. The experience of the last 20 years shows that supply limitations by OPEC have been aimed toward positioning the price of oil within certain levels, but that no political use has been made of oil supplies, as occurred in the 1970s. The memory of the adverse consequences of the 1970s strategy for the exporting countries remains.

These considerations suggest the need for taking action to ensure that fossil energy reserves last longer, and to diversify their source of supply.

First, we must take measures to slow the growth of energy demand. Such measures were implemented at the end of the 1970s, but have not been maintained. However, projects such as the EU's Auto-Oil Programme to reduce pollution by cutting fuel consumption, and the gradual improvement of power generation performance through combined cycle plants or production units incorporating other technologies are steps that will reduce the growth rates of primary energy consumption.

Second, we must further technological improvement in hydrocarbon exploration and production. These improvements, so impressive over the last 15 years, have affected geosciences in areas such as high-resolution seismic processing in three or four dimensions, which

allows a more precise location of hydrocarbon accumulations, and in multiple horizontal drilling, where productivity is improved by a factor of two to four. Advances have also been achieved in increasing the in situ oil recovery coefficient, which has risen 10 percent in the last 20 years and which could be raised again by a similar percentage, and in exploration and production in deep water, which are especially promising off the continental shelves of Africa and America.

Third, we must promote the replacement of oil products with natural gas, whose abundant reserves are still not sufficiently exploited. Technological advancements in this field should make it possible to slow the growth in oil consumption. I note here the manufacturing of synthetic oil from natural gas, by way of the gas-to-liquid technology; the improvements in the logistics of liquefaction, sea transport, and regasification; and the utilization of natural gas in applications which have been marginal up to now.

In short, it is possible to prolong the lifespan of hydrocarbons through measures that are more friendly towards the environment and contribute to meeting the objectives of the Kyoto Protocol.

Unlike the United States, on our continent we are still struggling to create a single EU energy market which is still more objective than reality. A single market would facilitate a much greater ability to respond to potential supply disruptions. Today, the European energy market remains a maze of national and regional markets separated by physical and legal barriers. To overcome physical barriers, extensive investment in interconnections will be needed. Suppressing legal barriers would involve not only the removal of some energy export tariffs, but also the dismantling of the monopolies surviving in some countries.

The EU electricity directive ordered the opening of a first market segment to free competition in 1999. Market openings should increase by 2003 to reach a level equivalent to one-third of demand. However, each country is motivated by a different degree of liberalizing zeal, and the norms to regulate the cross-border energy exchanges are still under discussion.

The European natural gas directive requires the member states to open at least 20 percent of their national demand to free competition. Many countries have gone much further, and today about 80 percent of EU natural gas demand is open to competition. According to EC estimates, this percentage will increase to 90 percent by 2008. The degree of market opening varies from one country to another.

Therefore, while the United States seems to be working on securing an ever-increasing flow of domestic or non-OPEC oil and natural gas, the EU will have to rely on its diplomatic skills to reinforce the interdependent links with its suppliers. And it will have to overcome the challenge of creating a single energy market in the next decade to reinforce its capacity to respond to supply disruptions.

Concern about the new geopolitics and potential threats of supply disruption have caused uneven support from the different signatories to the Kyoto Protocol. The EU oil industry has made extensive investment efforts in cleaner fuels production. Any further contribution from our sector to achieve the Kyoto goals must come mainly from using an increasing quantity of natural gas to replace other energy sources in power generation and space heating, at least in the foreseeable future. Beyond this, meeting the Kyoto objectives would have to come from reductions on the demand side.

In conclusion, we seem to be at the end of a transition tunnel. The state of the U.S. economy, the financial crisis in other countries, and, above all, instability in the Middle East, may be the harbingers of a new, possibly expansive cycle ahead. The United States and the EU are deploying different strategies to secure prosperity for their people, an objective that, for some, has a higher priority than formerly self-imposed environmental goals.

This is how the game board is set. From this starting point, we invite you to employ these two days in *Thinking the Unthinkable.*

Keynote Address

Security and Energy: Short-Term Implications of a Long-Term View

John M. Deutch
Massachusetts Institute of Technology

I am delighted to be the keynote speaker at this Repsol YPF–Harvard Seminar on Energy Policy because it gives me the opportunity to frame the discussion, *Thinking the Unthinkable*. I should point out, however, that I am not quite sure what it means to say "thinking the unthinkable." Given the importance of the topic, I want to be sure we understand our terms. Does the term mean that we should consider very improbable, but significant, events that might occur? Or does the term mean that we should think of very horrible events that might occur? Perhaps it means dealing with both the improbable and the horrible. Therefore, in order to open the widest possible scope for discussion, I shall assume both possible meanings and give you a little of both the improbable and the horrible.

Specifically, I wish to offer you four unthinkable thoughts. They are unthinkable thoughts about oil, natural gas, terrorism, and finally, about carbon. I offer these four thoughts to stimulate discussion about new roads we may travel, as we navigate through the

unpredictable and dangerous waters of energy policy in a turbulent and dangerous world.

First, oil. We have witnessed a great deal of popular hysteria about the U.S. war in Iraq, whether in opposition to, or support for, the war. Today, attention is turning to the consequences of a long-term U.S. military presence in the Middle East. For my purpose the question can be phrased as "What significance does the presence of the U.S. military in the Middle East have for the future security of world oil supplies?" My first unthinkable thought is: it does not matter very much for oil supply whether the United States is present in militarily strong terms in the Middle East.

We should remember that the original energy security concern in the 1970s did not stem from the political circumstances in the Middle East, but rather from possible Soviet Union intervention in the region, and particularly the Soviet Union's military intervention in Iran. More recently, we have been concerned about the conditions in certain states in the Middle East, whether they are secular states or religiously inclined states, that are not friendly to Europe or the United States, and about whether those countries will disrupt world oil supply. We frequently hear in the United States, for example, concern about what might happen if the Saudi royal family were to be replaced by a government hostile to Western values.

I suggest to you, as my first unthinkable thought, that the security of the supply of oil is not much influenced by such political change, and therefore the United States' involvement in the Middle East region is not so important to the security of supply. The United States' involvement may be very important, though, for other political reasons, e.g., assisting a peaceful solution to the Israeli-Palestinian conflict.

Why do I hold this view? Certainly the last 25 years of history would support my point. There has not been any politically-inspired price disruption arising from actions or attitudes of countries in the Middle East that are unfriendly to the United States. The basic reason is that economic necessity is a stronger force than political ideology. Eventually all these governments, regardless of their political

persuasions, will take their oil production to world markets and offer their oil on those markets. And moreover, since oil is fungible in world markets, every country will be able to purchase oil to meet its needs. To be sure, short-term supply interruptions will occur. There will be occasions when the price of oil moves up sharply because there is a perceived or an actual restriction of supply. But I claim that those short-term disruptions may be as likely prompted by economic speculation as by political change or turmoil in the Middle East. And, sooner or later, the oil will flow back to market, and stability in supply will be re-established.

So, my first unthinkable thought is that U.S. military presence or the threat of such presence in the region is not all that important in terms of ensuring the long-term secure supply of oil. To illustrate my point, let us reverse the political situation and imagine that every government in the Middle East magically would have what we would recognize as a democratic form of government based on a Western model, and that somebody like Ted Turner was the elected President of Syria or Dominique de Villepin was elected President of Iraq. Would we suddenly find a great change in world oil markets? Let me suggest to you that those individuals would remain eager to gain the maximum price for their oil in order to sponsor social and economic development in their countries. I do not think we would find a great difference in the trajectory of the price of oil. Short-term supply interruptions, however, might have a different character.

On balance, I say to you that we should have a continued concern with the Middle East, but we should not imagine that the U.S. military presence there is absolutely compelling in determining what happens to energy resources. Rather, what will happen in the Middle East is a consequence of the politics and the distribution of resources in the region. That does not mean we should not have concerns about political developments in the Middle East and elsewhere—it just means that oil should not drive our interests.

We should continue to encourage oil and natural gas exploration and production outside of OPEC and outside of the Middle East. There are welcome developments in supply both in the Caspian

region and in Russia. I have just returned from a trip to Russia where I saw the activities and the aspirations of the Russian oil industry to move Russian oil to market. The recently announced merger between Sibneft and Yukos is a welcome step in that regard. Russian oil in world oil markets helps to keep supply diverse. I do not believe that Russia will ever become the dominant oil producer; the production cost of Russian oil is too high. Therefore, Russia will be unable to gain dominance over Saudi Arabia or even Iraq in setting oil prices.

On the demand side, we should keep our eye on China. The Chinese appetite for oil is growing significantly, and this demand for oil will influence their foreign policy and the way they will try to establish their influence in East Asia and elsewhere in the world.

Let me turn to my second unthinkable thought, which is that natural gas inevitably will become a commodity traded on the world markets precisely the way oil is today. We are seeing in North America, in both Mexico and the United States, the prospect that great amounts of natural gas will be required to be imported from abroad. This means the United States will become an importer of natural gas, the way Europe and Japan are today. Stranded gas will find a way to market. Natural gas will be converted to liquids or liquefied natural gas (LNG) and sent to market, and chemical and fertilizer plants will move to be near the sources of supply. The implication is that the market clearing price of natural gas will no longer be what it costs to produce natural gas in east Texas or in the Gulf of Mexico. It will be the cost at the margin that has to be paid for landing natural gas, which is imported as LNG or in the form of liquid, from some part of the world where there are vast resources. In short, the price of natural gas will be dependent on a world market price rather than on local conditions.

How high might the price of natural gas become? That price might be in the range of $4–$6 per million cubic feet (Mcf). The actual amount depends on the netback that you assume at the producing wellhead. But somewhere in this range, LNG can profitably be landed in the United States, in Europe, or in the Far East. How high might the imported price of natural gas go? The backup price can only go as

high as what it costs to gasify coal and do carbon sequestration—this could be as high as $9 per Mcf.

The point I want to make regarding my second unthinkable thought is that natural gas will be an internationally traded commodity like oil, and it will be the international price of natural gas that will clear the market in Mexico, in Canada, in Europe, in Japan, and in the United States.

My third unthinkable thought has to do with terrorism, and this is the horrible part of my talk. Since the events of September 11, 2001 and the time leading up to the war with Iraq, we have not experienced additional major catastrophic terrorist attacks. I find this quite surprising. The absence of any new major terrorist incidents appears to have led to indifference about terrorism. And indeed, some even make what I believe to be an illogical suggestion, that the result of the war in Iraq has made terrorist events less likely, rather than more likely or equally likely. I find this indifference to terrorism a very serious mistake. My third unthinkable thought is that we must consider and plan for additional acts of catastrophic terrorism against our countries, our people, and our companies.

There is no industry more vulnerable to terrorist attack than the international energy industry. To be sure, energy infrastructure has always been vulnerable. Refineries, pipelines, tankers, and the like are vulnerable to explosives. Energy infrastructure involving oil, natural gas, or electricity represents soft, fixed targets for attack. We see this, for example, in Colombia and also in Chechnya. It should be pointed out, however, that there are other possibilities for acts of terrorism against energy facilities. The first is that there are a few handfuls of organizations that are internationally organized, disciplined, well-financed, and capable of carrying out acts of cyberterror—the ability to disrupt or gain control of the communications and computer systems on which our infrastructure depends. Examples include government agencies, banks, power plants, and air traffic control systems. This is certainly a different kind of terrorism from what we knew 30 or 40 years ago, but today's energy activities and operations are tremendously vulnerable to this kind of information intrusion. I

consider the possibility of cyberterror to be a greater risk than episodic bombing of pipelines, compressor stations, and refineries because information intrusions can bring down an entire system for a considerable period of time. In sum, I believe that over the next several decades we will have to address the terrorist threat from the point of view of security of our energy operations. So the third unthinkable thought is, I regret to say, that terrorism must be on our agenda.

My final unthinkable thought has to do with carbon. I think it likely, but not certain, that carbon, and, of course, greenhouse gas emissions other than carbon dioxide, will become the single most important issue on the world energy agenda going forward. And this is because of the adverse climate effects, perceived and actual, from the largely irreversible warming that is occurring. There is no question that an impressive scientific consensus on global warming and climate change exists around the world. Continued expansion of greenhouse gas emissions and the increase of atmospheric concentrations to twice pre-industrial levels will likely have an adverse effect on climate. We are not sure of the timing or magnitude of these effects, but physics says they will happen.

We have no worldwide political agreement about how to deal with this problem. The Kyoto Protocol was not a helpful model for two reasons. First, it did not include developing countries, where the projected growth of energy consumption is much larger than in the developed world. Thus, the Kyoto Protocol offered no formula for including greenhouse gas emissions from developing countries. Secondly, the mechanism adopted in Kyoto, that of setting targets based on a 1990 base year, was problematic in two ways: the targets were too low if an atmospheric concentration of twice pre-industrial levels was to be avoided, and using targets is a far less efficient procedure than a carbon tax or a cap-and-trade system for constraining emissions.

Moreover, I suggest to you that there is a security dimension to global warming. Restricting carbon emissions will create new tensions between north and south, between developed and developing nations, that will preoccupy us on a political level in the years ahead. Penalties will be imposed on carbon emissions, and there will be arguments between the zealous countries, certainly Western

European countries, and laggard countries that are unwilling to constrain their emissions. These laggard countries will be developing countries, such as China, India, and Indonesia, that will be on a growth path. We should welcome that growth because of their need for economic and social development. However, these differences will give rise to political tensions around the world, and it will occupy the political agenda in a much greater way than it has in the past.

I was very pleased to hear Alfonso Cortina's remarks about searching for technology solutions to this issue because in the long run only technology will solve the carbon problem. We have only four choices: use energy more efficiently for the purposes we need; use renewable energy sources more widely, whether wind or photovoltaics; use coal gasification, combined with carbon sequestration; and use more nuclear power. All of these choices face difficulties, but in the long run, technology is the answer to the problem of reducing carbon emissions while permitting energy use to expand.

In sum, I have offered you today four unthinkable thoughts.

- First, U.S. military presence in the Middle East is not terribly important from the point of view of the long-term stability of world oil markets.
- Second, natural gas is going to become an international commodity like oil and the world natural gas price will become the market clearing price in importing countries.
- Third, we should not forget about terrorism. We must make plans to minimize the risk and consequences of terrorist acts.
- And the fourth relates to carbon. Carbon is no longer going to be a topic relegated to environmentalists and diplomats. Rather, it increasingly will become more central in the political and economic agenda of nations.

These are my unthinkable thoughts. I hope they stimulate discussion. They may not come to be true, but I want to say how excellent it is for a group like this to come together to discuss new ideas, however unthinkable they may appear.

Session I

The Realities of the Post–September 11 World and the New Geopolitics of Energy

Chairman's Introduction

Alfonso Cortina
Repsol YPF

The objective of this first session of the XIII Repsol YPF–Harvard Seminar—*The Realities of the Post–September 11 World and the New Geopolitics of Energy*—is to portray the new geopolitical context arising after the terrorist attacks suffered by the United States in 2001.

As we know, the world's oil and natural gas reserves are scattered over the planet, but the largest oil field concentration is the Russia–Caspian Basin–Middle East axis, although recent discoveries in Latin America and West Africa are making these latter areas more important. While privately owned oil companies have been immersed in a process of mergers to gain critical mass, world production is still dominated by state-owned companies, focused on protecting their domestic interests. Instability in the Persian Gulf and the Middle East has created some concern about supply disruption. The restoration of Iraqi exports and the traditionally good relations between the United States and Saudi Arabia may be the keys to a fairly stable oil market in the midterm which will frame a new period of economic growth. The United States, the world's largest oil importer, is trying to reduce its dependence on foreign oil, and the European Union is

proposing to increase compulsory strategic stockpiles to 90 to 120 days of consumption. Such a step is considered not only an investment in supply security, but also an important tool to buffer against price speculation in the oil market.

We have three eminent figures from the international energy community to help us to focus the debate in this session.

- We are very pleased to welcome back Vicky A. Bailey, Assistant Secretary for Policy and International Affairs at the U.S. Department of Energy, where she is a principal advisor to Secretary Spencer Abraham. Ms. Bailey previously served as a Commissioner at the U.S. Federal Energy Regulatory Commission. She is well versed on the Washington perspective, and she is the ideal person to speak on *International Energy and United States Policy*.
- We are also delighted to welcome back Adrián Lajous, President of the Oxford Institute for Energy Studies and former CEO of PEMEX. We will learn today of his latest reflections as he speaks on *A Geopolitical Perspective on Oil Supply*.
- Finally, we are honored that Humberto Calderón Berti is able to join our Seminar again this year. Considered one of the founders of the modern oil market, Mr. Calderón Berti has held some of the world's most senior positions in energy. He has been President of OPEC and Minister of Foreign Affairs and also Minister of Energy of Venezuela. He has served as President of Petróleos de Venezuela, the fifth-largest oil company in the world. His decades of experience in world oil markets will allow him to offer a fascinating perspective on his topic, *Oil and World Security*.

International Energy and United States Policy

Vicky A. Bailey
U.S. Department of Energy

I am pleased to have the opportunity to consider some of the important national and international challenges in the energy world and to outline the energy policy of President George W. Bush and his administration. As we all know, energy is one of the most important elements contributing to economic development—indeed, history has shown the dynamic power of energy to drive economic growth. A variety of factors could impact world energy demand and prices through 2025—the availability of energy resources, developments in electricity markets, technology improvement and deployment, and economic growth, to name a few. The United States is the largest single energy market and a leader with respect to each of these factors or areas. Consequently, U.S. energy policy influences global energy security, and in turn we are affected by worldwide events and decisions.

