

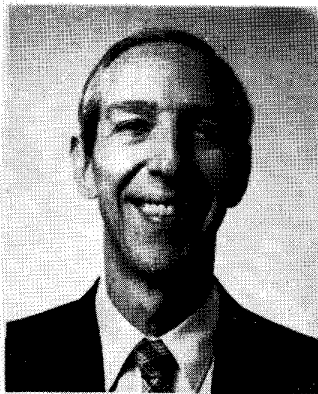
IA INTERNATIONAL ASSOCIATION FOR ENERGY ECONOMICS  
EE  
*Newsletter*

Published by the Energy Economics Education Foundation, Inc.

Editor: David L. Williams Contributing Editors: Paul McArdle, Tony Scanlan and Marshall Thomas

Fourth Quarter 2002

### President's Message



As I look back over the past year, my first reaction is how quickly my time in office has gone. My first message was written about this time last year was full of high expectations for what could be accomplished over during the coming year. I must admit that many of these expectations were fulfilled. We held two major successful conferences – the 25<sup>th</sup> International Conference in Aberdeen and the 22<sup>nd</sup>

North American Conference in Vancouver. Both had excellent attendance, strong programs, and outstanding locations. Thanks to all who were involved in their planning and execution. The Aberdeen Conference was particularly notable for the Scottish Evening and the pipers that were at our evening events. The Vancouver conference was held in one of the most beautiful venues in North America. I am sure there were many smaller events going on throughout the year at the affiliate or chapter level that attracted local audiences and were valuable additions to the larger programs.

Our *Energy Journal* continues to be edited and published on a regular basis and is the best Journal of its kind being published today. My thanks go to the editors – Adonis Yatchew and Campbell Watkins – for their dedication in maintaining the high standards we all have come to expect. My thanks also go to the many others (Associate Editors and the Board of Editors) who dedicate their time and effort to make this Journal a success. The Newsletter has evolved into a more robust publication and I thank the Williams team – Senior and Junior – for editing it and being so diligent in obtaining articles for it. We are hopeful that the Newsletter will evolve into a more useful and interesting publication in the next year since Paul Horsnell, our VP for Publications, has come up with some excellent ideas for improvements. Watch for innovations in the near future.

The part of the organization that you don't see very much of is the work of the Council. We held two meetings – a day long meeting in Aberdeen and a half day meeting in Vancouver. The Aberdeen meeting included a strategy session in addition to the normal business-related discussions. The most important

development coming out of these meetings was a very careful examination of our budgets for the next five years. While we have a substantial financial cushion, we have been spending more than we have been taking in during the past year or two and the projections for the future indicated more of the same. Red ink over a period of years would dissipate our cushion in a few years. We needed to take a hard look at why we were losing money in our operations. We looked at the expenses we have to make to maintain normal operations and those that were discretionary. We also looked at the income side. What we determined was that our income has been stagnant while expenses were climbing coming from our development of our website, business outreach (trying to extend our operations to areas where we don't have any members) and scholarship programs (reaching out to students). Dues had not been changed for more than 10 years. The subscription charge to

*(continued on page 2)*

### Editor's Notes

We open with an overview of the Aberdeen meeting by Paul Tempest and then follow with several papers from the meeting.

Lord Nigel Lawson, who was the UK Energy Minister and then Chancellor of the Exchequer, discusses the UK experience with energy privatisation. He notes the logic of privatisation as well as the major advantages of it and how the UK went about it, starting with the telecommunications industry and then moving through the nuclear power, electricity and gas industries.

Tony Hayward discusses the history and outlook for North Sea oil as seen from a BP perspective. He notes that after 30 years of uninterrupted growth the North Sea is at a turning point and faces the prospect of decline as existing field are depleted and new finds become fewer, smaller and more costly. He looks at the challenges of creating a new future for the area and at the global competitiveness of the area in light of the UK's recent budget.

Robert Priddle discusses a new perspective on energy

*(continued on page 2)*

**Contents:** President's Message p1 • Aberdeen - Some Highlights p4 • Energy Privatisation in the United Kingdom p6 • The North Sea in a Global Context: A BP View p8 • A New Perspective on Energy Security p12 • Electricity Restructuring: Is Ontario Getting it Right? p 14 • Australia on Top p18 • The Swedish Electricity Market: Current Issues p20 • Natural Gas Use in the Mexican Power Generation Sector: Political, Market and Regulatory Issues p22 • Publications p32 • Calendar p32.

**President's Message** *(continued from page 1)*

non-IAEE institutions had not changed for a similar period of time. Finally, we also focused on what each member was receiving as a package of benefits and learned that not everyone was receiving the same package nor paying the same amount of dues. The Council decided that it was time to raise the dues and there will be a modest due increase for most members in 2003. We also raised our Journal subscription price. Finally, by 2005, all members will pay for and receive the same set of benefits – making our package uniform throughout the IAEE. On the expense side, our website expenses have settled down and hopefully we will not need large one time cash infusions to upgrade it and maintain it. Our scholarship program has been continued, but at half the level of the past couple of years, without sacrificing the most important programs. Our business development will continue at modest pace. While it always is somewhat painful to obtain consensus on budget issues, I must compliment our Council for the willingness to go through the examination of our budget and lay out an excellent process that should keep us in good stead for years to come. We leave the IAEE a more financially sound organization as a result of our effort. My warmest thanks to all on the Council who put up with our insistence that we complete this task this year.

Another part of the organization that many don't see often is our Business Managers – Dave Williams, Sr. and Dave Williams, Jr. These two are the backbone of the organization, and the institutional memory. They are there every day working to ensure that the organization maintains its momentum. As President, I lean on them heavily to make sure that I am doing what needs to be done. The Council leans on them as well. Their involvement in our conferences is invaluable. I know that I could not have done my job as effectively without their support and expertise. My warmest thanks to both of you.

Finally, I want to thank all members for all that you do to continue the success of the IAEE. This is a wonderful organization. It offers so many opportunities to meet new people, maintain friendships, and enhance our professional skills through exposure to new ideas. We could not be

successful without all of you continuing your interest and membership. Let's keep up the terrific work and continue to make this the best organization for energy professionals in the world. Thanks and au revoir!

*Len Coburn*

**Editor's Notes** *(continued from page 1)*

security noting that the IEA was founded in order to contribute to greater international energy security, but in the years since its founding its focus has moved to other areas such as energy sector efficiency and environmental matters. With the events of the last several years, and especially since 9/11, energy security has been restored to its rightful place as one of the three pillars supporting economic development.

John Grant notes that Ontario, Canada, simultaneously opened its wholesale and retail electricity markets to competition on May 1, 2002, and, despite a fairly tight reserve position, they have met the challenges successfully so far. "Seamless" trading with neighbouring control areas, development of forward markets, and locational pricing are among the issues to be addressed going forward.

Tony Owen makes the case for Australia's ratification of the Kyoto Protocol, noting that the preconditions for ratification have been met. He suggests that the Prime Minister will eventually do a turnabout on the issue and ratification will follow.

Lars Bergman reviews the Nordic electricity market. He notes that electricity reform in the Nordic countries preceded the EU directive and has been more far-reaching than that prescribed by the directive. He touches on the peak load capacity problem in that some of this capacity has been closed down. The coming use of green certificate trading is also noted.

Alberto Elizalde Baltierra examines the main political, market and regulatory issues concerning natural gas use in the Mexican power generation sector. He also studies the impacts of a technology diversification policy regarding the primary energy used to generate electricity. For that, he make use of the LEAP system to simulate two scenarios of the power generation system to 2020.

**PRAGUE IAEE CONFERENCE STUDENT SCHOLARSHIPS AVAILABLE**

IAEE is offering a limited number of student scholarships to the 26<sup>th</sup> IAEE International Conference. Any student applying to receive scholarship funds should:

- 1) Submit a letter stating that you are a full-time student and are not employed full-time. The letter should briefly describe your energy interests and tell what you hope to accomplish by attending the conference. The letter should also provide the name and contact information for your main faculty supervisor or your department chair, and should include a copy of your student identification card.
- 2) Submit a brief letter from a faculty member, preferably your main faculty supervisor, indicating your research interests, the nature of your academic program, and your academic progress. The faculty member should state whether he or she recommends that you be awarded the scholarship funds.

IAEE scholarship funds will be used to cover the conference registration fees for the Prague IAEE International Conference. All travel (air/ground) and hotel accommodations, meal costs (in addition to conference-provided meals), etc., will be the responsibility of each individual recipient of scholarship funds.

Completed applications should be submitted to IAEE Headquarters office no later than May 6, 2003 for consideration. Please mail to: David L. Williams, Executive Director, IAEE, 28790 Chagrin Blvd., Suite 350, Cleveland, OH 44122.

Students who do not wish to apply for scholarship funds may also attend the conference at the reduced student registration fee. Please respond to item #1 above to qualify for this special reduced registration rate. Please note that IAEE reserves the right to verify student status in accepting reduced registration fees.

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Hosted by:

International Association for Energy Economics  
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Ethics and Equity Markets

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Sustainable Development in Energy Context

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New Technologies in Energy

### \*\*\*\* CALL FOR PAPERS \*\*\*\*

**Abstract Submission Deadline: December 31, 2002**

(include a short CV when submitting your abstract)

Anyone interested in organizing a session should propose topics, motivations, and possible speakers to:

Ivan Benes – (f) 420-2-2492-2072 (e) [ivan.benes@cityplan.cz](mailto:ivan.benes@cityplan.cz) or

David Williams – (f) 216-464-2737 – (e) [iaee@iaee.org](mailto:iaee@iaee.org)

Abstracts for papers should be between 250-1500 words giving an overview of the topic to be covered. Please indicate which track (listed above) your paper will fit. At least one author from an accepted paper must pay the registration fees and attend the conference to present the paper. The lead author submitting the abstract MUST include complete contact details (e.g., mailing address/phone/fax/email coordinates). Note that papers not placed in concurrent sessions will be allocated, space available, in poster sessions.

Concurrent session and poster session speakers will have their papers printed in the conference proceedings.

All abstracts must be submitted electronically to:

David Williams, International Association for Energy Economics  
28790 Chagrin Blvd., Ste. 350, Cleveland, OH 44122 USA  
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If interested, please contact IAEE Headquarters for detailed applications / guidelines.

STUDENT PARTICIPANTS: Please inquire also about scholarships for conference attendance to [iaee@iaee.org](mailto:iaee@iaee.org)

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## Aberdeen - Some Highlights

*Paul Tempest, Program Chair*

The 25<sup>th</sup> Annual International Conference held in Aberdeen on 26<sup>th</sup>-28<sup>th</sup> June 2002 was, from my point of view, a most valuable and enjoyable gathering of friends and colleagues in a warm, friendly setting. Others will have drawn attention to the high response, broad coverage and distinction of the contributors. From my own perspective, there were six highlights:

### Opening Plenary

**Robert Priddle**, Executive Director of the International Energy Agency, gave us a fine start of considerable substance. His detailed and careful analysis of the responses to the grave and sinister events of 11<sup>th</sup> September 2001 gave food for thought: "a new sense of vulnerability inducing the widespread fear of a new world disorder". We were delighted that **Vicky Bailey**, the new Assistant Secretary of the U.S. Department of Energy and **Gerald Doucet**, Secretary-General of the World Energy Council were also present to make major contributions: both focussed on global energy deprivation and the hopes that more enlightened international financing, skills deployment and technological "leap-frogging" might begin to provide a remedy.

### Luncheon Speakers

**Lord Nigel Lawson**, the BIEE President, gave a vivid, first-hand account of energy privatization in the UK while **Michael Lynch** gave another hilarious account, complete with stage-props, of "The Perils of Forecasting".

### Co-plenaries

One problem with co-plenaries is the impossibility of being in two or more places at the same time. From what I saw, the Middle East Co-Plenary was electrified by **Seyed Alavi's** clear and compelling account of Iran's current priorities, which was matched by **Dr. Chalabi's** equally well-structured remarks about Iraq. **David Newbery** gave a well-informed analysis of electricity liberalization in the UK with some striking conclusions of world-wide relevance, and I particularly enjoyed **Jonathan Stern** outlining the options for European gas. I was told widely that **Michelle Michot Foss's** co-plenary on U.S. Regulation led by **Dr. Shirley Neff** of the U.S. Senate Committee on Energy, together with **Paul Steven's** co-plenary on Energy Liberalization in Developing Countries and **Hoesung Lee's** co-plenary on Asia were all well-attended and well-addressed leading to lively debate and providing excellent opportunity for networking.

### Shell and BP

The session where **Malcolm Brinded**, Group Managing Director of the Shell Group and **Peter Davies**, Vice-President, BP introduced their latest company thinking on energy prospects was a splendid climax for the final morning. Printed copies of the new detailed Shell Scenarios booklet (covering the period to 2050) and the newly issued BP Annual Statistical Review for 2002 were available for every participant. In my summing-up I paid tribute to the two companies, who were the lead-sponsors and who were both involved in the planning of the conference from the very first bid-document to some of the on-the-spot administration, includ-

ing a breakfast and a dinner, at the conference itself.

### Parallels and Posters

I looked in on every one of the 21 parallel sessions and walked round each of the poster sessions each day. Yes, we should have given the poster presenters much more space. Yes, we placed heavy demands on time-constrained parallels chairs faced with four or five and, in one case, six speakers. Yes, our policy of accepting as many of the 200 or so papers offered as possible did lead to a congested programme and left too little time for effective formal debate. Yes, our strong policy of bringing the student membership to the forefront caused some eyebrow-raising. Nonetheless I think most of the people were mostly happy most of the time, and some seemed very happy.

### Nine Past-Presidents

**Len Coburn's** clever idea of assembling as many of the Past Presidents as possible for the final session gave a cheery final flourish to the Conference. My misgivings - that no grouping of nine energy economists could ever conceivably be persuaded to make nine contributions in turn within the allocated total of twenty-five minutes, i.e., 2.8 minutes each - proved to be quite unfounded, giving a crisp and sharp ending to the gathering.

There are also the images we will long remember: for me, first **Alex Kemp's** 24-strong Highland village band - immaculately turned out, resolute in the rain at Ardoe House and deafening once they got going inside. Second, the splendid atmosphere of King's College for the opening reception and third, by no means least, the Scottish Gala Evening and Banquet complete with the Lord Provost (a lady) and a cornucopia of ballads and reels and pipes and other quintessential Scottish entertainment.

Three remarks noted down at the time:

- "OPEC is like a tea-bag - it only works in really hot water".
- "God created economists to give credence to astrology"
- "Oil is not a weapon; oil is not a tank", said one of the Saudis.

Finally, a very big thank-you indeed to all the participants, members and helpers who gave freely of their time, experience and judgment to make the program - and indeed - the whole conference a success.

*Paul Tempest*

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## Energy Privatisation in the United Kingdom

*By Lord Nigel Lawson\**

I would like to say a few words about energy privatisation, and I would like to focus on only one key aspect of this.

The success of private sector oil companies in developing the industry and the market since its earliest beginnings is so obvious as to make it clear that state ownership of the oil sector is anomalous and unnecessary, and usually a historical relic of little relevance to the present. So the privatisation of oil, although important, should be uncontroversial – and the same goes for coal.

But gas and electricity are a different matter, and it is this on which I wish to focus, drawing on our experience here in the UK, which is what I know best.

There used to be a widespread assumption that, whereas privatisation might make perfectly good sense for industries in the competitive traded sector, a public utility had to be state-owned, otherwise the consumer would be exploited and security of supply endangered. Indeed, if you could not introduce competition, the argument went, where was the benefit of privatisation anyway?

I believe that there are a number of myths here.

Certainly that was the conclusion reached by the government in which I served during the 1980s. I would like to spend a little time on the logic of public utility privatisation.