It is this reality that caused President Bush in 2002 to issue a statement on national energy policy, which focuses on promoting

increased and diversified production of energy from a range of suppliers in many regions. In particular, we are encouraging energy security and the use of alternative energy sources in the Western Hemisphere, Russia, the Caspian region, and Africa—all places where I have been spending time over the past year and a half—but in other areas as well. Our scope is both domestic and international, which means that we want to enhance U.S. energy security as well as promote global energy security. U.S. policy also promotes sustainable energy development, with coordination of international measures and consultations with major energy-producing countries. Specifically, we are reaching out to key energy-producing and consuming countries in order to anticipate market developments better and to offset energy crises, thereby expanding our global capabilities to address supply disruptions. Moreover, we are undertaking technology initiatives to develop the next generation of energy technologies to meet our energy challenges.

It is the Bush Administration's belief that over the coming decades continued global economic progress will require expanded energy supplies and increasing emphasis on sustainable development. And the Bush Administration has targeted new technology as a main source for meeting this increased demand. To this end, we are partnering with other key energy-producing and consuming countries to share the cost, increase the knowledge base, eliminate duplication of efforts, promote energy efficiency, and expand markets for advanced energy technology.

The administration has highlighted four key initiatives, and the Energy Department is leading the way in pushing for new technology frontiers in the following areas: nuclear energy, carbon sequestration for emissions-free power plants, hydrogen, and fusion.

First let me mention Gen4, a joint nuclear energy research and development project on six new reactor designs that are more advanced, safer, more efficient, and more proliferation resistant.

Secondly, under the Carbon Sequestration Leadership Forum—which I mention partly because I want you to know that we have the

international community involved in these technology issues as well—we are reaching out to approximately 15 countries to develop the cutting edge of pollution control and carbon sequestration technologies that can make coal or natural gas plants truly emissions-free. In June 2003 we will host a ministerial conference to launch this initiative, which is a $1 billion project to design, build, and operate the first coal-fired, emissions-free power plant.

The development of hydrogen as a fuel source is another major initiative. In 2002 we announced the FreedomCAR and Fuel Initiative which addresses national and global energy security concerns through the development of hydrogen-powered vehicles. As you know, the initiative is based on the idea that hydrogen can be produced from diverse domestic sources. Fuel cell vehicles powered by hydrogen will be more than twice as efficient as today's engines, with the only byproduct being pure water. Hydrogen-powered vehicles will have a tremendous positive impact on the environment, as they will produce none of the harmful emissions that we see with today's gasoline-powered fleets.

These factors led to the development of the Hydrogen Fuel Initiative that, as President Bush announced during his State of the Union Address, aims for a future in which the first car of a child being born today will be powered by hydrogen. Therefore we are investing approximately $1.7 billion in hydrogen and fuel cell research over the next four years and about $1 billion over the next ten years.

Fusion is the fourth initiative. The United States will be rejoining the International Thermonuclear Experimental Reactor project (or what we call the ITER project), which is expected to achieve the first sustained burning plasma and help demonstrate fusion's commercial feasibility. It is worth noting that Spain is vying to be selected as the site for this project. Fusion energy plants would produce no harmful emissions, no long-term radioactive waste, and virtually no proliferation threat.

When we evaluate U.S. interdependency and vulnerability in terms of international energy supply, we keep some specific considerations in mind. First, imports supply about half of U.S. oil needs

and an even larger percentage of the needs of some of our most important allies and economic partners. Second, two-thirds of proven world oil reserves are in the Middle East. The United States has about two percent of proven world oil reserves. By contrast, OPEC nations provide about one-third of the total oil exports and also control two-thirds of the world's reserves. Also, six of the seven countries with the largest proven reserves are members of OPEC. In terms of natural gas reserves, more than 70 percent of the reserves are located in the Middle East and the region of the former Soviet Union.

Despite frequently expressed concerns about dependence on Middle East nations, all our economies clearly benefit from this relationship. This region is a core supplier, not just to the United States, but also to key economic partners in Europe and Asia. We all know that the Persian Gulf producers play an indispensable role in the world market, ensuring global energy security through production and exports of abundant resources, especially when supplies are disrupted. The world needs a highly flexible and resilient oil market that allows for some regions to compensate for ebbs and flows in others. The greater diversity and growth we achieve in world oil production, the stronger the market will be.

Saudi Arabia and other major Persian Gulf producers also demonstrated their commitment as reliable energy suppliers by offsetting recent disruptions in Venezuelan, Iraqi, and Nigerian exports. In addition, Saudi Arabia, the world's largest oil exporter, has a policy of investing in spare production capacity, in storage, and in diversifying export routes. Recently, we traveled there to thank them for their efforts during the war in Iraq and to restore our bilateral energy discussions.

Obviously the question of Iraq looms large. The administration has addressed this very clearly by saying that our actions in Iraq were not about oil. President Bush has said many times that the Iraqi oil belongs to the Iraqi people. As we look to the future, we know that a vibrant, independent, and responsible Iraqi government will contribute greatly to the stability of international oil markets, as well as to the political stability of the region. I think at this time that the people

of Iraq probably will have an opportunity to make decisions about their oil sector and decide how to take advantage of their own natural resources for the improvement of their own standard of living. That is the goal for the United States and for the coalition, and ideally the goal for the rest of the international community.

The Bush Administration's efforts to address America's energy security are not limited to domestic activities, but encompass international policy as well. As we have said from the beginning of the administration, we cannot and should not attempt to meet energy challenges in isolation because we are integrally linked to the development of energy around the world.

Let me talk briefly about our international initiatives and the relationships that President Bush has had with national leaders. With regard to the North American market, from the beginning of this administration we placed a high priority on stressing our energy relationships with Canada and Mexico. This policy was highlighted at the meeting between President Bush, Canadian Prime Minister Jean Chrétien, and Mexican President Vicente Fox in 2001. Out of these efforts came the North American Energy Working Group, which I cochair with my Canadian and Mexican counterparts. Through these efforts we are developing and implementing strategies for eliminating barriers.

Regarding our partners in the Western Hemisphere, I am scheduled to go to Brazil soon. In the countries of Argentina, Bolivia, Brazil, Colombia, Ecuador, Peru, Trinidad and Tobago, and Venezuela, we are promoting increased international development and advanced regional energy integration. In bilateral conversations we are talking about areas of common interest and sharing of information. We contributed funding to research, and we hope that technology centers, such as the one at Florida International University, will help strengthen cooperation on policy and regulatory, technical, commercial, and infrastructure issues. The longstanding United States–Venezuela energy relationship obviously was very much affected by the recent political unrest in Caracas, but we are encouraged by the recovery of Venezuela's oil production and exports. In the Caribbean, Trinidad and

Tobago is an important source of liquefied natural gas to the United States. This country is pursuing an export strategy that will likely increase its share of the U.S. markets.

Turning to another part of the world, we are strengthening our relationship with Russia, which is the world's second-largest oil supplier. In 2002 President Bush and President Vladimir Putin launched a new area of cooperation by creating a strategic bilateral energy initiative. To be sure, there are infrastructure issues with Russia, such as the lack of pipelines to move supplies, but we will go forward and work on these issues. In addition, we had a very successful Houston meeting, a commercial summit that provided an opportunity to meet with several of the Russian ministers.

When talking about Russia, one needs to consider the Caspian region as well. We have a very strong interest in resource and infrastructure development in that part of the world. We were in Baku and Ceyhan for the opening of the Baku–Tbilisi–Ceyhan pipeline, so very important because of the historic east-west corridor it occupies. I should also mention the Caspian Pipeline Consortium in Russia and the ideas of expanding that effort, keeping in mind the issues of whether the revenues exist to justify expansion and whether the tensions in the region will permit it. We are encouraging the governments in the Caspian region to establish the legal, fiscal, and regulatory environments necessary for further cooperation. The prevailing issues are export outlets and the unresolved legal status of the sea, that is, its ownership and development rights.

Energy from Africa also plays an increasingly important role in our energy security. Nearly 15 percent of America's oil imports come from that continent, most notably from West Africa. The Gulf of Guinea region, which extends from Nigeria to Angola, is one of the world's fastest-growing sources of oil and natural gas. We held an energy ministerial conference in Casablanca, Morocco, last year, with Secretary Spencer Abraham in attendance, where nearly 40 African countries reaffirmed a commitment to good governance, transparency, and stable regulatory structures. Obviously we talked about how to make the area more investment friendly, to create the kind of

investment climate that will attract private dollars. In this regard, partnerships of government and industry are very important.

While the technology initiatives, particularly hydrogen and fusion, hold enormous promise for future security, the United States recognizes the reality of the current situation and the immediacy of addressing the growing demand for oil and natural gas that is increasingly dependent on foreign sources. We are working to institute measures to promote increased domestic energy production, including streamlining of our permitting process, and regulatory changes to reduce our rising dependence on imported oil and natural gas.

We have a particular focus on addressing the implications of the growing demand for natural gas. The United States is close to the point where the domestic or even the North American supply of natural gas will be insufficient to meet our growing demand. Therefore, we are trying to address this critical challenge both bilaterally and multilaterally. We are expanding our cooperation on natural gas issues, and in particular we are cooperating with Canada and Mexico to study what efforts we can undertake. Liquefied natural gas (LNG) is becoming an attractive resource as well, and we are carrying on discussions about LNG. For example, we have had a workshop in Algeria with Minister Chakib Khelil, and we also hosted an LNG Summit in Washington.

Emergency preparedness is one of our key priorities; therefore we stress the importance of oil stockpiling. We are in constant consultations with our colleagues at the International Energy Association (IEA) in Paris on this issue. Collectively, the 26 IEA members hold over 1.3 billion barrels of government-controlled stocks, or about 114 days of import coverage. The United States has its own strategic petroleum reserve (SPR). President Bush has the authority to draw upon SPR stocks, and we are continuing to strengthen our energy security by making sure that the SPR is filled to its capacity by 2005.

International cooperation is crucial in this worldwide forum. The new realization of the commonalities of producers and consumers has led to increasing producer-consumer dialogue. For example, we are

very involved in the International Energy Forum (IEF). We were in Osaka, Japan for the IEF meeting in 2002, and in 2003 we met with Saudi Minister Ali Al-Naimi and announced that we will give financial assistance to help realize IEF goals and further strengthen this important forum. We have continual cooperation with the other Group of Eight energy countries. Also, Secretary Abraham is very committed to working with Asia, especially with key countries such as China, Japan, and India, and is very much involved in Asia-Pacific Economic Cooperation (APEC) activities. In Europe, as I noted, we are much involved with the IEA and are establishing a U.S.-U.K. energy dialogue.

Let me conclude by addressing a basic question: where is the United States spending its time and money on energy issues? We are spending money for the long term in partnership with the international community, and on the new technologies that have attracted a great deal of interest. And what of the valuable resource of time? We are spending much of it on building relationships. We think this is very important to our energy security because we are not independent. Indeed, we are inextricably linked and cannot accomplish alone our goals in international energy policy.

A Geopolitical Perspective on Oil Supply

Adrián Lajous
Oxford Institute for Energy Studies

A year ago we were invited to this Seminar to think the unthinkable. During the intervening months reality has surpassed imagination. The horror of the events of September 11 and the collective trauma that they caused have led the United States to make a fundamental revision of its security strategy and its Middle East policy. In this context, disarming Saddam Hussein can be seen as an objective subordinated to regime change in Iraq; this, in turn, can be seen as a step in the search for new solutions to the basic political instability in a region that represents a real threat for world peace. I want to stress my belief that the war was not fought over the oil of Iraq. Nevertheless, one of the possible consequences of the collapse and eventual reconstruction of Iraq's oil industry could be the weakening of the present international oil regime. This is the subject that I would like to address this morning.

By all indications, during the next 20 or 25 years oil will continue to be the major source of primary energy on a worldwide scale. Over

this period, its share of total energy consumption will remain similar to its present level, approximately 38 percent. Even though natural gas consumption will grow at a higher rate, its contribution to the energy matrix will only compensate for the relative loss that will be experienced by coal and nuclear energy. The contribution of new transport technologies and renewable sources of energy will not appreciably modify the basic pattern described. Due to the growth of the global economy and population, the stability of the structure of consumption is consistent with an important growth in the absolute demand for oil in this time horizon. This will occur in spite of the significant drop in energy intensity in industrial countries, where the growth of demand for energy and, more specifically for oil, has tended to separate from the growth rate of economic activity. This same tendency seems to have begun in the developing countries, even though there are marked differences among regions and nations. Nevertheless, a very important part of the increase in global demand will occur in developing countries, especially in Asia, thereby changing the direction of commercial oil flows.

The world oil industry will have to make an extraordinary effort to meet the predicted growth in the demand for oil and natural gas. In the case of oil, production will have to be increased by about 50 percent in the next 25 years. When considering the magnitude of this task, we must remember that this is a net increase, making it necessary to compensate for the decline in oil fields in mature basins. At the same time, an increase of this size requires countries located in the Persian Gulf to double, in the same period, their production in order to cover more than a third of world consumption. OPEC as a whole will have to contribute almost half of the world production. These magnitudes and proportions assume strong increases in oil production in Russia, the Caspian Sea, Western Africa, Canada, and Venezuela. In these last two countries, tar sands and extra-heavy crude are being increasingly exploited.

Many observers have seen the search for increased sources of oil supply outside the Persian Gulf and OPEC member countries as a way to guarantee the energy security of industrialized countries. The

diversification of sources is a desirable objective, but security should not be confused with diversification. What I would like to point out is that, in spite of a strong expansion in the capacity of some of the most important and interesting basins and regions, the dependence on the Persian Gulf will tend to grow. After all, it is in that region that nature has concentrated hydrocarbon reserves and coupled them with the lowest cost of extraction.

A review of the other oil-rich regions indicates the difficulties involved in exploiting areas outside of the Middle East. The recovery of production capacity in Russia has been possible thanks to the introduction of new technologies and practices of oilfield administration, as well as a better management of the extracting activities. This has resulted in an annual increase of almost 500,000 barrels per day. However, this stage of recovery will be exhausted in about four or five years, when Russia will have to tackle the development of new distant basins and at a high cost. In the Caspian Sea production will increase significantly, but at a slower speed than had been foreseen; moreover, problems still prevail with respect to the routes that oil must follow to reach the market. Offshore in West African deep water there are rich oil fields where development presents fewer political and social risks than those located on the coast and inland. However, the insecurity that prevails in the Niger River delta makes it difficult to rely fully on this source of supply in the Atlantic basin. The enormous potential of Venezuela stands out in all the Western Hemisphere, for conventional crude as well as the heavier crudes of the Orinoco belt. Also, my own country—Mexico—has not been sufficiently explored. Nevertheless, with present technology, a major effort will be required in order to reach and sustain a production level of four million barrels per day. Furthermore, a significant part of the increased volume will be earmarked for meeting internal demand.

Thus, in the medium and long term, the structural characteristics on which the present oil price system rests are the growing global dependence on supply from the Persian Gulf, the concentration in this region of surplus global capacity, and the region's low extraction costs. Countries of the region, beginning with Saudi Arabia, have

been regulating their global oil offering in the last five years with particular success. In this way they have sought to stabilize prices within the levels that the producers consider reasonable. This regulatory function assumes reliance on an institutional framework that allows controlling production, as well as generating and maintaining a relevant margin of surplus capacity. The state oil companies are the privileged instruments of this regulation; their governments intervene directly to regulate production, and it is easier to do this if the companies operate as a state monopoly. The global administration of supply requires that the major producers assume this responsibility and that, as a whole, they be prepared to do so as a last resort. The coordination of these tasks will be facilitated if one producer can assume a clear leadership.

Opening up the extraction activities of the oil industry to international investment, as well as the privatization of state companies in regions with ample natural resources, would inevitably weaken the capacity of these countries to administer supply and to influence price behavior. Fundamental to this policy are the mechanisms of generating and capturing oil revenues. Given the shortage of other resources, the well-being of the major exporting countries depends essentially on the level and stability of their oil revenues. In conditions in which demand grows moderately and is relatively stable in the relevant interval, it is easy to understand the risk for these countries of losing control over the rhythm of supply expansion.

Nor is it difficult to understand the reluctance of some of the major producers to introduce competition in their own upstream. International investment, without an appropriate contracting and regulatory framework, eats away at supply control. The logic of competition is inflexible; it is very difficult to imagine the terms and conditions of contracts and regulations that would make it possible to reconcile the objectives and interests of the producers and those of the international companies in an open and competitive structure. It is even more difficult to imagine the major producers coordinating their actions by means of indirect codified intervention, which would be stipulated in legislation, as opposed to the direct intervention they

usually undertake. In short, the strength of the present price regime is its simplicity, because it rests on a powerful, albeit somewhat coarse, instrument: volumetric modulation.

The collapse of the regime of Saddam Hussein and the consequent disintegration of the Iraqi oil industry open the possibility of a profound industry restructuring. In some North American government and industry circles, the debate is inclining towards an immediate privatization of the state company and its complete opening to investment by international competition. Nevertheless, it is clear that only an Iraqi government with at least a minimum of legitimacy can make this type of decision, which requires as a prerequisite the establishment of a new legal and regulatory framework. Its implementation requires that some regulatory entity supervise the transfer of property titles of surface assets and the concession of mineral rights.

Designing rules of the game and creating institutions take time. It may be necessary to create a hybrid transitory regime in which a state company is established, but is subject to competition with international companies. Another possibility is the creation of three regional state companies. The first step in accomplishing this would be to have valid spokesmen who would participate in the debates on the new architecture of the Iraqi oil industry, because imposing this from the outside would create serious risks for the future and would tend to justify the view that the war in Iraq was really for the oil. Some consideration, therefore, should be given to participation by private Iraqi businessmen. Also, companies from countries that were not a part of the U.S.-led coalition should be allowed access. It would not seem prudent to associate privatization with a process of outright denationalization. The picture that this would project to other countries of the region would be counterproductive.

The restructuring of the Iraqi oil industry and an expansive production policy aimed at significantly increasing its market participation could have important consequences on other producers, given the dimension of Iraq's potential and reserves. However, the possible destabilizing effect of these actions on the oil price level and on the price regime itself will not be immediate. The initial efforts will be

focused on the recovery of prewar production volumes. Then it will be necessary to renovate installations and repair infrastructure that were damaged by the 1990–91 Gulf War and that continued to deteriorate throughout the period of sanctions. Once these stages have passed, there will be a temporary interval to allow for new investments to mature. Eventually, the revitalization of the Iraqi oil industry with the support of international companies will have a double effect: to intensify competition in the international oil market and to encourage the opening to international investment in other countries of the region. There will be some who will be tempted to take advantage of Iraqi oil wealth, now under U.S. control, to radically modify the present international oil regime. These voices will strive to rapidly create irreversible conditions that would bring about this competitive logic, independently of the long-term interests of Iraq.

The theme of this Seminar is on the mark: we should think the unthinkable. I believe that we are obliged to reflect in a cold, rigorous, and disciplined manner on the architecture of the international oil industry. The present system has led an agitated life for 30 years. In the next 30, the oil industry will find itself with enormous challenges to face the expected growth of demand and changes in consumption patterns. Perhaps the time has arrived to adjust or reform the industry. Undoubtedly, choosing not to make adjustments or carry out reforms involves risks as great as those inherent in simplistically proceeding to the industry's immediate dismantling.

The price regime is located in the center of complex geopolitical tensions. Governments of industrial countries recurrently express their concern for global energy security. The large international companies find themselves restricted by the lack of attractive opportunities, while they accumulate liquidity and return cash to their stockholders. Few state companies have been able to modernize sufficiently to be up to the level of the circumstances. Among other things, the nature of their relationship with their respective governments does not permit it. In spite of the high prices, the oil revenues of the exporting countries are not enough to promote true economic development and to adapt to strong demographic pressures without

making deep structural changes. The work distribution between oil companies and service companies has been modified as the latter have assumed leadership in technological areas. These major players explore and experiment, in an incipient manner, with new forms of association and integration.

In order to advance, changes in the architecture of the oil system should adapt to the interests of all the players in the context of new industry dynamics. To try to impose them would only result in one more exercise of arrogance. I believe firmly that in the present circumstances we should promote a dialogue with OPEC, as both Robert Priddle and now Claude Mandil from the International Energy Agency have done. Only this will permit the maintenance of the successful cooperation between producing and consuming countries achieved in the last six months.

Oil and World Security

Humberto H. Calderón Berti
Calderón Berti and Associates

In the immediate aftermath of the unthinkable events of September 11, 2001, it was difficult to assess any likely outcomes for either the world at large or the energy industry. However, with the passage of time, we can speculate with a greater sense of reality. Now, in May 2003, I am convinced that, first, the terrorist events of September 11 constituted a turning point in the United States leadership of global policy and, second, these events are closely related to the oil world and will have a significant, long-lasting influence on the global oil map.

As we tried to make sense of September 11, we wanted to know who or what had provoked these assaults. Subsequent investigations highlighted the ideological commitment of the terrorist leaders, especially Osama bin Laden, and indicated that there were three basic reasons for their aggression: the Arab-Israeli conflict, the presence of American troops in Saudi Arabia, and the embargo imposed on Iraq since the Gulf War.

In the ideological commitment of the terrorist leaders, issues of religious fundamentalism, politics, and economic interest are mixed. For many years some Middle Eastern countries, particularly Saudi Arabia, have been financing religious expansion. Since I am respectful of religions, I cannot criticize this; however, it bears repeating that it is a combination of religion and politics that has produced international terrorism. A glance at the political map of North Africa and the Middle East emphasizes how many countries have achieved national liberation in the last decades of the twentieth century. In these countries, the people had high expectations for national recognition, political participation, and social and economic improvement. Regretfully, these expectations were not fulfilled. In the great majority of these countries, those who took over the liberation movements have hijacked political power, the social and economic conditions of the great majority of the people have become worse, and the emerging middle class has had no political access. In the majority of these countries, religious movements have been exploited in order to further political activism.

Nevertheless, these developments have led to an important cultural resurgence, beginning in 1973 with the Yom Kippur War. Israel won that war militarily, but the great beneficiaries were the oil-producing countries, particularly Saudi Arabia. This country began financing the expansion of Islam in a significant manner, not only in the Arab countries and in the Far East, but also in Europe and the United States, using its immense oil resources to buy internal tranquillity, and using religious expansion as a pretext to buy political solidarity. Ironically, this strategy produced an outcome quite opposite to its original purpose. Indeed, today Saudi Arabia is a country that finds itself deeply threatened by religious fundamentalism. Some observers claim that the main objective of Osama Bin Laden is to seize power in Saudi Arabia. Afghanistan is a poor country, without many resources or possibilities; Saudi Arabia is a much richer prize.

A clear global antiterrorist policy will have to focus on, among other things, the financing of the terrorist networks. Oil has financed a significant part of the development of international terrorism.

Moving beyond terrorism, this past year has seen political events of great significance in two important oil countries: Iraq and Venezuela.

International rhetoric has consistently declared that the motive for the U.S. invasion of Iraq was its oil. I do not believe this to be true; on the contrary, I want to stress that Iraq's oil is not the most significant cause of the war. The war was really about the weapons of mass destruction—particularly Iraq's major weapon of mass destruction, Saddam Hussein and his regional geopolitical ambitions. Recent history in the Middle East makes clear that Saddam has long constituted a serious threat to regional and world peace. He began his aggression with an attack on Iran, and ten years later he invaded Kuwait. His objective in both actions was the economic control of the oil reserves of these countries and political domination of the Persian Gulf. The American intervention in the Gulf War prevented Saddam from seizing not only Kuwait, but also the oil provinces in the Hasa Region, Qatar, the United Emirates, and even Oman and the Straits of Hormuz. In 1990 there was no military force in the area to prevent him from taking over the region's oil reserves. Only the extraordinary intervention of the Allied forces at that time made it possible to stop Saddam Hussein.

Iraq has a major place on the global oil map with its 112 billion barrels of oil reserves. It is a country that has been involved in wars and embargos, resulting in an oil industry in shambles, unable to explore its resources. Now, with the change in the regime, there could be important exploratory activity if politics allow access to international technology and financing. If that happens, Iraq's oil reserves could be increased substantially, possibly reaching 200 billion barrels. Before the conflict, Iraq was producing 2.8 million barrels a day (MMb/d), with a decaying industry whose productive capacity had diminished substantially. Here, too, international technology and financing can make a crucial difference. But the price will not be cheap.

This raises serious questions about foreign participation. Presently, the oil industry in Iraq is state owned, and the law does not permit the participation of foreign capital in traditional oil industry

activities. Yet without such participation, it will be impossible for Iraq to recover and significantly increase its production levels. For this reason, a partial privatization of Iraq's oil industry has been considered. Indeed, in the mid-1990s Iraq itself moved to open up slightly to French, Russian, and Chinese companies. However, for any significant change, there must be a major opening to foreign investment. With adequate financial and technological support, Iraq's oil industry could produce 4 to 5 MMb/d in a few years. In less than a decade the figure could reach between 7 and 8 MMb/d.

Such production has tremendous importance for the region and for the world because Iraq, besides having huge reserves and great potential production, has a strategic geographic location. Iraq's oil can be transported northward through Turkey to the eastern Mediterranean at the Ceyhan terminal, thus giving Iraq independence from total reliance on the Straits of Hormuz, which is an extremely vulnerable maritime sea route. Iraq's oil development has the potential to seriously impair the influence of Saudi Arabia in the international oil market.

Saudi Arabia, currently the world's largest producer, also has spare production capacity of approximately 2.5 MMb/d. It was precisely spare Saudi production that compensated for Venezuela's market exit in 2002. During the two months of the Venezuela general strike, there was a total paralysis of its production and exports, but this shortage was compensated by additional production from Saudi Arabia. When the war with Iraq began, again it was the Saudi production that compensated for the market loss of oil from Iraq.

With the war over, the question is how Iraq's oil industry can be improved—and who should do it. It is very important that the decisions concerning Iraqi oil be in the hands of Iraqis. Middle Eastern oil has an extremely important military and political significance, and to manage the change without Iraqi input would create a firestorm at a moment when we most need stability.

Turning away from the Middle East, Venezuela has the largest hydrocarbon reserves in the Western Hemisphere—77 billion barrels

of conventional reserves, 270 billion barrels of probable heavy crude reserves in the Orinoco belt, and 148 trillion cubic feet (Tcf) of natural gas reserves. It is worth noting here how the production cost of the Orinoco reserves has been reduced significantly. When we began to produce the heavy crudes, the cost was $5 a barrel, but now, with new technology of horizontal perforation, the cost has been reduced to less than 80 cents a barrel. And I have no doubt that there will be further technological developments.

For 80 years Venezuela has supplied oil to international markets. The United States imports 15 percent of its oil from Venezuela, compared to 20 percent from the entire Middle East. A closer look at these figures increases their importance: the United States imports 30 percent of its heavy oil from Venezuela. Even more, 42 percent of the heavy oil imports to refineries in the Gulf of Mexico come from Venezuela.

However, Venezuela faces difficult times. As a result of the oil strike in the months of December 2002 and January 2003, the Venezuelan oil industry experienced a tremendous shock. Personnel cuts were enormous; 42 percent of staff (18,000 people) have been dismissed. Of these, 70 percent are university-trained professionals dedicated to research and development, exploration and production, and refining. It must be asked, therefore, whether Venezuela can continue to be a dependable supplier of oil. The loss of so many key people in the Venezuelan oil sector will make it very difficult to sustain its production levels. To be sure, there has been an increase in production since the strike, rising to 2.6 MMb/d, perhaps to 3 MMb/d.

However, the precise numbers are not important. The importance relates to future production—and to the fate of the people who have been dismissed. If they are not rehired, then the Venezuelan industry will face a reality similar to that in Iran when the Shah was overthrown in 1979. Iran had produced 5.5 MMb/d, but after the Shah's downfall, the production fell to 2.5 MMb/d and stayed at that level for many years. Now, 25 years later, Iran produces 40 percent less than it produced before 1979.

The political situation in Venezuela is very unstable. The government will not be able to run the oil industry by itself. At the present time 1 MMb/d are produced by foreign companies. If the political situation continues as is, the government will try to bring international oil companies to play a more important role in the country. This is a very sensitive issue that has to be handled with great care by the companies. Any ill-timed negotiation between foreign oil companies and the present government could jeopardize their interest and future relations with new administrations.

In spite of the political instability in the Middle East, I believe the Iraqi war has demonstrated clearly that global oil supply will not be a serious problem. The important increase experienced in the last three years in Russian production and the potential participation of the international oil industry in Russia with the introduction of Western technology and capital are very significant. For an example, I refer to the recent agreement signed between BP and a consortium of Russian companies to invest $5 billion in the improvement of production facilities and in the development of new areas. All this is going to have a tremendous repercussion in the international oil world. I wholeheartedly believe that the importance of Russia and Central Asia is going to grow in the next few years. Already a pipeline is being constructed to transport oil, a million barrels per day, from Baku to Ceyhan.

I am convinced, despite the political turmoil, that there will continue to be an abundance of oil, that there will not be any serious supply problems and that, on the contrary, prices will tend to be kept in check. We did not have a significant increase in oil prices with the start of war in Iraq this year. Nor did we have an increase after Saddam's invasion of Kuwait in 1990, because other producing countries responded immediately with their available production capacity. Therefore, I am convinced that prices will be moderate. History has taught us that this is precisely what is in the best interests of the producing countries. In the 1970s, the majority of the OPEC countries (with the exception of Saudi Arabia) made the error of instituting the policy of sustaining artificially high oil prices—among

them Venezuela, with my assent, as Minister of Energy and Mines. High oil prices were proven to be counterproductive for everybody—for the consumers as well as for us, the producers.

I think that the only realistic strategy—and I have been insisting on this for a long time—is to maintain moderate oil prices. In this way, producing countries will be able to obtain the necessary revenue from their resources, the consuming countries will not have their economies burdened by paying so much for oil, and the international oil companies can receive adequate remuneration. With moderate oil prices over the next few years, the global economy will be able to resume its growth.

Session II

Confronting the New Realities: Policies for the Post–September 11 World

Chairman's Introduction

José Luis Díaz Fernández
Fundación Repsol YPF

We are about to begin the Seminar's second session, *Confronting the New Realities: Policies for the Post–September 11 World*.

By way of introduction, I would like to share some thoughts with you, focusing on what happened in world oil markets in four special moments: the 1973 and 1979 crises, the Gulf War in 1990–91, and the invasion of Iraq in 2003.

The behavior of the OPEC countries during the 1973 and 1979 crises was very different from that of 1991 and 2003. In the first two crises, the price of oil went up dramatically from less than $2 per barrel in 1971 to more than $35 in 1981. The latter price would be equivalent to a price of more than $70 a barrel today. Furthermore, in the 1970s, oil was used as a political weapon. For example, in those years a Spanish refining company had trouble getting oil supplies because it held commercial relationships with Israel.

The consequences of this policy of very high prices were devastating for the exporting countries. On the one hand, alternate energy sources were developed and strongly affected the demand for oil. On the other, the high prices encouraged new hydrocarbon exploration and production in many countries. As a result, the share of oil from OPEC countries in worldwide markets dropped from 56 percent in 1973 to 29 percent in 1985. Prices also went down to under $10 per barrel in 1986.

OPEC behavior in 1991 and 2003 has been completely different. Almost no oil was produced in Kuwait and Iraq during the 1991 war, and the 2003 war coincided with a simultaneous reduction in oil production in Nigeria and Venezuela due to tribal warring and political crisis, respectively. Yet in spite of these developments, oil prices were kept stable at reasonable levels and demand remained high. And oil was not used as a weapon.

Reflecting on this history, we ask ourselves whether there will be enough oil in future crises to keep prices stable or whether, given the concentration of oil reserves, future crises may resemble those of 1973 and 1979.

But I will not go any further; instead I will turn to our panel of distinguished speakers and ask for their thoughts.

- Our first speaker will be Paul Portney, President of Resources for the Future in Washington D.C. Dr. Portney has published extensively on costs and benefits of environmental regulation. Paul Portney has been a contributor to earlier Seminars, and we are pleased to welcome him back. He will speak about *Sensible Approaches to Energy Security.*

- Robert Stavins, Albert Pratt Professor of Business and Government at the John F. Kennedy School of Government at Harvard University and Director of the Environmental Economics Program there, is our second speaker. Rob Stavins, too, has been a contributor to earlier Seminars, and it is good to see him again. He will speak about *Enviromental Policy, the Kyoto Protocol, and Their Relation to Energy Security.*

- From Paris, our third speaker will be Claude Mandil, Executive Director of the International Energy Agency (IEA). A distinguished member of the French civil service, Mr. Mandil has held many executive positions, including Executive President of the l'Institut Français du Petrole (IFP) as well as General Manager of Gaz de France. He will speak about *Planning in an Age of Increased Vulnerability.*

Sensible Approaches to Energy Security

Paul R. Portney
Resources for the Future

Let me begin by posing a question that sets the stage for my discussion of energy security: why do we worry about the amount of oil that we consume?

I would suggest that there are two valid reasons for being concerned. The first has to do with climate change and other environmental effects—to which we can add related nonenvironmental externalities, adverse effects whose costs are not calculated in the price of oil. These concerns include a variety of issues, such as the accumulation of greenhouse gases in the atmosphere; the release of hydrocarbons resulting in smog; traffic congestion; and highway fatalities. A second reason for concern about the amount of oil that we in the West use has to do with the adverse macroeconomic consequences associated with periodic oil price shocks. A substantial body of research, while not completely dispositive, suggests that there is an asymmetry in the way the macro-economy responds to oil

prices: the harm caused by sudden and unexpected increases in oil prices is greater than the good resulting from sudden reductions in oil prices. Because this asymmetry is biased in favor of greater harm than good, it is vitally important to pay attention to the amount of oil that we consume.

Having given two valid reasons for concern about oil consumption, I find it necessary to discount another reason that is often present in discussions of energy security and oil policy. It is often argued that we ought to pay attention to the amount of oil that we consume because we will be running out of oil soon. I regard this argument as invalid. In the same way that the Stone Age did not end because people ran out of stones, the Oil Age will not end because we run out of petroleum; it will end because other fuels will be more economical to use for transportation and other purposes.

Having said this in introduction, I would like to quote from comments made recently by U.S. Senator Joseph Lieberman. Senator Lieberman gave a major address at Resources for the Future, in which he outlined his energy policy as he campaigns for the Democratic nomination for President of the United States. Senator Lieberman stated that his goal is simple: to reduce U.S. dependence on foreign oil by nearly two-thirds within ten years. Without intending any disrespect to Senator Lieberman (who is both a bright and decent person), I must say that this goal is completely unrealistic. If he has set this goal merely as a broad aspiration, if he lays out this goal as a means of moving us somewhat in the general direction of reducing oil consumption, then the rhetorical excess is forgivable. However, if he really believes that his plan, or anyone else's energy plan, can reduce U.S. consumption of imported oil by two-thirds in ten years, then he is deluding himself.