In the first place, when one looks closely at it, although there is probably an irreducible degree of monopoly in the public utilities, it is in fact much less than people used to take for granted. There is far greater possibility of introducing competition, and thus of deriving the economic benefits of competition, than those who run state monopolies customarily imagine.

The apologists for state ownership invariably extend the boundaries of monopoly far further than is necessary so to do.

In the UK, for example – and although this may be a trivial example, you would be surprised at how much passion this generated in Britain at one time – the former state monopoly in the gas industry extended even to the sale of gas appliances, so that only the state-owned gas industry was able to sell gas appliances to domestic consumers.

That is clearly not a natural monopoly.

In the electricity industry, far more fundamentally, although the distribution of electricity has some elements of natural monopoly, notably the network or grid, the generation of electricity is certainly not a natural monopoly. Yet it used to be automatically assumed in the UK that the whole electricity supply industry, both generation and distribution, was an irreducible natural monopoly.

It is only when one comes to privatise that it becomes clear that one can introduce competition into a number of areas where it was said there could not be competition.

Thus it is that today we now have a substantial degree of competition even in the distribution and supply of electricity – and the same goes for gas.

\*Lord Lawson is President of the British Institute for Energy Economics. He was UK Energy Minister from 1979 to 1981 and Chancellor of the Exchequer from 1983 to 1989. This is an edited version of his remarks at the opening luncheon of the 25th Annual IAEE International Conference, held in Aberdeen, Scotland, June 26 to June 29, 2002.

There is a further important point: Monopolies, where they exist, have to be regulated, whether they are in the public or the private sector. But it is far healthier if the regulator and the owner are not one and the same. Otherwise, you have a clear conflict of interest.

The most striking example of that is in Eastern Europe, where there used to be a full-blooded socialist system, with full-blooded state ownership of everything. As a result, there was the most appalling environmental degradation.

It is of the first importance, whether in terms of environmental regulation or price regulation or whatever is necessary to prevent the exploitation of the consumer and the public, to have ownership and regulation separated. That is what privatisation can achieve and has achieved in the UK. That is what did not happen during the period of state ownership, when the state was both the owner and the regulator. That is another practical advantage of privatisation.

What it did mean, however, was that, for the public utilities, privatisation was a particularly difficult and complex process, since it had to go hand in hand with setting up a proper and explicit regulatory structure. This meant an independent regulator, supported by a small staff, and armed with the powers required to prevent the consumer from being exploited.

We rejected the method, which used to be favoured for public utility regulation in the United States, of a limit on the permitted return on capital, as that can lead all too easily to the gross inefficiency of so-called gold-plating – that is, the practice of boosting profits through the extravagant use of capital.

Instead, we relied on price control, characteristically allowing the company to raise prices each year by  $x$  per cent less than the general rate of inflation, the number for  $x$  being chosen by the regulator on the basis of a reasonable expectation of the company's cost and productivity improvement, coupled with – and this is of the first importance – charging the regulator with the responsibility to promote competition in the industries.

The idea was that, over time, this second element, competition, would become increasingly important, and as it did the first, price control, would gradually fade away.

Yet another major advantage of privatising public utilities is that, not only does one get rid of the harmful effects of politicisation, but a completely different psychology is created. Even where there is no competition in the normal sense, in the goods and services markets, there is still competition in the capital markets for capital. That alters the way in which companies behave.

If they have to go out and compete for capital, there exists a very important form of competition, which is sometimes overlooked.

There is also the discipline of the share price.

The fact that companies are being judged every day by the markets and that this judgment is shown in the prices of their shares, however inadequate and imperfect that may be, is an added discipline which does not exist at all – by definition – under state ownership.

For all these reasons we came to the conclusion in the UK, and some (although not all) other countries have come to a similar conclusion, that even in the case of natural monopolies and public utilities (which as I have indicated are not coterminous), and which are particularly important in the

energy industry, but also extend outside it, notably in water supply, there is a clear practical economic advantage in privatisation.

There is also a degree of transparency that has to exist by law with privatised concerns, but which does not exist under state ownership. That was a benefit which we did not see in advance, but which we discovered once we had embarked on privatisation.

The first major utility privatisation that we decided to do was in telecommunications, with the privatisation in 1984 of British Telecoms.

When we came to look at this industry, although the state-owned corporation knew its overall financial results, it turned out that it had no idea which parts of its operation were profitable and which parts were loss-making. It had no idea of what cross-subsidies were taking place within it, and it was only when proper accounting was put in, which it had to be for privatisation, that this emerged.

Another important example of the facts only coming to light as a result of the preparations for privatisation concerned the true cost of nuclear power. While the nuclear power industry, and the electricity supply industry of which it is a part, remained in state hands, the true cost of nuclear power was concealed. By that I mean the best guess cost of the eventual storage or disposal of nuclear waste and even more important, of decommissioning the nuclear power stations at the end of their lives. The true level of these costs was concealed from successive governments. It may have been that the industries themselves were not aware of them, that they had not done the sums.

Why should they? They did not need to.

I am not accusing the people who ran the nationalised electricity industry of deliberate concealment from ministers. Although ministers were not aware of the facts, it may have been that those who ran these industries did not know themselves.

Certainly it is the case that it was only in the course of preparation for privatisation that these costs – which were not obvious because at that time no nuclear power station had ever had to be decommissioned, so that there was no history to look into – were far greater than the state owned industry had been providing for.

As a result, nuclear power generation had to be separated from the rest of the industry and only privatised subsequently after the issue had been properly addressed. That was an example of transparency which was clearly desirable and which only came about in the course of the move towards privatisation.

Over the years, mainstream economists have, I believe, made a big mistake. They have focused almost exclusively on the issue of competition versus monopoly, which is certainly an important issue, but not the only one.

The benefits of competition are very real, but the issue of ownership is almost as important as the issue of competition. That has been demonstrated in a very practical way by the wave of privatisation which has engulfed the world and which has had results that in almost all cases have been highly beneficial.

When we first embarked on privatisation in the UK – and we were, of course, the first country ever to do so, so much so that we had to invent this rather ugly word ‘privatisation’ to describe what we were doing – most observers took it for

granted that the motive was simply to raise money. This assumed – not altogether without some foundation – that governments always like to raise money, and that we had now found a clever new way of doing so.

But that was not the motive at all.

Indeed, had it been, we would not have reduced the market value of the public utilities by subjecting them either to a rigorous regime of price control or to the imposition of competition, let alone both.

No: the motive was to improve the performance of the economy as a whole by improving the performance of this very important sector.

That has been achieved to a remarkable extent. When the industries were state-owned, they invariably either made losses, or, if they were profitable, made a grossly inadequate return on capital.

In the private sector these same industries, even though subject to considerably more competition than they ever experienced under state ownership, are now all profitable and making the same sort of return on capital as other private sector companies. And, this marked turn-around has also greatly benefited the public finances.

Whereas the state sector of industry, with its frequent need for subsidy, tended to be a drain on the public purse, these same industries are today providing the Treasury with substantial tax revenues from the taxation levied on their profits.

In the gas and electricity industries the improvement in economic performance has been particularly marked. This has come, essentially, from two factors. First, given the rigorous price control to which I have already referred, private ownership provided for the first time an incentive to boost profits by cutting costs, and to do so by driving out waste, overmanning, and other inefficiencies.

The improvement in efficiency was quite remarkable. I think it is fair to say that, at the time of privatisation, no-one was aware – none of us in government, nobody in the financial markets – just how inefficient these industries had been under state ownership.

Hence, incidentally, what with the benefit of that marvelous attribute, hindsight, appears to have been a serious underpricing of the shares at the time of privatisation and the consequent phenomenon of the so-called “fat cats”.

The second factor behind the marked improvement in economic performance in the electricity and gas industries since privatisation has been the progressive introduction and extension of competition, where the regulatory (and deregulatory) authority, OFGEM, under the outstanding leadership of Callum McCarthy, has played the crucial role, to great effect. So much so that today, of the energy activities that were subjected to regulation – chiefly via RPI-X price control – at the time of privatisation some dozen years ago, roughly three quarters are now entirely free from regulation.

The former monopolies of retail gas and electricity supply, of gas storage, and of gas and electricity connections have all been brought to an end and replaced by vigorous competition, thus eliminating the need for administered price controls. Competition in gas and electricity metering is on the way; and in general regulation is being maintained only for the irreducible natural monopolies of the networks them-

*(continued on page 19)*

## The North Sea in a Global Context: A BP View

By Tony Hayward\*

What I'd like to do today is to look forward to the challenges that the North Sea will face in the future – there's probably not a better location to do this and the timing is right. Over the last 12 months or so it has become clear that the UK North Sea is at a turning point in its evolution.

Having enjoyed 30 years of uninterrupted growth, it now faces the prospect of decline as existing fields are depleted and new finds become fewer, smaller and more costly to develop.

This does not mean that the UK North Sea is in "harvest mode", and as I will discuss in my remarks, I believe there are steps the industry and the government can take together to create a new future for the UK North Sea.

### Agenda

So my agenda is to briefly cover:

- the history and outlook for the industry,
- summarize BP's position as seen through the eyes of a global super-major,
- reflect on the challenge of creating a new future – in the face of a seeming inexorable decline,
- and to look at the global competitiveness of the UK North Sea in light of the fiscal changes introduced in the recent budget.

### Production Outlook

Let me begin with the track record – always a good place to start:

From the early seventies through the mid-eighties, the North Sea enjoyed significant growth in production. This was driven by large scale finds including BP's own Forties field.

By the mid-eighties oil prices were lower and we faced a future production decline that, at the time, seemed similar to today. The big fields were in decline and squeezing more production and acceptable returns out of current and future developments became a greater challenge.

However, as many of you know, both industry and government met that challenge; new field development filled in many gaps in the map and volumes rose again through the nineties.

Specific interventions at this time were the CRINE cost reduction initiative led by industry, and Government's role in the elimination of PRT and in gas market liberalization.

So, where are we today?

The generally accepted view is that we are about half way through the basin's life.

The White Zone in the West-of-Shetlands, once seen by both BP and the industry as the opportunity to maintain current levels of production, has seen extremely disappointing exploration results.

Future exploration will add more reserves and one-off

\* Tony Hayward is Group Vice President and Group Treasurer of BP plc. This is an edited version of his remarks at the 25th Annual IAEE International Conference, held in Aberdeen, Scotland, June 26 to June 29, 2002.

successes such as Buzzard will still occur. But for the most part, new finds will be smaller, fewer and more spread out.

Basin production will be increasingly dependent on better technology, improved recovery from mature fields, and efficient development of remaining discoveries such as Clair.

The next 2-to-3 years will see the onset of a production decline, which is likely to accelerate beyond 2005. The challenge the industry and government face is how to create a future that manages decline in the most efficient way to ensure that every possible barrel of oil is recovered.

### BP at a Turning Point

BP's story in the UK North Sea mirrors industry experience over the last decade.

Through the 1990's we grew production at 5% pa and reduced unit costs by about 3% pa over the same period.

We developed numerous new fields. Significant post '93 investments included ETAP, Foinaven and Schiehallion. All required new technology and innovation, and were enabled by the change in fiscal regime in 1993 when PRT was removed.

The challenge today looks very different from a decade ago:

- Our base production has begun to decline from highs in 2000 and 2001, and most importantly, we don't have the same development opportunities as a decade ago. Clair, Rhum, Devenick and others are important but they're no substitutes for Bruce, Miller, Schiehallion, Foinaven, and ETAP ... and as I have already noted the White Zone failed to deliver any major new discoveries for BP.
- Investment has shifted to infill & mature field investments. In the nineties we drilled infill wells mainly in Forties and Magnus... today we are active nearly everywhere. Almost 50% of our capital in 2002 will be invested in infill drilling in mature fields.
- Going forward, we must manage decline in the most economical way. That means keeping unit production costs flat as base production decreases and utilizing infrastructure and economies of scale that are available today, but that probably will not be available a decade from now. All of this is, of course, predicated on the basin remaining competitive in a global context.

### BP Resources: Opportunities and Challenges

Let me now turn to BP's North Sea resource base, which is probably broadly reflective of the North Sea as a whole and certainly serves to illustrate the nature of our future challenges and, I believe, the industry's at large.

We have some 5bn boe of future resources including barrels beyond current technical limits. Just to put the North Sea in context – that is more reserves than in the Deep Water Gulf of Mexico where we have some 3bn boe net, and Azerbaijan where we have some 1.5bn boe – so the North Sea remains immensely important to BP and we expect to be doing business here for a very long time to come.

The "base", or already-producing reserves, contains developed reserves in excess of 2bn boe. This base requires ongoing investment and, operational and cost -control excellence.

We also have more than 1bn boe of what we refer to as



“quality development options”. These include fields such as Rhum, Devenick and Clair, and infill opportunities in existing fields. These will be the focus of our investment activity over the next few years.

We also have a significant tranche of reserves, more than 1bn boe, of “marginal development options”, which are not likely to attract investment today.

However, we know what we need to do to access them. The opportunities here need lower cost wells, enhanced oil recovery schemes or low-pressure gas operations.

The key to producing these reserves will be the application of technology such as 4D seismic, through tubing rotary drilling and additional compression. Accessing this significant prize is a major challenge.

And finally, a more elusive prize of 1bn boe exists beyond our current technological capabilities.

So there is a lot to go for. How are we going about it?

### **Creating the Future**

There are three key levers:

- The application of the right technology,
- The creation of commercially innovative solutions, and continually reinventing our business processes to lower unit costs and realize productivity gains.
- All of these can only work if they take place in an environment of fiscal stability and global competitiveness – something I will return to later.

### **Technology**

Let me start with technology.

Increased recovery factors in mature fields such as Forties reflect the ongoing delivery from technology. 4D seismic is one of the key applications. It has proven particularly successful in fields like Forties, Foinaven and Schiehallion where un-swept areas of the field provide the best infill targets.

Having identified un-swept oil, we need to access it at lower costs. In Alaska we succeeded in reducing access costs by 75% using Coiled Tubing Drilling – the challenge is to replicate that performance in the North Sea.

In the West of Shetlands we are in the process of designing wells for subsea through tubing rotary drilling at low cost. Through tubing rotary drilling and multilateral drilling will be key levers for accessing mature reserves.

Most of our new developments will be satellites. The next phase of ETAP is underway with the development of the Mirren & Madoes satellites. This is a great example of commercial consolidation unlocking the developments.

Other major satellites will be Rhum and Devenick. For Rhum, we are looking at a sub-sea tieback as a development option over a distance of 45km. This would be one of the longest high-pressure sub-sea tiebacks in the world.

The few remaining green-field developments such as Clair demonstrate how we have managed to unlock marginal fields by bringing Gulf of Mexico learnings and global best cost to the UK North Sea.

### **Commercial Innovation**

Let me now turn to commercial innovation.

We support and promote the need for change and have been very active in this area.

We’ve reduced our fallow acreage portfolio from 200 blocks to 50 and are actively working on the rest.

We can’t stop here. The industry needs to become even more innovative as we head into maturity. The key areas to address include redevelopment of old fields and decommissioning.

BP has a long history of commercial innovation in the North Sea.

MAST, the mature assets team which transformed the potential of Beatrice, Buchan and Clyde fields, was at the forefront of this. As the operator of ETAP we brought a collection of marginal fields together to create a giant oil and gas field.

More recently we have taken the Satellite Accelerator concept into the area of mature field redevelopment. Through this initiative, we are attempting to combine BP and supply chain expertise with 3<sup>rd</sup> party investment to access a significant redevelopment prize in the Northern North Sea Don field.

Another key area we must deal with is decommissioning. This has the potential to continue to be a major barrier to trades. We are considering more innovative ideas such as the temporary farm-outs of assets when they don’t meet our investment criteria.