To keep the question of oil dependence or oil self-sufficiency in proper perspective, allow me to mention one inescapable fact about energy security that is worth repeating for those of us in the United States, and indeed in any Western country. Even if we could produce all of the oil that we need, we would not be protected against oil price shocks. Oil is sold in world markets, so that even if the United States

was producing all 20 million barrels a day that we use (one quarter of the world's consumption), U.S. oil companies presumably would charge the prevailing world price. Even by becoming self-sufficient in oil, we would not insulate ourselves from oil price shocks.

What are the elements of a sensible Western energy security policy? I will identify five necessary components. First, it makes sense to encourage alternative sources of supply. We have already heard discussion about oil production in Africa, in Russia, and in the new states of the Caspian Basin. Subject to the constraints imposed by U.S. domestic or foreign policy and other economic policies, it makes sense to encourage these alternate sources of production and to work with countries that currently export oil to the United States to see how we can help them enhance their production.

Second, we need to examine obstacles to domestic production of oil. This is not a veiled reference on my part to the need to explore in the Arctic National Wildlife Refuge. Indeed, if I were the energy or environment czar of the United States, a prospect that makes all of my friends nervous, I would turn to the Arctic National Wildlife Refuge only after I had explored all other possible sources of oil and natural gas in the United States. When we consider our dependence on foreign oil and ways that we can reduce our use of oil, both foreign and domestic, it makes no sense not to consider what constraints may currently exist in the form of regulation or other policies that make it difficult to produce oil and natural gas in the United States.

Third, we need to explore energy conservation, particularly conservation in the transportation sector. I have already mentioned that the United States uses one quarter of the world's oil. Of the oil we use, 40 percent goes to personal transportation vehicles, which consist of passenger cars and what we call in the United States light-duty trucks. These trucks, it is important to note, are not the trucks used to transport goods, but are rather minivans, sport utility vehicles, and pickup trucks, which are used overwhelmingly to transport ourselves in our daily business and pleasurable activities. If 40 percent of the oil that we use goes to these personal transportation vehicles, and the

United States uses—as it actually does—about 25 percent of the world's oil, simple arithmetic indicates that one out of every ten barrels used in the world each day is used to fuel the cars in which Americans drive themselves around. And for that reason, it is worth paying particular attention to ways of enhancing energy conservation in the personal transportation sector.

Another reason to be concerned about energy conservation and U.S. fuel consumption relates to fuel efficiency. One might expect, given new technologies, that the overall fuel efficiency of the new vehicle fleet in the United States would be increasing; in fact, it has been falling steadily since 1986. The reason for this decline requires some knowledge of U.S. regulations regarding fuel economy. Vehicles are regulated into two classes. All new passenger cars have to meet a fleet average standard of 27.5 miles per gallon. However, minivans, pickup trucks, and sport utility vehicles are lumped into a different category of vehicle, the aforementioned light-duty truck, which is only required to average 20.7 miles per gallon.

The significance of these categories is clear to anyone who has looked at the new cars on the road in the United States, because many more new cars now come in the light-duty truck category, and fewer new vehicles are coming in the passenger car category. In fact, in the year 2002, for the first time in U.S. history, more light-duty trucks were sold than passenger cars. This trend is expected to continue. Thus, the average new car fuel economy in the United States is declining—not because the manufacturers are not meeting the targets that Washington has given them, but rather because consumers are buying more than half their cars from the less fuel-efficient segment of the market.

Virtually everyone who has studied this problem (including a National Academy of Sciences panel that I had the honor of chairing in 2000) has concluded that there is a simple way to improve the fuel economy of both the new car fleet and the existing motor vehicle fleet that is already on the road. The simple solution is to increase the federal excise tax on gasoline. Of course every politician is quick to say that such a tax increase is politically impossible. If it is indeed politically

impossible, then the next best way to improve fuel economy may be through the fuel economy standards that the National Highway Traffic Safety Administration, a part of the Department of Transportation, has issued.

However, requiring new passenger cars and light-duty trucks to get better fuel economy creates another problem: in essence, raising fuel economy standards makes it cheaper for people to drive each mile in those vehicles. Better fuel economy drives the cost per mile down, and at least some of the fuel savings will be taken back in the form of additional driving. The vehicle-mile-traveled elasticity with respect to the fuel price is believed to be between .1 and .2, which means that something that reduces the cost of driving each mile by 10 percent will result in a 1 to 2 percent increase in the number of vehicle miles traveled. If one calculates the externality values associated with additional vehicle miles traveled, including increased traffic congestion and the resulting time loss, then, by attributing dollar values to these values, one can argue that the costs associated with tighter fuel economy standards eradicate almost all of the benefits of reduced greenhouse gas emissions and reduced dependence on insecure sources of oil. Therefore, it is necessary to factor in these costs when thinking about how to increase the fuel efficiency of the new car fleet.

The fourth element of a sensible energy security policy is to invest in basic research related to cleaner, more fuel-efficient motor vehicle technologies. Hydrogen is the most obvious new technology in which to invest. However, if anyone thinks that hydrogen will be a major means of reducing pressure on our use of oil in the short term, in the next 10 to 15 years, they are kidding themselves. It is most unlikely that hydrogen will make significant inroads for at least 15 years, and possibly 20, or more.

The use of diesel fuel will make existing energy-efficient technologies more available; therefore, we need to take a look at existing environmental regulations in the United States that have made it difficult for diesel to get a toehold. Diesel engines are 30 to 40 percent more fuel-efficient than internal combustion gasoline engines. For this

reason, about 40 percent of new vehicles sold in Europe are diesels, a much larger percentage than in the United States. One constraint on trying to enlarge the diesel fraction of new cars sold in the United States consists of the so-called EPA Tier II emissions standards for nitrogen oxides and fine particles, and a separate and even more stringent set of standards in the state of California. We should examine those existing emissions standards to look at the trade-off between slight improvements in air quality in some cases and the possibility of significantly improving new car motor-vehicle-fuel economy.

The fifth element of a sensible energy security policy is to develop a coherent strategy for accumulating and making use of strategic reserves. In the United States we have between 600 and 660 million barrels in our strategic petroleum reserve (SPR), but to my knowledge, no well-formulated policy exists to determine when use of those reserves is appropriate. We need to do a better job of setting out the conditions under which we will use the oil from strategic stockpiles, in the United States and internationally.

In summary, allow me to repeat once again the five elements of what I see as a sensible energy security policy:

- To encourage alternate, diversified sources of supply in other countries that produce oil;
- To examine and possibly eliminate obstacles to expanded oil production in the United States and other Western countries;
- To encourage energy conservation;
- To invest in basic research and new energy technologies and take a hard look at environmental regulations that make it difficult to use existing, more fuel-efficient technologies; and
- To develop a coherent strategy for the use of strategic stockpiles.

I would like to make one final comment. The subject of this overall meeting is *Thinking the Unthinkable*. Most of the discussion about the possibility of supply interruptions and oil price changes relates to much higher oil prices. Let me add on this topic one other unthinkable

thought, the possibility of oil prices declining to $10 per barrel or less. Recall that Federal Reserve Board Chairman Alan Greenspan sees a greater risk in deflation than in inflation. Therefore, we should give some consideration to what deflation could mean for oil prices, in a different type of unthinkable situation.

Environmental Policy, the Kyoto Protocol, and Their Relation to Energy Security

Robert N. Stavins
Harvard University

I wish to address a fundamental question: can an effective global climate treaty be based on sound science, rational economics, and pragmatic politics? Some might think the answer to that question is "no." Were my answer to be negative, this would be the briefest presentation that I have ever made at a Repsol YPF–Harvard gathering. My answer, however, is more optimistic. I propose that yes, it is possible to base an effective global climate treaty on sound science, rational economics, and pragmatic politics.

The Kyoto Protocol, signed by the nations of the world in 1997, is an agreement to reduce the emission of greenhouse gases, including but not limited to CO_2, that result from the combustion of fossil fuels. The Kyoto Protocol may come into force quite soon. If this happens, it will be without the participation of the United States. Currently, 170 other countries are at least talking about ratifying the treaty, and many countries, including the member states of the

European Union (EU), have already ratified the protocol. Indeed, the numerical requirement for ratification that would bring the agreement into force is close to being met. To achieve ratification, 55 nations—who produce at least 55 percent of 1990 industrialized world emissions—need to sign.

Let us consider a few figures to see how these levels could be met. If all countries except the United States ratified the agreement, then approximately 64 percent of the emissions quota would be achieved, well above the 55 percent needed to bring the agreement into force. Even without acceptance by both the United States and Australia, who have indicated they will not ratify the agreement, the resulting figure of 62 percent would still easily exceed the threshold requirement of 55 percent. Had Canada not ratified, 58.5 percent of 1990 industrialized emissions would be achieved. It is only when either Japan or Russia is added to the ranks of the United States and Australia that we begin to see the possibility of the agreement not coming into force: with Japan's refusal, the figure drops to approximately 53 percent; with Russia's refusal, to about 44 percent.

These numbers are very instructive, for they explain what has happened over the last two and a half years: the countries that wanted the Kyoto Protocol to come into force had extremely strong incentives to lower the cost for Canada, Japan, and Russia to ratify the agreement. In doing so, they compromised the environmental integrity of the agreement to such a point that the Kyoto Protocol will have virtually no effect on global climate change. Thus, for a variety of reasons, I suggest that the impact of the Kyoto Protocol for the years 2008 to 2012, which cover the compliance period for the agreement, will be much less than was originally anticipated.

Let us review why the Kyoto Protocol will be ineffective. First, the world's largest emitter, the United States, is not participating. I should note that this would have happened whether or not George W. Bush had been elected President. In my view, had former Vice President Al Gore been elected, the situation would have been the same. The U.S. Senate voted unanimously, 95 to 0, during the Clinton Administration to reject the agreement. And both President

Bill Clinton and Vice President Gore indicated they would not submit the treaty to the Senate for ratification.

What is important now is the effect of the incentives offered to the crucial swing countries. These changes were contained in rules that were written in a series of conferences in 2001, under the U.N. Framework Convention on Climate Change. These changes, which, in effect, allowed countries to play with the numbers, ended up reducing the emission reduction targets. It has been predicted that the original Kyoto Protocol would have led to about a 13 percent emission reduction by 2050, relative to 1990. Without the United States, that figure fell to a 3 to 5 percent emissions reduction; with the new rules it fell to a 1 to 2 percent emissions reduction. Given the uncertainties involved in predicting and calculating these numbers, they are not significantly different from zero. And even if the Kyoto Protocol were to be implemented to its maximum, the resulting changes in emissions would have virtually no impact on global climate change.

The scientific consensus is increasing, however, that future global climate change is likely, and will result from anthropogenic emission of carbon dioxide, methane, and the other greenhouse gases. I base this on reports from the Intergovernmental Panel on Climate Change, on which I have served. This panel constitutes an informal expression of the current international scientific consensus. In addition, economic analysis from around the world increasingly points to the wisdom of some kind of policy action. Therefore, I can sum up our conundrum in the following manner:

- The Kyoto Protocol may come into force without U.S. participation.
- The effects on global climate change, however, will be virtually nonexistent, and will be indistinguishable from taking no action.
- Nevertheless, there is a scientific and an economic consensus that points to the need for a credible approach.

The question then is, "Can the Kyoto Protocol somehow offer a way forward?" Many economists, including myself, have severely

criticized the protocol. First of all, it will generate trivial short-term climate benefits while failing to address and provide a long-term solution. We need to take a long-term view of the problem because this is a long-term environmental problem: greenhouse gases accumulate in the atmosphere and have lag times of decades to centuries before decaying.

Furthermore, the Kyoto Protocol is "too little, too fast." Its short-term targets are excessively ambitious because they do not do much about the problem, even as they try to do so over an exceptionally short period of time. Meeting the targets requires many countries to render substantial parts of their capital stock prematurely obsolete. One reason is the 1990 baseline. For countries that had a substantial amount of economic growth during the 1990s—this means the United States especially—the Kyoto Protocol imposes extremely high costs. That is one of the reasons why there is such a dramatic difference regarding the Kyoto Protocol between our European allies and the United States: given the baseline of 1990, it is much less costly for European countries than it is for the United States. Moreover, the costs are much greater than they need to be because of the virtual exclusion of developing countries from full participation in the program.

That is the negative part. But to be positive, we must ask: is there a better way forward? I think there is a better way forward, a way that does not entail throwing out all that has been accomplished in recent years. This way forward is based upon the U.N. Framework Convention on Climate Change that was signed in 1992 by 161 nations at the first Earth Summit in Rio de Janeiro. It was subsequently ratified by 50 countries, including the United States, and entered into force in 1994. The way forward contains three elements that are consistent with and could come under the Framework Convention on Climate Change—changes that I would characterize as a new global climate policy architecture. By "architecture" I am referring to a basic structure, not to all of the details, but just three elements.

The first element requires all nations to be involved, and to be involved in meaningful ways. Developing countries must be fully involved for three reasons. First of all, they are experiencing much

more rapid rates of economic growth than is the industrialized world. To take one example, it is predicted that China's emissions of CO_2 are going to surpass the emissions of CO_2 from the United States in about 15 years. In fact, each year we seem to move that horizon more than a year closer. In addition to this, the developing countries have the lowest cost options now for addressing global climate change, for reducing CO_2 emissions. This is primarily because their generation and use of energy is so much less efficient than in the industrialized world.

There is, in turn, an ethical response to that point, namely that the industrialized world should reduce emissions first. Indeed, the developing countries have articulated this argument again and again. After all, the excess greenhouse gases already in the atmosphere were caused by the industrialized countries. That is a reasonable objection.

Nonetheless, it is important to include developing countries now. It is agreed that if a narrow coalition of countries, as well-meaning as they might be, take action on this problem by themselves, a major result of their action will be to drive up the cost of producing goods and services, in proportion to both their carbon content and the energy input required to produce them. In other words, it would drive up the cost of virtually everything in the economy—just for the coalition countries. It would also cause a shift in comparative advantage, and therefore the relocation of the most energy-intensive production outside of the coalition countries. As a result of the industrialized countries "being good" and going first, they would push the developing countries onto a more carbon-intensive growth path than they would otherwise traverse. Such action would make it economically attractive for the developing countries to go the carbon-intensive route rather than encourage them to go the non-carbon-intensive route; instead of providing a mechanism for them to join the agreement, we would be pushing them in the wrong direction, making it more costly for them join the agreement later.

There is another ethical objection, namely that the developing countries cannot afford lower carbon emissions and should not have

to pay. In considering this issue, a useful metaphor can illustrate an important distinction regarding how to pay for costs: there is a difference between saying the developing countries have to get on the train and saying they have to pay for their tickets. In my view, they must get on the global climate policy train with the rest of us, but they should not have to pay for their tickets, at least not yet. There are means to deal with this issue. One way is what are called "growth targets." Using this approach, developing countries would have targets, but those targets would become increasingly binding and stringent only as the countries became wealthier, as their economies reached certain thresholds. And if that were combined with a tradable permit system, then essentially the industrialized world would be financing the costs of the emissions cuts in the developing world. At the same time the industrialized world, by using growth targets together with international tradable permit systems, would confront all three of the problems of the rapid economic growth in those countries: it would address the emissions, exploit the low-cost options for controlling those countries' emissions, and eliminate the problem of emissions leakage through international trade.

The second of the three elements of my proposed global climate policy architecture is to create a long-term program for what is fundamentally a long-term problem. Unlike so many other environmental problems in which we can reasonably set a five- or a ten-year time horizon in the statute or regulation or agreement, this problem cannot effectively be addressed that way, in terms of either science or economics.

I have seen many global climate modeling efforts from around the world, and all these models are consistent in one significant respect: the least-cost path to reach any future target in terms of concentration of greenhouse gases in the atmosphere is to start out with very gradual emissions reductions, departing slowly from baseline, then to continue emissions growth but not as steeply as baseline, and finally and gradually to curve away and to proceed with much more ambitious emissions cuts in the long term. This contrasts with the Kyoto approach, which is extremely abrupt and ambitious in the short term.

So, short-term targets should be very moderate, but they should be firm. The long-term targets need to be much more stringent, but they should be sufficiently flexible to allow for acquisition of future knowledge. This does not mean, of course, waiting until later to put those long-term targets in place. In that case we would be back here 20 years from now, and I would be giving the same presentation. It means putting those targets in place now, to give signals to the private sector about what is coming, so that when investment decisions are made today, everyone understands what the relative price pattern will be into the future. This approach is consistent with the science of the accumulation of greenhouse gases; it is consistent with the cost-effective path; and it is consistent with politics.

We often complain that in representative democracies, politicians try to pass out benefits now and place costs on future generations. However, in this case, the right thing to do is to move costs onto the future, to shift the most ambitious part of the costs and the most severe targets to later. For these reasons, I would claim that this global climate policy architecture can be not only scientifically appropriate and economically rational, but also politically pragmatic.

The third and final element of an effective global climate policy architecture is a central focus on so-called market-based policy instruments, already contained in the Kyoto Protocol. Article 17 of the protocol focuses on emissions trading, with alternative approaches that could be better, including carbon taxes, and hybrid approaches that combine a tax and a tradable permit system. These ideas are of great interest now in the EU, and to a lesser extent in the United States as well.

This final element completes my three-part architecture for a global climate policy that is based on sound science, rational economics, and pragmatic politics. The issue of pragmatic politics leads to a political question: does the Bush Administration's environmental policy measure up to the issues I have addressed?

First, it should be pointed out that, besides nonparticipation on the international level, the Bush Administration does indeed have a policy. Its domestic policy calls for emissions to be slowed, stopped,

and then reversed. This is precisely the timetable I have described: that we should not be reversing emissions immediately, but instead should be bending slowly away from the 1990 baseline, stabilizing emissions, and then reducing them. What is missing in the administration's proposal is a plan for dates and targets. So, the administration has a good basic structure and the fundamental notion to slow, stop, and reverse emissions. What is needed now is a timeline of when and how that is going to happen.

Second, the administration has embraced, in theory and principle, the use of market-based instruments, including tradable permit systems. This is good, but at this point the administration envisions a voluntary, not a mandatory, program for CO_2 emissions reduction in the United States. The administration has no interest, and the Congress only mixed interest, in mandatory reductions. What is really needed is a cap-and-trade program, like the one the EU is putting into place now. (For the record, I should note that for a variety of reasons it appears the overall drop in emissions in the EU is going to be considerably smaller than originally anticipated.)

I believe the Bush Administration was correct when it criticized the Kyoto Protocol. Although the way in which it withdrew from the protocol was problematic in terms of international relations, the substantive objections to the protocol were sound. At the same time, the administration chose not to take the opportunity to recommend an alternative to the Kyoto Protocol. In the near future, the countries of the world are going to recognize that essentially nothing is happening in terms of CO_2 emissions, even if the Kyoto Protocol comes into force; when that realization occurs, there will be an opportunity to take new action.

We need to create a new global policy, whether it means amending the Kyoto Protocol, calling it Kyoto Protocol Part II or even the Salamanca Protocol. I would hope that at that future time, American leaders—whether the Bush Administration in its second term or another administration—will work together with our major Western allies to craft an approach that is based on sound science, rational economics, and, of course, pragmatic politics.

Planning in an Age of Increased Vulnerability

Claude Mandil
International Energy Agency

The International Energy Agency (IEA) was established in 1974 in the wake of the oil crisis of the previous year. Recognizing their vulnerability and the need to counterbalance the political and economic power of the producer (mainly OPEC) countries, 16 major energy-consuming nations banded together and the IEA was born. For nearly 30 years, the IEA has acted as the energy security "safety net" for industrialized countries, demonstrating how collective action effectively serves as a hedge against vulnerability.

The IEA has grown to include 26 members on four continents. Through our members' holdings of over 1.3 billion barrels of emergency oil reserves, we are committed to act together, if necessary, to offset any interruption in energy supply. In light of the uncertainty that has plagued the global oil market in recent months, the agency's role has gained greater prominence as energy security has again topped governments' policy agendas.

When I assumed the position of IEA Executive Director in early 2003, developments in the oil market gave cause for great concern. OECD stocks had been tight for nearly a year as a result of OPEC production cuts and industry just-in-time practices. In July 2002, crude stocks fell to the lower part of the five-year range and in January actually fell below it. A similar trend was seen in product stocks.

This situation was made worse by a number of other factors. A strike in Venezuela, beginning in December 2002, reduced oil production and effectively closed the ports, causing exports to fall dramatically for a sustained period of time. Other unsettling factors included a long, harsh winter in North America and parts of Europe, ongoing problems with the nuclear power sector in Japan, unrest in Nigeria, and the anticipation of war in Iraq potentially causing broader disruption among oil producers in the Persian Gulf.

These converging developments showed signs of creating "the perfect storm." The market reflected this uncertainty through volatility: prices rose and fell, reaching nearly $40 per barrel in February and then falling below $30. With stock levels already low, the disruption in Venezuela substantially reduced the producers' cushion of spare capacity. If Iraqi production of 2.5 million barrels per day (MMb/d) stopped completely, the margin would be very tight. If the producers could not make up the difference, the IEA would need to act.

The IEA Secretariat had been monitoring the market very closely and providing regular updates to our member countries. On the eve of the outbreak of hostilities in Iraq, we circulated an update on the situation in the oil market and concluded that, if producers kept their word and increased production, the market would be adequately supplied—for the time being. The consuming nations did not release their stocks (which total several years' worth of Iraqi oil exports), but we stood ready to respond, promptly and massively if necessary. Working closely with member states and producers, we issued statements that ultimately calmed the market. There was no price spike or disruption in supply. The consumers' sense of vulnerability diminished as energy security was assured.

I believe that the founders of the IEA would be pleased with this result. But they would be surprised by one new development in this "consumers' response"—the agency's close communication with producer countries. While we still do not agree with OPEC's attempts to manage the market or set a target price for oil, we believe that an active dialogue is important and can help to achieve common objectives—stability in the market after war breaks out in a major oil-producing area of the world, for example.

Thus far I have focused on the near term, showing how vulnerability can effectively be reduced through collective action. However, as we look forward, there are many areas of potential vulnerability in the energy sector. One such issue on which the IEA is focusing its attention is the challenge of mobilizing unprecedented levels of investment to meet future energy demand. Again, we will need to act collectively to ensure our energy security in the future.

Every year the IEA publishes the *World Energy Outlook* (WEO), which looks at important supply, demand, and other market trends in the energy field. The 2002 WEO made projections through 2030 assuming, importantly, that current policies remain in place. Under this analysis, world primary energy demand is expected to continue to increase, averaging 1.7 percent growth annually to 2030. Natural gas and renewable energy will both grow very quickly, but oil will remain dominant in the 2030 energy mix—unless existing government policies change dramatically.

The world's energy resources are adequate to meet the projected growth in energy demand, but only if adequate incentives exist to bring them to market. The IEA believes that mobilizing the investment needed to achieve this will be more difficult than in the past for a number of reasons:

- The scale of investment required for energy-supply infrastructure and technology development and deployment will be larger than in past. Capacity must increase in oil, natural gas, and coal production and transportation systems, in addition to electricity generation and networks. For example, more than $4 trillion will

be needed for power-generation capacity expansion between now and 2030. In addition, oil investment will have to increase as demand grows and surplus capacity is used up. Investment will also be needed to compensate for lost capacity through decline in production in existing fields. Next, a soaring natural gas trade implies huge investments in pipelines and liquified natural gas (LNG) facilities. And finally, environmental concerns are expected to push up the cost of bringing many types of energy to market.

- Energy investment is traditionally risky because of technical, economic, and geopolitical factors. As a result, returns on energy investment need to be higher than in other industries to compensate for risk—yet investment returns in recent years have often been below the average for the industry in general, and more volatile.

- In the past, much energy investment came from the public sector. Because of market liberalization and constraints on government spending, more financing will be required from the private sector. But the trust of the financial sector must be regained—for example, energy investors in the United States sustained large losses in 2002, perhaps resulting from an overly optimistic view of the impact of deregulation.

A growing share of investment will be needed in developing and transitional economies where demand growth will be fastest and energy resources are concentrated. WEO projects that almost all (95 percent) of the increase in energy production will occur in non-OECD countries in the next three decades, compared to 60 percent between 1971 and 2000. Many developing countries will increasingly require external financing—due to low internal rates of savings—for large-scale energy projects. Examples include upstream oil and natural gas projects in Russia and the Middle East, though restrictions on foreign direct investment remain. Similarly, there is a need for power plants/transmission/distribution networks in Africa, Asia, and Latin America. Securing financing for energy infrastructure will be critical in alleviating poverty and creating productive economies.

But governments in developing countries have not always behaved responsibly toward such projects. A number of investors have been driven from the infrastructure business in developing countries, and a number of leading companies that invested in power and trading have struggled or failed. Net private capital flows to emerging market economies fell to the lowest level in ten years in 2002—new lending has been close to zero in recent years and was negative in 2001–2002. Given the continued global economic slump, there is little sign of renewed investor interest.

From the perspective of industrialized consumer countries, the prospect of insufficient investment raises significant energy security concerns and creates vulnerability. Governments—in both industrialized and developing countries—must act to foster an attractive investment environment and build investor confidence. To accomplish this, the following factors will be fundamental:

- Stable and sound macroeconomic policies to control inflation and promote growth;
- Removal of market barriers; and
- Transparent, efficient and stable legal, regulatory, and institutional frameworks.

Mobilizing investment in developing and transitional countries will be the greatest challenge, but it is a critical factor in building productive economies that participate in global markets. Industrialized countries' policies should also encourage investment, where economically and environmentally sound, in developing advanced energy technologies and efficient energy end use. To provide broader understanding of the role our member governments and others can play in ensuring adequate energy investment, the IEA is focusing the theme of the 2003 *World Energy Outlook*, which will be released in November, on investment. We conducted a brainstorming session on *Investment Challenges in the Energy Sector* just before our biennial ministerial meeting in May 2003. The level of interest far surpassed our expectations—experts from industry, academia, and member governments arrived from around the world to share their views and

debate solutions. Their input will be incorporated into the WEO analysis and findings.

In closing, I would suggest that the IEA has been planning in an age of vulnerability that began almost 30 years ago. While we have been successful—the world has not experienced the disruptions in energy supply that rocked the early 1970s—there are new dimensions and types of vulnerability to face. Only through anticipating such vulnerability and proactively confronting it collectively, will we continue to overcome it.

Session III

Liberalization and Energy Restructuring in the Aftermath of the Shocks of 2001

Chairman's Introduction

William W. Hogan
Harvard University

This session will focus on a topic that we have discussed at earlier Seminars, the liberalization of energy markets, in particular the natural gas and electricity markets. I am often astonished at how difficult it has been to succeed in liberalizing and restructuring the electricity market. But we know that electricity has many complex technical problems that affect market design, which itself is a complicated issue even without the special conditions in electricity. Of course, market design does not matter too much if the market is in the condition (good for customers and bad for suppliers) where there is excess capacity and adequate and inexpensive supply. In such a situation, almost any market design will work. The question of interest, however, is what happens when the system is stressed? How well does the design perform then?

We have been learning about the effects of market design in stressed electricity markets—at great cost—around the world. The most notable and unhappy case of a stressed market was that of the California price spikes of 2000–2001. The situation in California has been resolved, after a fashion, but its memory continues to haunt

restructuring everywhere. All the wrong lessons appear to have been learned, and the correct ones too little articulated.

The particular problems that really precipitated the high prices—and all of the publicity—were problems almost unique to California. However, the price problems that became painfully visible beginning in the spring of 2000 had been preceded by great difficulties in market design—early difficulties that received almost no publicity. These are the difficulties that do occur in other markets around the world. We should draw lessons from this set of difficulties and compromises that were made with efficient market design.

We need to draw these lessons because the market design problems we have had in the United States have occurred elsewhere. We know of the troubles in Brazil, which, like the western United States, is very dependent on a hydro system. There are similar troubles brewing in New Zealand, where they are worried down under about what will happen in a very dry year. Thus, we need to attend to the many difficulties that are not unique to California or the United States. The U.S. Federal Energy Regulatory Commission (FERC) has been working on these matters, which is one reason that we can obtain a great deal of information from this American experience.

Europeans are encountering the same technical problems because the electrical systems are the same. Therefore, we can draw on the work, for instance, of Yves Smeers of the Catholic University of Louvain, Belgium, and Jacqueline Bouchet from ElectraBell, Brussels, who have written extensively about that topic. These examples show that we have much to learn from each other's experiences—in North America, in South America, and in Europe.

However, we can also draw lessons from a successful experience in restructuring and market design—in another part of the United States, in a system that has worked well, the Pennsylvania-New Jersey-Maryland Interconnector (PJM) system in the U.S. Northeast. After some initial mistakes, PJM developed an important market design model that seems to work well.

Our speakers will allude to these lessons, good and bad, so this is an appropriate time to turn to our panel. We can benefit from the thoughts of a group of distinguished speakers who have both the ability to step back and look at these problems and the responsibility to work directly on these problems in a very practical and immediate way.

- Michel Massoni is the Director of Grid Access for France's Commission de Régulation de l'Énergie (CRE). We are very fortunate to have Mr. Massoni here today, because at CRE he has the critical role of ensuring open access and nondiscrimination for those who use the transmission grid and supporting electricity markets in France. He is working at the center of the problem. To this regulatory position he adds experience from the industry side, from Electricité de France and Gaz de France. Mr. Massoni will address the topic, *French Electricity Liberalization and the European Context*.

- María Luisa Huidobro is President and CEO of the Spanish Power Exchange (OMEL) and is also on the Board of Directors of Spain's National Transmission Network (REE). She is working daily in Spain to implement the essential requirements that are needed to design and operate successful electricity markets. In addition, she discusses these issues with her peers in power exchanges across Europe. We are looking forward to an insightful address on the topic, *The Outlook for Liberalization of Energy Markets in an Age of Increased Uncertainty*.

- Theresa A. Flaim is Senior Vice President of Strategic Planning and Analysis with the Tennessee Valley Authority (TVA). For those of you who are not familiar with it, the TVA is a very large U.S. government corporation, not unlike a European state-owned enterprise, that provides power for a substantial portion of the southeastern United States. Prior to her work for the TVA, Dr. Flaim had a similar position with Niagara Mohawk, a large, privately owned utility in New York State. She has been through the restructuring process in a very intense way, an experience that makes Dr. Flaim uniquely well qualified to address her Seminar

topic, *Restructuring Wholesale and Retail Electricity Markets in the United States*.

- Our final speaker will be William L. Massey, Commissioner at the U.S. Federal Energy Regulatory Commission since 1993. Bill has been through the fluctuations of the public policy debate on electricity restructuring in the United States and has a very sophisticated understanding of what is required to institute good policy. I look forward to his views on how best to proceed in the United States, as he speaks on *Electricity Market Reform: The U.S. Federal Energy Regulatory Commission Experience*.

French Electricity Liberalization and the European Context

Michel Massoni
Commission de Régulation de l'Énergie (CRE)

The main aim of the European Directive of 1996 for electricity is the promotion of an internal energy market throughout the European Union (EU). This ambitious goal can be achieved, but only if at least two conditions are fulfilled. First, fair competition must exist between suppliers; given the natural tendency toward oligopolistic structuring of the European energy sector, this is not a trivial condition. Second, network operators must be efficient and independent from energy suppliers.

To ensure that these conditions are fulfilled, specialized ex ante regulation is necessary. This is because it is very difficult for the regulatory bodies, acting ex post, to give the appropriate incentives in a timely fashion during the transition from a regional monopoly to a competitive market. In France the regulatory body, the Commission de Régulation de l'Énergie (CRE), is setting such regulations. Today it will be my pleasure to describe the role of the CRE, first in implementing the EU directive in France, and then, reversing the focus, in critiquing some of the proposed EU directives.

France was late in enforcing the European directives: Parliament passed the French electricity law on February 10, 2000, and the French natural gas law on January 3, 2003. However, now in place, these laws are enforced by the CRE, where regulators are keenly interested in implementing fair competition in the French market. The situation regarding French compliance with EU directives can be briefly described as follows.

- The qualification of consumers is partial but in full accordance with the EU directive. The competitive market can now cover 170 kilowatt-hours (kWh), making the French market the fourth-largest in Europe in terms of volume.
- The French transmission system operator (TSO) remains a division of Électricite de France (EDF), although this will change in 2004. However, regulations are currently in place to guarantee independent and neutral management of the grid under the strict control of the regulator.
- Like most member states, France chose the regulated third-party access (RTPA) option with tight monitoring of the enforcement of network operators' users rights and the enforcement of a regulated tariff for network use set by the regulator.
- The accounting procedures used in unbundling of vertically integrated firms (notably EDF) are now in effect and allow a separation of the generation/supply and transmission/distribution accounts.
- The current tariff is a postage-stamp charge made at a connection point, based on a cost-plus method; it charges the demand side in order to minimize the competition distortions between generators situated in France and in neighboring countries. In early 2004, a revised decree will take into account the experience gained from the first version.
- The cross-border conditions for trading are set on the basis of bilateral agreements between TSOs, which are controlled by their respective regulators. France has specific agreements with

the UK, Italy, and Belgium. They aim at making international electricity trading easier, while not relying too much on pure market mechanisms that make market distortions likely, such as when large generators exercise market power.

Moving beyond the requirements of the EU directive, the CRE independently encouraged the implementation of the following mechanisms to facilitate competition among suppliers in the French market.

- Since the costs of technical losses in transmission are currently socialized in the network-use tariff, the regulator asked the French system operator to pay for supplies of compensation energy; as a result, EDF competitors now supply a large portion of supplies.
- To help end users choose their suppliers more freely, the CRE asked the Réseau de Transport d'Électricite (RTE) to implement the balancing responsible entity (BRE), which is liable for the payment of the aggregated imbalance costs of a portfolio. This liability prevents EDF from being the only de facto BRE with an undue competitive advantage. Most, if not all, competitive suppliers on the French market are now active BREs.
- To make the costs of the system imbalance more transparent and market-based, the CRE recently approved of the RTE operating a balancing market. This mechanism integrates measures to prevent and even deter too much arbitrage within the French power exchange.

The CRE closely monitors the wholesale market, which is a necessary but not sufficient condition to the development of supply competition. The CRE had long urged the freedom of electricity trading in France; after lengthy dispute, this freedom was finally confirmed by the law of January 2003. Simultaneously, since November 2001 CRE has encouraged the creation of a day-ahead market operated by Powernext, a subsidiary of Euronext and various firms belonging to the energy and financial areas.

The results of these measures are encouraging. EDF remains the major competitive supplier, but more than 50 competitors (either

generators or traders) are also active on the qualified French market. In 2002, these competitors supplied more than 300 qualified consumers, 16 percent of the qualified energy consumption. EDF competitors supplied 87 percent of the energy bought by the TSO to cover technical losses on the grid.

By the end of 2002, 24 percent of the competitive market was supplied outside EDF. Three independent generators, generating 20 terawatt-hours (TWh), are linked with major foreign competitors. During 2002, more than 80 TWh (out of a national consumption of approximately 430 TWh) were traded on the French wholesale market. It is also noteworthy that after only one year of activity, the 24 members of Powernext, the French power exchange, traded about 2.5 TWh, which is a volume that demonstrates the potential for future growth.