More recently, the Magnus enhanced oil recovery scheme is an extra-ordinary example of commercial innovation at its best.

### **Magnus EOR**

Gas that was previously flared or reinjected in the West of Shetlands is now piped through a new sub-sea pipeline to Sullom Voe for enrichment with gas liquids; and from there it flows through another new line to Magnus for injection into the reservoir for use in an enhanced oil recovery scheme – that will add 50m bbls of field reserves and extend field life beyond 2015.

When the gas comes out of the reservoir, it will then be piped to the gas processing terminal at St Fergus, north of Aberdeen.

The commercial agreements required to complete this project involved the JV partners in Schiehallion, Foinaven, Sullom Voe, and Magnus; more than 30 different companies in all.

### **Business Processes**

Let me now talk about business processes and some of the things BP is doing to keep investment spending in the UK while at the same time unlocking the full capability of our suppliers

Over 80% of our third-party spending in the North Sea is with UK companies. This year, that represents 80% of around \$2.3bn, including \$1bn in capital expenditures.

Up to 10% of our annual expenditure is with Small to Medium Sized Enterprises or “SMEs”. We see these companies as an important source of innovation, which is critical for the future of the North Sea – it is vital that we unlock more of this potential and make it easier for smaller companies to gain access to companies like BP

In that regard we have run a number of “Share Fairs” for suppliers and contractors and SMEs to share our future plans.

We’ve also worked closely with government on these issues. We’ve been an active participant in the DTI spon-

sored SME mentoring program where a number of our younger high-potential staff have developed mentoring relationships with SMEs.

We have also been active participants in the PILOT Progress Partnership Work Groups and contract initiatives and have signed up to the industry's commercial code of practice welcomed by government earlier this year.

In the second half of last year, we began to re-engineer our own internal business processes with the objective of delivering Great Operating performance.

With the Great Operator or GO business process we are focusing on key operational performance levers; making investments in intellectual capital, rather than financial, and driving for best in class across all our operations – a 25% increase in performance.

This means being able to minimise the production decline rate of our mature fields by excellent reservoir understanding and management, by drilling the very best infill wells at significantly lower costs, by achieving world class standards in the way we execute our projects, and by keeping our facilities – be they platforms or pipelines – operating as close to 100% efficiency as we possibly can.

One of the other important consequences of our Great Operator drive will be continued progress along our journey of eliminating injuries to our people. Over the past decade we have already reduced the incidence of injuries more than 10 fold, and are now approaching industrial world-class performance.

The DAFC frequency rate for all our North Sea operations year-to-date is 0.05 a fantastic achievement – one that the North Sea team is rightly very proud of!

#### **Role of a Super-major**

Let me now turn to the role of a super major.

BP is a strong believer that there is room for everyone in the North Sea – from super-majors, medium sized independents, new entrants and niche players.

So where can we contribute in a distinctive way?

The scale and the consistency of our investment is important. This year we will be investing around \$2.3bn in total in the UK North Sea, including \$1bn in capital. That has a significant impact on the supply chain – as I've already said - with the right investment climate - we have the financial strength to maintain this level of spending through the cycle – perhaps in a way that smaller players may find difficult.

We bring a global perspective to the UK North Sea – the ability to transfer learning from other provinces – for example, deepwater Gulf of Mexico expertise applied to the West of Shetland, and the reverse, of course, applies.

Our diverse portfolio and breadth of activity mean that we can generate options and take risks that others cannot – the Magnus EOR is an excellent example of that.

And we can play a major role in the industry leadership needed to take the North Sea forward and create a new future... most recently through PILOT and related initiatives.

This brings me to one of the issues that is facing the industry today – the need for fiscal stability.

#### **Global Competitiveness**

I have highlighted examples of resource expansion and production growth enabled by both management excellence in the industry and a stable fiscal regime provided by the

government.

The stability of the fiscal regime had encouraged the industry to focus on the remaining potential of the area – up to 18bn bbl of oil, and up to 90 TCF of gas which has yet to be produced or developed – and had led to the situation where, against all predictions, we were seeing a continued increase in production – to a new peak of 2.5m barrels of oil and 10.9bn cubic feet of gas per day next year.

The stability could not offset eventual decline, but it had succeeded in extending the life of the whole province, in maintaining our self-sufficiency in oil and gas for much longer than predicted and in sustaining the 265,000 jobs which depend on the North Sea, including a very large number in Scotland.

Unfortunately the situation changed with the recent budget statement.

As a company, and indeed the industry, we have previously commented on the impact of the budget – the estimated £8bn which will be lost to the industry through to 2010, the uncertainty over the timing of the abolition of Royalty, and the now very high marginal tax rates on our oldest fields – the very ones in which it is necessary to continue to invest. Our challenge now is how to maintain the profitability of a business that has been severely hampered by a significant windfall tax.

The measures announced in the budget did a number of things:

They took money out of the business – in total nearly £8bn will be lost to the industry through 2010, and even at \$15 per bbl, £4bn would be lost over the same period.

The government increased taxes on profits but left in place a regressive tax – royalty – with removal mooted but not delivered – creating a degree of uncertainty which doesn't help anyone planning investments to recover more oil and gas from established fields such as Forties or Magnus.

And they put into place a new regime designed for a high oil price world, which takes no account of the possibility that prices will fall back to their long-term average – which is around \$18-\$20 per barrel.

The global competitiveness of the North Sea has been reduced by the fiscal changes, and this is unfortunately likely to lead to reduced investment and to hasten the decline in production.

BP believes, therefore, that further changes in North Sea taxation are now required. The sooner these can be agreed, the greater chance of minimising the damage caused by the Budget. The abolition of Royalty and the allowance of Financing costs are, of course, necessary, but by no means, sufficient improvements. Without further changes, BP and other companies will find it much more difficult to justify the sort of investments, particularly in mature fields, which can significantly prolong the life of the North Sea.

Their direct impact will be compounded by the fact that a change made in this way, without consultation with the industry, reduces the confidence in the stability of the regime going forward and imposes an added element of risk on all future decisions.

The tax system which was in place prior to the budget wasn't perfect but it was effective.

Its effectiveness was demonstrated by the level of

*(continued on page 16)*

**Institute for International Energy Studies (IIES)**  
**7<sup>th</sup> INTERNATIONAL CONFERENCE**  
**THE IMPACT OF GLOBALIZATION ON MIDDLE EAST**  
**OIL AND GAS INDUSTRY**

December 9<sup>th</sup> –10<sup>th</sup> 2002, IRIB Conference Center-Tehran, Iran

Co-Organized by Iranian Association for Energy Economics, an affiliate of International Association for Energy Economics

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New Arrangements in Financing and Investing in Energy Sector  
Deregulation and Its Impact on Middle East Oil and Gas Industry  
Sanctions and the Future of Oil Supply  
Revisiting Caspian Energy  
E-Commerce / E-Procurement Application in Oil and Gas Industry

**Main Speakers:**

- |  |  |
|--|--|
| ◀ <b>HE Bijan Zanganeh,</b><br>Minister of Petroleum, I.R. Iran                                | ◀ <b>Mr. David Fitzsimmons,</b><br>Group Vice President, bp, UK            |
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## A New Perspective on Energy Security

*By Robert Priddle\**

My theme is energy security. That will come as no surprise to those of you who know the origins of the International Energy Agency (IEA). Our founding fathers created the Agency in order to contribute to greater international energy security, especially oil security. That remains our core role.

Yet it is fair to say that, in the 1990s, the (now) 26 member nations of the IEA looked to the Secretariat for public policy analysis and proposals largely in other areas. Their preoccupations, then, were the pursuit of greater economic efficiency in the energy sector, through deregulation and the introduction of competition into gas and electricity markets, and how best to tackle greenhouse gas emissions from energy production and use. Oil security was rather taken for granted. And there was little reason to be concerned about energy security more generally, at least in terms of the availability of the necessary primary resources: the presumption of abundance was, indeed, confirmed by the IEA's work on supply prospects for the next 20 years, published in the World Energy Outlook series last year, under the by-line "Assessing Today's Supplies to Fuel Tomorrow's Growth".

So, what has changed? Why is energy security back at the top of the agenda? Our minds spring automatically to September 11 last year. There is no doubt that the terrorist attacks on the United States have significantly changed the world. A spate of conferences has sought to analyse exactly how. Typical amongst them was one at the London School of Economics in April under the title: "A New World (Dis)order".

In the fuel markets, the appalling events of September 11 led to an immediate surge in the oil price, reflecting fears of repercussions which could threaten oil supply. That price reaction was very short-lived; and it was followed by a sharp price fall. But the immediate effect was a heightened sense of vulnerability – and of solidarity in the face of unforeseen horror. The Secretary General of OPEC immediately announced OPEC's readiness to make good any lost oil supply – a significant assurance, to which I shall return. For its part, the International Energy Agency geared up to act, tailoring its emergency response readiness to the new circumstances.

We have now had a little time to take stock of September 11. It was, certainly, an appalling and grave event. Energy installations everywhere have had to move to a higher state of alert. We have seen anti-aircraft missiles deployed around the nuclear fuel processing plant at La Hague. The vulnerability of gas terminals, gas pipelines, oil installations and generating plants has been reappraised. Last week announcements were made in New Jersey and Pennsylvania about the distribution of potassium iodide pills to those living within 10 miles of nuclear plants, as a safeguard against thyroid cancer. The President has signed a bill that requires such pills to be available to all Americans living in the vicinity of nuclear plants.

Beyond the United States, the world is, evidently, more at risk. Events in Afghanistan, Iraq, Israel and Palestine,

Pakistan and India all had, or have, the potential to disrupt world peace or, at least, world trade, especially trade in oil. Iraq's suspension of oil exports in April followed the first overt call to oil producers for many years to use oil as a weapon to shape political events. The idea – but not the reality – found an echo in Iran and Libya. The stability of the regimes of the Persian Gulf, especially the Kingdom of Saudi Arabia, came under new scrutiny as the dominant nationality of the September 11 hijackers became known.

These are, indeed, grave events and grave threats. But the geopolitical risk to continuity of oil supply is, in itself, nothing new. These are but current, concrete examples of the known geopolitical risk, against which the governments of the industrialised world decided, over twenty five years ago, they must protect their citizens. On the other hand, the terrorist threat, in the form perpetrated in the United States, is indeed new. The actual and potential consequences for peaceful, local communities are appalling. But the direct and immediate effect of such terrorist action on energy supplies would be essentially local. International markets would flicker, but not be fundamentally disrupted.

So we have to dig deeper to account for the renewed, world-wide anxiety about energy security. One important indicator is that this renewed concern pre-dates September 11. Energy security was already the main focus of discussion when IEA Ministers met in May, 2001. Commissioning the National Energy Review had been one of the first actions of the incoming Bush administration. The European Commission was consulting its member states and others throughout last year on its Green Paper on energy security in the European Union.

The Californian energy crisis in late 2000 and early 2001 was one precursor. Interruption of electricity supply and fluctuations in the price of both electricity and gas beyond the range with which consumers could reasonably be expected to cope – beyond, indeed, the capacity of major players to survive – sent shock-waves through the system.

But the origins of the new political preoccupation lie further back still. The year 2000 had seen mounting concern on the part of oil consuming countries about excessively high crude oil prices. This was the year of Energy Secretary Richardson's constant, highly-published perambulations around OPEC producers in pursuit of commitments to increase oil supply. By September, discontent about the price of oil products, expressed through direct action by truckers, fishermen and others, starkly confronted governments in Europe, winning a variety of tax and other concessions. In February of 2001, the Australian government abandoned routine excise duty uprating in the face of similar protests.

The protestors' fire was directed as much at the taxation policies of consumer governments as it was at oil companies and, behind them, the producing governments responsible for high crude oil prices. Oil producing states had done a good job in 2000 in drawing attention to the high proportion of taxation in the final price of many oil products, especially in Europe. But, while some governments in consuming countries had, indeed, adopted policies of successive, real increases in oil product taxation, in pursuit of environmental objectives, the proportion of taxation in the gasoline price had actually fallen in Europe in 2000 in the face of the rise in the crude oil price. Governments of oil consuming states had some justification for feeling that their electors' wrath was

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misdirected.

The high crude oil prices of the year 2000 stemmed from OPEC's newly-refound authority in the market. Perversely, that, in turn, stemmed from OPEC's disastrous misjudgment, late in 1997, to increase production quotas just as the Asian financial crisis began to bite deeply into oil demand. The consequence of that was the price collapse of 1998, which persisted into 1999 until, at the third attempt, OPEC and some non-OPEC producers convinced the market that they were serious about cutting production back and could be relied upon, more or less, to fulfil the commitments they had made to each other in this respect. This was the classical tea-bag effect in operation. OPEC is like a tea-bag. It only works when it is in really hot water.

Unfortunately, attempts to manage the market by governments acting collectively, in meetings held at irregular intervals and preceded by much publicity, are highly imperfect. Governments are also, by nature, unadventurous. They look back, rather than forward. The newly-disciplined OPEC production cuts were biting as oil demand began to take off again, stimulated by the low prices of 1998 and early 1999. This led to the price peaks of 2000 and the consumers' anguish to which I have referred.

The Californian experience then came piling on top – the consequences of an ill-designed competitive regime, superimposed on a previous regime which, for years, had given inadequate incentives for new investment in generation capacity. Inappropriate price caps triggered supplier bankruptcy. The regime appears to have encouraged manipulative trading. Gas demand soared and gas prices, too. All this was enough to sow serious doubts in the minds of legislators and the public about the desirability of the process of market deregulation, in the USA and elsewhere. Could the new, competitive markets be relied upon to maintain short-term supply reliability, at a reasonable price, and secure the necessary flow of investment to provide the capacity to meet future demand growth?

Our answer, in the International Energy Agency, is, largely, yes. We derive this answer from analysis of the performance so far of competitive electricity markets around the world. We published our findings last week in a book entitled "Security of Supply in Electricity Markets – Trends and Issues". Despite all the attention which California has received, the international picture is reassuring. Where electricity prices have been appropriate, as in the UK and the Northeast of the USA, abundant investment has flowed into the electricity market. Generating reserves have declined following market liberalisation. This is no surprise. One of the objectives of liberalisation is to achieve greater economic efficiency by eliminating over-capacity. But reserves have generally remained robust.

But this is retrospective analysis. It wasn't available when the lights were going out in California and prices were soaring beyond reasonable levels. The process of deregulation then came into question. Couple this with soaring gas and oil product prices, new OPEC confidence in its powers of market management, new global conflicts and then a new, specific terrorist threat and it is no wonder that governments are looking again at the basics of energy security. This preoccupation extends beyond the OECD countries. ASEAN is reviewing its mutual oil emergency commitments, with the determination to give them new reality. ASEAN + 3

(ASEAN + Japan, China and Korea) are debating emergency arrangements. The Chinese government has committed itself to build oil emergency stocks and is drawing directly on IEA experience. The need for action in this area was a recurrent theme at the Asia Oil and Gas Conference in Kuala Lumpur earlier this month. Governments have never doubted that national security is their responsibility. They have been starkly reminded that their responsibilities extend to energy security, even in liberalised markets.

That reminder is no bad thing. It will bring conflicting policies into better balance. But I do not want to give the impression that the picture is all black.

I have said that analysis of primary energy resources shows that reserves are plentiful – though largescale mobilisation of financing is necessary to turn reserves into available supplies. The process of deregulation is proceeding, despite California. Iraq may have cut oil production for political reasons; but its action had practically no effect on the international oil market. Indeed, that action provoked one of the most forthright recent affirmations, by an oil supplier of producers' commitment to maintain the reliability of supply. "Oil is not a weapon. Oil is not a tank.", said the Saudi Foreign Minister on 19 April. And I remind you again that the first action of the OPEC Secretary General, Ali Rodriguez, when news broke of the September 11 attacks, was to assure the market that producers would make good any oil supplies which might be lost.