Anticipating the next electricity regulatory forum to be held in Rome in July 2003, the EC emphasized that its overall objective is to create an efficient, competitive electricity market. This requires that all qualified consumers be able to choose their supplier, but also requires that the market structure and rules create conditions for effective and efficient competition on the supply side. CRE believes that the EC and the national regulators should address several major issues related to market structure and market rules.

The commission proposes to create regional integrated markets to assure a higher degree of rapid integration. CRE welcomes the commission's objective concerning regional markets, but stresses that this can happen only if a minimum degree of harmonization is reached within each regional market, especially on the following issues: fair market and grid access rules for all suppliers and all consumers; effective unbundling of TSOs, legally and behaviorally; rules for bilateral contracts, day-ahead and infra-day nominations; and rules for balancing, congestion, and system services. Given the wide diversity among member states, this harmonization process should be gradual and customized to each regional market.

CRE also stresses that regional markets will only increase the effectiveness of competition in the European supply markets if the integration process is not limited to power exchanges and wholesale

markets. Wholesale trades are closely related to balancing energy, grid congestion management, and the supply of ancillary services. For this reason, if a regional market is restricted to the wholesale market organization, it would enable market players—primarily the incumbent companies—to take advantage of the lack of competition on balancing, congestion, or system services and to impose abusive prices or distort competition on the wholesale market.

Furthermore, the integration of balancing, congestion, and ancillary services enables a significant increase in transmission capacities. The TSOs can rearrange the repartition of the physical flows on their grids and thereby increase the capacity available for commercial transactions. These actions are efficient in certain cases but must be tightly controlled by the regulators to counteract the natural tendency of TSOs to maximize the congestion rent they can capture.

Given the high degree of concentration on the supply side, demand-side participation is an important issue, one that the commission's draft strategy paper does not address. CRE considers that a comprehensive framework for demand-side participation should be established within each regional market. This framework shall include demand-side participation in the supply, wholesale, balancing, and system services markets, according to each specific situation.

The trend in Europe is toward implementing entry-exit pricing for use of the grid, whereby a customer paying the tariff and accepting the connection agreement at his connection point has access to all the interconnected networks and is free to trade with any market participant. Moreover, transmission operators use the "postage stamp" system, which does not contain any reference to nodal prices.

The main argument in favor of this pricing system is its simplicity and equity. However, it cannot be as efficient as nodal pricing because it cannot capture all relevant parameters. Moreover, even when the relevant area network does not suffer congestion (a very unlikely hypothesis), fixed costs almost always remain to be paid. For economic efficiency such costs should not be allocated without reference to the elasticity of the demand or other economic characteristics of supply and demand curves at each node.

Quality and security of supply should be ensured by establishing a comprehensive investment framework on the generation side; in this respect, the question of whether the short-term signals provided by the market give appropriate incentives for the medium term must be addressed. The reinforcement of the interconnections, particularly within each regional market, is an issue of high priority, especially where congestion is structural.

However, it would be unrealistic and inefficient to solve the problem of high price areas only through interconnection developments. Especially in the countries where high prices are partly due to inefficiency on the generation side or to the high growth rate of demand, the fastest, cheapest, most environment-friendly, and most pro-competitive solution is to build new, more efficient power plants. EU member states and their regulators should make sure that the conditions for investment are favorable.

Some stakeholders suggest that prices resulting from market-based capacity allocation mechanisms may give appropriate signals for long-term investments, such as generation or transmission infrastructures, and that they generate a surplus that can be used to invest to increase capacity. On the contrary, there are many convincing reasons why, in an oligopolistic generation situation, addressing the issue of financing and developing interconnections and the issue of their allocation through the same price signals is misleading. These should be carefully separated.

In most European countries where the electricity industry is in the process of liberalization, competition at the generation level is more oligopolistic than perfect. Econometric studies, mainly those carried out in the UK under the previous pool arrangement, showed evidence of abuse of a dominant position by electric generators, particularly during peak hours when transmission capacity constraints were binding. Similar situations are very likely elsewhere in Europe, especially in structurally importing countries that have insufficient interconnection capacity with other countries.

From both theoretical and empirical models it is now well known that these markets can at times exhibit very little market power and

at other times suffer from a great deal of market power. The transition between these different states of the market occurs when demand rises above levels for which most producers can compete in offering the required load, either because of peak demand conditions or because of unexpected shortage in supply.

Therefore, CRE is very skeptical about the assumption that the most appropriate model for Europe should be the integration of the markets for capacity and of the power exchanges by a market-splitting scheme. Even if this model were theoretically appropriate, the prerequisites for this model, such as strong coordination and cooperation between TSOs and power exchanges, are not in place in Europe.

To implement efficient regional electricity markets, all interconnection capacity allocation mechanisms have to be considered in relation to the actual competitive situation. Theoretical studies have shown that, under certain market and grid structure conditions, especially in a highly meshed network with a highly concentrated market structure, possibilities of collusion between market participants will be increased if access to interconnections is tradable. Indeed, this additional cost will reinforce the credibility of a threat of retaliation for a market participant deviating from the collusive equilibrium. Moreover, the repeated relationship between market participants on the auction place increases the temptation of explicit or implicit collusion.

Considering specifically implicit auctioning, the reality of the continental electricity markets is that the power-exchange fixing price, on which the price of access to the interconnection is based, is subject to inefficiencies, market power, and manipulations, especially when the liquidity on the said power exchange is low, as recent experience with some European power exchanges shows. Under such conditions, the access price to the interconnection being determined, in market splitting, by the price differential between power exchanges (when they exist), this allocation method is likely to be unable to provide efficient economic signals.

As the EC studies suggest, the severe lack of market splitting could partly be solved through the introduction of Financial

Transmission Rights, which, however, require a regional transmission operator to operate a day-ahead nodal market and a balancing nodal market. This cannot be achieved unless the principle of postage-stamp tariff is reconsidered and the European TSOs reach a degree of integration far above the present level.

As far as the other market power mitigation systems listed by the EC are concerned (market monitoring by imposing a cap on wholesale power and/or imbalance prices), no evidence in the liberalized electricity markets shows that they are efficient. Moreover, their impact on market incentives to invest in generation has been proven to be possibly counterproductive. Indeed, several experts consider that the volatility of price in wholesale markets is intrinsically linked to the risk supported by generators and should therefore constitute a normal payoff to remunerate their risky investment.

The EC's draft papers deal with the issue of generation adequacy in terms of available generation power and the location of this generation. As far as available generation capacity is concerned, CRE recommends being very cautious about the various support mechanisms already used because none of them was proven to be efficient and because the most favored, capacity payments, has been strongly criticized. The usual criticisms about these capacity payments are their cost (since immobilizing generation capacity is very costly for producers), the inappropriate incentives they deliver for real-time dispatch, and the gaming opportunities they create. CRE believes that demand-side solutions should be considered more seriously by the EC.

As far as the locational incentives for generation investment are concerned, the EC only considers the access tariff or congestion charges as a support for the corresponding signals. It is CRE's conviction that these tariffs are not best suited to provide efficient long-term incentives, as they are subject to regular changes and instability. Instead, the connection charges and the contributions to the financing of the grid investments required by the connection of a new power plant should be preferred.

Another question raised by the EC's draft strategy paper is whether the congestion management schemes, whichever allocation system is used, do not already provide strong incentives for the location of generation investment. Furthermore, the efficiency of any locational incentive for generation investment remains to be addressed, as many criteria are taken into account when deciding to build a new generation plant, such as security of supply, availability of the primary fuel, cold source availability, land planning, and so forth.

In consideration of the present state of competition in the member states, CRE wishes to stress the importance that the grid access conditions be transparent and nondiscriminatory. Experience shows that the complexity of the technical requirements and of the financial conditions of access are such that only a strong, independent, competent, and sectorial regulator acting ex ante can make sure that they do not hide an anticompetitive clause.

Finally, the issue of renewable energy. As the commission states, subsidies for renewable energy or combined heat and power (CHP) may lead to severe market distortions. For example, systems where renewable energy has priority access right to the grid or where renewable energy, due to the subsidy, is sold at a fixed price different from the market price, can result in situations in which all the scarce interconnection capacity is allocated to trades of renewable energy, thus preventing competition from external agents on the wholesale market. The priority access given to renewables can also call for additional security margins by the TSOs and substantially increase the cost of the transmission activity.

I will conclude by returning to my original point: an independent, competent sector regulator can set the rules and make the hard decisions in a timely manner. The creation in each member state of an independent, competent sector regulator is therefore a prerequisite for the implementation of the regional markets as a crucial step toward the internal electricity market.

The Outlook for Liberalization of Energy Markets in an Age of Increased Uncertainty

María Luisa Huidobro
Cía Operadora del Mercado Español de Electricidad (OMEL)

I am delighted to return to the Repsol YPF–Harvard Seminar and report on the current state of electricity market liberalization. This issue means a great deal to me; I have been engaged in working for liberalization for many years, in both government, as a member of the Spanish Ministry of Energy, and now in the private sector, in the Spanish Power Exchange. I will begin by reporting on trends that appear well underway, including the official developments in the European Union (EU). Then I will mention several areas where the outcome is still unclear; these areas include investment in capacity, how to perform demand side management, and others. And I will conclude by suggesting an unthinkable development that may not be so unthinkable after all.

In Europe, liberalization is proceeding on an accelerated schedule. After a revision of Directives 96/92/EC and 98/30/EC, setting rules for the internal electricity and natural gas markets respectively, the European Commission considered these directives to be insufficient to fully develop the European single market. A revised directive

for the internal electricity market was issued, which stipulates that by July 1, 2004, all non-household customers will be free to choose their supplier. By July 1, 2007, this choice will be available to all customers, whatever their size. Procedures have been established to monitor and control progress in market deregulation and in implementation of public service conditions. The revised directive also stresses the increased separation of ownership between the transmission and distribution networks. Large vertically integrated companies will not have to divest themselves of these networks, although legal, functional, and decision-making independence in activities related to transmission and distribution are essential and will be regulated.

Public service obligations include consumer protection as a fundamental tenet. It is important to understand that this area is not only about environmental protection and security of supply, but also about consumers' rights, including the right to change their suppliers. All households and small enterprises have the right to universal service—the right to be supplied with electricity of a specified quality at reasonable prices and to have a supplier of last resort. In addition, other measures will be taken to protect customers. For example, distribution companies have the obligation to connect customers to their grid, and to improve transparency in contractual terms and conditions and dispute settlement mechanisms. Lastly, of course, eligible customers will be able to switch to new suppliers.

The continued development and expansion of power exchanges is another encouraging trend, particularly as it is linked to the technical improvement of networks. Both developments encourage the ease and transparency of market activities. The new EU regulation for access to the network for cross-border electricity transactions aims to establish impartial, harmonized standards for cross-border tariffs and for the allocation of available interconnection capacity between national transmission networks. Further, this regulation may involve the establishment of a compensation mechanism for cross-border electricity flows, compatible congestion management mechanisms, and the allocation of available commercial capacity.

Turning to major items of concern, we immediately face issues of the guarantee of supply and of market liquidity. It would be too easy to assume that establishment of markets assures adequate supply, but we know that this principle is already under debate. Whether organized markets can produce signals to attract and channel necessary investments in generation and transmission is a major concern facing everyone engaged in liberalization. Recent data for both Europe and the United States show that investments are continuing in parallel with liberalization.

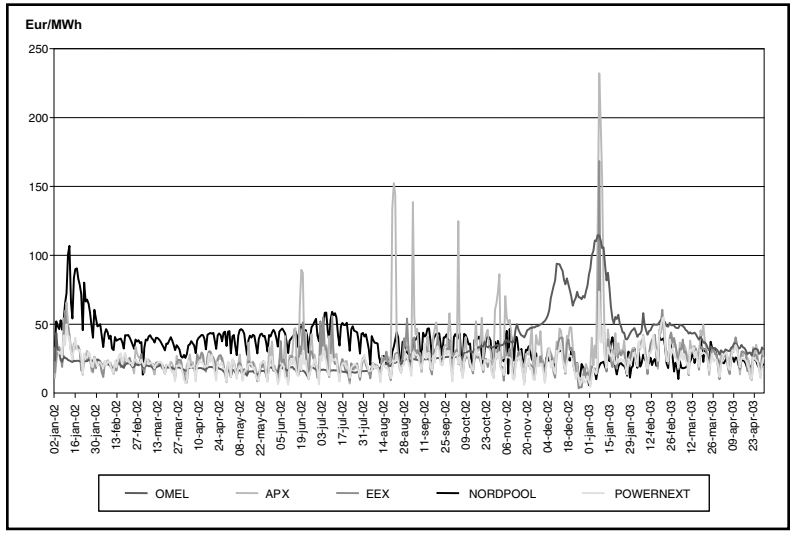
We are always aware of the importance of markets (and power exchanges) in providing relevant information regarding prices, with pricing transparency a critical issue in all market transactions, whether balancing, spot or futures transactions. So, how has market development fared?

The United States has large physical energy markets in which financial and derivative instruments are present at a somewhat lower level of development. Many observers have noted, however, that despite the pricing crisis that occurred in California in 2000–2001 and the trading scandals associated with companies such as Enron, the move to expand markets has not been halted, at least in those states that have already begun the process. And on a national level, the Federal Energy Regulatory Commission (FERC) is continuing its work to implement a standard market design aimed at creating still larger regional markets with a common structure.

European organized markets are characterized by a trend towards diversification of products offered by market operators: daily market, intraday or adjusting markets, over-the-counter markets, bilateral transactions settlements, and forward and future contracts. However, some European markets have been affected by the Enron scandal, particularly in financial transactions. As to the expansion of cross-border markets, I will save that for my conclusion.

Prices in the major power exchanges in Europe—OMEL in Spain, APX in the Netherlands, EEX in Germany, Nordpool in the Nordic countries, and Powernext in France—are compared in Figure 1. These are average daily prices for 15 months, January 2002–April 2003.

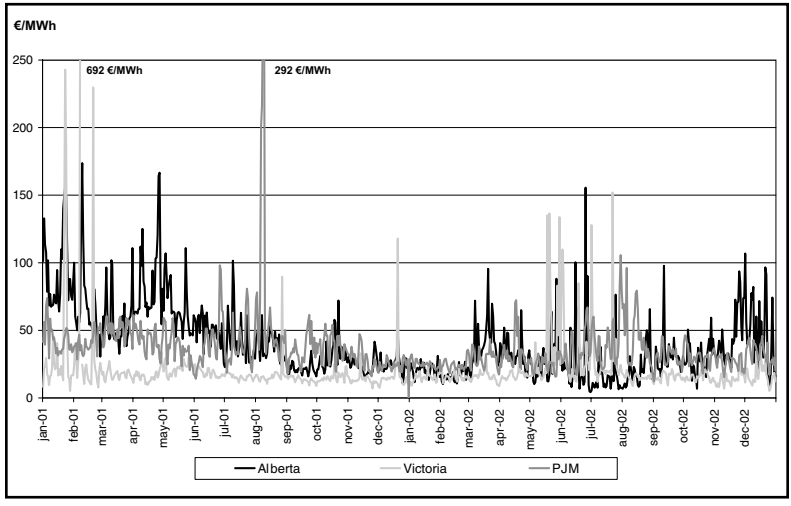
Figure 1
Electricity Prices in European Markets
January 2002–April 2003



Overall, prices were relatively stable during early 2002 but have become somewhat more volatile in some countries recently. Spain had higher prices early in the period, but now Nordpool has that distinction. The causes of these changes, whether demand/supply conditions, or weather, or other factors, vary from country to country. The notable volatility current in Nordpool may reflect capacity that is lower than usual. But that could change. It is also important to realize that the volatility of prices is greater when the quantity of electricity contracted is lower. This happens more frequently in the newer markets; for example, APX in the Netherlands or the French market, the last one to come to the club, have had very marked fluctuations.

Figure 2 shows a similar comparison for three power exchanges in other parts of the world: Alberta in Canada, Victoria in Australia, and the very large Pennsylvania-New Jersey-Maryland Interconnector (PJM) in the United States. This figure shows daily prices for two years, January 2001 through December 2002. Note how volatility has been reduced in the second year, marked by "safe" peaks.

Figure 2
Electricity Prices in Alberta, PJM, and Victoria
January 2001–December 2002



We might ask why prices seem more vulnerable to price spikes in the North American markets than in the European markets. One possibility is that there has been less divestiture in Europe and less contracting in North America, a condition that would force more power onto the volatile spot markets. Also, there are organized real-time spot markets in PJM and Alberta, but not in most European countries. Real-time spot markets are subject to greater volatility than day-ahead or earlier spot markets.

The role of demand and its relationship to market price is another important concern. Demand side response to price variation not only links wholesale and retail transactions, it offers a way for the producer and the retailers to assume less risk. And it is good for security of supply. However, it is very difficult for consumers to adopt efficient patterns of consumption if they only face constant prices or tariffs. An efficient link between wholesale and retail markets may be necessary for the development of electricity markets.

Consumer price response programs, in which organized markets can participate, are possible vehicles for integrating demand into the

market and for inducing an efficient response by consumers to price changes. However, while these programs may offer benefits to consumers and to the electric systems, they may also impose a tariff or be difficult to accept by market participants at the beginning of deregulation processes. Experience with such models, based principally on bilateral contracts processed through integrated companies, has produced a series of undesirable results. These include the failure to pass on price reductions to consumers, sharp drops in wholesale prices, and the lack of a relationship to organized market prices.

Another relevant issue is the place of the electricity production reserve margin in the market, and how market prices are affected by the level of production reserve. The electricity production reserve margin is calculated in the Spanish market by determining all sale bids presented by producers that have not been matched; this is the level of available surplus energy. The consideration of the reserve margin is an essential factor for correct price formation. In the daily market there is a high inverse correlation between the evolution of the electricity power production reserve margin and the evolution of market prices. This correlation provides evidence about the correct behavior of prices in our market, and it gives an efficient price signal to the market about the value of energy as demand and supply conditions approach relative scarcity.

The theme of this Seminar is thinking the unthinkable, so I will conclude by suggesting something that is, or has been, unthinkable, in an institutional sense. I refer to a development that we at OMEL, and at other power exchanges throughout Europe, have begun to consider: the possibility of cooperation among power exchanges to produce either a unique price for electricity throughout the continent when there are no physical constraints, or a nodal price when there is congestion at particular borders. Let me caution first that such a development will not solve the physical problems that may arise from inadequate capacity or transmission infrastructure resulting from inadequate investment. New investments must be made. Nor will it solve the problem of lack of coordination among transmission system operators (TSOs) on ancillary services.

However, as we explore ways to achieve better price rationalization among our various regions, we can create a mathematical model and incorporate the appropriate information based on implicit actions and communications between power exchanges regarding bids and bilateral transactions. The different power exchanges receive bids and bilaterals, and the TSOs publish day-ahead commercial capacity and make subsequent corrections during the day. We can combine all the bids (without reference to the individual bidders), adjust the flows between them up to capacity level published by TSOs, and get a clear price. If there are no constraints, this becomes the price; if there are constraints, we would use nodal pricing methodology for the constrained areas. This is much like what Nordpool does for the Nordic countries.

Restructuring Wholesale and Retail Electricity Markets in the United States

Theresa A. Flaim
Tennessee Valley Authority

I am delighted to have this opportunity to talk about restructuring wholesale and retail electricity markets in the United States. I will begin with a conceptual and issue-related focus on why we started down the path of deregulation and will conclude by reflecting on some of the lessons that I have learned, based on ten years or so of experience in electricity markets.

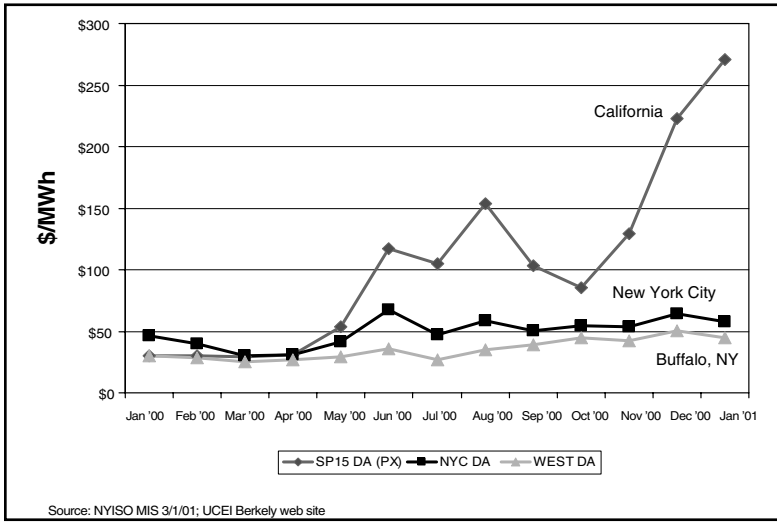
There is much colorful history about why the United States started down the path of deregulating electricity markets. Abstracting from the details, the basic driver was that in about half of the states, electricity retail generation prices were two to three times higher than wholesale spot market prices. Industrial customers in particular argued that such prices were excessively high, blaming utility mismanagement and regulatory mistakes. The hope, therefore, was that if we deregulated generation and introduced competition, the cost of management mistakes would be shifted from consumers, as is the case in the regulated model, to suppliers. The ultimate goal,

of course, was to create a system that would lead to greater innovation in services as well as lower overall costs.

By the late 1990s, approximately half the states had passed legislation to open their retail markets to competition, or were planning to do so. On the eve of deregulation in the Northeast and California, wholesale generation market prices were in the range of 2 to 2.5 cents per kilowatt-hour (kWh), compared to the average regulated generation price of about 6 to 7 cents per kWh. In 1998, California officially opened its markets. Market prices stayed low for several years. Then in June 2000, California began feeling the effects of a very severe capacity shortage that, coupled with the worst market design in the country, caused prices to skyrocket (see Figure 1).

California was a spectacular disaster. Events leading to it have been studied extensively, and the fallout will be felt for years to come. In many ways, though, California can be viewed as a very extreme example of problems that have emerged in other regions of the United States.

Figure 1
Day-ahead Electricity Prices in California and New York
January 2000–January 2001



When considering the U.S. experience to date, it is useful to think in terms of three categories of issues that have challenged deregulation in the United States since we started down this path in 1992.

- First, money issues: who pays for and who benefits from deregulation?
- Second, technical issues: how do we design wholesale and retail markets that work?
- Third, institutional and regulatory jurisdiction: who is in charge, who owns the system, and who gets to decide what is to be done?

In each of these categories, I will discuss where we were in the United States in 1996. Then, I want to talk about our situation today compared to that in 1996. I picked that time frame because it seems to me that Europe today is about where the United States was in 1996 and perhaps can learn from our experience during the interim period.

Unquestionably, the largest issue in 1996 was who was going to pay for stranded costs. The U.S. utility industry had about $150 billion a year in revenue. It also had stranded costs, that is, the costs of sunk utility investment and supply contracts that were estimated to be above market and, therefore, would have to be written off. These stranded costs were estimated in the range of $200–$500 billion. At the time, one could not go to a single electricity-related conference in the United States without having the floor debate explode into an argument over who was going to pay for stranded costs. Stranded costs were once thought to be intractable. Now they are largely resolved and you rarely hear anybody bring up the subject.

Today the major money issues vary across regions. High-cost regions have ongoing concerns about how to protect customers, particularly small customers, from high market prices. In such states there are also concerns about how to get access to larger regional markets to achieve better efficiencies. In the low-cost regions—those that traditionally have had low, regulated rates—the issues are the

opposite. I am working in a low-cost region now, and low-cost regions are concerned about keeping the benefits of the old regulated system and about whether the benefits of competition at the wholesale level will exceed the costs of implementation. Finally, they are concerned about whether local customers in these low-cost regions will be forced to pay for the transmission investments, which are perceived to be necessary to benefit people in the high-cost states.

Turning to the technical issues in wholesale markets, in 1996 the debate in the United States centered on the link between transmission operations and short-term markets. One of the unique difficulties of electricity markets is that transmission operations and short-term markets have to be integrated. However, the physics of integrated bulk reliability systems are extremely complex. Most people do not understand them, and half of those who think they do, actually do not.

Introducing politics into such a complicated technical subject makes the issues extremely difficult to deal with. In California, the opponents of combining these two systems argued that this was just an example of the monopolist refusing to give up control. They prevailed, and the California market design separated these two functions. Because of the lack of consensus during this period, the Federal Energy Regulatory Commission allowed regions to experiment with different market designs. In California, the result was the disaster of 2000–2001.

Today, there is widespread recognition about the core market design features that are necessary to make wholesale markets work. Debate still takes place between regions about whether wholesale competition is worthwhile, but there is very little debate about what is necessary to make these kinds of markets work. They include:

- Independent operation of transmission; but integrated with
- Voluntary energy spot markets;
- Location marginal pricing; and
- Financial congestion revenue rights.

It has been said, accurately, that on the retail level our expectations about the potential benefits of opening up retail markets were too high, especially for small customers. In effect, we put the retail cart before the wholesale horse. There was heated debate about the mechanical details of opening up markets to residential customers. Some advocates absolutely insisted that the domestic customers had to be able to go to the market when the industrial customers did; one slogan said that "big dogs cannot be allowed to eat first." If the big dogs (industrial consumers) were allowed in the market first, they would muscle the little dogs (retail customers) out of the way. At the same time, people insisted that small customers needed to have a regulated, protected price to which they could retreat if market prices got too high, or if they decided they really did not want to be in the market at all.

At the outset, the economics of commodity retailing for the mass market were very poorly understood. Having spent a number of years studying this subject in some detail, I can tell you the economics are really ugly. It is difficult to make any money just reselling a commodity to small retail customers. Today I would say that it is widely acknowledged, although not always publicly, that we pushed retail markets too fast and that we should have spent more time getting the wholesale market issues resolved first.

We now face an extreme reluctance to remove the regulated price protection for small customers. To me, a mixed system makes a lot more sense: keep small customers on regulated service and move the big customers to the market. Having said that, the challenge is how to achieve such a mixed system. In states that have moved forward and waved the flag about how even the little customers were going to benefit from participation in the market, it is politically embarrassing to have to say, "Well, this did not really work, and we need to roll back the reforms." Not only that, but every state has opened its markets a little differently, and most of them passed state laws that will require new legislation in order to put a revised framework in place.

There is a large category of institutional questions related to ownership and jurisdiction, which effectively asks, "Who is in charge?" The United States has a very heterogeneous system, a mix of public and private ownership and a mix of state and federal jurisdiction, which conflicts with both the realities of the market and the physics of the electrical network. I note the importance of these questions, but will not discuss them here.

Looking back on the last ten or so years in the United States, what lessons have we learned? First, I would emphasize that we have made real progress. It may be difficult to realize this because of the vociferous debate over the current state of electricity markets. I believe that wholesale markets can work. However, whether it is worth taking on the effort really depends on where you are and how inefficient your current system is. In Europe, which has a system with a very balkanized grid and many inefficiencies in the markets, it is probably very well worth taking on. However, I would not underestimate the amount of work involved. This task is much harder than many of us thought it would be at the outset.

With these reservations, I have four specific recommendations for you to consider.

First, manage expectations. It is important to manage expectations not only about the future benefits, but also the costs, that is, the nature and extent of the expected difficulties. It is very important that the benefits of restructuring not be exaggerated. It is hard to control such expectations, especially when lawmakers are passing legislation and feel compelled to stress the benefits of their actions.

It simply is not possible to improve everyone's situation relative to the status quo. As an economist, I always find it curious when politicians and regulators insist that a new system must make everyone better off. This cannot be the case because markets operate by relentlessly creating winners and losers. In addition, some customers have been subsidized under the old regulated world, and going to a market-based system will increase their costs. If deregulation works, prices should be lower on average over the long run, even though

market prices will frequently be higher than cost-based rates. In fact, they need to be higher, because price is the signal that will tell suppliers when we need new supply and consumers when we need to curtail demand.

I would not underestimate the cost of putting this kind of system in place. Free markets are not only not free, the costs of setting up a working electricity market are substantial.

Another difficulty is that elected officials naturally prefer programs where the benefits occur up front, with the costs shifted into the future after they are out of office. Restructuring demands the opposite: the costs are incurred up front and the benefits are realized over the long run. Moreover, there are no windfall gains. All this means that, contrary to much speculation in the media, you cannot get an immediate reduction of 20 percent or 30 percent after putting a market system in place—unless somebody experiences windfall losses of the same amount.

Second, get the technical details right—on the retail market side and especially on the wholesale side. Be prepared before acting: a "fire-aim-ready" approach will not work. Very small details can have catastrophic results when the system is under stress. Getting the wholesale market design should be the first priority. It is the hardest part of the reform, and it should be tackled first. If the wholesale market is working reasonably well, you can give access to large customers in a relatively straightforward way, and small customers benefit even if they are not participating in the market.

Third, understand the role of retail markets. It is definitely necessary to have some retail load participating in the wholesale market, but it does not all need to be there. You need some price-responsive load to help markets clear and to help mitigate price spikes. I recommend putting large customers into the market—perhaps those larger than 500 kWs or a megawatt, depending on the size of your system. I would not put domestic customers into this market, at least not initially. Personally, I would never put them in until I had compelling economic evidence that the potential benefits were real. Not only are the

economics of commodity retailing for the mass-market really ugly, but the political pressure is unbearable when spot market prices are high and small customers are directly exposed to those prices. Also, recognize that you cannot have it both ways—it is not possible to have a well-functioning market and price protection at the same time. It turns out that those two work directly against each other. Thus, if you have customers that you feel absolutely must have a provider of last resort and a regulated commodity price to retreat to, then that is the clearest evidence that they should not be put into the market in the first place.

And fourth, develop a realistic plan for dealing with institutional issues. This involves looking with ruthless clarity at who will benefit and who will be worse off. It is also important to see if the benefits and costs will vary by country or by stakeholder group. If there are likely to be winners and losers, you need to think about how to move forward. How will you drive the process towards resolution when interests conflict? Stated differently, how will winners be able to educate, persuade, or bribe the losers so that it will be possible to put a working system in place?

Electricity Market Reform: The U.S. Federal Energy Regulatory Commission Experience

William L. Massey
U.S. Federal Energy Regulatory Commission (FERC)

Electricity regulators around the world are endeavoring to restructure electricity markets, and in doing so they are having common experiences. It is useful to compare notes on what works and what does not. In the United States, after ten years, we have a good sense of what works, yet certain hurdles still remain on the path to well-structured electricity markets. Most of these hurdles are political in nature, not technical.

In the United States, the market for wholesale electricity trading has been evolving for approximately 15 years. At the federal level we have been moving in the right direction for quite a few years. It is fair to say that now we know what to do. We have three main goals in our efforts to structure electricity markets. First, we want to facilitate the creation of large, regional transmission institutions that operate both the transmission grid and the spot markets. Second, we want to insure that the transmission and market operators are independent of merchant interest. Third, we want to insure that the rules of

congestion management are right; this involves a system of locational marginal prices and a real-time market that clears on that basis.

We have made a great deal of progress in reaching these goals, particularly in several regions of the country. However, the meltdown of the California market, coupled with the collapse of Enron, has created a political backlash against the further evolution of organized electricity spot markets in the United States. Since the California spot market malfunctioned, the fear has been that all organized electricity spot markets will malfunction, and thus hurt consumers. This is an irrational fear, but it is, nonetheless, a reality. Also, the collapse of Enron has been viewed in some quarters as an indictment of the very idea of electricity markets, and the allegations of market manipulation have caused some to believe that there are simply bad—that is, unethical—actors in the industry. This has made it more difficult, politically, to move forward with market design measures that will facilitate good markets and long-term consumer benefits.

The U.S. Federal Energy Regulatory Commission (FERC) is a government agency whose decisions are subject to review by U.S. courts. Its five voting commissioners are appointed by the President and confirmed by the Senate for five-year terms. Not only does FERC have jurisdiction over pieces of the electricity industry, but we also regulate about 130 interstate natural gas pipelines, license about 2000 hydroelectric projects, and regulate interstate oil pipelines.

There is a jurisdictional split in electricity regulation between FERC and the 51 state regulatory commissions. My agency has jurisdiction over wholesale sales as well as the rates, terms, and conditions of transmission service. The 51 state commissions, which include the District of Columbia, have jurisdiction over retail transactions and local distribution service. States are responsible for the environmental siting of transmission and generation. This jurisdictional split makes it difficult to structure electricity markets so that they function well.

The commission's work over the last decade has given us a great deal of experience with issues of market structuring. In 1992,

Congress passed the Energy Policy Act, which promoted greater access to the transmission grid by third parties. The commission therefore began to grant market-based pricing for wholesale generation. In 1996 we issued a generic third-party access rule called Order 888. Under this rule, all transmission providers were required to offer a separate, unbundled wholesale service, which was based upon a contract path model.

The contract path relies upon the fiction that power flows follow the physical path that had been contracted, somewhat similar to the natural gas pipeline model. In reality, however, electricity actually follows the path of least resistance as we all know. Power flows are affected literally by everything else that is happening on the grid at that moment. In this respect, electricity networks are unique and somewhat unpredictable. Congestion occurs with regularity, but is hard to predict with certainty. Moreover, under our third-party access system, congestion costs were socialized, creating a very inefficient system. Nevertheless, this rule represented a step forward.

Many grid management problems arose under third-party access, problems which exist in other countries and jurisdictions. Vertically integrated grid operators also owned electric generation, and there were regular allegations of self dealing. There were well over 100 of these operators in the United States, and each had its own idiosyncrasies. The markets were regional, but the grid management was subregional. The grid management institutions were too small to support large, vibrant markets. Virtually no locational price signals existed to guide investment decisions.

It is often true that all scheduled transactions are simply not feasible in real time. There could be a line failure, a change in demand, or simply an unforeseen transaction in another region that changes the power flows. Some grid operators restricted the transmission capacity that was available for third-party access in order to play it safe and avoid curtailments. However, curtailments of transactions occurred regularly. This system discouraged marketers who did not want to take that risk.