What this reflects is a new maturity in the relationship between oil producers and oil consumers. Late in 2000, in Riyadh, Ministers from oil producing and consuming states met for the seventh meeting of the series started early in the 1990s (now known as the International Energy Forum). That meeting came at a propitious time. The year had seen extensive bilateral contacts between consumers and producers. The U.S. Energy Secretary attended the Forum for the first time ever: he could hardly do otherwise. Though price and production control were forbidden subjects, as always, the underlying issues were addressed with a new directness. And when the Saudi Crown Prince proposed that the time had come to give the dialogue some institutional permanence, there was no dissent. That initiative is expected to mature in September in Osaka, at the eighth meeting of the International Energy Forum. Producers and consumers will create a joint secretariat to underpin future work. They will review – and not doubt extend – successful joint efforts over the past two years to improve the topicality and accuracy of the demand, supply and stock data available to the market (the Joint Oil Data Exercise – JODE).

Looking to the future, what the experience of the last few years has done is to rebalance government energy priorities. Environmental issues remain important. So, too, is the pursuit of greater economic efficiency through deregulation and the introduction of competition. But the third pillar, energy security, is now restored to its rightful place. The energy contribution to sustainable development rests on all three pillars. This message is not welcome to all – for example, some members of the single-issue environmental community. They don't like its starker forms of expression, for example, in the United States. But it is a message which the entire IEA community has agreed to promulgate and will be seeking to see reflected in the outcome of the World Summit on Sustainable Development in Johannesburg in August.

## **Electricity Restructuring: Is Ontario Getting it Right?**

*By John Grant\**

As many know, electricity restructuring is proceeding rapidly in much of the United States and indeed many parts of the world. As far as Canada is concerned, the two provinces of Alberta and Ontario have led the way but there isn't exactly a rush to get on board. Most of the Canadian provinces already benefit from relatively low-cost and ample electricity supply, based on endowments of hydro power or coal and, in Ontario's case, large-scale nuclear installations. Given this endowment, most Canadian provinces see themselves as exporters of electricity (as well as other energy products) to the United States and will do whatever is necessary, including providing open access to their electricity grids at the wholesale level, to obtain FERC permission to make those exports; but generally there has been little enthusiasm for opening up retail markets. Keep in mind that in Canada, most of the integrated utilities are owned by the provincial government, so that the natural inclination of the incumbent to preserve its monopoly franchise is reinforced by the government's position as the owner of the monopoly asset. Of all the provinces, only Ontario and Alberta, both of them under fairly right-wing regimes, have pursued electricity restructuring through to the retail frontier.

In Canada, too, electricity has been and continues to be primarily regulated at the provincial level. While a federal licence is required to export electricity to the United States, there is no body in Canada that exerts an authority comparable to FERC, the U.S. Federal Energy Regulatory Commission. Again, given that the vast majority of generation and transmission assets are owned by the provincial governments and given, too, that interprovincial transmission has been very small compared to the within-province load and the export flows to the United States, the feds have stayed out of trouble by keeping a low profile. In the negotiations that led to the North American Free Trade Agreement, electricity was conspicuous by its absence.

Why then, did Ontario become such an anomaly? Go back for a moment to 1990. At that time, the provincially-owned utility, Ontario Hydro, operated roughly 90% of generation and almost all the transmission facilities within the province. Distribution was primarily in the hands of some 300 municipally-based utilities, although Ontario Hydro also had a significant chunk of distribution in the rural areas of the province. Although there was a small private-sector presence in Ontario's electricity industry, it is fair to say that Ontarians considered it "their" patrimony and were exceedingly proud of the high professional reputation and on the whole the low, stable prices, provided by Ontario Hydro's mix of large and small hydro, fossil, and nuclear generation and its strong well-optimised transmission network.

But Ontario Hydro over-reached itself. It suffered major cost overruns on a major new nuclear station, and then suddenly and unexpectedly had to deal with falling demand in

the early 1990s, requiring it to raise prices just when natural gas prices were falling, angering its major industrial customers and leading to dire threats of switching away. Hydro's management came up with a plan to restore its balance sheet by merging with the debt-free municipal utilities, but this was a political non-starter. By 1997, to cap an already dire situation, evidence of severe mismanagement of the nuclear stations came to light. The provincial government, already in fiscal straits itself as a result of federal downloading and a weak economy, was in no position to bail the company out, and so it made use of the advice of a 1996 Advisory Committee, on which I sat, that proposed breaking up Ontario Hydro and opening a fully competitive electricity market at the wholesale level. The generation and transmission companies would be re-capitalized with appropriate balance sheets, and Hydro's excess debt would be allocated to a government agency to be paid down one way or another out of electricity rates over a period of years. A key part of the reasoning here was that Ontario would need access to U.S. electricity markets, and in the context of FERC's Open Access pronouncements, it would have to open its own wholesale market to U.S. suppliers in a reciprocal manner.

In retrospect, the truly ambitious part of the government's plan was the proposal to open retail markets to full competition simultaneously with the wholesale market. This caught the local municipal utilities by surprise and, I have to say, they have generally been unhappy partners in the subsequent developments, although our markets did open this year on May 1 and all customers, large and small, now have an effective choice among suppliers.

Enough about the history. As many are aware, Ontario has thus taken its place in a worldwide march toward open electricity markets. It caught the tide, so to speak, and for partly fortuitous reasons it has become a market leader in some respects. It has entirely avoided the market design weaknesses that plagued California and it has experienced relatively few issues and problems in the first few months of operating its new markets, partly because of a very intensive period of testing and coordination that has taken place since the Independent Market Operator was established in the spring of 1999. But these processes are far from mature. I would like to spend my time primarily discussing the issues that remain on the table. Of course, we are far from alone. In that context, our working relationships with the Independent System Operators in New York, New England, and Pennsylvania-New Jersey-Maryland or PJM, and with the Midwest ISO and control authorities in Michigan and Minnesota, not to mention our extremely important interties with the provinces of Quebec and Manitoba, all need further work. Although many Ontarians still cling to the notion of Ontario as in some sense a self-sufficient electricity fortress, the reality is that we will gain a great deal from the market access that the new arrangements make possible. This was dramatically demonstrated recently, in fact, when due to the exceptionally hot weather, Ontario as a whole was importing some 2700 MW of its total record peak load of roughly 25500 MW – i.e. over 10% of its requirements. We would never have been able to meet that demand from internal resources. Mind you, this reflects a situation that we hope is only temporary, that is, the delayed return to service of our ailing nuclear reactors. If six of these do return to duty over the next few years, as planned, they will add some 3500 MW to baseload

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capacity and put Ontario in a position to be a net exporter most of the time. Although prices did rise sharply during that episode, the markets did meet the challenge, which has given us somewhat greater confidence in our new tools.

From an economist's point of view, the critical reform in restructuring is a shift in the basis of pricing from long-run average cost as calculated by a monopolist, to short-run marginal cost as experienced by a myriad of competing entrepreneurs. The result should be a transfer from producer to consumer surplus and a much greater effort on the part of producers to innovate. Not only that, but it will give consumers a reason to respond to the new price signals, because the supply curve looks like a hockey stick most of the time – that is, a very large part of the supply is available at relatively low cost, but the curve rises very sharply over the last ten percent of its range; in peak hours, or when weather or equipment outages supervene, the resulting price spikes can be very dramatic. As a result, if there is any meaningful price elasticity out there, we should, over time, observe a reduction in peak loads in favour of off-peak usage that is far cheaper to supply, thus saving very substantial amounts in both generation and transmission investment over time.

The good news is that this will provide an opportunity to reduce costs. The bad news is that consumers don't seem to like it. In Ontario, consumers have seen very stable prices for decades, punctuated by the one very severe increase in the early 1990s that I referred to earlier. Now that the new market is open, fully 20% of residential consumers have chosen to accept a fixed-price contract with a retailer rather than accepting the pass-through of the wholesale spot price that they would otherwise receive. Of course, there is another reason why consumers may be wary of a spot-price passthrough, and that is that the technology of interval meters has not yet caught up with the new market design.

If you think about it, this is one of those "killer apps" where a combination of a remotely-readable interval meter with home management software, controllable appliances, and access to prices over the internet stands to save the average householder a fair amount of money. As far as Ontario is concerned, unfortunately, we have now produced a viable egg, but it has yet to hatch this particular chicken, and I am not the only one who is quite impatient for someone, ideally a Canadian technology company, to come along with the solution.

One of the things we have learned as we have struggled with setting up this marketplace is the vast importance of a consistent and appropriate regulatory environment. In the old days, Ontario Hydro in effect was its own regulator, and its Chairman appears to have communed from time to time with the Premier of the Province to take whatever strategic decisions needed making. In an open market, on the other hand, it is critically important that all the players be seen to have equal opportunity, and this includes those entities that remain under provincial ownership. Unfortunately, the province decided at the outset of restructuring to retain all the generation stations of Ontario Hydro in a single successor company; this company thereby retained close to 90% of all the capacity in the province, quite an unacceptable starting point. A key accomplishment of our Market Design Committee, in that context, was to work out a Market Power Mitigation Agreement whereby the generation company is obligated to reduce its control to no more than 35% of the

capacity available to the province within 10 years of market opening. In the interim, it is subject to a revenue cap which, roughly stated, obligates it to make a rebate to customers if the annual average price of energy it receives for most of its supply in Ontario goes above the price it had charged before the market opened. The provincially-owned transmission company is obliged for its part to expand Ontario's inertie capacity with Michigan and Quebec, so that imports could play a larger role and hopefully exercise some restraint on prices. But studies suggest that market power will remain a concern until and unless the largest generator controls no more than 20 to 25% of the capacity serving Ontario.

Now that FERC has proven itself aggressive in forcing the pace of regional consolidation of the U.S. electricity grids, and is more or less bent on requiring each region to operate under a standard market design, the question naturally arises whether Ontario's market will interface seamlessly with those around it. It has to be said that there is no way that our key could fit all the locks in any case: New York and New England, now pursuing a marriage with each other, have market designs very similar to ours but not exactly the same; Quebec doesn't operate a market; Michigan is different again. One of the interesting proposals now on the table is to construct a 975-MW High Voltage Direct Current link under Lake Erie, a link that would connect Ontario for the first time directly to Pennsylvania and Ohio; each of these is under a different regime again. Once Ontario's ailing nuclear reactors are back in service, the Lake Erie link may prove very beneficial in getting our electricity out to the vast midwest U.S. market, but, again, since this business is infinitely complex, Ontario regulators and the IMO are having to think very carefully about how it is to be integrated to the grids at both ends.

The Lake Erie Link is in fact an example of what is now called "merchant transmission" – that is, it proposes to sell its capacity in advance to those who finance it, and it will not apply for rate base regulated pricing. In effect its capacity will be auctioned off in the form of so-called "transmission rights". But these rights do not necessarily imply that their owner can access the grid at either end. To win access to the Ontario grid you have to be a successful bidder or offeror in the IMO's market – that is, you have to offer your energy no more expensively, or offer to take it at no lower a price, than whatever the clearing price turns out to be. On the other hand, access to the grid in Pennsylvania or Ohio depends on your ability to meet somewhat different tests. So there is a great deal of effort now being expended on facilitating "one-stop shopping", i.e., smoothing the way for would-be traders.

Finally, I want to note a couple of other items that are in the category of "good things to have" and that we are currently investigating. One is a forward market. The other is locational pricing for energy.

As far as a forward market is concerned, there is no question that if we could establish a forward price curve based on deep, liquid trading activity, it would provide a major benefit to market participants both in managing and hedging their energy needs and could add to investor confidence in undertaking long-lived investments in generation. Actually, there are two types of forward market that are being considered, one is a day-ahead market, the other involves the longer-forward delivery dates.

The day-ahead market is actually a fairly high priority and may be developed relatively soon. The IMO has just signed an agreement with the New York and New England Independent System Operators to explore whether a single Day-Ahead market, or compatible Day-Ahead markets, would best enable their market participants to engage in seamless transactions within and across their markets.

One of the problems we face in promoting seamless trading between the neighbouring control areas is that, due to technical limitations, intertie transactions must last for at least one hour; whereas within the individual markets, prices and volumes are set every five minutes. Up to four hours before the hour in question, bids and offers over the interties are placed in the same hierarchy as domestic bids and offers, and cleared on the same basis in order to decide whether they should be accepted; but, once accepted, they are in effect placed at the bottom of the stack during the hour, and the subsequent five-minute markets examine only domestic bids and offers. Depending on how things develop over the hour, significant anomalies can arise, and it may happen that Ontario commits itself, for example, to using expensive imported energy during a given hour when, as it turns out during the hour, less expensive domestic energy has come available.

The IMO, with New York and New England, is exploring whether day-ahead markets in which participants would make binding commitments and be settled on those commitments, would add to pricing efficiency. In this sort of regime, the spot markets would in effect become balancing markets, where prices would reflect emergent circumstances such as hot weather or unplanned equipment outages, but the amount of power settled at those spot prices would be very substantially less than it is today.

Locational energy prices arise because, in the presence of transmission constraints between one place and another, the cost of serving load at one location can differ from the cost at another location. Even if a cheaper generator were available to meet demand at a given point, it may not be physically possible to deliver its power to that point, so that a more expensive generator may have to run to serve it. In the Ontario market, we set one Ontario price, using an algorithm that places the generation in merit order, assuming that no such constraints exist; but in the actual operation of the market, the IMO often has to call upon certain other generators to run and may have to tell certain accepted generators not to run. These generators are compensated individually at the expense of the market as a whole. Better investment signals would be sent, however, if prices at each location actually reflected the cost of serving it, because generators and transmitters would both then be incented to take steps to reduce the congestion. Generators would locate close to load, and transmission would be reinforced where the price differentials made it worthwhile. The problem with locational pricing, however, is that Ontarians will need to be convinced that market efficiency trumps their notion of equity, fostered over 100 years of public power, namely that everyone in Ontario should pay the same price for their electricity no matter how expensive they are to serve.

Let me sum up by simply noting that, as as can be seen, we are making substantial strides, and I don't think we have made significant mistakes along the way, but the evolution of this marketplace is by no means complete. In my opinion, the

vision to be accomplished is one in which North America has in effect a set of harmonized markets for energy, where traders can move product from place to place, whether in the form of coal, gas, or electricity, subject only to environmental policy, to strict reliability and security considerations, and, of course, the prudential requirements that must be enforced to ensure that contracts, once entered into, will be honoured. Spot markets will be reinforced by deep, liquid forward and futures markets so that traders can hedge and speculate confidently and invest in new innovation and upgrade their assets in response to reliable market signals. Is it a lot to ask? Absolutely it is. Are we moving in that direction? I think we have taken some giant strides in the last five years. From here in Ontario, the news is good.

### **The North Sea in a Global Context: A BP View** *(continued from page 10)*

activity, the level of production, the level of employment and the level of revenue. It had made the UK to coin a phrase "a great place to do business and a great place from which to do business"

Over time, breaking that equilibrium will have damaging consequences for the offshore industry and the areas of Scotland and the North East which particularly depend on it, and for the onshore activity that is tied to offshore success.

I hope it isn't too late for reconsideration and dialogue.

If there is an overwhelming desire to change the established tax regime, I do think its possible to design a set of measures which restore confidence for those investing in the UK and which ensure the regime is sensitive to the real competitive challenges which the North Sea faces.

Royalty should be abolished immediately and the system should incorporate the possibility that prices will fall back towards the long-run average.

I believe we have a common interest in getting this right.

### **Summary**

In summary, we are at a very important moment in the history of the North Sea after 30 years of un-interrupted growth. We face the onset of decline.