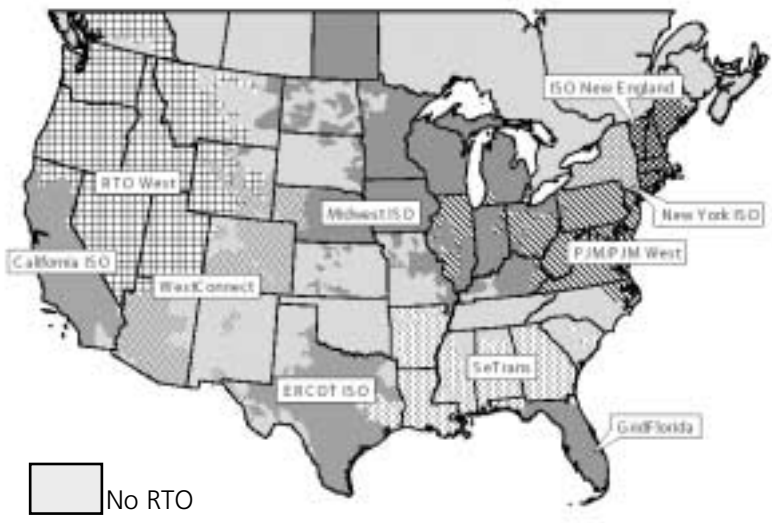
In 2000, the commission decided to tackle these grid management problems with a rule we called Order 2000, which promoted a reorganization of the grid into large regional operators. Each country has its own acronyms for these institutions; in the United States we called them regional transmission organizations or RTOs. There were to be no more than eight to ten of these institutions for the entire country. The RTO had to be completely independent of merchant interest. Each RTO was encouraged to operate a real-time imbalance market and to use a market-based system to manage congestion.

Despite these excellent structural features, we did not mandate the formation of these institutions. We strongly encouraged their creation, but the design elements were not prescribed. Nevertheless, the industry correctly perceived that the commission was serious about this new policy, and in most regions these institutions began to form.

Figure 1 shows the ten RTO regions within the United States. Some are currently functioning. Others have only been proposed. In some regions incumbent utilities opposed the formation of these institutions or did not move quickly, so formation has been somewhat haphazard. In the Northeast, RTOs—such as the Pennsylvania-New Jersey-Maryland Interconnector (PJM), the New York ISO, and ISO New England—have been operational for several years; those areas moved quickly to form large, regional institutions. In the Northwest, however, RTO West only exists on paper and is several years away from being operational. So, our policy of forming these institutions on a voluntary basis, which was a political compromise, has borne fruit but has been somewhat haphazard.

Meanwhile, in the midst of this institutional revolution, the meltdown of the California electricity market occurred during the summer of 2000. The market was short of generation capacity. California relied very heavily on imports of hydro-capacity from the Pacific Northwest, and 2000 turned out to be a low hydro year. The California utilities were required by state policy to make all purchases in the day ahead and hourly markets; therefore there was virtually no

Figure 1
Approved RTOs and Existing ISOs
(Utility Participation as of March 2003)



Note: Map includes service territories of transmission-dependent utilities.

hedging through long-term contracts. This was a very serious mistake. Spot prices soared and stayed very, very high for almost a year. Indeed, while California paid $7 billion for power in 1999, one year later the cost for the same amount of power was $30 billion.

In a capacity-short spot market, the generators had market power and used a series of bidding strategies to game the market and keep prices high. Since retail prices were capped, there was very little demand response, which is important in electricity markets. A major utility, Pacific Gas & Electric Co., was actually forced into bankruptcy. These events were on the front pages of newspapers all around the world, and they did not instill confidence in electricity markets.

The commission's softer approach of encouraging good market institutions was not working, and we were experiencing one disaster after another. We felt that we had finally had enough of poorly designed electricity markets, of markets that could be easily manipulated, and of discriminatory grid access.

However, since 1998 one electricity market has functioned very well. PJM is an independent grid and market operator; its prices have been reasonable, and there has been significant new entry by generators. The PJM spot market uses the system of locational marginal prices to send efficient price signals to the marketplace. The more we studied PJM, the more we liked it. Market participants did, too.

We therefore invited experts from around the country to offer their market design recommendations, and virtually all of them applauded the PJM model. The commission vowed never again to suffer through another California crisis arising from a poorly structured market. We vowed to insure that all wholesale electricity markets across the United States were well designed. To this end, in 2002 we proposed a generic market design, a standard market design, with three key features patterned after PJM: a spot market using bid-based, security constraint dispatch with locational prices; a day-ahead market; and a standard transmission service where a basic access fee gives scheduling rights as well as firm transmission rights that may be used to hedge congestion costs. We also proposed a strong program of full-time market monitoring, market power mitigation, and clear tariff conditions prohibiting market manipulation. This was a mandatory program for all U.S. wholesale markets.

Overall this was an excellent proposal that brought together all of the state-of-the-art thinking in the United States about electricity market design. It proposed a number of features that I have been advocating for years. Nevertheless, incumbent utilities and a number of states have vigorously opposed our proposal. They argue that it would interfere with state jurisdiction, that it was a cookie-cutter approach that failed to respect regional differences and regional needs, and that it was too prescriptive. Yet, no one actually offered a better market design. Nobody has a better mousetrap.

The opponents of our standard design proposal took their arguments to the U.S. Congress. And, recently the Senate threatened to block our proposal altogether. Therefore, we chose to modify our proposal to allow more flexibility on a regional basis, but to ensure that all the regional markets are designed in an efficient way that will benefit consumers. We are going to include a provision allowing regions to argue that the cost of a particular feature will exceed the benefits, and thus, should not be required. We will facilitate a much stronger state role, with respect to a number of issues, such as planning and resource adequacy.

This has been a very frustrating process. We understand that market design must take into account the physics of the electricity network. Wholesale markets cannot be structured on a state-by-state basis because the political boundaries are too small and because the electricity market flows do not follow these political boundaries.

We will continue to insist on the fundamental design elements I have described. The core of each market must be a well-functioning spot market with locational price signals. Also, the grid and spot market must be operated independently of merchant interest.

As we review the experiences in Europe and the United States, common themes emerge. I will mention five of them in closing.

- There is a need for more consistent grid tariffs among trading regions.
- It is necessary to enlarge markets: state-by-state markets may be too small.
- Transparency of prices is critical.
- Independent ownership and independent operation of the transmission grid and the organized power markets must be guaranteed.
- Consistent congestion rules among regions are important.

These goals may be difficult to achieve in European markets because of the different policies in different countries. They can be

difficult in U.S. markets as well. Nevertheless, whenever there are varying congestion rules among regions, it is very hard to manage congestion and to manage the grid. Similarly, you cannot readily trade among the regions if you are a marketer because of sharp differences in market rules. We must solve these problems.

Biographies of Speakers

Vicky A. Bailey is the Assistant Secretary for Policy and International Affairs at the U.S. Department of Energy (DOE), where she serves as a primary adviser to Secretary Spencer Abraham. Before going to DOE in 2000, Ms. Bailey worked in the private sector as President of PSI Energy, Inc., Indiana's largest electric supplier and the Indiana operating company of Cinergy Corp. Earlier, Ms. Bailey had lengthy experience in the government regulatory sector. From 1993–2000 she was Commissioner at the Federal Energy Regulatory Commission, where she focused on the new issue of electricity restructuring. At the state level, she served for seven years as Commissioner on the Indiana Utility Regulatory Commission. Here, she was involved in efforts to balance and mitigate the impact on states of the Clean Air Act Amendments of 1990 and the Energy Policy Act of 1992. Secretary Bailey holds a B.S. degree from the Krannert School of Management at Purdue University and has done postgraduate work at Indiana University.

Humberto H. Calderón Berti has had a long and distinguished career in the oil industry, both in his native Venezuela and internationally. After joining Corporación Venezolana de Petroleo (CVP), the first national oil company of Venezuela in 1970, he was instrumental in the nationalization of the entire Venezuelan petroleum industry in 1976. Mr. Calderón Berti became Minister of Energy and Mines in Venezuela from 1979 to 1983. During that period he also served as President of OPEC in 1979–1980. From 1989 to 1993 he was a deputy to the Venezuelan National Congress from the state of Anzoategui and also served as President of the Congressional Permanent Commission of Energy and Mines. In 1992 he also served as Venezuela's Minister of Foreign Relations. Mr. Calderón Berti received a B.S. in geology from the Universidad Central de Venezuela and a master's in petroleum engineering from the University of Tulsa, Oklahoma.

Alfonso Cortina de Alcocer has served as Chairman of the Repsol YPF Group since June 1996. Prior to this appointment, he was Chairman and Managing Director of Portland Valderrivas, S.A.; Chairman of the Delegate Commission from 1990 to 1996; and Vice-Chairman, Managing Director and Chairman of the Delegate Commission of that firm from 1984 to 1990. In addition, he has had extensive experience in the banking industry, including service with Banco de Vizcaya Group; Banco Hispano Americano Group; Hispano Hipotecario, Sociedad de Crédito Hipotecario, S.A.; and Banco Zaragozano. Mr. Cortina has been Chairman of the Asociación Hipotecaria Española and member of the Executive Committee of the European Mortgage Federation, a European Union agency. He was honored by the Madrid Official Chamber of Commerce and Industry as Businessman of the Year in 1995. He is a member of the Executive Committee of the Foundation for Technological Innovation (COTEC) and a member of the European Round Table of Industrialists. Mr. Cortina holds degrees in advanced industrial engineering from ETSII, Madrid, and in economics from Madrid University.

John M. Deutch is Institute Professor at the Massachusetts Institute of Technology (MIT). A member of the MIT faculty since 1970, Professor Deutch has served as Chairman of the Department of Chemistry, Dean of Science, and Provost of the university. He has also served in significant federal governmental posts. Most recently, he was Director of Central Intelligence from 1995 to 1996 and directed the U.S. Central Intelligence Agency. Earlier in that decade, he served as Deputy Secretary of Defense and later as Undersecretary of Defense for Acquisitions and Technology. From 1977 to 1980, John Deutch served in the U.S. Department of Energy, as Director of Energy Research, and as Undersecretary of the department. He earned a B.A. in history and economics from Amherst College, and a B.S. in chemical engineering and Ph.D. in physical chemistry from MIT. He is a director or trustee of many national institutions and writes extensively on scientific and international issues.

José Luis Díaz Fernández has been President of Fundación Repsol YPF (Madrid, Spain) since its creation in January 1996. The Fundación was established to coordinate Repsol YPF's work in promoting educational, cultural, and research activities. And as Vice President of Fundación YPF (Buenos Aires, Argentina), Mr. Díaz Fernández also promotes educational and cultural activities in Latin America. During his long career in the energy world, he has served Repsol YPF in many roles, including as Chairman and CEO of Repsol Petróleo and as chairman and CEO of Campsa. Mr. Díaz Fernández has a Ph.D. in mining engineering from the Universidad Polytécnica de Madrid and has served on the faculty of its School of Mines. He is a member of the Spanish Engineering Academy.

Theresa A. Flaim joined the Tennessee Valley Authority (TVA) in June 2002 as the agency's first Senior Vice President of Strategic Planning and Analysis. Her focus is on regulatory and pricing reform, industry restructuring, and competitive market assessments to help TVA develop its strategic business plan. Prior to joining TVA, Dr. Flaim served for nine years as Vice President of Strategic Planning at Niagara Mohawk Utility Company, based in upstate New York. In that position, she led the development of business and regulatory

strategy and the evaluation of competitive market conditions for the Syracuse, New York–based power corporation. Dr. Flaim is recognized nationally as an expert on the electric power industry and has written and testified at industry-related events across the nation. Dr. Flaim has an M.A. and a Ph.D. in resource economics from Cornell University and a bachelor's degree in history from the University of Missouri, Columbia.

William W. Hogan is Lucius N. Littauer Professor of Public Policy and Administration at the John F. Kennedy School of Government, Harvard University and is Research Director of the Harvard Electricity Policy Group. For more than a decade, Professor Hogan has been actively engaged in the design and improvement of competitive electricity markets in many regions of the United States and around the world. He has worked to design the market structures and market rules by which transmission system organizations coordinate bid-based markets for energy, ancillary services, and financial transmission rights. In particular, Professor Hogan is the principal architect of pricing and financial transmission rights systems based on locational marginal cost pricing, to efficiently price the effects of transmission congestion. He has been actively supporting the Federal Energy Regulatory Commission's decision regarding independent system/market operators, regional transmission organizations, and a standard market design, based on the experience in the New York and PJM markets. Professor Hogan received his undergraduate degree from the U.S. Air Force Academy and his Ph.D. from UCLA.

María Luisa Huidobro y Arreba is President and CEO of the Spanish Power Exchange (OMEL). She is also a member of the board of directors of the Spanish National Electricity Transmission Network (REE). Mrs. Huidobro served as Director General of Energy of the Ministry of Industry and Energy from 1990 to 1997, the critical period when the groundwork for liberalization in the Spanish energy industry was set in place. She also serves on the faculty of the Catholic Graduate School of Business (ICADE) in Madrid.

Adrián Lajous is a special advisor to the President of Mexico on international oil matters. He brings to this role his long experience at PEMEX, the Mexican national oil company, where he was Director General of the corporation and Chairman of the Board of the PEMEX Group of operating companies. Prior to joining PEMEX, Mr. Lajous was Director General for Energy in the Mexican Ministry of Natural Resources and Industrial Development, where he was actively involved in drafting Mexico's first Energy Program in 1978–1979. He has also served on the board of Repsol YPF and as a member of its Chairman's Committee. He is currently President of Petrométrica in Mexico and of the Oxford Institute of Energy Studies, and a member of the boards of directors of many international energy companies. Mr. Lajous was decorated with the Orden del Mérito Civil by King Juan Carlos I of Spain.

Claude Mandil is currently serving a four-year term as Executive Director of the International Energy Agency (IEA), based in Paris. This post is the climax of his commitment to international cooperation in energy affairs and parallels his career as a distinguished French civil servant. While serving as Director General for Energy and Raw Materials at the Ministry of Industry, Post, and Telecommunications, Mr. Mandil was instrumental in arranging for France to become a member of the IEA in 1991. He was France's first representative on the IEA's governing board and served as its Chairman in 1997–1998. His long career with the French civil service has focused on energy issues. Most recently he has been Chairman and CEO of the Institut Français du Pétrole and Managing Director of Gaz de France. Earlier posts have included the Nuclear Safety Working Group of the G7, 1991–1998; Director General of Bureau of Mines and Geology, 1988–1990; CEO of the Institute for Industrial Development, 1984–1988; and Technical Advisor to the Minister's cabinet, 1981–1982. Mr. Mandil is a graduate of l'École Polytechnique and l'École des Mines.

William L. Massey has served as a Commissioner of the U.S. Federal Energy Regulatory Commission (FERC) since 1993. He has actively participated in FERC's restructuring of the natural gas industry, notably via Order No. 636, and was an architect in the development of Order No. 888, FERC's historic electric restructuring initiative. Since

1997, Mr. Massey has served as FERC's lead commissioner on the subject of merger policy. He has had extensive legal and policymaking experience in both the judicial and legislative branches of the federal government, including service as a senior staff member of the U.S. Senate Committee on Energy and Natural Resources. Before joining FERC, Mr. Massey was in private legal practice. He received an L.L.M. from Georgetown University Law Center and a J.D. from the University of Arkansas School of Law.

Michel Massoni serves as Director of Electric Grid Access at the French Commission de Régulation de l'Énergie (CRE). As head of grid access, he oversees the equity of legal, pricing, and material conditions for access to public electricity grids. He also monitors the activity of grid managers. A career civil servant, Mr. Massoni has been involved with many aspects of the French national infrastructure. He served in the Department of Roads, in the Directorate of Land Transport, and as head of the Railways Department and as Technical Advisor to the Minister's Office for Railways. In the 1990s, he joined Electricité de France and Gaz de France. From this extensive background he moved into the CRE. Mr. Massoni is a graduate of l'École Polytechnique and l'École National des Ponts et Chaussées.

Bijan Mossavar-Rahmani is Chairman of Mondoil Corporation, a privately held company active in international oil and gas operations, with a focus in West Africa. Between 1988 and 1996, he was President of Apache International, Inc., prior to which he served as Assistant Director for International Energy Studies, Energy and Environmental Policy Center, Harvard University. A former delegate to OPEC Ministerial Conferences, Mr. Mossavar-Rahmani has published more than ten books and dozens of articles on global energy markets. His books include *OPEC and the World Oil Outlook, Natural Gas in Western Europe, Energy Security Revisited,* and *The OPEC Natural Gas Dilemma.* Mr. Mossavar-Rahmani is active in industry and international affairs, and serves as a member of the International Consultative Group on the Middle East, Chairman of the Board of Foxtrot International LDC, Director of the American-Iranian Council, member of the Corporate Advisory Board of the Eurasia Group, and

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Paul R. Portney is President of Resources for the Future (RFF), an influential nonpartisan research and educational organization based in Washington, D.C., specializing in developing and applying methods of economic analysis to environmental questions for over 50 years. Dr. Portney, an economist and environmentalist, joined RFF in 1972 and served as Director of Research and as Vice President before being named President in 1997. Dr. Portney's career away from RFF has included stints as Chief Economist at the Council of Environmental Quality in the Executive Office of the President, as Chairman of the Environmental Economics Advisory Committee at the U.S. Environmental Protection Agency (EPA), and as Visiting Professor at Princeton University and the University of California, Berkeley. Dr. Portney holds a doctorate in economics from Northwestern University and has published widely on the costs and benefits of environmental regulation.

Robert N. Stavins is Albert Pratt Professor of Business and Government at the John F. Kennedy School of Government, Harvard University; he is also Director of the Environmental Economics Program at Harvard University. Professor Stavins is an economist with a primary interest in environmental and resource policy issues. His current research includes analyses of the diffusion of pollution control technologies, the design and implementation of incentive-based approaches to environmental protection, and alternative strategies for mitigating global climate change. He is director of many environmentally oriented institutions and has been a consultant to governmental agencies, international organizations, and advocacy groups. Professor Stavins served as Director of Project 88, a national bipartisan effort to develop innovative approaches to environmental and resource problems. He holds a B.A. in philosophy from Northwestern University, an M.S. in agricultural economics from Cornell University, and a Ph.D. in economics from Harvard University. He began his career working with the Peace Corps in Africa and in the Middle East.

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