Our challenge is to create a future where decline is managed in such a way to ensure that every possible barrel is recovered and that the North Sea never enters harvest mode.

The keys to this are firstly Technology – how innovative can the industry be in its application of technology – the signs to-date are very encouraging.

Secondly, Commercial Innovation: with support from the DTI, can we create ever more innovative commercial structures to ensure a steady flow of capital from all sources—from super-majors, the independents, venture capitalists and private equity - into the North Sea - again the early indications are very encouraging.

And finally, can the government create the right long term fiscal regime to ensure that the North Sea remains globally competitive so that the available capital flows to the North Sea and to Scottish and UK jobs and not to other countries for construction or other provinces for investment.



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## Australia on Top

By Tony Owen\*

Australia is the industrialised world's largest per capita emitter of greenhouse gases, with emissions amounting to 27.9 tonnes of CO<sub>2</sub>-e (carbon dioxide equivalent) in 1999 (the latest year for which comprehensive Annex B country data are available). This dubious distinction, combined with a refusal to ratify the Kyoto Protocol, has given Australia pariah status in the international environmental debate. Although outcast amongst most Annex B countries, it has, however, got one powerful ally (the USA) in its trenchant stance. And it can always rejoice in the fact that at least it signed the Protocol in 1997, which is more than all but one of the OPEC states could manage!

Put simply, the Australian government's logic for refusing to ratify the Protocol is based upon a government perception that it would place upon domestic industry a cost burden that would not be borne by its traditional competitors in Asia who, at least during the first commitment period, will be exempt from any requirement to reduce their own Greenhouse Gas (GHG) emissions. At first sight this argument is very appealing (i.e., there are lots of votes in it). However, it is predicated on a defensive fortress mentality, and fails to appreciate opportunities for cutting edge environmentally-sensitive technologies in those same Asian countries, where current environmental standards are pitifully low.

Australia is, in many respects, unique among developed countries. It has a wide range of climatic zones (not everywhere gets continuous sunshine!), relatively high population growth, a highly urbanised population but with long distances separating urban centres, and land use patterns that are still undergoing significant change. It also has one of the highest GDP growth rates of any OECD country.

A major factor contributing to Australia's emissions of GHG is the domination of energy generation by low-cost fossil fuels, and particularly coal. There is no nuclear power industry, and hydro-power makes only a very small contribution to total electricity generation. Further, energy exports play a major role in the economy, either in the form of exports of primary energy (i.e., coal, oil<sup>1</sup> and liquefied natural gas) or energy-intensive (i.e., steel and aluminium) products. It is the threat (real or imaginary) posed to these and allied industries that has persuaded the Australian government that ratification would impose an unacceptable competitive imposte on export-orientated domestic industry. For example, a recent LNG supply contract with China will entail extra domestic Australia

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<sup>1</sup> Australia is, however, a net importer of oil and oil products.

lian emissions of 1.5 million tonnes (Mt) CO<sub>2</sub>-e a year to produce the LNG. If other potential LNG suppliers did not have a Kyoto-based obligation in terms of restricting domestic GHG emissions, then clearly Australia would be placed at a competitive disadvantage as an LNG supplier.

Australia's total net greenhouse gas emissions over the first compliance period (2008-2012) are projected (Table 1) to average 581 Mt CO<sub>2</sub>-e per year, representing an 11% increase on its 1990 Kyoto baseline of 525 Mt CO<sub>2</sub>-e. At present, therefore, Australia appears to be well on-track for meeting its Kyoto target of 108%. Indeed, there may even be the opportunity to come in well under the target and sell emission permits to those countries that fail to meet their own target. So why is the government so insistent that it will not ratify the Protocol?

The devil, as always, lies in the detail (in Table 1). Approximately 70% of Australia's total emissions in 2000 were from the energy sector and, in turn, two-thirds of these arose from electricity generation. By the first compliance period, emissions from the energy sector are projected to have risen by almost 40% over their Kyoto baseline level, even with current greenhouse abatement measures in place. Such measures include Generator Efficiency standards, Mandatory Renewable Energy Targets, Minimum Energy Performance Standards, and voluntary "good citizen" programs for industry. In the absence of such measures, it has

**Table 1**  
**Australian Greenhouse Emissions**  
**1990, 2000 and 2008-2012 (Kyoto accounting).**

Sector	1990 Mt CO <sub>2</sub> -e	2000		2008-12 (average)	
		Mt CO <sub>2</sub> -e	% of 1990	Mt CO <sub>2</sub> -e	% of 1990
<b>Energy</b>	299	372	124%	418	139%
Stationary	209	264	127%	284	136%
Transport	61	76	124%	91	148%
Fugitive	30	32	107%	43	144%
<b>Agriculture</b>	91	98	108%	95	104%
<b>Waste</b>	15	17	112%	15	100%
<b>Industrial Processes</b>	12	15	127%	24	201%
<b>Impact of GGAP<sup>a</sup></b>				-11	
<b>Land use change &amp; forestry</b>					
Forestry sinks <sup>b</sup>	0	-10	-	-21	
Land use change <sup>c</sup>	107	61	57%	61	57%
<b>TOTAL EMISSIONS</b>	<b>525</b>	<b>553</b>	<b>105%</b>	<b>581</b>	<b>111%</b>

Source: Australian Greenhouse Office

- Total estimated abatement across all sectors from Australia's Greenhouse Gas Abatement Program (GGAP).
- Estimate of net forestry sequestration from Kyoto-compliant plantations that exist in 2000.
- Preliminary projections of land use change (CO<sub>2</sub> only).

been estimated that this latter figure would be about 50%.

Transport (and particularly road transport) is also a large contributor to energy sector emissions. These are projected to rise by 48%, largely driven by increases in freight and passenger car emissions. In turn, they themselves are driven by ongoing growth in GDP and population growth. The impact of emission reduction measures is projected to be much lower than for electricity generation, amounting to an estimated average reduction of just 0.7% of 1990 levels by 2008-2012.

Fugitive emissions cover methane, carbon dioxide and nitrous oxide emissions from the production, processing, transport, storage, transmissions and distribution of raw

fossil fuels. Methane leakage from coal mining, and fugitive methane and carbon dioxide emissions from oil and gas production and transmission, account for most fugitive emissions. Projected rapid growth in fugitive emissions through to the first commitment period results mainly from projected increases in the production of natural gas. Here, again, emission reduction measures are estimated to have a relatively minor impact, reducing emissions by just 0.5% of their 1990 level by 2008-2012.

So where are the “savings” coming from that justify a projected 11% increase?

In terms of the Kyoto Protocol reference date (1990), Australia was indeed “fortunate” to have *Land Use Change* generating about one quarter of its total emissions. Emissions from this source are the result of the burning of removed vegetation, the decay of unburnt vegetation, and emissions from soil disturbed in the process of clearing. These actions can be offset by carbon sequestration due to re-growth of vegetation on previously cleared land. A decline of 46 Mt CO<sub>2</sub>-e (or 57%) from this source by 2000 reflects lower levels of land clearing and this saving, together with Kyoto-permissible reforestation, is the main factor behind Australia’s seeming ability to meet its target. However, the news gets better. The average 2008-2012 projection for *Land Use Change* is a business-as-usual (i.e., “without measures”) projection, and consequently further efforts to reduce land clearing will simply augment this ability.

The bad news, of course, is that savings arising from *Land Use Change* will make a significantly lower contribution in any future commitment period, and thus substantial emission reductions in other sectors of the Australian economy, and particularly electricity generation, are likely to be required. For an economy so heavily reliant on energy exports this could be difficult without recourse to Kyoto’s flexibility mechanisms.

Over recent months there has been growing media criticism of the Australian government’s reluctance to ratify the Kyoto Protocol. Last August, 254 economists (including the author of this piece) were signatories to a statement calling on the Prime Minister to ratify the Protocol in Australia’s economic and environmental interests. In essence, the statement was that “As economists, we believe that global climate change carries with it serious environmental, economic and social risks and that preventive steps are justified. Policy options are available that would slow climate change without harming employment or living standards in Australia, and these may in fact improve productivity in the long term.” Whilst Australia’s politicians have rarely been concerned with the views of economists, they were far more sensitive to the widespread condemnation of Australia’s Kyoto stance at the recent Earth Summit in Johannesburg (like economists, even politicians like to have some friends!).

Now that the pre-conditions for ratification of the Protocol have been met (assuming there is no change of intent by Russia), then it is probably safe to assume that Australia will also eventually ratify (as soon as the Prime Minister’s turnaround can be accomplished without too much embarrassment). Without being part of the process, it would be very difficult for Australia to influence procedures and protocols for forthcoming commitment periods and, in particular, the terms under which its major Asian trading competitors and their future GHG reduction obligations are incorporated in to

any future global agreements.

I’ll end with a constructive(?) suggestion. For the second commitment period (if there is to be one), perhaps GHG emission targets should be based upon national emission levels arising from “consumption” of GHG rather than production. This approach has three advantages for Australia:

1. Theoretically (economics, of course), it’s the only sound option;
2. Primary commodity exporters are not penalised in favour of importers (EU please note!); and
3. The complexity of the process would ensure that it could never be implemented (a technique familiar to most politicians!).

We live in interesting times!

#### **Acknowledgement**

This article has relied upon publicly available data published by the Australian Greenhouse Office. The views expressed, however, are solely attributable to the author.

#### **Energy Privatisation in the United Kingdom** (*continued from page 7*)

selves.

So, has this process led to the exploitation of the consumer, as the opponents of public utility privatisation confidently predicted?

Far from it.

Since privatisation in 1990, UK gas and electricity prices have fallen, in real terms, by an average of 30 per cent for all users, industrial and domestic alike.

And in the considered view of the present regulator, the major reason for these dramatic price reductions has been the introduction of competition and deregulation, rather than price regulation.

Nor have lower prices been at the expense of reduced investment in these industries. Over the past five years, for example, investment in electricity distribution in the UK was almost 30 per cent higher in real terms than in the 5 years prior to privatisation.

Nor has security of supply been threatened in any way. Indeed, electricity generating capacity in Britain is currently some 30 per cent higher than average demand – an even bigger margin than at the time of privatisation.

All in all, it is difficult to escape the conclusion that those in Europe who persist in rejecting full-blooded privatisation and deregulation of their energy utilities are motivated not by their desire to safeguard their consumers or indeed, to enhance their nation’s economic well-being, but rather to protect these industries and persist with hidden subsidies at a time when international treaty obligations make other forms of protection increasingly hard to sustain.

In conclusion, the moral seems to be this: News is when things go wrong.

As I have indicated, the privatisation of the UK’s gas and electricity industries is something that has gone supremely right.

As a result, the story is seldom told.

That is why I thought it worth telling today.

## The Swedish Electricity Market: Current Issues

By Lars Bergman\*

### Background

The Swedish electricity market is an integrated part of the Nordic (Norway, Sweden, Finland and Denmark) electricity market<sup>1</sup> that emerged by the end of the 1990's as a result of regulatory reforms that opened up competition in generation and retailing. Although the Nordic countries are small in terms of population, the level of per capita electricity consumption is quite high, particularly in Norway and Sweden. Thus the total consumption of electricity in the area is around 390 TWh per annum (150 TWh in Sweden). This means that the Nordic electricity market is one of the major integrated electricity markets in Europe.

Electricity market reform in the Nordic countries (except Denmark) preceded the EU electricity market directive<sup>2</sup> and has been more far-reaching than prescribed by that directive. In particular, the reform in the Nordic countries has included both the elimination of border tariffs and the creation of a common power exchange, Nord Pool. In addition close cooperation between the transmission system operators (TSOs) in the four countries has been established, and similar rules for transmission pricing adopted. The EU directive, in contrast, only concerned the regulatory framework of national electricity markets within the union.

The initial experiences of electricity market reform in the Nordic countries are quite positive. First and foremost "the lights did not go out". In fact the electricity market has continuously cleared in spite of "supply shocks", resulting from significant variations in the supply of hydropower in Norway and Sweden. In addition to this basic achievement of the new market institutions electricity prices have fallen and, according to the scanty evidence that is available, productivity has increased in the electricity supply industry.

These observations suggest not only that competition, in fact, can produce increased efficiency and lower prices, but also that the new market institutions and regulations are well-designed and able to foster continued efficiency increases to the benefit of electricity consumers in the Nordic countries. However, there is also concern about problems so far hidden by the overcapacity in generation and transmission (being the legacy of the "old" regulatory system). In the following I will briefly comment on three issues, namely market power, the increasing scarcity of peak-load capacity, and the impact of "green certificate" trading that is about to be introduced.

### Market Power

Entry barriers to the generation segment of the Nordic electricity market are significant. This is due partly to remaining overcapacity and partly to prohibitive constraints on the use of coal and natural gas for power production in Norway and Sweden. Thus the incumbent power companies are well protected from competition from new entrants. However, the integration of the national electricity markets to a large extent has diluted the market power that used to

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<sup>1</sup> See footnotes at end of text.

prevail on the quite concentrated national markets. Table 1 shows that the power companies that would be dominating on the national markets have rather modest shares of the integrated Nordic market.

**Table 1**  
**Production by Major Power Companies**  
**2001 (TWh)**

Company	Production TWh	Share of National Production %	Share of Nordic Production %
Plant located in Sweden			
Vattenfall	76.6	49	20
Fortum	29.6	19	8
Sydskraft	32.7	21	8
Sweden Total	157.8	100	41
Plants located in Norway			
Statkraft	33.3	27	9
Norsk Hydro	9.8	8	3
Norway Total	121.9	100	31
Plants located in Finland			
Fortum	40.4	56	10
Pohjolan Voima Oy	15.9	22	4
Finland Total	71.6	100	18
Plants located in Denmark			
Elsam	16.1	45	4
Energi E2	11.8	33	3
Denmark Total	36.0	100	9
Total in Nordic Countries	387.3		100

Source: Konkurrensen på elmarknaden (Competition on the Electricity Market. SOU 2002:7

Needless to say, the shares of the entire Nordic market are relevant only if inter-connector capacities are sufficient most of the time. So far bottlenecks in the transmission system have only temporarily divided the Nordic market into regional, more concentrated sub-markets. However, mergers and increasing cross-ownership relations between generators have re-established part of the market power that was diluted when the national markets were integrated, and concerns about abuse of market power are voiced with increasing frequency.

An issue that has been the subject of considerable discussion is the doubling of the average Nord Pool price level between 2000 and 2001. While 2000 was an extremely "wet" year, 2001 was "normal" from the precipitation point of view. Thus a price increase between 2000 and 2001 should be expected. But the price increase that actually took place exceeded what was generally expected, and there was a rather common view that the major generators somehow were able to raise prices above the competitive level. As a result of these sentiments a government committee was appointed to investigate the matter. In its report<sup>3</sup> the committee came to the conclusion that the underlying factors were a combination of fuel price increases, reduced hydropower supply, increased demand and the phasing out of the Barsebäck 1 nuclear reactor. In other words the committee did not consider the price increase to be a result of the exercise of market power.

However, the development of Nord Pool prices exhibit significant "spikes" that may reflect the exercise of market power during short periods when transmission and/or generation capacity is scarce. A claim that the major generators

collude and systematically withdraw capacity from Nord Pool in order to increase spot market prices have recently been made, and the case is under investigation.

### Peak Load Capacity

In January and early February 2000 very low temperatures were simultaneously experienced in all the Nordic countries, and power demand reached levels very close to the maximum capacity of the system. On one occasion the Swedish TSO appealed to the public to reduce their day-time consumption of electricity and thus help to maintain system stability. This incident drew attention to the peak-load capacity issue, more precisely to the fact that no capacity charges are paid to generators in Sweden<sup>4</sup>. In the current system the owners of peak-load capacity earn revenues only if the capacity is used for supplying power to the real-time (balancing) market. As some peak-capacity is demanded only a small number of hours per year, or perhaps only every second, third or even fifth year, the incentives to keep peak capacity available are weak unless the prices of balancing power may be very high when capacity is scarce and the owners are risk-neutral.

However, the generators have exhibited risk-aversion, i.e., they have chosen to close down some of the peak capacity rather than keeping it available for rare high-price periods. Thus as the maximum load on the system has increase by around 1 000 MW between 1996 and 2001, the total installed capacity in Sweden has decreased by 3 500 MW during the same period. Gradually it has become recognized that a redesign of the market institutions is called for, but the views on what the most efficient way of dealing with the peak-capacity problem differ. However, there is agreement that within a relatively wide margin the cost of temporary load reductions are lower than the cost of keeping seldom used generating capacity available.

### Green Certificate Trading

As of January 2003, tradable “green certificates” will be introduced. Electricity based on renewable energy sources such as wind and biomass is considered to be “green”, while electricity from existing large-scale hydropower plants is not. The aim of the new system is to promote the use of renewable energy in order to keep carbon emissions low, and to increase fuel diversity in power production. Under the new system a generator will get a certificate, but no direct subsidies, for each unit of “green” electricity produced. The consumers, on the other hand, will have to buy a certain number of certificates per unit of electricity consumed. In 2003 only six certificates will be needed for each 100 MWh of electricity consumed, but the required number of certificates will gradually increase. The goal is that the production of “green” electricity in 2010 should be at least 10 TWh.

There are several concerns about the impact of “green” certificate trading on the electricity market. One is that the annual variations in the supply of wind power and (new) hydropower will make certificate prices quite volatile, and in the absence of hedging options investments in “green” generation capacity will be risky. Another is that the green certificate market will offer new possibilities to exercise market power. The basic concern, however, is that the “green” certificate system will seriously distort investment

and production decisions in the power industry.

### The Perennial Nuclear Power Issue

In addition to the issues briefly discussed above the future of nuclear power remains a major issue in Swedish energy policy. In accordance with the latest “long term energy plan” one 600 MW reactor, Barsebäck 1, was closed down in 1999. The “sister” reactor Barsebäck 2 is due to be closed in 2003. However, the closing down of Barsebäck 2 is subject to stringent conditions (about energy conservation and the availability of new power) that few believe can and will be satisfied. Instead there is some interest in the “German model”, i.e. introducing a cap on the total life-time production of all the existing nuclear plants, and leave it to the power companies to decide which plants to close down and when. The nuclear power issue has been subject to heated debate for more than 20 years in Sweden. The decision to phase out all nuclear power plants has remained firm all the time. But the uncertainty about when the phasing out will take place is equally firm.

### Footnotes

<sup>1</sup> For a more elaborated discussion of the design and experiences of the Nordic electricity market, see Bergman (2002).

<sup>2</sup> For a discussion of the EU electricity market directive see Bergman et.al. (1999). For a discussion of the earlier history of the Nordic electricity market, see Hjalmarsson (1996).

<sup>3</sup> SOU 2002: 7.

<sup>4</sup> In Norway payments to generators that keep peak capacity available for the TSO have recently been introduced.

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### Future IAEE Events

June 5-7, 2003	26 <sup>th</sup> IAEE International Conference Prague, Czech Republic Dorint Don Giovanni Prague Hotel
October 19-21, 2003	23 <sup>rd</sup> USAEE/IAEE North American Conference Mexico City, Mexico Camino Real Hotel
April 30-May 3, 2004	27 <sup>th</sup> IAEE International Conference Tehran, Iran Venue to be Announced
April 19-23, 2005	28 <sup>th</sup> IAEE International Conference Taipei, Taiwan Venue to be Announced

## **Natural Gas Use in the Mexican Power Generation Sector: Political, Market and Regulatory Issues**

*By Alberto Elizalde Baltierra\**

### **Abstract**

We examine the main political, market and regulatory issues concerning natural gas use in the Mexican power generation sector. We also study the impacts of a technology diversification policy regarding the primary energy used to generate electricity. For that, we make use of the LEAP system (Long-range Energy Alternatives Planning-SEI Boston) in order to simulate two scenarios of evolution of the power generation system in Mexico between 2000 and 2020. The first one (business-as-usual) simulates government's current energy policies that consider most of the increase in installed capacity to be done by combined cycle plants. The second one evaluates the policy of diversification where both coal and hydro plants are added as a complement to facilities using gas. Impacts on the natural gas supply/demand balance are then discussed. Increasing gas imports will be necessary in the future to complement domestic supply as illustrated by simulation exercises reported in this work. Our simulation results also indicate that the adoption of a diversification policy concerning technologies used to generate electricity can be a way to limit foreign dependency on gas imports, especially in the long run (2010-2020). This is particularly relevant for the future supply/demand balance of the North American natural gas market. It is also suggested that efforts addressed only to the demand-side could be insufficient to control gas imports. Important measures should additionally be taken on the supply-side in order to increase domestic gas production, such as by relaxing PEMEX's budgetary constraints.

### **Introduction**

Mexico is moving from the almost complete control of production, transmission and distribution of electricity by the government to increased private participation in the generation sector. As in the case of the petroleum industry, the Mexican electricity industry works almost entirely through a single state-owned producing company, the Federal Electricity Commission (CFE-*Comisión Federal de Electricidad*). The national transmission and distribution network is operated primarily by the CFE. Meanwhile, distribution and marketing in Mexico City and its periphery are handled by the state-owned Central Power and Light (LFC-*Luz y Fuerza del Centro*). Private participation in power generation projects has been allowed since 1992 when the Public Electric Power Service Law was reformed. Thus, the private sector (both domestic and foreign companies) can today invest in cogeneration, self-supply and small-scale production, in BLT projects (Built, Lease and Transfer) and as Independent Power Producers (IPPs). According to Mexico's Secretary of Energy (Sener, 2001b), about 25 GW of electric generation

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capacity is needed between 2001 and 2010 to keep pace with increasing demand<sup>1</sup>. Nearly 22 GW are slated to be run on natural gas, most of them (95%) using gas turbines in combined cycle. Some proposals for regulatory reforms are currently under examination in order to ensure sufficient resources to finance the expansion of the electric generation sector.

Mexico today has a considerable natural gas resource base. Approximately 190 Tcf of natural gas resources remain in Mexico, 30 Tcf of which are proved reserves (Pemex, 2001). Compared to the U.S. and Canada, Mexico is an immature gas region, but one with considerable up-side potential. Producing 1.5 Tcf per year, Mexico is thus considered as a "sleeping giant" with respect to gas production potential. *Petróleos Mexicanos* (PEMEX-the national oil company) maintains a monopoly on domestic gas exploration and production and a strong market power in transport systems. Private companies have been allowed since 1995 to participate in downstream projects. Because of PEMEX's strong budgetary constraints, there is uncertainty as to whether its indigenous production can be increased sufficiently to satisfy rising demand. Conversion of power plants from heavy fuel oil to natural gas, in compliance with new environmental regulations<sup>2</sup>, and construction of new power plants using gas turbines in combined cycle are the most influential factors affecting future gas demand. The Mexican Secretary of Energy forecasts a growth in gas demand from 1.6 Tcf in 2000 to 3.5 Tcf in 2010 (Sener, 2001c). Imports would thus progress from 0.1 Tcf to 0.7 Tcf respectively.

The aim of this work is to discuss the main political, market and regulatory issues concerning natural gas use in the Mexican power generation sector. We also study the impacts of a technology diversification policy regarding the primary energy used to generate electricity. For that, we make use of the LEAP system, as earlier note, in order to simulate two scenarios of evolution of the power generation system in Mexico between 2000 and 2020. The first one (business-as-usual) simulates the government's current energy policies that anticipate that most of the increase in installed capacity will be accomplished by combined cycle plants. The second one evaluates the policy of diversification under which both coal and hydro plants would be added as a complement to facilities using gas. Impacts on the natural gas supply/demand balance are then discussed.

### **Natural Gas Use in Mexico's Electric Power Generation Sector**

#### **Political and Regulatory Issues: Restructuring the Electric Power Industry**

Mexico's Political Constitution has established, since the electric industry's nationalization in 1960, the nation's exclusive right to provide public electric power service, among other activities. Electric power generation, transformation, transmission, supply, distribution and marketing activities for public service have thus been performed and coordinated by the state-owned companies CFE and LFC. A small amount of private participation was allowed in the generation sector by means of self-supply projects in the industrial and oil sectors.

The Mexican government adopted in the early 1990's a

<sup>1</sup> See footnotes at end of text.

policy encouraging natural gas use thanks to its excellent environmental qualities (clean combustion), its suitability for use in more efficient technologies such as combined cycle plants and the presence of relatively abundant gas sources. This energy policy seeks to promote a change in the pattern of use of industrial fuels through a reduction in the use of fuel oil and an increase in the use of natural gas. The policy consists of four main strategies (Sener, 1997a):

1. Construction of the new combined cycle electric power plants.
2. Reconversion of several of CFE's electric power plants, substituting the use of fuel oil with natural gas as the basic element.
3. Greater industrial use resulting from the environmental measures instituted in 1998.
4. Promoting greater use of natural gas in industry and households.

In this regard, natural gas is a product with an enormous potential for utilization in Mexico. The program to substitute fuel oil with natural gas in CFE's plants, investment plans for building new combined cycle plants that will use this product, and the environmental regulations that went into effect in 1998 for all industries, ensure a strong demand for natural gas in Mexico.

The 1992 amendments to the Public Electric Power Service Law, and its regulations, created a significant opening of the generation segment to private companies in order to attract the additional investment needed to ensure the availability and supply of electricity. In accordance with the 1992 reforms, there are today four modalities for private participation in electric power generation: self-supply, cogeneration, small-scale production and independent production. As provided in Article 36 of the Public Electric Power Service Law, self-supply is understood to mean utilization of electric power for one's own use when:

- I. The electricity comes from plants intended to meet the needs of a set of co-owners or partners, and
- II. The permit holder agrees expressly to use the electric power solely within the perimeters authorized by the Secretariat.

Cogeneration is understood to be:

- I. Production of electric power together with steam or some other type or secondary thermal energy or both;
- II. Direct or indirect production of electric power from thermal energy not utilized in the process; or
- III. Direct or indirect production of electric power using fuel produced in the processes.

Small-scale production is understood to mean the generation of electric power intended for:

- I. Sale to the CFE of all electric power produced. The project may not have a total capacity of more than 30 MW in an area determined by the Secretary of Energy.
- II. Self-supply for small rural communities or isolated areas lacking in electric power service, in which case the projects may not exceed 1 MW; and
- III. Exportation up to a maximum limit of 30 MW.

Independent production is the generation of electric power provided by a plant with a capacity of more than 30 MW, intended exclusively for sale to the CFE or for export.

The Energy Regulatory Commission (*CRE-Comisión*

*Reguladora de Energía*) is charged with granting permits for electric power generation, importation or exportation for an indeterminate period. Permits for independent power producers are granted for a renewable period of 30 years.

The more recent priorities for public investment have been oriented towards strengthening the transmission and distribution areas, while encouraging private participation in power generation through independent production, self-supply, cogeneration and small-scale production. In view of the current financial restrictions, it is possible that the levels of investment required cannot be provided entirely by the CFE and LFC, which means that in order to satisfy the nation's enormous electricity needs it will be necessary to supplement public investment with resources from the private sector in the areas allowed by existing or future legislation.

According to the Secretary of Energy (Sener, 1999), the outcome of the 1992 reform has not been very encouraging. In 1999, CFE's participation in the capacity of electric power generation was 90%, PEMEX 4.4%, LFC 2.3 and private companies 3.3%. However, of the increase in generation capacity carried out or to be carried out from 1998 to 2001, CFE resources will fund only 2%. The remainder will be BLT (build, lease and transfer) and independent producers (IPP) projects.

Another proposal for restructuring the Mexican electricity sector, seeking private participation throughout the electric value chain, arrived in 1999 at the end of the previous administration (1994-2000). The most important argument put forward was that the federal government did not have the financial resources to maintain or increase the level of operations of the electric sector, and that reforms to the 1992 law had not given the expected results with respect to private sector participation (García et alii, 2001). The proposal was unsuccessful due to general opposition within political parties other than the *Partido Revolucionario Institucional* (PRI), in control of government at the time. Since the 2000 presidential elections and the resulting change of government and political control, new proposals to restructure the electricity industry have appeared. Industrial organization of the sector and new modalities of financing the expansion of service are at the center of discussions. The political weakness of the present federal government may be a serious obstacle for its initiative to restructure the electric sector, especially if the opposition of "official trade unionism" is considered (García et alii, 2001).

#### **Public Electric Power Service: the Use of Natural Gas Turbines in Combined Cycle**

From 1990 to 2000, the public electric power service capacity<sup>3</sup> grew from 25 299 MW to 36 697 MW (Table 1). The existing capacity is today sufficient to meet the present and foreseeable short-term demand. Electricity imports and exports represent less than 1% of total demand (self-sufficient market). Steam plants using fuel oil and/or natural gas are the most employed technology to generate electricity. As mentioned before, for environmental and efficiency<sup>4</sup> reasons mainly, a policy of transition from fuel oil consumption to natural gas use was adopted in the early 1990's by the Mexican government. As a result, 1711 MW of combined cycle capacity were installed between 1990 and 2000. The gas transition policy also expects to substitute fuel oil with natural gas in most of the existing steam plants. Gas consumption to

**Table 1**  
**Mexico's Public Electric Power Service:**  
**Installed Capacity and Gross Generation 1990-2010**

	1990		2000		2010	
Effective capacity by technology (MW)		%		%		%
Hydroelectric	7805	30.9	9619	26.2	12809	20.5
Steam (fuel oil and gas)	11367	44.9	14282	38.9	12621	20.2
Combined cycle (gas)	1687	6.7	3398	9.3	24912	40.0
Turbo gas (gas and diesel)	1779	7.0	2360	6.5	2578	4.1
Internal combustion (diesel)	86	0.3	116	0.3	328	0.5
Geothermal	700	2.8	855	2.3	978	1.6
Dual (fuel oil and coal)	0	0.0	2100	5.7	2800	4.5
Coal-fired (coal)	1200	4.7	2600	7.1	4000	6.4
Nuclear (uranium)	675	2.7	1365	3.7	1365	2.2
Wind power	0	0.0	2	0.0	2	0.0
<b>Total</b>	<b>25299</b>	<b>100.0</b>	<b>36697</b>	<b>100.0</b>	<b>62393</b>	<b>100.0</b>
<b>Gross generation (TWh)</b>	<b>114.3</b>		<b>192.8</b>		<b>329.4</b>	

Source: 1990-2000: (CFE, 2001); 2010: (Sener, 2001b).

generate electricity has thus grown from 144 PJ in 1990 to 333 PJ in 2000 (CFE, 2001).

According to the Secretary of Energy's document on prospects for the electric power sector 2001-2010 (Sener, 2001b), gross generation should rise from 193 GWh in 2000 to 329 GWh in 2010 (Table 1). The Secretary of Energy thus predicts an average annual growth of 5.5% in electric power demand. Combined cycle plants would provide most of the needed electricity. About 21,514 MW of this technology would be installed during the studied period (83% of total added capacity). Combined cycle plants would dominate the power generation sector because their participation would rise from 9% in 2000 to 40% in 2010.

### **Simulation of the Mexican Power Generation System**

#### **Methodology**

In order to study the future role of natural gas in the Mexican power generation sector for public service, we simulate two scenarios of evolution of this activity between 2000 and 2020. We make use of the LEAP system (Long-range Energy Alternatives Planning-SEI Boston), based at the Mexican Petroleum Institute offices. For this simulation, we adopted a methodology consisting of three main steps:

1. Programming into LEAP of Mexico's energy balance for the base year (1996).
2. Definition and programming of variables driving the future national demand of energy. We have selected national Gross Domestic Product (GDP), in the form of energy intensity (energy/GDP) and population growth<sup>5</sup> as key drivers<sup>6</sup>. Demand analysis was done by sector (agriculture, households, commercial and public services, transport and industry) and by kind of energy (primary: oil, associated natural gas... and secondary: fuel oil, electricity...).
3. Programming of the transformation sector that includes electric power generation, oil refining, natural gas processing plants and coke refining. Simulation of oil refining took into account the reconfiguration project in Pemex's refineries, established mainly to decrease fuel oil production and to increase gasoline outputs. Natural gas processing plants produce natural gas volumes expected by PEMEX

for the period 2001-2010. Expected volumes of gas to be produced for the next ten years are reported by the Secretary of Energy in its document on prospects for the natural gas market 2001-2010 (Sener, 2001c). For the period 2010-2020, gas production is projected following the same trend expected during 2001-2010. Coke refining system's inputs and outputs were extrapolated from 2000 to 2020 according to past trends (1990-2000).

We describe now the main characteristics of two scenarios studied.

#### **Business-As-Usual Case (BAU)**

Considered as the reference case, this scenario simulates the government's current energy policies from 2000 to 2010. Period 2010-2020 is analyzed using the trends of the preceding decade. The main assumptions of the scenario were as follows:

1. An average annual GDP growth of 5.2%, according to Secretary of Energy's predictions (Sener, 2001c).
2. A population increases from 97.2 million in 1999 to 118.7 million in 2020 (CONAPO, 1998).
3. Installed capacity of the power generation sector is assumed to evolve from 2001 to 2010 in the same way as capacity is anticipated by the CFE and published in the document on prospects for the electric power sector 2001-2010 (Sener, 2001b). From 2010 to 2020, we projected installed capacity to increase following the expected trend of the preceding decade.

#### **Electric Power Diversification Case (EPD)**

This scenario also simulates the government's current energy policies, with the exception of the evolution of the power generation sector. Annual growth in GDP and population are considered the same as in the BAU case. Regarding the power generation sector, a policy of energy and technology diversification is supposed to be adopted from 2007. The Secretary of Energy, in its document on prospects for the electric power sector 2001-2010 (Sener, 2001c), already reports first indications of this change of policy. Instead of installing almost all capacity using combined cycle plants, it is proposed to install additional hydro and dual plants.



**Table 2**

**Mexico's Public Electric Power Service: Estimations of Gross Generation and Electricity Demand by Sector, Under SE, BAU and EPD Scenarios, 2000-2020 (TWh)**

	2000 a		2005		2010				2015		2020	
	History	SE	BAU	EPD	SE	BAU	EPD	BAU	EPD	BAU	EPD	
<b>Gross generation (TWh)</b>	193	239	252	252	329	330	330	405	405	492	492	
<b>Electricity demand by sector (TWh)</b>												
<b>Agriculture</b>	8	8	11	11	9	13	13	16	16	20	20	
<b>HCPS</b>	53	68	63	63	86	79	79	97	97	120	120	
<b>Transport</b>	1	2	2	2	3	3	3	3	3	4	4	
<b>Industry</b>	93	114	125	125	167	168	168	207	207	248	248	
<b>Total</b>	<b>155</b>	<b>192</b>	<b>201</b>	<b>201</b>	<b>265</b>	<b>263</b>	<b>263</b>	<b>323</b>	<b>323</b>	<b>392</b>	<b>392</b>	

a Source: (Sener, 2001b).  
 SE: Secretary of Energy's estimations (Sener, 2001b).  
 BAU: Business-As-Usual case.  
 EPD: Electric Power Diversification case.  
 HCPS: Households, Commercial and Public Services.

**Table 3**

**Mexico's Public Electric Power Service: Estimations of Installed Capacity by Technology Under BAU and EPD Scenarios, 2000-2020 (GW)**

GW	Hydro		Steam		Combined Cycle		Turbo Gas		Internal Combustion		Geothermal		Dual		Coal		Nuclear		Total	
	BAU	EPD	BAU	EPD	BAU	EPD	BAU	EPD	BAU	EPD	BAU	EPD	BAU	EPD	BAU	EPD	BAU	EPD	BAU	EPD
2000	9.6	9.6	14.3	14.3	3.4	3.4	2.4	2.4	0.1	0.1	0.9	0.9	2.1	2.1	2.6	2.6	1.4	1.4	36.7	36.7
2001	9.6	9.6	14.3	14.3	6.7	6.7	2.4	2.4	0.2	0.2	0.9	0.9	2.1	2.1	2.6	2.6	1.4	1.4	40.1	40.1
2002	9.6	9.6	14.2	14.2	7.9	7.9	2.5	2.5	0.2	0.2	0.9	0.9	2.1	2.1	2.6	2.6	1.4	1.4	41.3	41.3
2003	9.9	9.9	13.9	13.9	11.4	11.4	2.5	2.5	0.2	0.2	1.0	1.0	2.1	2.1	2.6	2.6	1.4	1.4	45.0	45.0
2004	10.5	10.5	13.7	13.7	12.0	12.0	2.6	2.6	0.2	0.2	1.0	1.0	2.1	2.1	2.6	2.6	1.4	1.4	46.1	46.1
2005	10.5	10.5	13.4	13.4	14.9	14.9	2.6	2.6	0.2	0.2	1.0	1.0	2.1	2.1	2.6	2.6	1.4	1.4	48.7	48.7
2006	10.5	10.5	13.4	13.4	16.9	16.9	2.6	2.6	0.2	0.2	1.0	1.0	2.8	2.8	2.6	2.6	1.4	1.4	51.5	51.5
2007	10.5	10.8	13.4	13.4	19.2	19.0	2.6	2.6	0.2	0.2	1.0	1.0	2.8	2.8	2.6	2.6	1.4	1.4	53.8	53.8
2008	11.4	12.1	13.2	13.2	19.7	19.0	2.6	2.6	0.3	0.3	1.0	1.0	2.8	2.8	4.0	4.0	1.4	1.4	56.3	56.3
2009	12.8	14.5	12.9	12.9	21.8	19.0	2.6	2.6	0.3	0.3	1.0	1.0	2.8	3.9	4.0	4.0	1.4	1.4	59.5	59.5
2010	12.8	15.2	12.6	12.6	24.9	19.7	2.6	2.6	0.3	0.3	1.0	1.0	2.8	5.5	4.0	4.0	1.4	1.4	62.4	62.4
2011	12.8	15.2	12.6	12.6	26.0	20.8	2.6	2.6	0.3	0.3	1.0	1.0	2.8	5.5	4.0	4.0	1.4	1.4	63.5	63.5
2012	12.8	16.0	12.6	12.6	28.8	20.8	2.6	2.6	0.3	0.3	1.0	1.0	2.8	8.3	4.0	4.0	1.4	1.4	66.3	67.1
2013	12.8	16.0	12.6	12.6	31.6	22.8	2.6	2.6	0.3	0.3	1.0	1.0	2.8	8.3	4.0	4.0	1.4	1.4	69.1	69.1
2014	12.8	16.8	12.6	12.6	34.4	22.8	2.6	2.6	0.3	0.3	1.0	1.0	2.8	11.1	4.0	4.0	1.4	1.4	71.9	72.7
2015	12.8	16.8	12.6	12.6	37.5	25.0	2.6	2.6	0.3	0.3	1.0	1.0	2.8	11.1	4.0	4.0	1.4	1.4	75.0	74.9
2016	12.8	17.6	12.6	12.6	40.3	25.0	2.6	2.6	0.3	0.3	1.0	1.0	2.8	13.9	4.0	4.0	1.4	1.4	77.8	78.5
2017	12.8	17.6	12.6	12.6	43.7	27.6	2.6	2.6	0.3	0.3	1.0	1.0	2.8	13.9	4.0	4.0	1.4	1.4	81.2	81.0
2018	12.8	18.4	12.6	12.6	46.7	27.6	2.6	2.6	0.3	0.3	1.0	1.0	2.8	16.7	4.0	4.0	1.4	1.4	84.2	84.6
2019	12.8	18.4	12.6	12.6	50.1	30.4	2.6	2.6	0.3	0.3	1.0	1.0	2.8	16.7	4.0	4.0	1.4	1.4	87.6	87.4
2020	12.8	19.2	12.6	12.6	53.5	30.4	2.6	2.6	0.3	0.3	1.0	1.0	2.8	19.5	4.0	4.0	1.4	1.4	90.9	91.0

BAU: Business-As-Usual scenario.  
 EPD: Electric Power Diversification scenario.  
 Note:BAU case's total capacity and its technology are based on CFE's estimations in the period 2001-2010 (Sener, 2001b).  
 For the EPD case, only total capacity is based on CFE predictions (Sener, 2001b). From 2007, technology choice is diversified from combined cycle to hydro and dual (fuel oil and coal) plants.

**Discussion of Results**

According to the results of simulation, gross generation would increase from 193 TWh in 2000 to 492 TWh in 2020 (Table 2). This table also reports forecasts of electricity demand by sector. The industry will continue to be the major and the most dynamic consumer (270% of augmentation during 2000-2020). Between official estimates (SE) and BAU and EPD cases there are no significant differences. In order to satisfy the rising demand, it would be necessary to install nearly 55 GW of additional capacity beyond current capacity for the next twenty years (Table 3). Thus, Mexico's installed power capacity for public service would increase from 37

GW in 2000 to 91 GW in 2020. Differences between BAU and EPD scenarios concern the technology employed in plants from 2007. Combined cycle capacity in 2020 would be 53 GW for the BAU case, while 30 GW under EDP case. In 2020, 19 and 20 GW of hydro and dual capacity should respectively be installed under EPD scenario, in contrast to 13 and 3 GW respectively for the BAU case (Table 3).

The differences in technologies to be employed for generating electricity would have impacts on patterns of fuel consumption. The generation of electricity would evolve from an industry characterized by fuel oil consumption to one dominated by natural gas. In both scenarios, fuel oil would dramatically drop from 955 PJ in 2000 to about 180 PJ twenty

**Table 4**  
**Mexico's Public Electric Power Service: Estimations of Fuel Consumption, Under SE, BAU and EPD Scenarios, 2000-2020 (Petajoules).**

Fuel consumption (Petajoules –PJ–)	2000 <sup>a</sup>		2005			2010		2015		2020	
	History	SE	BAU	EPD	SE	BAU	EPD	BAU	EPD	BAU	EPD
Fuel oil	955	n.a.	514	514	381	393	390	281	266	189	161
Diesel	25	n.a.	9	9	7	12	12	12	12	13	13
Natural gas	333	n.a.	949	949	1347	1376	1170	2001	1500	2674	1761
Coal	183	n.a.	313	313	470	451	635	452	1002	444	1518
Uranium	90	n.a.	107	107	105	106	106	106	106	104	104
<b>Total</b>	<b>1586</b>	<b>n.a.</b>	<b>1892</b>	<b>1892</b>	<b>2310</b>	<b>2338</b>	<b>2313</b>	<b>2852</b>	<b>2886</b>	<b>3424</b>	<b>3557</b>

n.a. : not available.

a Source: (Sener, 2001a).

SE: Secretary of Energy's estimations (Sener, 2001b).

BAU: Business-As-Usual case.

EPD: Electric Power Diversification case.

years later as a result of substitution for this fuel by natural gas (Table 4).

Coal consumption would grow from 183 PJ in 2000 to 444 or 1518 PJ in 2020, under BAU and EPD cases respectively. In this context, it is important to note that the EPD case assumes the addition of considerable dual capacity primarily using imported coal at competitive prices. Natural gas would be the fuel experiencing the most important growth due to the fact that its consumption would rise from 333 PJ in 2000 to 2674 PJ (BAU) or 1761 PJ (EPD) in 2020. The participation of natural gas in the fuel consumption for generating electricity would increase from 21% in 2000 to 78% in 2020 under the BAU scenario (even more than current participation of fuel oil -60%-) and to 50% under the EPD case (Table 4).

The technology diversification policy assumed by the EPD case would have impacts on Mexico's natural gas supply/demand equilibrium as showed in Table 5. Official projections (SE) and the BAU case's projections are similar in the period 2000-2010 since they are based on almost the

same assumptions, including the power generation sector. Once electric power diversification policy would have been adopted (2007), there would be significant differences between BAU and EPD cases. These differences lie in the oil and power generation sector. As the BAU case considers the installation of a bigger number of combined cycle plants than the EPD case, its natural gas needs would also be larger. Demand in the oil sector, under the BAU case, would also be higher because it mostly represents a percentage of gas volumes supplied to end-users (power generation and others). Natural gas imports can be influenced by the adoption of the diversification policy (Table 5). The rate of imports/demand would reach 23 or 35% during the studied period under BAU or EPD scenarios, respectively.

#### Conclusions

We have examined the main political, market and regulatory issues concerning natural gas use in the Mexican power generation sector. Some conclusions can be drawn.

Like many other developing countries, Mexico is facing

**Table 5**  
**Mexico's Natural Gas Supply and Demand: Estimations Under SE, BAU and EPD Scenarios, 2000-2020 (millions of cubic feet daily).**

Millions of cubic feet daily (mmcf)	2000 <sup>a</sup>		2005			2010		2015		2020	
	History	SE	BAU	EPD	SE	BAU	EPD	BAU	EPD	BAU	EPD
<b>Supply</b>	3824	6118	6327	6327	8207	8367	7654	11061	9371	13693	10683
<b>National</b>	3543	4321	4323	4323	6307	6309	6309	7189	7189	9016	9016
<b>Pemex's processing plants</b>	2791	3796	3796	3796	5155	5156	5156	5864	5864	7519	7519
<b>Direct from fields</b>	752	525	527	527	1152	1153	1153	1325	1325	1497	1497
<b>Imports</b>	281	1797	2004	2004	1900	2058	1345	3872	2182	4677	1667
<b>Demand</b>	3860	6118	6327	6327	8207	8367	7654	11061	9371	13693	10683
<b>National</b>	3836	6118	6327	6327	8207	8367	7654	11061	9371	13693	10683
<b>Oil sector</b>	1402	1578	1393	1393	1652	1516	1366	1849	1527	2092	1576
<b>Industrial sector</b>	1353	2125	2089	2089	2638	2586	2586	3007	3007	3454	3454
<b>Power generation sector</b>	871	2154	2591	2591	3471	3758	3195	5465	4097	7303	4809
<b>Households and commercial</b>	209	240	224	224	369	382	382	513	513	587	587
<b>Transport</b>	1	21	30	30	77	125	125	227	227	257	257
<b>Exports</b>	24	0	0	0	0	0	0	0	0	0	0
<b>Statistical differences</b>	-36	0	0	0	0	0	0	0	0	0	0

a Source: (Sener, 2001c).

SE: Secretary of Energy's estimations (Sener, 2001c) -reference case-.

BAU: Business-As-Usual case.

EPD: Electric Power Diversification case.

today an increasing demand for electricity. Its state-owned companies CFE and LFC are no longer able to finance the required expansion of the electric power industry. The generation sector is already open to private investment under different financing modalities that are currently obtaining poor results. A more competitive industrial organization and modalities of financing that would allow more private participation are now at the center of discussions to restructure the electric power industry.

For economic, environmental and efficiency reasons, combined cycle plants using natural gas constitute today the most convenient choice for expanding the Mexican power generation sector. However, the availability of domestic natural gas is restricted. Increasing gas imports will be necessary in the future to complement domestic supply as illustrated by simulation exercises reported in this work. Our simulation results also indicate that the adoption of a diversification policy concerning technologies used to generate electricity could be one way to limit foreign dependency on natural gas imports, especially in the long run (2010-2020). This is particularly relevant for the future supply/demand balance of the North American natural gas market. It is also suggested that efforts addressed only to the demand-side could be insufficient to control gas imports. Important measures should additionally be taken on the supply-side in order to increase domestic gas production, such as relaxing PEMEX's budgetary constraints or allowing new foreign investments to participate in the Mexican upstream gas sector.

#### **Footnotes**

<sup>1</sup> The planning of expansion of the electricity generation sector is done by the CFE (centralized planning). Fuel choices for power generation are also subject to national policy.

<sup>2</sup> In January 1998, the standard NOM-085-ECOL-1994 came into force in its more restrictive phase. This has substantially raised environmental standards concerning nitrogen oxides and sulfur emissions of industrial fuels in most major metropolitan areas. These measures, if implemented as planned, will change Mexico's fuel mix, clearly encouraging consumption of cleaner fuels such as natural gas in certain regions of the country (Elizalde, 1999).

<sup>3</sup> Cogeneration and self-supply plants are not included.

<sup>4</sup> Combined cycle using gas turbine is the most efficient technology available in the market for generating electricity (CFE, 2000). In Mexico, this technology can reach efficiencies of 52%.

<sup>5</sup> The National Council for Population projection of population growth (CONAPO, 1998) is used to obtain the energy consumption per capita in the household sector.

<sup>6</sup> This approach to demand drivers has been used extensively by the MODEMA model at the University Energy Program of the National Autonomous University of Mexico.

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## Dues Increase

At its October 6 Council meeting in Vancouver, the IAEE Council voted to increase dues by \$5.00/year for direct members and those Affiliate members receiving *The Energy Journal* and \$10 for those Affiliate members receiving only the *IAEE Newsletter*. Additionally, the Affiliate option to receive only the *Newsletter* will be phased out beginning 2005. Dues for all Affiliate members will then be \$55.00 per year.

JT Bernard, Vice President and Treasurer, pointed out that it has been ten years since the Association has made any changes in its dues structure. During that time costs, as measured by the U.S. Consumer Price Index, have risen approximately 30%. Very few Associations have been able to hold their dues constant for this long a time, he noted.

Additionally, direct members will be given the option of contributing to the IAEE Scholarship Fund when making their dues payments.

These changes will be made effective January 1, 2003.

## Publications

**Arab Oil & Gas Directory 2002.** Price: \$630.00. Contact: Petromedia, Ste. 251, 28 Old Brompton Road, London SW7 3SS, United Kingdom. Phone: 44-20-7644-4979. Fax: 44-20-7644-4861. Email: petro\_media@yahoo.com URL: <http://www.arab-oil-gas.com>

**Italy's Energy Markets.** Price: #595.00. Contact: CWC Publishing Limited, 3 Tyers Gate, London SE1 3HX, United Kingdom. Phone: 44-20-7089-4200. Fax: 44-20-7089-4201. Email: publishing@thecwcgroup.com URL: [www.thecwcgroup.com](http://www.thecwcgroup.com)

**Fuel Cells: The Sourcebook.** Price: \$440.00. Contact: Esco Vale Consultancy Services, Nutley Dean Business Park, Norwood Hill, Horley, Surrey RH6 0HR, United Kingdom. Phone: 44-1293-862086. Fax: 44-1293-863002. Email: sales@escovale.com URL: [www.escovale.com](http://www.escovale.com)

**Environmental Meteorology – Determination of the Emission from Motor Vehicles,** Editor VDI Verein Deutscher Ingenieure (July 2002). Price: EUR 124.30. Released in German Language only. Contact: Beuth Verlag GmbH, D-10772 Berlin, Germany. Phone: 49-30-2601-2759. Fax: 49-30-2601-1263. Email: postmaster@beuth.de

**The Cost of Climate Policy,** Mark Jaccard, John Nyboer and Bryn Sadownik (2002). 288 pages. Price: \$29.95. Contact: Andrea Kwan, UBC Press, The Univ of BC, 2029 West Mall, Vancouver, BC V6T 1Z2, Canada. Phone: 604-822-4548. Fax: 604-822-6083. URL: [www.ubcpress.ca](http://www.ubcpress.ca)

**Prospects for Caspian Gas** (2002). Contact: Jenni Wilson, Centre for Global Energy Studies. Phone: 44-20-7309-3610. Email: marketing@cges.co.uk URL: [www.cges.co.uk/CaspianGasorderform.htm](http://www.cges.co.uk/CaspianGasorderform.htm)

**Oil & Gas: Crises and Controversies – Volume 1: Global Issues,** Professor Peter Odell (2001). 494 pages. Price: #55.50. Contact: Multi-Science Publishing Co. Ltd, 5 Wates Way, Brentwood, Essex CM15 9TB, UK. Fax: 44-1277-223453. Email: mscience@globalnet.co.uk

**Oil & Gas: Crises and Controversies – Volume 2: Europe's Revolutions,** Professor Peter Odell (2001). 500 pages. Price: #55.50. Contact: Multi-Science Publishing Co. Ltd, 5 Wates Way, Brentwood, Essex CM15 9TB, UK. Fax: 44-1277-223453. Email: mscience@globalnet.co.uk

**Greenhouse Gas Emissions: Market Fundamentals and Trading Opportunities** (2002). Price: \$749.00. Contact: Alan M. Herbst, Utilis Energy, LLC, 85 Eighth Avenue Ste 6H, New York, NY 10011. Phone: 917-371-8161. Fax: 413-604-5615. Email: info@UtilisEnergy.com URL: [www.utilisenergy.com/reports.html](http://www.utilisenergy.com/reports.html)

**Climate Policy After Kyoto,** Tor Ragnar Gerholm, Editor (1999). Price: #24.50. Contact: Multi-Science Publishing Co. Ltd., 5 Wates Way, Brentwood, Essex CM15 9TB, UK. Email: mscience@globalnet.co.uk URL: [www.multi-science.co.uk](http://www.multi-science.co.uk)

**The Coming Oil Crisis,** Colin J. Campbell. Price: #23.50. Contact: Multi-Science Publishing Co. Ltd., 5 Wates Way, Brentwood, Essex CM15 9TB, UK. Email: mscience@globalnet.co.uk URL: [www.multi-science.co.uk](http://www.multi-science.co.uk)

**Fashions in the Treatment of Packaging Waste,** Professor Marian Radetzki (2000). Price: #11.25. Contact: Multi-Science Publishing Co. Ltd., 5 Wates Way, Brentwood, Essex CM15 9TB, UK. Email: mscience@globalnet.co.uk URL: [www.multi-science.co.uk](http://www.multi-science.co.uk)

**Towards an Energy Policy,** Dieter Helm, Editor (2002). Price: #35.00. Contact: Camilla Hodges, Customer Services, OXERA, Blue Boar Court, Alfred Street, Oxford OX1 4EH, United Kingdom. Phone: 44-1865-253013. Fax: 44-1865-251172. Email: enquiries@oxera.co.uk URL: [www.oxera.co.uk](http://www.oxera.co.uk)

**The Handbook of Gas Quality,** G.J. Van Rossum (2002). 874 pages. Price: \$99.00. Contact: The World Book Centre, 209, Sir D V Road, Churchgate, Mumbai – 400020 India. Phone: 2027299 Email: munaf@vsnl.com

**Saudi Arabia to 2020 Oil and Gas? Economy? Government? Politics?** (2002). Price: #2000.00 Contact: Gillian James, CGES, Centre for Global Energy Studies. Phone: 44-20-7309-3610. Email: marketing@cges.co.uk URL: [www.cges.co.uk/CaspianGasorderform.htm](http://www.cges.co.uk/CaspianGasorderform.htm)

**Egypt Oil & Gas Report** (2002). 168 pages. Price: \$1500.00 Hard Copy. Contact: Petur Georgesson, Rising Star Energy Publications, 59 Moussadak St., Cairo, Egypt. Tel: 202-338-7292. Fax: 202-338-7292. Email: george@risingstargroup.com

**World Energy Outlook 2002.** Price: \$150 Paper/\$120 PDF. Contact: International Energy Agency, BP 586, 75726 Paris Cedex 15, France. Tel: 33-1-4057-6690. Fax: 33-1-4057-6775. Email: books@iea.org

## Calendar

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**2-5 December 2002, Angola Oil & Gas Conference & Exhibition 2002 at Luanda, Angola.** Contact: Estelle Bourguignon, Exhibitions Organiser, CWC Associates, 3 Tyers Gate, London, SE1 3HX, UK. Phone: +44 (0) 20 7089 4209. Fax: +44 (0) 20 7089 4201 Email: ebourguignon@thecwcgroup.com URL: <http://www.thecwcgroup.com>

**3-4 December 2002, Gas Processing Contracts & Negotiations at Houston, TX.** Contact: Registrar, Energy Seminars Inc., PO Box 7979, The Woodlands, TX, 77387, USA. Phone: 281-362-7979. Fax: 281-296-9922 Email: registrar@energyseminars.com URL: [www.energyseminars.com](http://www.energyseminars.com)

**4-6 December 2002, Energy Supply Options for End-Users at Dallas, Texas.** Contact: Ken Dee, President, Global Energy Agenda, USA. Phone: 508-823-5797. Fax: 508-823-5197 Email: gesei@attbi.com URL: [www.dist-gen.com](http://www.dist-gen.com)

**6-6 December 2002, 4th Annual Russian Energy Summit at The President Hotel, Moscow, Russia.** Contact: Ms Naheed Sharmin Islam, Marketing Manager, CWC Associates, 3 Tyers Gate, London, SE1 3HX, UK. Phone: +44 (0) 20 7089 4188. Fax: +44 (0) 20 7089 4201 Email: nislam@thecwcgroup.com URL: <http://www.thecwcgroup.com/conferences>

**9-12 December 2002, Mechanics and Operations of Oil Trading at Gorse Hill, Surrey, UK.** Contact: Karen Jones, Training Manager, Petroleum Economist, 15/17 St Cross Street, London, EC1N 8UW, United Kingdom. Phone: +44 (0) 20 7831 5588. Fax: +44 (0) 20 7831 5313 Email: jones@petroleum-economist.com

(continued on page 32)

**Calendar** (continued from page 31)

URL: [www.petroleum-economist.com](http://www.petroleum-economist.com)

**9-10 December 2002, 7th IIES Intl Conference - The Impact of Globalization on Middle East Oil and Gas Industry at Tehran.** Contact: Seyed Alavi, Sec-Gen of the Conf & Dir, Intl Affairs (IIES), Iran. Phone: 9821-225-8096. Fax: 9821-222-1793 Email: [conferences@iies.org](mailto:conferences@iies.org) URL: [www.iies.org](http://www.iies.org)

**December 11, 2002 - November 2, 2013, Emerging Opportunities in the Russian Gas and Electricity Sectors at Moscow, Russia.** Contact: Tom Blackwell, Mr, Adam Smith Institute Conference Division, 9 Northburgh Street, London, EC1V 0AH, UK. Phone: 0044 20 7490 3774. Fax: 0044 20 7505 0079 Email: [tom@asi-conferences.com](mailto:tom@asi-conferences.com) URL: [www.asi-conferences.com/energy](http://www.asi-conferences.com/energy)

**12-13 December 2002, Intelligent Wells 2002 at Houston, TX, USA.** Contact: Katrina Gregory, Senior Marketing Manager, IQPC, Oil and Gas Division, Anchor House, 15-19 Britten Street, London, SW3 3QL, UK. Phone: 0044 20 7368 9333. Fax: 0044 20 7368 9303 Email: [marketing@iqpc-oil.com](mailto:marketing@iqpc-oil.com) URL: [www.iqpc-oil.com/NA-1921/ediary](http://www.iqpc-oil.com/NA-1921/ediary)

**14-18 December 2002, Algeria Energy Week (Exhibition, Conference & JST 5 Workshops) at Palais de Expositions & Hotel International, Algiers, Algeria.** Contact: Ms Naheed Sharmin Islam, Marketing Manager, CWC Associates, 3 Tyers Gate, London, SE1 3HX, UK. Phone: +44 (0) 20 7089 4188. Fax: +44 (0) 20 7089 4201 Email: [nislam@thecwcgroup.com](mailto:nislam@thecwcgroup.com) URL: <http://www.thecwcgroup.com/conferences>

**16-18 December 2002, Turkmenistan International Energy Exhibition & Conference at Turkmen Chamber of Trade & Industry & Serdar Business Centre, Ashgabat, Turkmenistan.** Contact: Ms Naheed Sharmin Islam, Marketing Manager, CWC Associates, 3 Tyers Gate, London, SE1 3HX, UK. Phone: +44 (0) 20 7089 4188. Fax: +44 (0) 20 7089 4201 Email: [nislam@thecwcgroup.com](mailto:nislam@thecwcgroup.com) URL: <http://www.thecwcgroup.com/>

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**16-17 December 2002, Sand Control & Management at Sheraton Imperial Kuala Lumpur.** Contact: Jo Jo Lee, Senior Marketing Manager, IQPC Email: [jojo@iqpc.com.sg](mailto:jojo@iqpc.com.sg) URL: [www.iqpc.com.sg/AS-550/Oil](http://www.iqpc.com.sg/AS-550/Oil)

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**19-21 January 2003, Middle East Electricity Exhibition at Dubai International Exhibition Centre, UAE.** Contact: Charlie Hastings, Senior Marketing Manager, IIR Exhibitions, PO Box 28943, Dubai, UAE. Phone: +971 4 336 5161. Fax: +971 4 336 0137 Email: [chastings@iirdubai.com](mailto:chastings@iirdubai.com) URL: [www.middleeastelectricity.com](http://www.middleeastelectricity.com)

**13-16 February 2003, Understanding Energy Supply Logistics at Gorse Hill, Surrey, UK.** Contact: Karen Jones, Training Manager, Petroleum Economist, 15/17 St Cross Street, London, EC1N 8UW, United Kingdom. Phone: +44 (0) 20 7831 5588. Fax: +44 (0) 20 7831 5313 Email: [jones@petroleum-economist.com](mailto:jones@petroleum-economist.com) URL: [www.petroleum-economist.com](http://www.petroleum-economist.com)

**3-4 March 2003, Energy Risk Management & Risk Assessment at New York.** Contact: Jeff Kaminski, Euromoney Training - Americas, 225 Park Avenue South, New York, NY, 10003, United States. Phone: 212-843-5225. Fax: 212-361-3499 Email: [jkaminski@euromoney.com](mailto:jkaminski@euromoney.com) URL: <http://www.euromoneytraining.com/databasedriven/coursedetail.asp?busareaid=3&CourseID=700>

**4-6 March 2003, Electric Power 2003 - 5th Annual Conference & Exhibition at Houston, TX.** Contact: Conference Coordinator, Electric Power, 1220 Blalock, Ste. 310, Houston, TX, 77055, USA. Phone: 713-463-9595. Fax: 713-463-9997 Email: [info@tradefairgroup.com](mailto:info@tradefairgroup.com) URL: [www.electricpowerexpo.com](http://www.electricpowerexpo.com)

**IAEE Newsletter**

**Volume 11, Fourth Quarter 2002**

The *IAEE Newsletter* is published quarterly in February, May, August and November, by the Energy Economics Education Foundation for the IAEE membership. Items for publication and editorial inquiries should be addressed to the Editor at 28790 Chagrin Boulevard, Suite 350, Cleveland, OH 44122 USA. Phone: 216-464-5365; Fax: 216-464-2737. Deadline for copy is the 1st of the month preceding publication. The Association assumes no responsibility for the content of articles contained herein. Articles represent the views of authors and not necessarily those of the Association.

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